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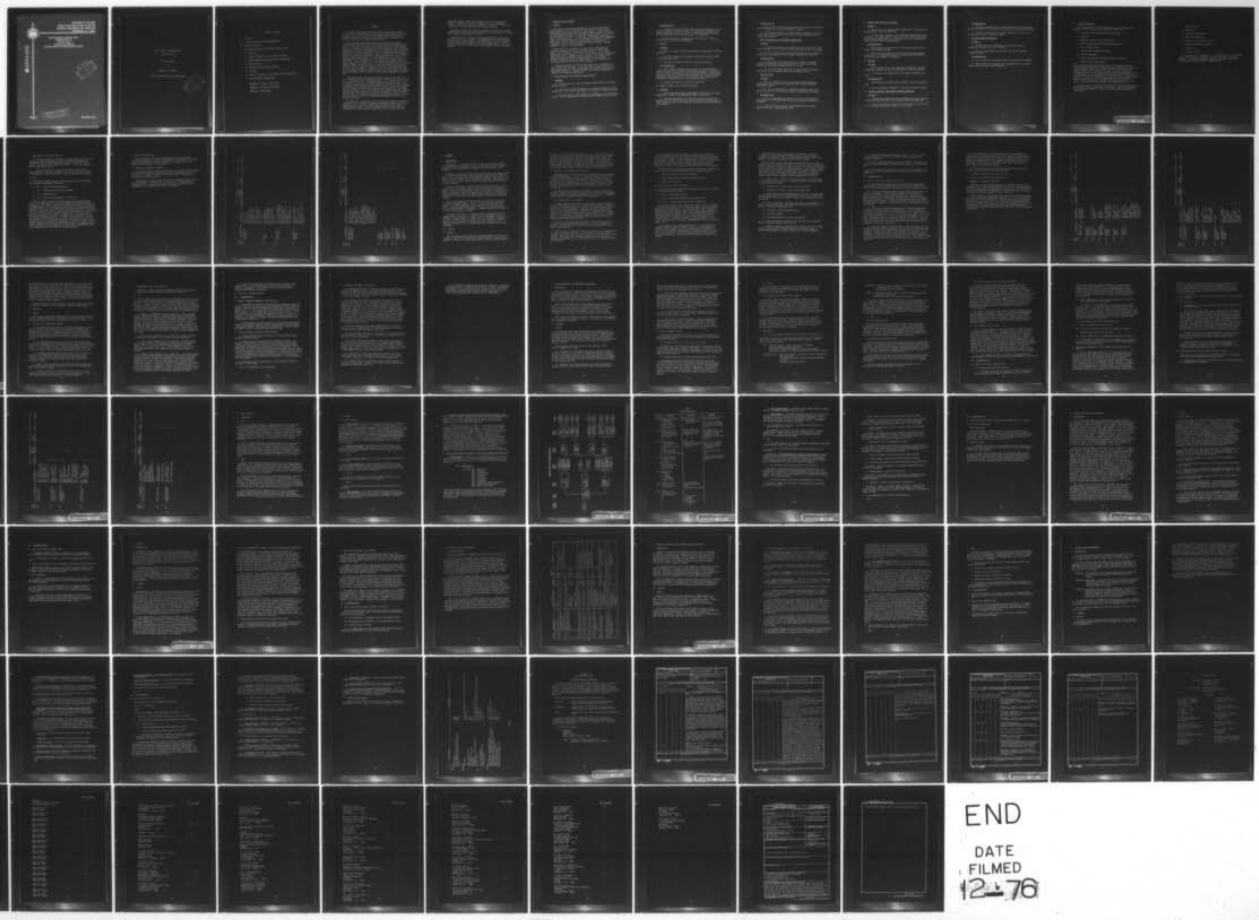

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ARMY SCIENTIFIC ADVISORY PANEL
SUMMER STUDY '76
19 - 30 JULY 1976
VOLUME 6 of 6 VOLUMES
SOLDIER SUPPORT SYSTEMS SUBGROUP REPORT

SEPTEMBER 1976

Army Scientific Advisory Panel

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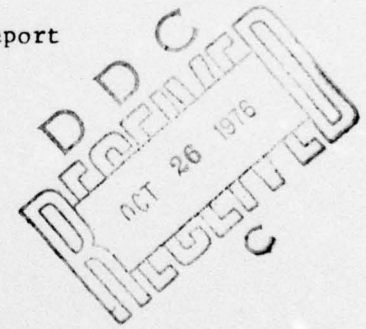
Volume 6 of 6 Volumes

Soldier Support Systems Subgroup Report



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FOREWORD

The Army Scientific Advisory Panel (ASAP) conducted its Summer Study '76 at the Armed Forces Staff College, Norfolk, Virginia, during the period 19-30 July 1976. The Panel addressed the theme of Future Systems through the six subgroups of Armament, Aviation, Electronic, Missile, Mobility, and Soldier Support Systems.

Thirty-six individuals from the ASAP and sixty representatives from the Department of the Army General Staff and major commands participated in the two week study. The Specific tasks of the participants were (1) to examine the compatibility of two documents - the Science and Technology Objectives Guide (STOG), which delineates desired operational capabilities in various categories, and the systems development plans prepared by the Army Laboratories - and (2) to determine if the laboratory programs contained the appropriate technology efforts to achieve the desired systems capabilities. It was requested that in the process that technical efforts non-supportive of the STOG or of marginal value be identified. Three ancillary tasks were subsequently added by which subgroup chairmen were requested to: (1) assist US Army Training and Doctrine Command (TRADOC) representatives to acquire and interpret significant material for use in input for STOG-78; (2) identify and describe ideas to be pursued by TRADOC in cooperation with U. S. Army Materiel Development and Readiness Command (DARCOM) using Concept Development and Validation (CDV) funds; and (3) suggest new initiatives appropriate for Army R&D.

The Summary Study participants arrived at a general concensus in their respective reports regarding the STOG. First of all, they felt that it is a good vehicle for providing guidance to the laboratories as well as a mechanism to conduct a dialogue between developer and user. The laboratory programs are generally responsive to the STOG and have improved in relevance to requirements over that of previous years. Most technology base efforts relate to some Science and Technology Objective (STO) to varying degrees. The level of detail of the STOG appears appropriate; however, the STOs should not constrain good laboratory efforts in high pay-off areas. The participants heartily endorsed the concept of having the STOG replace a variety of other guidance documents and serve as a guidance directory.

The STOG can be expected to be more useful and relevant in subsequent iterations, but it should not become so institutionalized that other opportunities for providing guidance and exchanges are precluded. The document should convey the user's comments on how he fights and his perception of desired systems capabilities and not closely specified

solutions. Soldier support technology, as well as techniques for better utilization of hardware in support of Corps of Engineers missions, should be covered more adequately in the STOG. The subject of smoke as a problem area arose in all areas examined.

Lastly, the STOG should include provision for countering advanced and alternate threats and reflect a strong intelligence input. A time frame should be identified in the STOG.

The reports of the subgroups are being published as six separate documents, each with a summary of recommendations near the beginning of the volume on colored paper. The documents are on file with the Defense Documentation Center. The value of Summer Study '76 will be the extent to which the appropriate Army managers find the conclusions helpful.

I. SOLDIER SUPPORT SYSTEMS

A. OVERVIEW

The degree of correlation between the Science and Technology Objectives Guide for FY 77 (STOG-77) objectives in Soldier Support Systems and related laboratory plans varies widely. In the case of the Army Medical Research and Development Command (AMRDC), for example, the program plan for medical, dental and life support research has almost a one-to-one match. In the case of Human Engineering Laboratory (HEL), the program plans do not seem generally responsive to STOG-77 objectives. It was reported in the briefings that HEL did not consider the STOG-77 as prime guidance for their program. The HEL program is, however, a good program.

One problem that is apparent is that STOG-77 objectives and laboratory plans are written to different levels of specificity. Hence, it is difficult to relate one to the other. Also, in many cases where a match exists, it is not clear whether or not the planned level of effort is commensurate with the need. For example, some broad Army Research Institute (ARI) programs list a string of research areas that are not integrated into a coherent program and no scope is specified for the various elements.

A general weakness of STOG-77 items is the lack of guidance as to when a capability is needed. Also, some STOG-77 items are written in such broad terms that almost any program in the general area could be considered responsive. Perhaps STOG-78 items could be sharpened in terms of time frame and specificity.

B. HUMAN RESOURCES AND PERSONNEL ADMINISTRATION

Findings:

1. Overall, there is a good correlation between STOG-77 and Army laboratory plans.

2. There must be greater emphasis on a technical program to assess the effects of the quality and quantity of personnel to meet Army needs.

3. There is need for work related to development of unit effectiveness in terms of techniques of leadership and management at all levels.

Recommendations:

1. A program of research which anticipates and prepares for future manpower concerns, such as the impact of significantly changing population distributions, and the impact of changing economic conditions on recruitment and retention of personnel, is recommended.

2. Establish efforts to measure unit effectiveness in terms of techniques of leadership and management.

C. TRAINING

Findings:

1. There is a general lack of coordination between STOG-77 and Army R&D plans.

2. The areas of vehicle and mission simulation are ones in which the Army generally lags.

3. Simulation technology needs more supporting research.

Recommendations:

1. Army training programs require scientific and technological support in five critical areas not explicitly addressed in STOG and that are not properly represented in Army laboratory programs. (Retention; technology base for training devices and simulators; large unit combat simulation; technology base for field technical manual preparation; and modes of presentation other than the printed page.)

2. Provide more support to simulation technology.

D. MEDICAL, DENTAL, AND LIFE SUPPORT SYSTEMS

Findings:

1. The existing Army Medical R&D Command program plans are highly responsive to STOG-77, although gaps do exist in the STOG.

2. Personnel replacements for Army units during the first six months of any future war will have to come primarily from the ranks of those casualties that can be "repaired" and those who are diseased that can be cured.

Recommendations:

1. Several science and technology objectives should be incorporated into the Biomedicine and Health Capability Category.

2. The biomedical aspects of chemical agents, diagnosis, potential vaccine protection, potential drug protection and/or therapy should receive major emphasis.

E. HUMAN ENGINEERING AND PERFORMANCE ENHANCEMENT

Findings:

1. The STOG objectives appear limited in scope in that they do not cover the range of on-going and projected research activity in the Army.

2. The STOG objectives are not expressed evenly in their degree of specificity; they range from very broad to very specific matters.

Recommendations:

1. Recommend that the STOG be upgraded to reflect a coherent, balanced and comprehensive presentation of the human engineering/ performance enhancement program needed by the Army.

2. The Army should make better use of human factors information, much earlier in the systems diesing and development cycle.

F. FOOD AND WATER

Findings:

1. There is a general lack of long-range feeding system user requirements and objectives; nor does the user provide definitive, time-phased needs.

2. The need for techniques for utilizing subsurface water more efficiently and for the efficient disposal of sewage were indicated.

Recommendations:

1. That the technology base aspects, as well as the peacetime requirements, of subsistence and food service systems be addressed in the STOG.

2. Water purification, supply, and distribution should have higher priorities in the applicable STOs.

F. CLOTHING AND INDIVIDUAL EQUIPMENT

Findings:

1. The STOG does not address itself sufficiently to the support of the individual soldier in the field.

2. The NBC threat requires a very comprehesive program to include all aspects of soldier support, especially in the areas of individual clothing and equipment protection; and in the event of contamination, decontamination equipment and procedures.

Recommendations:

1. More resources be applied now to achieve the required objectives of future NBC protection.

2. That the STOG encopass the specific objectives/requirements for support of the individual soldier in adverse operational areas, such as the Artic, desert, or mountains.

H. AIR DROP

Findings:

1. There appears to be a very close mathc between the air drop development objectives in the STOG and the work currently underway.

2. The STOG does not define really long range development objectives.

Recommendations:

1. Efforts should be started upon equipment location and assembly aids.

2. Efforts should be considered in "stand-off" delivery systems.

I. NUCLEAR, BIOLOGICAL AND CHEMICAL WARFARE PROTECTION

Findings:

1. Although the program described in ARMCOM reports are responsive to STOG for CW and BW, there is no evidence that NW is addressed.

2. Often the greatest deficiencies in NBC appear to be not in the 6.1 - 6.2 area, but actually in the 6.3 - 6.4 areas.

Recommendations:

1. Establish guidelines and a review procedure for incorporate NBC protective features in new designs for equipment, clothing, and shelters.

2. Provide a requirement for a simple water kit to test for possibility and presence of chemical agents.

J. SOLDIER SUPPORT ENGINEERING

Findings:

1. The STOG and system development plans are essentially compatible documents with only a few gaps.

2. There are few systems in this area, but rather dispersed, fragmented efforts.

Recommendations:

1. A 6.1 program for camouflage should be established and funded.

2. NBC protection be included as an integrated part of environmental control systems, where applicable.

II. GENERAL DISCUSSION:

For convenience the "Soldier Support Systems" program has been divided into the following nine sub-topics. These are:

a. Human Resources and Personnel Administration

b. Training

c. Medicine, Dentistry, and Life Support

d. Human Engineering and Performance Enhancement

e. Food and Water Supply

f. Clothing and Individual Equipment

g. Air Drop Equipment

h. Nuclear, Biological and Chemical Warfare Protection

i. Soldier Support Engineering

This has been made necessary since there is no separate section in the STOG-77 which describes the scientific and technical objectives for soldier support systems. This casual treatment of soldier support systems should not be allowed to continue. It leads to the consideration of the need for soldier support systems technology as a sort of afterthought, i.e., something to be considered after a problem is presented by a materiel design that never was forced to account for the needs of the soldier. This is a major deficiency in the STOG-77. "Soldier Support Systems" is perhaps an adequate name for the items above. The subgroup seemed to prefer "Life Support Systems."

In addition to the systems previously cited, further examination of the STOG-77 revealed other areas that properly can be accounted for in "Soldier Support Systems." These are included under Soldier Support Engineering:

a. Electric Power

b. Countermine

c. Fuels and Fuel Handling

d. Field Fortifications

e. Logistics over the Shore (LOTS)

f. Materials Handling Equipment

g. Demolitions

h. Physical Security

In an attempt to be responsive to the charge given to the subgroup, these items were also considered. Time did not permit an in-depth analysis. The chemical, medical, training, and human engineering areas would benefit from a more intensive study.

A. Human Resources and Personnel Administration

I. INTRODUCTION

Manpower costs account for a major part of the Army's budget. The area of human resources, therefore, offers significant potential for leveraging good investments in research and development. STOG-77 defines a broad set of user needs. Research and development projects in response to STOG-77 needs in human resources and personnel management are contained in the program of the Army Research Institute for the Behavioral and Social Sciences (ARI) with one task area also in the program of the Human Engineering Laboratory (HEL), and one in the Army Medical R&D Command.

II. FINDINGS

A. GENERAL

Overall, there is a good correlation between STOG-77 and Army laboratory plans. The level of effort of ARI programs appears suitable to the stated STOG objectives and current state of technology. The closeness of the match suggests there has been a good level of communication between users and ARI in this area.

1. Excellent work is being done in the ARI on improved performance based measurement of job skill levels, and on individual capabilities to permit the matching of type requirements with typical individual soldier capabilities. This work is considerably superior to most work of the same sort carried on in other parts of the economy. Work on physical strength standards is less well developed, and requires more support.

2. The work of ARI in searching for improved methods for the prediction of military aptitude is also first-rate. The balance of efforts to develop new predictors is appropriate, and is likely to be productive.

3. Research on improved methods for the assessment of officer and enlisted performance, and for improved officer and enlisted military career information systems is relevant and appropriate. The work is carried on at the appropriate level.

4. The development of a better technological basis for more efficient, more precise, and more comprehensive military career management suffers from an inadequate system of reports on officer performance where significant variations in performance are adequately portrayed. The problem is not one of an adequate research base or an adequate set of procedures for such an evaluation, but rather with policy decisions which would support the adoption of improved procedures. The problem is especially critical at the company offieer level, and in combat units.

B. Supportive Work Needing More Emphasis

1. The STOG addresses the Army's need to rely on properly selected persons whose special abilities and potentialities are discovered, developed, and used properly to achieve Army missions. ARI's programs are generally responsive. There must be greater emphasis on a technical program to assess the effects of the quality and quantity of personnel to meet Army needs. Currently, very few mental Category I and II soldiers are being recruited, posing a serious problem for finding NCO's in technical and combat areas. Needed is an expanded technical program to analyze data on the total military force, to determine how well individual officers and enlisted men of varying abilities have acquired military capabilities that will increase the Army's combat effectiveness. ARI has one such project on enlisted personnel, beginning with accessions in 1974. ARI had initiated an earlier project on 1973 ROTC accessions. However, the capacity of the Army to provide the data, and the ARI capacity to provide the research analyses is not fully apparent. Major issues involved include the following: analysis of specific training, unit assignment, and job performance measurement as they relate to later career achievements, team/unit composition data to estimate effects of unit personnel turbulence/rotation on combat readiness; effects of leadership (officer and NCO) continually in units on unit performance and capability measures; effects of varying quantity/quality of officer and enlisted "supply" on the force effectiveness of the Army; and in-depth studies of attrition. Outcomes of these studies will inform decisions on recruiting methods, training programs, and decisions about staffing and deployment.

2. The work in defining the role of women in the Army is described in terms that appear to be sensible and reasonable. The research outcomes, however, will not give any realistic basis for determining the appropriate female proportion of total strength.

C. Good Quality Work not in STOG-77

1. ARI has a program of research on "Contemporary Issues" that is relevant to current concerns in racial relations, drug abuse, the "generation gap", and Army-Community relations. This work is not specifically identified as a need in STOG-77. It has lost funding by recent Congressional action.

2. ARI has a program of research in automated instructional technology that is not specifically in STOG, but is directly relevant to achievement of several objectives. The work should be continued.

D. Gaps

Four STOG-77 items related to human resources do not have identified, responsive programs. These are:

a. 16.6 Levels of Borrowed Personnel

b. 16.7 Organizational Structure Guidance

c. 16.8 Staffing Ratios

d. 17.9 Selection and Management of Personnel.

There is need for work not now being done related to the development of unit effectiveness in terms of techniques of leadership and management at all levels. Several STOG items are relevant: STOG-77-16.5 on organizational effectiveness; STOG 77-16.6 on using borrowed military manpower; STOG-77-16.7 on organizational structures; and STOG 77-16.8 on decisions on staffing ratios. Since these objectives are critical for the Army, the need for a better program in this area is obvious. The cost of training may become too high, for example, if a large portion of trainees are minimally capable, and require excessive time to develop and sustain minimum skill levels. Policies on rotation would also then need review, as would related personnel policies on the enlisted grades associated with various military assignments. Within the Army, there are enough variations in leadership styles and in modes of personnel utilization employed to make it feasible for variants to be appraised; some may be demonstrated to be effective and generalizable.

E. Work to be Terminated

Since no specific STOG need is identified for the ARI work on "Contemporary Issues", it would be appropriate to review this work within proper DA organizations. Either a need might be established or the program should be permitted to phase out.

F. Comments for TRADOC for STOG-78

As in other areas, the objectives defined for research and development in human resources would benefit by more precise definition of the objectives. It appears, however, that ARI has a good understanding of the needs and their priorities.

Consideration should be given to research to anticipate and prepare for future manpower concerns, such as the impact of significantly changing population distributions and the impact of changing economic conditions on recruitment and retention of personnel.

STOG No.	Description	LAB Program	A Responsive	B Good Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
16.1	Capabilities Measurement	ARI- In-house research Criterion Referenced Testing	X				
		ARI - Basic research Performance based testing	X				
		ARI - Manpower Accession and retention	X				
		ARI - Performance Oriented skill	X				
16.2	Role of Women	ARI - Manpower Systems Management		X			
		ARI - Manpower Accession and Retention	X				
		ARI - Role of Women	X				
		HEL - Female Soldier Performance	X				
16.3	Assessment of Performance	ARI - Basic Research - officer career planning	X				
		ARI - Basic research - automated testing and career modelling	X				
		ARI - Manpower Systems Management	X				
		ARI - Manpower Accession and Retention	X				
16.4	Prediction of Military Aptitude	ARI - Basic research - cultural factors and aptitude	X				
		ARI - Basic research - stated values	X				
		ARI - Manpower Systems Management	X				

STOG No.	Description	LAB Program	A Responsive	B Good Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
16.5	Organizational and Individual Effectiveness	ARI - In-house research - Leadership Development	X				
		ARI - In-house research - Classification Models	X				
		ARI - Basic research - Integration of Newcommers	X				
		ARI - Basic Research - Culture fair testing	X				
		ARI - Techniques for increasing Soldier Productivity	X				
		ARI - Army Contemporary Issues	X				
16.6	Levels of Borrowed Personnel					X	
16.7	Organizational Structure Guidance					X	
16.8	Staffing Ratios					X	
17.9	Selection and Management of Personnel					X	
	Contemporary Issues				X		

B. TRAINING

I. INTRODUCTION

Training is a very important area in which the Army must develop and apply advanced technology. There are few areas in which a higher return in terms of improved effectiveness and reduced costs can be achieved.

A number of concurrent factors are causing fundamental changes in the Army's approach to training. Both the STOG-77 needs and Army R&D plans reflect this. However, further coordination between them is needed. A number of STOG-77 needs are not adequately addressed. Furthermore, there are needs, not listed in STOG-77, which are being responded to by good research programs.

The Army places major reliance on the Army Research Institute for the Behavioral and Social Sciences (ARI) for providing technological support for its training programs. Much of this work is highly praised. Some is considered to take too long, and to result only in reports of limited usefulness. The most valuable support comes when technological assistance is provided in the form of persons working in the training setting.

The scope and adequacy of ARI projects are difficult to assess on the basis of documentation. There is a lack of articulation among various ARI program documents. Also, end objectives are often not clear. Program descriptions tend to be written in very broad terms that do not match STOG-77 statements. Program statements developed for the FY 77 effort show improvement.

A number of the STOG-77 objectives relate to simulation devices. Planned projects relevant to a number of these needs are assigned to DARCOM's Program Manager for Training Devices (PM-TRADE). Briefings provided by TRADOC described plans to develop tank gunnery trainers and other devices. The STOG-77 objectives in this category were not adequately addressed, and the TRADOC plans were considered to be much too modest.

II. FINDINGS

A. General

The ARI Laboratory plans reflect a growing program in the area of training. There are some good, well-focused efforts. However, it also appears that there is a scattering of poorly focused and underfunded

activities with poorly defined objectives. More contact between users and ARI to clarify needs, objectives, and program plans seems needed. The panel was informed that this was recognized and steps have been taken to obviate the problem in the FY 77 program. The ARI program includes some significant efforts which probably should appear in STOG-77, but are absent. An example is the area of automated instructional technology. Other examples are Individual Training and Personnel Programs and Management Systems for Career and Unit Purposes.

B. Supportive Work Needing More Emphasis

The general area of vehicle and mission simulation is one in which the Army generally lags. It is a key area which should receive more attention. Maintenance training is a high cost area, due to the typical reliance on operational hardware. Significant cost savings potential exists through the use of electronic simulation technology. The Navy and Air Force have begun active programs in this area. The current ARI program plans do not give sufficient attention to this problem area.

The general area of simulation technology needs more supporting research, ranging from the behavioral aspects of "transfer of training" to the development of specific simulation techniques (e.g., engagement simulation, sensor display simulation, EW simulation.)

C. Good Quality Work not in STOG-77

A notable omission from STOG-77 is the need to develop automated instructional technology, both as a free-standing capability and as an adjunct to simulation systems for training. The ARI program includes some effort in this direction. There has also been a significant effort in this area sponsored by TRADOC at Fort Monmouth, New Jersey. This effort is called "Computerized Training Systems Project" (PROJECT ABACUS). In addition, the PM TRADE-managed program includes planned efforts in Automated Performance Measurements Evaluation, and Automated Training Techniques Evaluation.

There is a continuing need for research on learning behavior and methods for assessing learning performance. This is fundamental to effective training systems. This need is being addressed at a low level in the ARI plan.

ARI has a major activity directed toward developing and implementing the idea of "imbedded training". This concept involves designing training capabilities into the regular operating situation for units and systems. For example, in a computer-based tactical data system, an effective training mode can be included at low cost if designed in from the beginning.

Given the importance of NOE flight capability, there should be greater recognition given to the need for crew performance factors and related training needs. ARI's program includes a significant program in this area. In addition, the PM-TRADE program includes planned efforts which address this area of need. Examples are projects on visual simulation techniques (Panoramic Optical Probe, Special Purpose Algorithms for CGI) and a project on Synthetic Flight Trainer Systems.

PM-TRADE has additional programs planned which may be responsive in part to some STOG-77 training-related needs. Examples include:

a. Armor Training Device Technology Study

b. TOW/SHILLELAGH Second Generation Training System

c. Remote Target Systems

D. Gaps in Work in Support of STOG-77

No effort in available laboratory plans (ARI) was found in response to the following STOG-77 items:

a. 8.10 Air Defense Trainers

b. 13.10 Simulation--Enemy Communications and EW

c. 15.1d Training Devices--Electronic Simulation.

ARI has established a field unit at Fort Bliss, Texas, to conduct research studies related to air defense training. An initial project will develop a training model for four Army skill codes, including CHAPPARAL and VULCAN crewman. There are no known plans, however, to address the specific STOG-77 needs for air defense training devices. Planned programs of PM-TRADE, such as Multiple Integrator Laser Engagement System (MILES), may provide technology relevant to the stated needs for Air Defense Trainers, but do not appear to be currently oriented toward the specific requirements of STOG-77 objectives number 8.10.

In the area of Enemy Communications and Electronic Warfare, PM TRADE has planned a study to define a basis for structuring an EW training device program. This study is included in PM-TRADE FY 77 plans. It is possible that some needs in this area could be covered by research activities of the Army Security Agency School at Fort Devens, Massachusetts. Research plans of ASA were not available for review.

The STOG-77 item 15.1d on Electronic Simulation is not well defined. A number of planned PM TRADE activities are potentially responsive to this need, but from available descriptions, they do not appear to be closely correlated with the STOG statement.

There appears to be at this time no realistic way to train for indirect fire, for battlefield scenarios to produce casualty assessment and for command and control. To date there are two studies ongoing and one future study that may possibly answer the above. Another area is suitable targets for training. Mine/Countermine Casualty Assessment System (MICAPS) is another area where more answers are needed. Training Devices/Simulators are being developed in support of Combined Arms/ Combat Service Support, Weapons Systems and Biological Training.

a. Indirect Fire. Presently, the Army possesses a limited means of simulating direct fire only. Simulation problems can be subdivided into two general categories:

(1) Assessment of casualties and destructive efforts.

(2) Simulation of weapons effects visual/sound cues.

b. Command and Control Training Systems. Presently, the Army does not possess the means to train commanders without troops in assessing the battlefield situation in order to enable them to command and control the battle.

c. Electronic Warfare. Presently, means to train personnel in the area of elctronic warfare is very limited at Bde/Bn level and below. Areas of concern and development are:

(1) Electronic counter/countermeasures.

(2) Electronic sensors

(3) Electronic Warfare Study--user requirements

d. Driver Simulators. Presently, the Army does not possess the means to simulate tank/vehicular driving.

e. Targets. Presently, the Army, Navy, and Air Force are delving into all areas that will provide realistic battlefield targets enabling its personnel to achieve proficiency to combat standards.

f. Weapons Effect Signature Simulator (WESS). There is a need for WESS systems of all types of weapons to provide realism on a simulated battlefield.

g. Mine/Countermine Casualty Assessment (MICAPS). Presently, the Army does not possess means to simulate mine casualties in a training mode.

None of the above are especially listed in the STOG; however, each category should have consideration for training by use of devices or simulators.

III. RECOMMENDATIONS

A. Gaps to be filled in Support of STOG-78.

1. Army training programs require scientific and technological support in five critical areas that are not explicitly addressed in STOG and that are not properly represented in Army laboratory programs.

(a) Each major training program requires technical assessment to discover the degree to which training standards are reached, an analysis of retention of training over time, and of the degree to which that which is learned is the critical skill required for maximum combat effectiveness. In addition, training methods must be geared to the capacities of students. Training programs require special skills and varieties of support. ARI should have a more comprehensive program in this area.

(b) There is no Army technological base for the development and evolution of training devices and simulators, no central laboratory to develop and test appropriate training aids, and no capability for developing a program in 6.1, 6.2, and 6.3a that would support the entire Army training program. We applaud the reported arrangement to use the Navy technological base to acquire an immediate capability. The Army's needs are sufficiently broad, diverse, and unique to justify a substantial effort that could be closely articulated with the major work in progress in the Navy and Air Force.

(c) The Army requires a larger program in the development of a set of procedures and supporting equipment that permits the development and testing of simulation procedures that involves large units of the Army engaged in simulation of combat. The argument for a capability "to scrimmage" is persuasive; the current programs to develop an improved technology in this area are not adequate to the job. The planned programs that have been made available for our review will not be sufficient to the task.

(d) The Army needs a technological base for the preparation of field manuals and technical manuals. Recent research with elementary school texts has shown that many students can learn the subject matter easily, but cannot understand the material in the way in which it was presented. Manuals need to be pretested for more than reading level. A continuing effort need not delay production time, and can have a great effect on usefulness of manuals.

(e) Modes of presentation other than the printed page need to be studied and developed for use in Army training.

2. Develop programs to fill gaps cited in D.

B. Work to be Terminated. None identified.

C. Comments for TRADOC for STOG-78.

Discussion with laboratory personnel is recommended to plan time dimensions on the needs and to determine the value of existing programs for which there is not an identified need in STOG-77. More communication with ARI and PM-TRADE is recommended to clarify stated needs to ensure coordination of efforts related to future STOG items.

It was observed by the Subgroup that TRADOC was very concerned about the lack of a dedicated DARCOM laboratory for 6.1, 6.2, and 6.3a effort in training devices and simulators. DARCOM performs this work through PM-TRADE who subcontracts the effort to the Naval Training Equipment Center in Orlando, Florida, and many other Army hardware efforts in many laboratories. The generic technology base for Army missions would probably best be developed and executed for the Army by a dedicated Army organization.

STOG No.	Description	LAB Program	A Responsive	B Good Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
7.17	Vehicle and Mission Simulator	ARI - Aircrew Performance Enhancement		X			
8.10	Air Defense Trainers Electronics						
8.106	Air Defense Trainers Targets	PM TRADE - High Performance Aircraft	?				
13.10	Simulation - Enemy Communi-cations and EW	PM TRADE - Electronic Warfare	?				
14.4	Maintenance Training Methods	ARI - Simulated Performance Tests		X			
		PM TRADE - Main-tenance Trainers	?				
15.1a	Training Devices - Lasers	ARI - Combat Unit Training	X				
		PM TRADE - Low Energy Laser	X				
15.1b	Training Devices - FTX Simulation	ARI - Training and Education Simulation Support Requirements	X				
		ARI - System embedded trng.	X				
		PM TRADE - Maneuver Control, Casualty Assessment System		X			
		PM TRADE - Command Group Training Supt. System					

STOG No.	Description	LAB Program	A Responsive	B Good Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
15.1c	Training Devices - Flight Display	ARI - Training and Performance Enhancement		X			
		PM TRADE - Wide-angle laser Scan Visual System, etc.	?				
15.1d	Training Devices - Electronic Simulation	PM TRADE - Computer-Animated Visuals	?				
15.1e	Training Devices - Engagement Simulation	ARI - Combat Unit Training	X				
		PM TRADE - Indirect Area Fire	?				
		PM TRADE - DRAGON Flight simulator	?				
15.1f	Training Devices - Sub-caliber devices	PM TRADE	X				
15.1g	Training Devices - Crew/Unit Training	ARI - Independent Research, Night Simulation	X				
		ARI - Computer-Mediated Team Training	X				
		ARI - System Embedded Trng	X				
		ARI - Combat Unit Training	X				
		PM TRADE - Armor Crew Trnr.	X				

STOG No.	Description	LAB Program	A Responsive	B Good Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
15.1h	Training Devices - Maintenance Trainers	ARI - Simulated Performance Tests		X			
		PM TRADE - Maintenance Training Studies	?				
15.3	Transmission of Instructional Material	ARI - Embedded Training		X			
		PM TRADE - Graphic Transmission	X				
15.4	Natural Language Computer Program	ARI - Software Research	X				
15.7	Analysis of Training Alternates	ARI - Basic research - cost effective analysis	X				
		ARI - Combat Unit Training	X				
		ARI - Automated Educational Technology			X		
		ARI - Tactical Leadership Training			X		
		ARI - Learning Behavior and Measurement			X		

C. MEDICAL, DENTAL, AND LIFE SUPPORT SYSTEMS

I. INTRODUCTION

Army R&D programs in the area of medicine, dentistry, and life support are under the Army Medical Research and Development Command (AMRDC). The existing AMRDC program plans are highly responsive to STOG-77, though gaps do exist in the STOG.

As the United States completes this bicentennial year and looks back to consider our involvement in military conflict, it becomes evident that during 40 percent of these 200 years, our nation experienced armed conflicts though not all of these were officially entitled "war". In considering that "the past is prologue" and existence on this planet seems to be one of eternal conflict, it is important to develop useful solutions now for those time critical problems that may face future military forces. Military leadership recognizes that it takes people to operate weapons. To overlook the simple requirements of food, water, and supply, not to mention diseases and environmental problems existing in areas of the world where we may have to fight, may well bring about defeat of the best equipped and highly trained Army. One has only to recall the disastrous experience of the 1958 Lebanon Landing in which 40 percent of the troops were incapacitated within 72 hours from gastrointestinal problems, or the 1973 Middle East War, where some units in the Jordan Valley experienced 100 percent attack rates of leishmaniasis. Operational plans that ignore medical factors may well be doomed to failure. It is of utmost importance that all elements of military preparedness be in step and paced together.

Where will replacements come from in the first 6 months of a new war? Military experts point out that the time lapse between M-Day (mobilization) and D-Day of a new war will be short; M-Day might even follow D-Day. Six months will be required to establish and operate a draft system while combat units will be losing personnel. New weapons and military developments have resulted in tactical plans and operations estimates of a many fold increase in the number of anticipated casualties. Replacements then can only come from the repair of those who are wounded or the cure of those who are diseased. New and innovative combat surgical modalities, preventive medicine procedures, solutions to environmental difficulties, and cures for new diseases will be time critical. Useful solutions should be developed now. Congress should not line out Military Medical R&D items without prior assurance that National Institute of Health (NIH) - Department of Health, Education and Welfare (DHEW) can and will fulfill the military requirement and accept accountability. In the absence of DHEW assurance, accountability devolves to the legislative body for such action. In addition to recognition of the fact that tacticians must not ignore medical input, it further should be recognized that what we

do medically must be in consonance with the posture of the Army in the field now and in the future, and in harmony with the medical support mechanisms of the Navy and Air Force. There is an emerging Army study, TOMSS (Theater of Operations Medical Support Systems), that will have U.S. Navy (plus Marines) and U.S. Air Force participation which will continually review and update medical treatment, medical evacuation, cogent clinical research, and medically-oriented materiel development to determine existing deficits for which knowledge and technology have either not been tasked to provide solutions or have not yet been able to provide answers despite tasking.

"Lessons Learned" from past military operations should be addressed in the STO's as well as in the statement of Desired Capabilities.

II. FINDINGS

A. General

There is good correlation between STOG-77 and AMRDC program plans. Clearly, there has been close coordination; however, additional science and technology objectives will be identified in Part D - GAPS.

B. Support Work Needing More Emphasis

1. The AMRDC program description for Infectious Diseases reveals an insufficient level of effort in the prevention, treatment, and epidemiological research of malaria and other parasitic diseases, rickettsial diseases, and respiratory diseases. In particular, work in early identification of infectious agents, namely the promising laser-mass spectrograph system at Fort Detrick, should receive maximum effort.

2. The AMRDC program description reveals an insufficient level of effort in combined stress operations, medical aspects of helicopter, Combat Crew and Airborne Medicine, problems associated with rapid translocation of large numbers of ready combat troops, and the ability to operate, maintain, and repair highly sophisticated medical equipment.

3. The AMRDC program reveals an insufficient level of effort in recovery from injury research and means to reverse shock lung syndrome, and techniques to improve metabolic status immediately following surgery of the combat wounded, and identification and treatment of sepsis.

4. Maximum effort in Military Burn Technology and Research must be sustained as the thermally injured provide the most comprehensive model of the combat wounded.

5. Continued improvement of field medical materiel to provide diagnostic capabilities, early treatment and pain prevention at the most forward levels of combat must be strongly emphasized.

C. Good Quality Work Not In STOG-77

AMRDC has a program on health standards for military pollutants. No corresponding need statement was identified in STOG-77.

D. Gaps

The following science and techology objectives should be incorporated into Capability Category Number 77-17, Title Biomedicine and Health, of the STOG. Current objectives in the STOG are broadly stated, as they should be; however, detailed investigation has identified the following projects of particular need in view of briefings and scenarios presented. The appropriate paragraphs where these additional objectives should be included will be identified immediately after the listing number below.

1. (Add to STOG paragraph 77-17.2, page E.24). Develop methods for the immediate treatment of traumatic amputations by the medical aidman in the field. Develop a broad spectrum, injectable antibiotic with low incidence of side effects and allergic reactions, long shelf life and ease of determining whether it has lost potency or been damaged. Develop methods for immediate control of pain in the field; nonaddictive drugs and or electronic devices. Eliminate the need for the medical aidman to make sophisticated treatment decisions as to the type of fluid for immediate field use by developing or identifying one fluid that can be rapidly and generally utilized. Improve treatment of eye trauma.

2. (Add to STOG paragraph 77-17.4, page E.24). Develop methods for rapid field treatment of cold injuries of the extremities.

3. (Add to STOG paragraph 77-17.5, page E.25). Develop measures to cope with problems of performance in combined stress operations. (Heat) (Effects of heat and contaminants on operation of combat vehicles, i.e., tanks, APC's, etc.) Develop means to cope with the stress associated with field operation of sophisticated expensive equipment.

4. (Add to STOG paragraph 77-17.7, page E.25). Improve the environment for ground transportation of casualties and identify and develop alternative means of ground transportation in those situations where friendly forces do not have air superiority. Develop new improved devices for eye protection and vision improvement compatible with all combat device modes. Develop the capability to manufacture replacement fluids and provide all components of blood, or blood substitutes for use in the theater of operations. Develop constant pressure/flow device to eliminate inherent problems of gravity flow systems utilized by the aidman in delivering fluids to the combat wounded in the field.

5. (Add to STOG paragraph 77-17.8, page E.25). Prevent lethal complications of radiation exposure, develop systems to support radiation casualties of less than 600 rad, and provide support of patients with 600-1200 rad exposure.

E. Poor Work. None identified.

III. RECOMMENDATIONS

A. General Comments--Managerial Considerations

1. The biomedical aspects of chemical agents, diagnosis, potential vaccine protection, potential drug protection and/or therapy require a similar technology base in biochemistry, pharmacology, physiology, immunology, etc., to that associated with the parallel aspect of biologic agents, and, to a major degree, with radiation injury as well. From this standpoint, the chemical prophylaxis and therapy tech base is isolated. Full ROI would require a mechanism to take advantage of the immunology, biomedical vaccination, and drug development efforts and capabilities of the SG-DA.

2. Epidemiological and other aspects of field medicine need greater emphasis and support; however, proposed Congressional cuts in funding of specified biomedical R&D areas, if sustained, will seriously impair the Army's ability to cope with these problem areas.

B. General Comments--Technical Considerations

1. Systems analysis should be made of all field Soldier Support elements including medical.

2. Medical support systems should be included in SCORES. For example, (a) Would drug or vaccine, or both, giving low order LD50 protection against CW agents (all other factors being equal) produce significant prolongation of troop function as to be decisive? (b) to what degree does the increased physical and physiological stress caused by wearing individual protective equipment in a chemical warfare scenario impact on the ability to achieve the objective? (c) During tactical use of nuclear weapons would drugs providing low order LD 50 protection against radiation produce significant prolongation of troop performance as to be decisive?

3. R&D efforts for flash protection of eyes should be linked to R&D night vision systems.

C. Work to be Terminated. None identified.

D. Comments for TRADOC for STOG-78

The emerging TOMSS study will provide linkage for medical support required in TRADOC scenarios. As scenarios are developed, it is recommended that the study sponsor, Health Care Operations Directorate, Office of the Surgeon General, DASG-HCO, Autovon: 227-2213, be advised so that input may be provided.

With respect to the enemy use of infectious organisms (BW), a potential new worry may exist. Research in the genetics of micro-organisms has shown that it is possible to synthetically recombine genetic material (DNA) to create organisms which have particular properties. Presently, much of the U.S. scientific community has voluntarily imposed a ban on itself for this work. However, Harvard is seeking permission to build a genetics lab in Cambridge, and more recently the University of Michigan has elected to enter this research arena. The public concern regarding recombinant DNA is well founded. In addition, there is the military concern that manipulation of DNA may be employed to produce BW agents for which research on counter-measures by our military forces will not be possible in the absence of a permissive public policy.

To further emphasize the lessons learned aspects of military medicine, it is recommended that the following examples be added to "Lessons Learned", STOG paragraph 4, page E.23:

(a) Skin problems accounted for 25 percent of all hospitalization and 33 percent of outpatient visits in Vietnam and resulted in lost duty time of 262,162 man days.

(b) In WW II, rickettsial diseases such as scrub typhus and Q fever caused major military problems. For example, 16,239 casualties in allied troops in the Pacific Theater were attributable to scrub typhus alone. Epidemic typus was a real threat to a number of civilian wartime populations but proper vaccine protection prevented the loss of any American soldier to this dread disease.

(c) During WW II, there were admitted to medical facilities 90,535 casualties with a diagnosis of cold injury. A typical case of frostbite required 3 to 4 months of hospital inpatient care.

(d) Arboviruses were a significant cause of disease in WW II. There were 89,461 cases of dengue, and 10,420 cases of sandfly fever resulting in 788,628 man days lost.

(e) No effective drugs are available for treatment or prevention of trypanosomiasis. Although data to assess the risk of leishmanial infections to U.S. forces are limited, it must be noted that in the 1973 conflict between Israel and Arab nations, some units in the Jordan Valley had 100 percent attack rates of leishmaniasis.

D. HUMAN ENGINEERING AND PERFORMANCE ENHANCEMENT

I. INTRODUCTION

Human engineering and performance enhancement research activities extend from the earliest possible conceptualization of military weapons and operating systems, through the spectrum of development, engineering, evaluation, and installation, to final combat performance and execution. Hence, a multitude of opportunities exist for involvement and use of these scientists and their data and products.

Three Army R&D activities, the Army Research Institute for the Behavioral and Social Sciences, the Human Engineering Laboratory, and the Army Medical Research and Development Command, have programs variously responsive to STOG-77 objectives in the area of human engineering and performance enhancement. There is work planned or ongoing that relates to each of eight STOG-77 items in this area.

Since this area is basic to effective utilization of Army personnel, for both current and future Army needs, a strong and well-coordinated set of programs is necessary.

II. FINDINGS

A. General

The STOG objectives were compared with the available Army R & D materials, and in turn, these were compared with the ODDRE Technology Coordination Paper (TCP) Human Resources, Chapter V: Human Factors in Weapon System Development and Operation, in which the Services' and Advance Research Project Agency (ARPA) work programs and objectives are described for the FY 76 period and forecasted as to number of years to complete.

From a broad, overview perspective, this analysis permits several judgments to be made.

(1) In general, the STOG objectives appear limited in scope in that they do not cover the range of ongoing and projected research activity in the Army, and do not match the range of the TCP coverage. Further, the STOG objectives are not expressed evenly in their degree of specificity; they range from very broad and encompassing problems, to very specific matters.

(2) Similarly, the TCP categories do not reach far enough in several subareas. Specifically, several major Army problem areas

are not very discernible (such as combat capability and readiness in adverse environment, antitank weapon systems, women soldiers, helicopter nap-of-the-earth and night tactics, etc).

(3) While the work programs of the Army R&D agencies are generally appropriately based in systems approaches and evolutionary methodological/technological efforts, the correlation between STOG-77 and laboratory plans is found to be only fair. The work in some cases appears insufficiently focused on STOG objectives, or does not have sufficient emphasis or scope. Some HEL programs in particular appear to have little relevance. On the one hand they do not reflect more than trivial or ancillary attention to some objectives, or on the other, far exceed the stated objectives.

(4) As the STOG and its implementing procedures are put into full effect in the Army, it is likely that the general condition of apparent disarray will be minimized.

(5) There are a few large questions in the human engineering area which may need attention: organizing some STOG objectives into "technology enhancement" areas vs. organizing all into Army mission/capability areas; using STOG objectives as the basis for human engineering lab work program development and funding; requirements for improving the ODDRE TCP human factors chapter.

B. Work in Support of STOG

Certain STOG objectives (both short and long term) appear to be receiving adequate attention in the human engineering and performance enhancement R&D areas.

(1) Aviation (STOG 7.13, 7.14, 7.16, 7.17, 15.8)

The AMRDC, ARI, and HEL R&D programs appear to provide reasonably comprehensive coverage of prominent requirements. The STOG objectives do not express fully these apparent requirements, or at least, the close coupling needed between the hardware engineering and human engineering/human performance efforts.

(2) Human Resource Data for Weapon System Design (STOG 15.2)

The aggregated laboratories/R&D centers efforts, especially including the HEL DOD Human Factors Engineering Data Bank operation, may reflect progress toward a capability to develop and apply human resources data in weapon and support system design. STOG objective 77-15.2 states the need quite clearly. Emphasis is placed on the "data to be used early" in the process, and the exact status of this capability will have to be evaluated in terms of specific weapon systems.

(3) Others

Two STOG items, 15.5 (Evaluation of Multi-Sensor Data) and 15.6 (Improved Maintenance Performance Aids) are addressed by programs that are only marginally responsive, though they appear to be good programs in their own right.

(4) Supportive Work Needing More Emphasis

As will be noted on the attached matrix, a number of programs have been identified as needing more emphasis. Crew workload and related human factor issues are of critical importance to achieving a nighttime Nap-of-the-Earth capability. The entire Army tactical basis of air mobility is in jeopardy if this capability is not attained. Although the two STOG items (7.13 and 15.8) are directly concerned with the area and a number of responsive laboratory programs exist, the magnitude and importance of the problem call for a more intensive effort.

To a lesser extent, the same concern holds true for STOG 7.16. Improved Man-Machine Interface. While the STOG item is broadly worded, it does relate to new battlefield sensors and tactical data systems. Major advances in these are anticipated. The role of man in these is often going to be a crucial factor in their success. More attention to this area is warranted.

C. Other Work

(1) The R&D programs reviewed show a reasonably good grasp of the larger system settings and interacting issues that are inherent in much of the current and future Army development programs. Certain project titles illustrate:

ARI: Software Research: Human Factors in Programming
System Embedded Training Development
Aircrew Performance Enhancement in Tactical Environment
Man-Machine Interface in Integrated Battlefield Control System

HEL Work Units: Human Eye Movement as Related to Target Acquisition and Camouflage
Long Term Performance Effects when Operating Army Equipment
Infantry Systems Performance

NARADCOM: A System for Combat Support Under Extreme Cold Conditions
Infantry System of Clothing
Air Crewman System of Clothing

AMRDC: Environmental Stress, Physical Fitness and Medical Factors in Military Performance
Helicopter, Combat Crew and Airborne Medicine

(2) ARI has a program, Human Performance in Field Assessment, that has a number of elements. Most of these seem to be in the nature of support work for field tests and are not related directly to STOG-77 items. There is a clear need for this type of activity, but most of it probably does not serve to advance technology, but is more in the nature of engineering support. Some of the program elements may, however, have significant new technology. In this case a future STOG objective to cover this would be appropriate.

d. Gaps

(1) New Generation Tank

STOG objective 5.7c states a need for human factors engineering for the next main battle tank (also see 77-5.2i). The only efforts identifiable are concerned mainly with the application of present technology. The lack of technology program/project effort for what seemingly would be a major Army requirement in the human engineering, personnel, training, training device, medical areas - and indeed, with the whole life-cycle process - is important to evaluate.

(2) Maintenance Performance Aids

STOG objective 14.3 implies quite strongly the need for human factors information in designing "simplified field repair for all vehicles and equipment." (What is simplified/what does simplified mean for soldiers?) Similarly, STOG objective 15.6 requests "Improved maintenance performance aids." The HEL program and the TRADOC related research of ARI bear on these objectives, but do not face them directly.

Much emphasis has been given to the job performance and job training aids area in recent years, but little human resources R&D effort has been supported in this area (at least as far as visibility of funding allocated).

This area requires evaluation, both from standpoint of STOG identification and Army R&D program capability.

(3) Soldier Performance in Combat Environments

Two STOG objectives broadly and generally depict the major areas of soldier performance problems in combat environments. Objective 17.4 indicates need for improved performance in environments of extreme heat, cold, and altitude. Objective 17.5 requests measures related to behavior and performance in conditions of continuous military operations, night combat, and rapid air translocations. While certain efforts of NARADCOM, Corps of Engineers R&D, and HEL relate to these problem areas, the aggregate does not appear to equal the sizes of the problems, and more importantly, do not appear to be organized sufficiently for a direct focused approach to them. In particular, the matters being concentrated on are largely hardware and equipment-centered, without much attention to the soldier variables per se.

(4) Overall, there is a clear need for further coordination of Army objectives and program content in the area of human engineering and performance enhancement. ODDRE has conducted topical reviews and had coordination meetings for the next version of the TCP to improve program plans across the Services. Army agencies involved in Army problems need to effect improved internal coordination on numerous projects.

E. Poor Technical Quality Work

(1) It is not possible to identify work of poor quality without intensively focused inquiries. It seems possible to take issue with projects in several areas as to the degree to which the project is structured relative to the fundamental requirement (i.e., peripheral pieces being worked on compared with what is needed for a central attack), and the amount of effort and/or funding being provided. The importance of the latter is that some efforts are probably not worthwhile because the allocation provides only token effort and is therefore delusionary in nature. (These statements should be regarded with some caution because a fundamental function of research is to produce experts: the researcher may be equipped thereby in a small area to provide guidance, advice, data, and information that enters directly into Army systems and decisions that do deal with the larger problem.)

(2) Certain programs at HEL, as noted on an attached matrix, seem marginal in focus and scope; they may be candidates for redirection.

III. RECOMMENDATIONS

A. Gaps to be Filled to Support STOG

(1) Upgrade STOG, Focus R&D Program

A coherent, balanced, and comprehensive STOG - guided Army human engineering/performance enhancement program is needed.

are the basic resource employed throughout the Army strategic, combat, and support capabilities (reflected directly by the organization of the STOG), all STOG categories should contain clearly identifiable Human Engineering and Performance Enhancement objectives. Along with the new ones, the existing objectives in this area should be upgraded to express clearly the central thrust required.

(2) Depth Examination of Early Use of Human Factors Information in Systems Design and Development

This problem is widely discussed, but little systematic R&D effort is visible. The need in connection with the future Army main battle tank design and development discussed earlier in II D(1) provides a cogent opportunity to identify how and when research data and R&D effort can be provided. Further, there is widespread concern that in the current acquisition process system, an item or system is entered into early development stages without any involvement by personnel of relevent laboratories.

(3) Focus R&D For Maintenance Performance Aids

This was discussed in II D(2) above.

(4) Focus R&D on Soldier Performance in Combat Environments

This was discussed in II D (3) above.

(5) Initiate Improvements in ODDRE Human Resources TCP Chapter V

As indicated in IIA(2) above, the TCP range does not appear to reflect the problem areas of the Army in the Human Engineering and Performance Enhancement areas.

B. Significant Commments for Use by TRADOC in Providing Input for STOG 78

(1) In the Human Engineering and Performance Enhancement area, it is suggested that TRADOC should express a substantial need for immediate interface involvement and participation at the earliest possible time in the conceptualization, design, development, feasibility testing, etc., of new Army weapons and support systems that are being worked up by DARCOM development agencies. As noted in Recommendation III A (3), the human factors information component needs to be addressed and this component ought to be necessarily coupled with TRADOC doctrine and training proponency. While TRADOC and DARCOM interactions and interfaces may well exist and function to

some degree (and even perhaps satisfactorily) as reflected by the new Concept Development and Validation funding management, there is no visible human engineering and performance enhancement R&D coupling. It is argued here that this R&D interface is essential for achieving practical weapon and support system performance that will approach the design objectives.

(2) TRADOC may wish to add a STOG objective related to the technology of field testing.

C. New Initiatives

(1) Experimental Center for Measuring Task Performance Capabilities of Women Soldiers

STOG objective 77.162 appropriately identifies the requirement for developing a technological basis for defining the role of women in the Army. ARI and HEL programs reflect that important work is being initiated. However, it is likely that few competent measures can be developed under the conditions of unit day-to-day functioning. It is suggested that the creation of a small experimental center capability, for obtaining measurements across a wide sample of Army job tasks under carefully controlled conditions and variables, would speed up the development of the requisite technological data base, provide legally valid basis for policy decisions, and assure appropriate criteria to use in the personnel management processes.

Because ARI and HEL both have programmatic interests, it would appear that a joint research activity could be established for a period of 3 years maximum at a basic training center (such as Fort Jackson).

This experimental research center would be responsible to identify relevant job tasks, prepare suitable experimental facilities, design the measures, conduct the investigations, and collect, analyze and document the data.

D. Concept Development and Validation Candidate Efforts

Section III D - New Initiative: Experimental Center for Measuring Task Performance Capabilities of Women Soldiers

This proposed initiative would appear to be a suitable candidate for DARCOM/TRADOC CDV funding.

IV. Detailed Study Results and Rationale for Findings

(1) The attached chart (Att 1) shows the basic distribution of the work of the laboratories review in the area of human engineering and performance enhancement, arraying the STOG objectives against the current version of the ODDRE Human Resources TCP breakouts.

(2) The analysis represents a way of depicting the work, but does not purport to show the close connectors necessary between human engineering work and the systems being developed. For example, ARI is closely involved in "integrated battlefield systems." This work includes, as one part, the design and development of job performance aids and system proficiency maintenance techniques in the development of the Tactical Operations Center.

(3) It appears characteristic of the range of work in this area that "human factors R&D" does not stand alone but draws upon a range of data across several disciplines and exists in a meaningful form when it is a part of a larger system/equipment/capability development.

(4) Accordingly, the analysis and recommendations for the human engineering and performance enhancement subarea are oriented toward systems and systems-related problems that are important for Army's future capability.

V. STOG/Program Analysis

Attachment 2 reflects a matrix summarizing the analysis.

DDR&E Human Resources Capability Coordination Paper Chapter V: Human Factors in Weapon System Development Subarea Breakouts	STOG OBJECTIVES						
	5.?C HE for next tank	7.13,14,16,17 Airmobility and helicopter human factors	13.4 Visual efficiency	14.3 RAM-D issues	15.2,5,6,8 HE technol issues	16.2 Women in Army	17.4,5 HF issues
Human Performance Capabilities							
Visual Perf Capability		A B	A B		B		
Other Sensory Processes		C			A		A
Info Proc/Decision Making		B			A B		
Perf Under Varying Workloads		B			B	A B	A
Bio Feedback							
System Simulation Analyses & Models							
Command, Control, Simulation & Analyses					B		
System Development Design Tools		B		A	B		
Speech Recognition Models							
Systems Simulation & Effectiveness Analysis		A B		B	A B		
Personnel, Training, Manpower & Maintenance							
Factors in System Design and Life Cycle Costing		B		B	A B		
Personnel, Training Factors In Relation to Engineering Design							
System Maintenance Factors				B	A		
Operability Design Concepts and Criteria							
Control/Display Characteristics		A B			B		
Command, Control, Communication Systems and Operations		B			B		B
Work Station Design		B			B		D F
Standards, Specifications and Application		A					
Operational Assessment of Deployed/ Deployable Capabilities							
Assessment of Existing & New Systems	A	B C			B	B	C

LABS:
A - Human Engineering Laboratory
B - Army Research Institute for the Behavioral and Social Sciences
C - Army Medical R&D Command
d D - Natick R&D Command
E - Mobility Equipment R&D Command
F - Corps of Engineers R&D Office

STOG No.	Description	LAB Program	A Reponsive	B Good Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
15.8	NOE Helicopter Flight Tactics	HEL - Aviation		X			
		ARI - In-house research-NOE human capabilities		X			
		ARI - Human Factors in System Development		X			
		ARI - Aircrew Performance Enhancement	X				
17.4	Improved Performance in Adverse Environments	AMRDC - Helicopter & airborne medicine	X				
		AMRDC - Environmental stress	X				
17.5	Mechanisms Affecting Behavior/ Performance	HEL - Long term Performance	X				
		HEL - Night Visition	X				
		AMRDC - Military Psychiatry		X			
		AMRDC - Environmental Stress		X			
		HEL - Audition/Acoustics					?
		HEL - Noise Reduction					?
		ARI - Human Performance in Field Assessment			?		
7.13	Reduced Pilot Workload & Fatigue	HEL - Vision		X			
		HEL - Aviation	X				
		ARI - In-house display		X			
		AMRDC - Helicopter & Air Force Medicine	X				

STOG No.	Description	LAB Program	A Responsive	B Inadequate Emphasis	C Good - Not STOG	D Gaps	E Poor
7.16	Improved Man-Machine	ARI-Basic Research-Battlefield Information Systems		X			
		ARI-Human Factors in System Development		X			
		ARI-Man-machine interface	X				
5.7C	Human engineering	ARI-Human Factors in System Development				X	
		HEL-Human Engineering				X	
15.6	Improved maintenace performance aids	ARI - Human Factors in System Development				X	
		HEL - Human Engineering				X	

E. FOOD AND WATER

I. INTRODUCTION

A. Food

The U.S. Army Natick Research and Development Command (NARADCOM) has the major materiel developer responsibilities for food R&D. Nutrition and wholesomeness R&D is conducted by Letterman Army Institute of Research (LAIR). The Department of the Army is the executive agent for the DOD Food Research, Development, Testing, and Engineering (RDTE) program. Army user responsibilities are divided between the U.S. Army Quartermaster School for Field Feeding, the Troop Support Agency for garrison feeding, and the Army Surgeon General for nutritional standards.

In FY 75, DOD's subsistence procurement amounted to approximately 2.5 billion dollars. The food industry consists of over 40,000 food plants, but less than 1% actually perform any R&D and 90% of all R&D efforts are proprietary. Because DOD food requirements include unique needs to meet extended storage, excessive handling, worldwide distribution and operation in unusual environments, DOD must rely upon its own R&D efforts or contract support from industry to meet those needs.

B. Water

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM) is the lead DARCOM laboratory for water R&D. NARADCOM deals with the water requirements associated with field feeding. OCE provides policy guidance for user responsibilities, the U.S. Army Quartermaster School is responsible for the water distribution system, and the Surgeon General provides sanitation standards.

The STOG guidance in the areas of water supply and waste treatment are contained in capability categories 77-9, Tactical Engineering; 77-14, Logistics; and 77-19, Environmental Quality Control. The RDTE products of MERADCOM include processes and equipment for the production, storage, and distribution of potable water; the collection and treatment of waste water for reuse and/or disposal; and shipboard waste treatment for all Army watercraft having fewer than 25 men on board.

The systems developed by MERADCOM are for tactical organizations generally operated and maintained by engineer trained personnel. Equipment systems emphasize mobility where possible. Semipermanent facilities to serve large troop populations are developed where required.

II. FINDINGS

A. General Comments

1. Food research. This area is described in the STOG in Capability Category Number 77-14, Logistics. Prioritized objective Number 14.1 pertains to food and packaging. Research and development actions in this area are being accomplished by NARADCOM. Two documents have been provided by that laboratory for analysis. The USANARADCOM Plan for Technical Achievement, 1976-1996 serves a valuable purpose in providing long-range goals and objectives while the USANARADCOM Listing of RDTE Work Units Reports, FY 76 provides a listing of active and recently completed RDTE Work Units. The latter provides a more solid basis to answer ASAP questions than the Plan for Technical Achievement since it concerns current actions.

2. Nutrition Research. The STOG does provide guidance in the area of nutritional research with STOG 17.10. The U.S. Army Medical Research and Development Command through LAIR has research efforts in the following areas:

a. FY 77

(1) Military Public Health. Ten projects have been identified in the program.

(2) Military Nutrition. Projects dealing with facilities (all Services); use of nonanimal protein; field nutrition; level of fat in diets; nutrients and their impacts; and hospital feeding systems have been identified. Total funds: $1,038,000.

b. FY 78

Ten projects pertaining to the DOD Food RDTE Program have been identified with a fund projection of $1,142,000.

c. FY 79

Eleven projects have been identified with a fund projection of $1,256,000.

3. Water Research. This area is described in the STOG in Capability Category Number 77-9.10 and 77-9.11. Research and Development Actions in this area are being accomplished by MERADCOM. Research under way is described in:

a. The ASAP Summer Study Mobility Equipment Systems Summary 1976. This document provides a long-range technical forecast describing needed research in two areas: Integrated Water Supply, Storage and Distribution for the 1990-2000 timeframe; and Liquid and Solid Waste Disposal System for the 1990-2000 timeframe.

b. The MERADCOM projects in support of the STOG water and waste treatment areas are summarized in Table 1. The current RDTE program relative to STO 77-9.8 in the development of a family of new water purification units is in accordance with the DA approved ROC entitled "Family of Water Supply Equipment". The new multipurpose water purification system making use of the reverse osmosis process is intended to produce potable water from fresh, brackish and sea water sources and to remove chemically any radiological agents from water to an acceptable level for drinking. A trailer mounted 600 GPH unit is currently undergoing field test and advanced development of a truck mounted 1500 GPH unit has been initiated. Also, in connection with this STO, studies have been initiated on the modification or adaptation of the 6-inch lay-flat hoseline with pumps and storage tanks for distribution of water for extended distances in arid regions.

B. Work of Good Quality in Support of STOG but Inadequately Emphasised

1. Food Research. A review of the NARADCOM RDTE list reveals that many and varied projects are under way in program categories 6.1, 6.2, and 6.3. The technology base areas in subsistence which have specific actions are:

Area: Subsistence

Tech Base	100:	Nutrition
	200:	Chemistry
	300:	Microbiology
	400:	Acceptance
	500:	Stability
	600:	Processing
	700:	Packaging
	800:	Rodent and Insect Protection
	900:	Food Service Equipment
	1000:	Advanced Concepts

These areas appear to be receiving adequate emphasis. The technology bases listed above are supported by projects, and personal interviews with project supervisors revealed that the research is dynamic and purposeful. Chart 1 illustrates the subsistence program as a part of life support.

MISSION AREA AND TECHNOLOGY AREAS

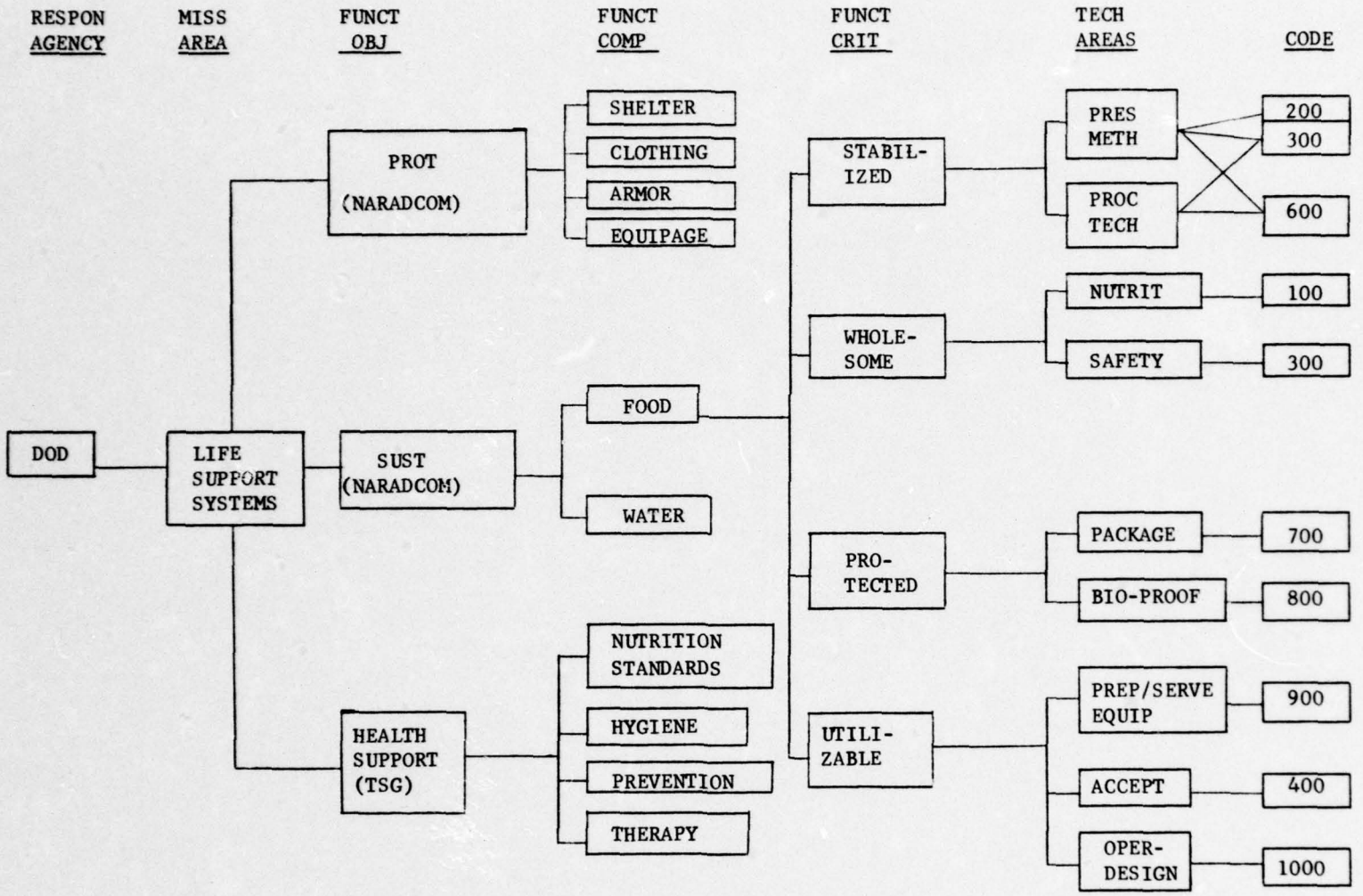

TABLE 1

WATER PURIFICATION

STO #	KEYWORDS	MERADCOM	COMMENTS
9.6	Rapid Constr/repair Bases/Ports/ Facilities Reduce time, skill Prefab, modular Indigenous mt'ls	Temp Cam/Water Supply Waste Water reuse (200 k)	General Objectives: (1) Process, equipment for production, storage distribution of potable water
9.8	Tactical Eng Water Purification Fresh/Brackish, Sea Water Distribution Arid Areas	Transportable, Multi-purpose water equip Tactical Hoseline (730 k)	(2) Collection, Treatment of waste water and shipboard waste treatment for Army Watercraft (w/less than 25 men)
9.10	Tactical Eng North Temperate Sub Artic Evacuation of frozen mtl Engr Activities low temp, high wind, low visibilities	Field Latrine Facility, Rinse Shower, Laundry Wastewater (125 k)	More effort on making waste water reusable rather than safe for environment CG & AF also funding work
9.11	Tactical Engr Desert, Tropic Stabilization of Soils Dust Control Water purification Gap Crossing Constr of LOC		Work on shipboard waste disposal not covered by a STO
14.7	Bulk liquid POL/H_2O Storage Handling Dispensing Organic Transp		
19.2 1bc	Stds/Criteria for Waste Water treatment/reuse	Physical/Chemical Waste water treat/ rinse Sewage Disposal (340 k)	
19.3c	Research in Tactical sanitary and Wastewater	 Reverse Osmosis 600 GPH 1500 GPH Lay flat Hose, 6" with pumps	

2. Nutritional Research. The Medical R&D command research program appears to adequately support STOG STO 17.10.

3. Water Research. The MERADCOM program supports STOG objectives as shown in Table 1. Insufficient emphasis has been given to the techniques for retreating waste water (laundries, showers, kitchens, and sewage) and their use for non-consumptive purpose. A complete recycle system analysis should be initiated.

C. Work Identified as Good Quality and High Relevance But Not in Direct Support of the STOG

The NARADCOM food program contains a number of projects being accomplished to support other than Army activities (e.g., Navy, Marine Corps). These projects appear to be purposeful and will add to the technology base development.

D. Gaps

1. Food R&D Programs. The following general statements are provided concerning gaps in the overall program.

a. A lack of long-range feeding system user requirements and objectives.

Discussion: The NARADCOM Plan for Technical Achievement discusses long-range requirements and objectives related to the laboratory R&D efforts (pp. 5-10). The plan stresses that these must be adaptable to the future battlefield. The user must provide his future requirements and objectives for combat zone feeding to NARADCOM.

b. The User Needs should be definitive and time-phased.

Discussion: Many RDTE actions under way at NARADCOM result from initiatives on the part of laboratory personnel; or as a result of "provide by a certain date a list of your needs in subsistence developments". Users should provide requirements in subsistence with the same emphasis as in weapons systems.

c. Research is needed in the area of subsistence war reserves.

Discussion: What type of rations can be stored as war reserves? How are they rotated?

d. RDTE needed to develop field feeding sanitation equipment.

Discussion: The Army field feeding system is going toward centralization of messes at higher levels. There is no suitable equipment available to clean and sanitize large items such as pots and pans.

e. Messing equipment is required to support centralized feeding in the field.

Discussion: The Army would like to centralize messes at the battalion level. The company level kitchen trailer may not lend itself to consolidation and testing is required. (The Marines want to stay with tents.) RDTE efforts should be aimed to this area.

f. RDTE needed in field refrigeration systems.

Discussion: When ice cream arrived in Vietnam, the troops ate it until it came out of their ears since limited storage capability existed. If these types of foods are to be used in future field feeding, then satisfactory equipment to handle them is needed.

2. Nutrition Program. No gaps were noted in this program.

3. Water Programs. The following areas require attention.

a. Techniques are needed to use subsurface water more efficiently.

Discussion: Drilling equipment and personnel training and availability are inadequate.

b. Sewage disposal systems are inefficient.

Discussion: No equipment or techniques exist to dispose of large quantities of waste without building long lead time conventional disposal systems.

c. Emphasis is needed to reduce water consumption.

Discussion: Water is a "cheap commodity" until you must provide it under combat conditions or in an arid environment. The reuse of waste water for non-consumptive purposes would contribute to solving the supply problem.

E. Work Identified to be of Poor Technical Quality.

None.

III. RECOMMENDATIONS

A. Actions should be taken to fill the gaps identified in II.D above.

B. Work to be Terminated.

None identified.

C. The STOG should be revised to cover the area of Soldier Support Systems more adequately. For example, the STOG should have objectives which apply to the subsistence technology base areas listed in paragraph II.B above. Water purification, supply and distribution should be given higher priorities in the applicable STO's.

D. New Initiatives.

1. The ASAP final report should recommend that action should be taken to fill gaps listed above. Those actions would be both management oriented and technological.

2. The ASAP should recommend that the dialogues between the user elements (TRADOC) and the laboratories should be more frequent and meaningful. Too much laboratory research depends upon the initiatives of the laboratories. The user must be more aggresive and the system must permit a useful interchange between the user and developer.

F. CLOTHING AND INDIVIDUAL EQUIPMENT

I. INTRODUCTION

The US Army Natick Research and Development Command (NARADCOM) has the materiel developer responsibility for individual combat clothing and equipment. These items consist of the complete clothing ensemble; underwear, combat uniform, footwear, outer-garments, and load carrying equipment needed to accomplish the combat mission. All of the individual equipment designed to provide camouflage, chemical, flame and ballistic protection such as the NBC protective clothing, body armor, and helmet are included in this category. Edgewood Arsenal is responsible for the individual protective mask. Specialized equipment to meet specific environmental or operational conditions such as extreme heat, cold, or altitude are also considered in this subgroup. The majority of this work is carried out by the Clothing, Equipment and Materials Engineering Laboratory (CEMEL). The US Army Infantry Center, Fort Benning, GA, is the user proponent for the development of these items.

CEMEL had a FY 76 budget of 9.7 million dollars (9700 K) of which RDTE was 4,100 K broken down by 6.1 - 300 K, 6.2 - 1800 K, 6.3 - 800 K, 6.4 - 1200 K. In support of procurement in the Production Engineering area they had 2400 K, PEMA 500 K, and Customer Orders 2,700 K. This budget supports research, development and engineering covering 1400 individual items, most of which are relatively low cost but must be procured in large quantities to satisfy the total Army and other Defense Department requirements. For example, in FY 75 the Defense Department bought 1,260,000 pairs of combat boots at a cost of $15.50 per pair. (Projections call for the procurement of 4 million pairs of combat boots in FY 76-77.) This laboratory does work for all services and carries many programs from 6.1 through 6.4 and writes the specifications and provides technical support to manufacturers. An example of in-house research is the interaction of photo/thermal energy with materials. Much of the textile and fiber research necessary to support military requirements is also done within CEMEL since commercial industry is "fashion" oriented. Although a portion of CEMEL is involved in fairly basic research, the majority of the staff is end product oriented with numerous short-term projects.

The "Plan for Technical Achievement 1976-1996" which was sent to the panel members was not designed or intended to be the systems development plan for NARADCOM but was a general blueprint of the technological base needed during the period. A more appropriate document to be used to compare the STOG with the NARADCOM efforts to meet these objectives is the "Listing of RDTE Work Units Reports." This document lists specific projects which are/were being conducted to solve the future needs of the Army in the areas which NARADCOM has responsibility and was used by this subgroup to conduct its analysis.

II. FINDINGS

A. General Comments.

1. The STOG does not address itself sufficiently to the support of the individual soldier in the field. Certain priority items are generally included, e.g., personnel armor (77-5.8, 77-14.6), NBC protective equipment, (77-5.2e, 77-10.1, 77-10.2, 77-10.8), field clothing camouflage protection against both visual and IR detection devices, (77-12.10, 77-14.5) and flame protective clothing 77-5.2e, 77-10.1d, 77-14.5) have visibility; but certainly there is need of a point of focus for developing other items of equipment such as a new and better combat boot, or a combat boot for special applications, e.g., cold weather, jungle or desert use. In fact, NARADCOM devotes 50 K or one man-year of effort to this cause, but no STOG reference can be matched directly to this program. Hence, in the area of clothing and individual equipment, the STOG is not always in consonance with identified needs. In the areas covered by the STOG, NARADCOM generally has developmental programs to move toward and achieve the desired objectives.

2. The problem of the Army development versus purchasing commerical equipment and clothing was addressed. The Director of CEMEL was asked why he does not purchase commercial clothing and equipment. The following points seem relevant and reasonable:

(1) The fiber producers, e.g., Dupont, carry out research for their own purposes.

(2) The textile makers are usually small firms that do no research and development.

(3) The Army goals in textiles are different than commercial: lifetime of commercial civilian clothing is determined by fashion; the Army, by wear and durability.

(4) Some Army development equipment items, e.g., mountain boots, have been sold commercially.

(5) This problem is aggravated by the Small Business set-aside and procurement procedures/regulations. Since present procurement regulations require specifications for competitive bidding, procurement of acceptable commercial items without the use of specifications is not currently possible.

3. The NBC threat requires a very comprehensive program to include all aspects of soldier support, especially in the areas of individual clothing and equipment protection and, in the event of contamination, decontamination equipment and procedures. The R&D effort applied to this NBC threat is very minimal. Chart 1 shows the proposed protective clothing goals.

4. Discussion with laboratory personnel indicates a lack of the integration of the individual with his clothing and equipment in the early stages of the weapon/vehicle system design. This interface is essential and although required by STOG 77-15.2 must be continually emphasized by all members of the R&D community.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized.

A review of the individual projects listed in the FY 76 RDTE Work Units Reports and personal interviews with project supervisors indicated that most essential areas are emphasized with the exception of NBC protection.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs but Not in Direct Support of the STOG.

This category points out the disparity between the limited STOG objectives in this category and the diverse area of clothing and individual equipment that NARADCOM is working on. It is difficult to determine if textile and fiber research is in direct support of the STOG and it is not necessarily a valid assumption that the STOG is a complete listing of operational requirements in all areas.

D. Gaps.

1. There exists a difference between technical feasibility and operational necessity which all members of the R&D community must recognize. The NBC threat that the US Army faces in the field requires that more resources be applied now to achieve the required objectives during the time period under consideration. Currently, only $140 K is applied by NARADCOM to chemical protection research on textile fibers and fabrics.

2. The STOG does not address the special clothing and equipment problems associated with large numbers of women in the force structure.

3. The STOG does not encompass specific objectives/requirements for the support of individual clothing and equipment in adverse operational areas, e.g., arctic, desert, or mountains.

E. Work Identified to be of Poor Technical Quality.

None.

CHART I: Proposed Protective Clothing Goals

Clothing Type	Present	Current Program	Proposed Program	
			Intermediate	Long Range
Facewear	Mask, M17A1	New protective mask (Silicone)[a]	New moldable elastomeric mask material	Agent impermeable moisture permeable mask
Headwear and Neckwear	Hood, butyl coated nylon	Permeable hood impregnated foam attached to suit	Improved or new hood material	Improved or new (permeable or impermeable) hood
Torsowear and Limbwear	Suit and Clothing Outfit, Chemical Protective[b]	Modified suit and new charcoal outfit[c]	New or improved garmet materials	Chemical protective combat uniform; specialty impermeable suits
Handwear	Gloves, impregnated	Butyl rubber gloves with improved dexterity and protection; cotton gloves to absorb mo sture	New or improved glove material	Agent impermeable moisture permeable gloves
Footwear	Boots, dubbined leather Socks, impregnated	Butyl rubber overboots Charcoal impregnated sock, lining or insert	New or improved boot material	Agent impermeable, moisture permeable boots
System	Items developed separately	Items developed with integrated design and closures.		

a - New Protective Mask Program is funded separately and has its own schedule; type classification FY 79 IOC FY-81.
b - Also toxicological agents protective coveralls and explosive ordnance disposal suit.
c - UK charcoal impregnated nonwoven material to be used as a protective liner.

III. RECOMMENDATIONS

A. Gaps to be Filled to Support STOG.

1. Immediate emphasis needs to be applied to the development of both individual and collective NBC protective clothing and equipment.

2. Action needs to be taken to correct the gaps identified in IID above.

C. Significant Comments for Use by TRADOC in Providing Input for STOG-78.

TRADOC should take the initiative to revise/expand the STOG to cover the gaps listed in IID and establish appropriate materiel acquisition documents to achieve the identified needs.

D. New Initiatives.

1. There is a requirement for consolidating existing studies in the anthropometrics; sizing and design of combat clothing and equipment for female personnel.

2. A joint effort under the direction of the Surgeon General is required to meet the support equipment needs of wounded personnel. This is especially important in the arctic environment where movement is restricted.

3. The Army spends and consumes large amounts of resources in support of chemical products for the individual soldier, i.e., soaps, cleaning compounds, and insect repellants. The STOG must address the requirement for improved products for the combat soldier.

G. AIR DROP

I. INTRODUCTION

The Army's airdrop capability is closely coupled with the Air Force. The Air Force has responsibility for procuring and operating the aircraft used in an airdrop operation, and for establishing the flight path options, particularly altitude and speed. The Army provides the personnel and material to be airdropped and at the technical level is responsible for the development and procurement of the special material, e.g., parachutes, platforms, etc., required for the airdrop, and for the preparation of material for an airdrop.

The development of the special material required for an airdrop and of the rigging techniques to be used in preparing equipment for an airdrop is currently the responsiblity of the U.S. Army Natick Research and Development Command (NARADCOM). This organization also provides a technical interface between the Army and the Air Force, advising the Air Force in certain aspects of the development of aircraft for the airdrop mission. All of the following is based on information provided by the NARADCOM.

II. FINDINGS

A. General

There appears to be a very close match between the airdrop development objectives as defined in the STOG and the work currently underway or tentatively planned for initiation in FY 77, with the bulk of the activity already underway. The situation is depicted in the attached table. Aside from a few items which are planned but unfunded and thus consitute a technology gap, the single potentially most significant discrepancy between the objectives set up in the STOG and the current NARADCOM plans lies in the upper limit established for the weight of a heavy load. The STOG calls for an upper weight limit of 50,000 pounds while the current NARADCOM development efforts, (as well as our existing capabilities) have 35,000 pounds as an upper limit. The decision to push the weight limit to 50,000 pounds needs to be reviewed by TRADOC and then, if appropriate, the NARADCOM plans should be revised.

From somewhat more of an overview point of view the close correspondence between the STOG and the ongoing work at NARADCOM can be taken as a suggestion that the STOG does not define really long range development objectives. It is not clear what is being left out but the impression is unmistakable that while the STOG may be defining capabilities we would like to put into the inventory 10 years hence, it does not provide the guidance that would lead to new starts in development 5 to 10 years hence. What is missing is the definition of things we would like to be able to do but only have ideas for and no well defined, clearly feasible approaches for, at present.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized

The NARADCOM work on soft landing techniques, appears to be receiving considerably less emphasis than its potential would suggest is appropriate. There are two, perhaps complementary approaches to the soft landing problem, which comes under item 77-7.10d of the STOG, that are being investigated by NARADCOM. The first of these is the use of retrorockets on the pallet used for airdrop of heavy material, to slow the descent during the last 10 or 20 feet of the drop so that a soft landing is achieved. The most significant negative factor here is the cost of the retrorocket equipment and associated with the controls of the rockets so that zero velocity is reached just as the pallet reaches the ground with engine turn-off at that instant.

The second approach to soft landing is through the use of inflatable air bags on the underside of the pallet. These bags are inflated during the descent process, possibly by ram air, and then are collapsed as the bag and then the pallet strikes the ground. The large thickness possible for the inflated bags, a thickness which has no corresponding bulk handling problem since it does not exist until after the cargo pallet has left the aircraft, provides a fall distance of several feet for decelerating the payload. Not only does this substantially reduce the peak deceleration but it also can be arranged so that the air escaping from the bags as they are crushed produces an air cushion effect, allowing the payload to slide across the ground. In this way the payload can go smoothly from moving at the wind speed to zero translational velocity.

At present NARADCOM is studying, at a low level of effort, the required design tolerances for a retrorocket soft landing system, and is maintaining an awareness of the work of other countries, particularly France, in the use of inflatable air bags. The two approaches are actually quite complementary and appear to hold great promise for soft delivery of a heavy load. Such a technique, if perfected, could, for example, make possible the delivery of a combat vehicle with its crew on board ready to go. At present this technical area of soft landing techniques is receiving a much lower technical effort than its potential leads us to believe it deserves.

C. Work Identified As Not Being In Support of the STOG

All of the airdrop related work currently going on or planned was noted to be directly relevant to the STOG, i.e., every task effort underway or planned can be associated with a STOG item.

D. Gaps In Work In Support of the STOG

While NARADCOM has plans which address each item in the STOG a number of these are unfunded in the near future and in some cases appear to represent only a general intention to do work in the subject area. We consider that these items represent effective gaps in the program plans relative to the STOG.

Perhaps the most serious of these gaps is the lack of work on the development of equipment location and assembly aids, (STOG # 77.7.10.6). It is planned for work in this area to be initiated in FY 7T or FY 77, whenever funds become available. Moreover, a technical approach to this problem has not been clearly identified.

As can be seen from the attached table, work on a new maneuverable reserve parachute, (STOG # 77.7.10.a), is still unfunded for the 6.4 portion of the effort. The technical effort in this area has some history, however, and the basic approaches to be developed appear to be well defined. Similarly, work on a bundle delivery system, (STOG # 77.7.10.f), is unfunded for FY 77. Here also the technical area has a prior history and an approach to this problem has been defined.

In another way, perhaps the most serious deficiency in the NARDCOM airdrop program, in terms of its long range implications, is the lack of planned effort in computer simulation, (STOG # 77.7.10.g), until FY 79. Performance of work on this task would lay the foundations for a more scientific approach to future developments. Without it, future developments will, of necessity, continue on the present cut and try basis.

III. RECOMMENDATIONS

A. Gaps To Be Filled In Work In Support of the STOG

The four items discussed in Section IID, above, each represents a real gap that should be filled. In the near future work should be budgeted on the following:

(1) The development of equipment location and assembly aids.

(2) The engineering development of a new maneuverable reserve.

(3) A bundle delivery system.

(4) The development of a more complete basic understanding and supporting computer models for airdrop system design.

B. Work That Should Be Terminated.

No recommendations.

C. Significant Comments For TRADOC In Providing Inputs For STOG 78.

The very neat way the items of the current STOG match up with ongoing or prior efforts in the airdrop development area suggests that the STOG represents a set of things the technical people have been talking about for a long time and which, though requiring serious development work, they feel fairly confident of being able to achieve - if only they are given the necessary R&D funds. But surely the list of material requirements should include capabilities that we would like to have but whose technical feasibility we are unsure of. Such items seem to be missing from the STOG.

In searching for an example to make the above comment more concrete, we came upon the following requirement, which we suggest be given careful consideration for incorporation in the STOG-78. Because of the capabilities of enemy air defense it may not be possible to bring airdrop aircraft anywhere within many miles of the intended drop zone. For this reason the possibility of using steerable parachutes with a high glide-to-sink ratio with remote control steering should be explored. It may be possible to achieve glide-to-sink ratios as high as 10:1, so that from 20 kft., distances up to about 40 miles could be covered. Exploratory work in this area should be undertaken for airdrop of both personnel and heavy material.

This is, of course, only a single example, but is intended to show the kind of new concepts in airdrop capability that ought to be formulated for possible incorporation in the STOG-78. These are capabilities that are desirable but whose technical feasibility we have to start thinking about. For our future military posture such new ideas need to be examined and the STOG appears to be the best place to initiate such thinking.

STO #	DESCRIPTION	R&D TASKS OR WORK EFFORT	ELEMENT	REQUIREMENT	REMARKS	GAPS
7.4.a	Low Altitude	LAPES	6.4	QMR		
7.4.b	Personnel & Equip (up to 50K) 250 Knots plus, 400 feet or less	Staged Personnel System	6.3	Draft LOA	No efforts for 50K System/400 ft. hi-speed planned FY 79	X
7.4.c	High altitude (25,000 ft) platform (20K lbs) and CDS	Hi-level technology (platform) Interim HLCADS* Ultra HLCADS *High level (ITON) Container Air Drop System	6.2 6.4 6.3	Draft LR Draft LOA		
7.10.a	New Reserve parachutes	Maneuverable Reserve	6.2/ 6.4	Draft LR	6.2 FY 76, 7T 6.4 FY 77 (UNF)	
7.10.b	Ground Assembly Aids	Ground Assembly Aids	6.2		to be initiated in FY 7T or in FY 77	
7.10.c	Free-Drop containers	Free-drop parameters Free-drop water container	6.2 6.2		Started in FY 76 Started in FY 76	
7.10.d	Improved Energy Dissipator	Instant-Form Material Soft-Landing Concepts (retro-rocket)	6.2			
7.10.e	Improved Rigging	Personnel Rigging Cargo Rigging Sof-Landing (retro-rocket)	6.2/6.4 6.2 6.2	Draft LR	(6.4 in FY 77 (UNF) weapon pack dragon)	
7.10.f	Accompanying Bundle	Bundle Delivery System	6.3	Draft LOA	UNF FY 77	
7.10.g	Simulation	High G'ide Flight Performance Some work done Previously (computer			Simulation Task planned FY 79	

H. NUCLEAR, BIOLOGICAL, AND CHEMICAL WARFARE PROTECTION

I. INTRODUCTION

Evidence of Soviet/WP preparedness in CW has led to a relatively unfavorable assessment of US capabilities posture both as it relates to protection and deterrence. Although there is some commonality between the separate elements of NBC protection, there are also very great differences, particularly as they relate to Nuclear effects (EMP, Blast, flash). The residual effects of Nuclear are perhaps the area where some commonality exists.

The preponderant effort in CB areas resides at Edgewood Arsenal (EA). Natick Research and Development Command (NARADCOM) is cognizant over protective aspects of clothing and shelters as part of this general charter. The emphasis of NARADCOM's programs appear to be significantly different from that at Edgewood Arsenal; more highly specialized protective features characterize the latter organization's work.

The 1976 ARMCOM plan document describes efforts primarily in detection and alarm development, in contrast with the earlier 1975 document. An updating of the earlier information may be needed to assess responsiveness to STOG's in areas other than detectors and medical protection.

II. FINDINGS

A. General

Taken as a whole, the program described in ARMCOM reports for 1975 and FY 77 are responsive to STOG's for CW and BW. One is left with the feeling that work for Nuclear is completely lacking. There is little, if any, indication of how Edgewood Arsenal works with laboratories responsible for vehicles, shelters and armor to meet requirements for protection against CBW.

Often the greatest deficiencies in NBC appear to be not in the 6.1-6.2 area but actually in the 6.3-6.4 areas. For example, Edgewood Arsenal has developed effective collective shelter systems for protection against NBC. However, CB shelter and shelter systems have not been type classified yet and have not been procured.

B. Work Which Appeared to be Responsive to the STOG.

1. Detectors for CB Agents - (10.4) At the present time, EA is spending $5.4M in 6.1 and 6.2 for CB detectors. There is some concern because the ionization detector (ID) seems to work, but the basic principles underlying this device are unknown. Hence it is difficult to anticipate the problems, interferences, and false alarm rates for the ID.

The enzyme detector scheme is attractive because of its high specificity; however, an end item is saddled with many engineering problems.

2. Detectors for B Agents - This is one area which offers a challenge. Present techniques are not ideal, and the S&T side is "idea poor".

3. Decontamination Equipment - (10.5) Decontamination of Personnel and Equipment--no new information given for FY 77. The program described in 1975 ARMCOM plan appeared entirely consistent with STOG.

C. Work of Good Quality in Support of STOG but Inadequately Emphasized.

1. Protective Clothing versus Collective Shelters - The biggest challenge in protective clothing is to achieve CB protection without increasing the heat stress in the soldier. Obviously, this trade off will always exist.

At the present time our newest protective clothing developed by NARADCOM incorporates an absorbent material which will last approximately six hours in a toxic environment. Its useful life when not in a CW atmosphere is not yet known. The logistic burden imposed on the system by the six-hour resupply of a division may be insurmountable. There is therefore a definite need for improved filtering materials which would selectively counteract toxic gases but which would not be poisoned by perspiration.

It should be pointed out that because of this six-hour usable life of protective clothing and because of the high logistic burden imposed by the same, the use of integrated collective shelters should become a high priority item. Hence the fighting troops would have a place to go and would not have to be individually exposed and individually protected at all times.

For armored vehicles, there are two methods of achieving CB protection. Either the whole vehicle is sealed and an environmental system is used for providing clean air or personnel are individually protected. A

decision has been made that only the individuals should be protected. In consideration of the added human stress provided by protective clothing and gas masks and the staggering logistics burden, it seems to this group that the collective protection of the vehicles has some meaningful advantages and that this decision should be reexamined in light of the present day capabilities and threats. Armored combat vehicles should be provided with an air conditioned, filtered environmental support system.

2. The NARADCOM Shelter Program - The Natick R&D Command has an ongoing field shelter program to replace the present field tents and shelters. However, no consideration has been given to the impact of NBC on these shelters.

Though these shelters are not complete NBC shelters with double air locks, environmental systems, etc., it is possible to achieve significant increases in NBC protection with small changes which will not effect the high mobility requirements. For example, the proper choice of water/NBC repellent on the fabric over NBC permeable water repellents could have large impact on survivability. Though shelters are not provided with environmental systems, they should have a zippered opening to which an environmental system could be added when necessary. Though the shelter is not hermetically sealed, slight overpressurizing and filtration would increase survivability in a CB attack. With a little imagination, small, significant, but inexpensive improvements can be made to many shelters and vehicles.

3. Paints - At the present, there is very little decontamination equipment in the field. It's highly probable that what is there is not in operational condition, and would be impractical or highly time consuming for decontamination of vehicles and other equipment. Hence, there is a critical need to make decontamination as easy as possible. That is another reason that overpressurized vehicles are required. Protective systems which only protect personnel in vehicles would be very difficult to decontaminate from both the inside and outside. To ease the decontamination of the outside of the vehicles, it would be practical to have paints which would be exceedingly nonabsorbent to chemicals. Hence, it might then be possible to simply decontaminate by washing down with pure water rather than bleach solutions, etc. Therefore, research in the area of protective paints and nonabsorbent paints is really an important area in NBC protection. A recent decision by NARADCOM has been made not to use the better polyurethane paints.

D. Work Identified as Good Quality and High Relevance to Future Army Needs but Not in Direct Support of the STOG.

None

E. Gaps.

Included in the category of work that should be done to support STOG but not being accomplished are the following, either because no specific plan was found in the NARADCOM or ARMCOM documents, or because no means of coordinating with appropriate development agencies, as for armored vehicles and tanks was defined:

1. Maximum protection for tactical vehicles against CW/BW, flame and nuclear effects.

2. Shelters and equipment protection against Nuclear.

3. Combat vehicle CB protection.

4. Filtering materials in the 6.1-6.2 area.

5. Nonabsorbent paints in the 6.1-6.2 area.

6. Development of highly effective decontamination equipment for the decontamination of vehicles, Howitzers, etc., (e.g., high speed jets as used by the Soviets).

III. *RECOMMENDATIONS*

A. Establish guidelines and a review procedure for incorporating NBC protective features in new designs for equipment, clothing, shelters, etc.

B. Work to be terminated--none.

C. Comments for TRADOC in providing inputs for STOG 78. It is recommended that user requirements define the time dimension. These dates should be developed in consultation with the laboratories to reflect technological feasibility.

D. Requirement for a simple water kit to test for potability and presence of chemical agents.

I. SOLDIER SUPPORT ENGINEERING

I. INTRODUCTION

The scope of this task area is extremely broad, wherein STO's in 14 of the 19 capability categories in STOG-77 are germane; only STO's 1, 2 (strategic) and 15, 16, 17 (combat support) are not germane.

The SDP's (System Development Plans) which include the appropriate technology efforts are those of the DARCOM Laboratories; NARADCOM, and MERADCOM; and the Chief of Engineer's RDO Laboratories, CERL, CRREL, and WES. The 21 specific laboratories efforts in these SDP's which are appropriate are the following:

NARADCOM: Field shelters; field laundry-bathing-latrine facilities; field clothing and equipment repair facilities; and heaters

MERADCOM: Camouflage; containers (partial); construction; countermine (partial); demolitions, environmental control equipment; electric power; field fortifications; fuels and lubes (partial); physical security

OCE/RDO: Cold region aspects of combat engineering; construction of permanent military facilities; environmental impacts of military operations; energy sources and conservation for fixed installations; OM&R of military facilities; protective structures; and temporary base construction

As a generalization, the DARCOM Laboratory technology efforts specialize on Army operational objectives whereas OCE/RDO Laboratories specialize on the Army in the training mode, (i.e., the peacetime Army).

The correspondence between the STO's and the SDP's is given in the matrix in Table 1.

II. FINDINGS

A. General

A review of Table 1 reveals that the STOG and the SDP's are essentially compatible documents with only a few gaps, i.e., primarily those in the NARADCOM SDP.

In general, the Laboratory plans included the appropriate efforts with some major exceptions: No 6.1 efforts to support Camouflage (MERADCOM): No 6.1 and 6.2 funded plans for physical security (MERADCOM): Environmental Impact of Mil Ops (OCE/RDO); and Temporary Base Construction (OCE/RDO). Moreover, no technology base program supports the Army Functional Component System--the major system for temporary base construction (OCE/RDO) although in this case, no requirements exist.

It was also found that few "systems" exist in the scope of the task area. The keywords are dispersion and fragmentation; the appropriate STO's are a fragmented set and the SDP's are dispersed accordingly to be compatible. This fragmentation disguises the importance and visibility of these technological efforts. This fact contributes in part to the lack of adequate funding to implement SDP's for the Soldier Support Engineering required in the mechanized battlefield.

And it was found that adequate Soldier Support Engineering is essential for victory in the mechanized battlefield; ineffective SSE is effective interdiction.

Finally, it was found that no TRADOC representation from the TRADOC Engineer was present, whereas STO's 18 and 19 are in his mission area.

Finding of a specific nature are given in the following sections.

B. Work of Good Quality in Support of STOG but Inadequately Emphasized

This work is identified in terms of appropriate SDP elements in Table 1.

Camouflage: The program is of excellent quality; emphasis must be placed on adequate requirement documents in 6.3 and 6.4 areas, e.g., decoys. Emphasis should be placed by equipment developers to utilize technology becoming available. The Military Worths Model developed by MERADCOM for camouflage should be expanded into other areas of research. Inclosure 1 to this report is a brief description of the model.

Countermine: The METRRA (Metal Reradiation Radar) technology air borne, vehicular mounted and man portable deserves emphasis because it is the only foliage penetrator detector known for stationary objects.

Environmental Control Equipment: Particular emphasis should be placed in utilization of waste heat, heat exchangers, solid state controls, complete environmental systems to include NBC protection. A vehicular heat source analysis should be conducted.

Electric Power: Work of good quality in power conditioning, integrated power switches and transcalent devices, i.e., heat pipe technology for heat transfer in electronic devices such as thyristors, transistors, etc. These require more emphasis as well as work in ceramic components for mobile gas turbine engine generator power sources.

Containers: Emphasis woefully inadequate for rack type container inserts for ammunition, parts, etc.

Energy Sources, etc. (OCE/RDO) MERADCOM): Work in solar power sources and solar heating/cooling technology is excellent and should be emphasized. The work in refuse derived fuel is excellent in quality as well as the work in developing cost avoidance systems for total energy at fixed installations.

Demolition: Emphasis is required to systematize the effort.

Physical Security: More emphasis is required in the 6.1 and 6.2 research efforts and in the use of microprocessor technology to perform a major part of the physical security equipment functions.

SDP Element	STO #
NARADCOM	
-- Field Shelters	-- None
-- Field Laundry - Latrine Facilities	-- None
-- Field Clothing - Repair Facilities	-- None
-- Heaters	-- 14.14
MERADCOM	
-- Camouflage	-- 5.2a; 7.2a; 8.2d; 9; 9.1, 2, 5, 6, 10, 11; 10.6; 11.3; 12.10; 13.7
-- Containers (partial)	-- 6.9
-- Construction	-- 18.9
-- Countermine (partial)	-- 12.1
-- Demolition	-- 9.7
-- Environmental Control Equipment	-- 9.10; 10.6; 8; 11.10; 14.14
-- Electric Power	-- 3.1c; 8.2a,e; 9.6; 11.2,3,4b,4c; 12.11, 14.2, 14.3, 8d, 9; 18.6
-- Field Fortifications	-- 5.2e; 9.2; 10.5
-- Fuels & Lubes (partial)	-- 5.73; 18.6
-- Physical Security	-- 14.13
OCE/RDO	
-- Cold Region...combat energy	-- 9.3, 5, 10; 18.9
-- Construction of perm mil facs	-- 18.1, 2, 4, 5, 6, 7, 10
-- Environmental impact of mil ops	-- 19.1, 2, 3, 4, 5
-- Energy sources ... fixed facs	-- 18.6
-- OM&R of mil facs	-- 18.1, 3, 5, 7
-- Protective structures	-- 18.2
-- Temp. base construction	-- 9.2, 6

OM&R (Operations Maintenance and Repair) of Fixed Facilities: The work is good but the emphasis is inadequate; the ROI of this emphasis cannot be short of phenomenal in reducing maintenance dollars of fixed facilities.

Temporary Base Contruction: A breakthrough on laminated structure of polyurethane foam and shotcrete promises adequate mobility in shelter construction in all environments, including desert environments.

C. Work Identified as Good Quality and of High Relevance to Future Army Needs but not in Direct Support of STOG

Field Shelters: The present studies on field shelters at NARADCOM are of excellent quality but are not supported by a specific prioritized objective in STOG-77. This work has received high priority in the past and is in direct support of needs previously identified by TRADOC.

Field Laundry...Facilities/Field Clothing...Repair Facilities (NARADCOM): The work on field latrine and waste disposal i.e., highly mobile field systems to support troops, relates to capability category 77-14. No specific prioritized STO's are included therein. Ditto for field clothing, repair facilities, etc.

Construction of Perm Mil Fac's: The work in architectural habitability, i.e., the physical, social, and psychological needs of the soldier and his family in the peacetime Army, is of great import and of good quality but only lightly supported in STO 77-18. The same statement applies to the use of the industrialized building industry to provide permanent military facilities at construction cost reductions of as much as 25 percent.

D. Gaps--Work that Should be Done to Support STOG but Not Being Accomplished

Camouflage: A 6.1 program should be established and funded.

Physical Security: A 6.1 and 6.2 program should be funded.

Environmental Control System: NBC protection must be included as an integrated part of the environmental control systems, where applicable.

Electric Power: TDME (Test Diagnostic Measurement Equipment) and solar power systems efforts are required.

Field Fortifications: Shelter cavities in form of soil "pipes" required with materiel reinforcement to be developed and NBC protection added.

Environmental Impact of Military Operations: A 6.1 program should be established.

OM&R of Military Facilities: A 6.1 program should be established.

Temporary Base Construction: A 6.1 program should be established.

E. Work Identified to be of Poor Technical Quality.

None.

III. RECOMMENDATIONS

A. Gaps to be filled to support STOG

See Paragraph IID. The responses are identical.

B. Work to be Terminated

None.

C. Significant Comments for Use by TRADOC for STOG-77

1. Configure soldier support systems into a set of "systems".

2. Develop STO's in Capability Category Number 14 on the following:

a. field shelters

b. cleaning/laundry/bathing, and combustion toilets

c. field clothing and equipment repair facilities

d. shelters for ammunition supplies to cover work in ongoing programs at NARADCOM in response to existing guidance by TRADOC. Item number 6, Inclosure 2, is recommended text.

3. Camouflage (MERADCOM) and Physical Security (MERADCOM) should be subjects of separate STOG capability categories; Electric Power (MERADCOM); Environmental Control Equipment (NARADCOM and MERADCOM; Fuels and Fuels and Lubes (MERADCOM) should be consolidated within the STO's so that the effort is not dispersed throughout the document. See Inclosure 3 for specific recommendations on Camouflage. If a separate STO cannot be established for physical security, then the priority should be raised to conform to DCSOP's priority.

4. Minimally prioritized STO's should be developed for the Army Functional Component System; it would be preferable to develop a separate STOG capability category in Temporary Base Construction to be compatible with the TRADOC approved study on Advanced Bases.

5. Demolition (MERADCOM): The outcome of an in-progress demolition study is necessary to develop significant comments on STOG-78. The approach has been coordinated with DA staff personnel and influenced by the ABCA Operational Concepts 1986-1995 and discussions with Naval EOD personnel and particularly by two major studies by the UK. The following STO objectives from 9.7 would be addressed:

a. rapid concrete/steel target destruction

b. remote control of demolition initiation

c. controlled demolitions in built-up areas (MOBA)

6. Countermine (MERADCOM): The use of harmonic radars (METRRA Technology) should be emphasized in operational objectives.

D. New Initiatives

1. Electric Power (MERADCOM): System studies of use of nonlogistic or synthetic fuels shold be initiated by TRADOC or DARCOM.

2. Fuels and Lubes (MERADCOM): The Development of a highly concentrated energy source should be a new initiative.

3. Construction of Permanent Facilities: The development of staffing guides and ratios in the assessing and development of organization in Corps of Engineers districts and divisions which implement MCA program.

E. Concept Development and Validation (CDV) Candidates

1. Field Shelters (NARADCOM): Development of a new generation of general purpose tentage is recommended.

2. Field Latrines (NARADCOM): Development of a highly mobile combustion type field latrine system is recommended; this would be in accordance with a TRADOC LOA which is in coordination.

3. Camouflage (MERADCOM): The efforts in smoke, aerosols, and foams are candidates for CDV to give emphasis and funds to these programs beyond the resources of the camouflage program.

4. Countermine (MERADCOM): Airborne and vehicle mounted METRRA technology is recommended.

5. Electric Power (MERADCOM): Solar power systems and laser transmission and distribution systems are recommended.

6. Construction of Permanent Military Facilities: Use of industrialized building industry to furnish elements in MCA program is highly recommended. The dental clinic program in OST requirement in FY 78 or FY 79 is specifically recommended.

IV. Detailed Study Results

Numerous working papers were prepared by staffs of NARADCOM, MERADCOM and OCE/RDO. These are too bulky for presentation herein.

SDP Element	STO Number
NARADCOM	
Field Shelters	- NONE
Field Laundry---Latrine Facilities	- NONE
Field Clothing and---Repair Facilitiies	- NONE
Heaters	- 14.14
MERADCOM	
Camouflage	- 5.2a; 7.2a; 8.2d,9; 9.1, 2, 5, 6, 10, 11; 10.6; 11.3; 12.10; 13.7
Containers* (partial)	- 6.9
Construction	- 18.9
Countermine* (partial)	- 12.1
Demolition	- 9.7
Environmental Control Equipment	- 9.10; 10.6, 8; 11.10; 14.14
Electric Power	- 3.1c; 8.2a, e; 9.6; 11.2, 3, 4b, 4c; 12.11, 14.2, 3, 8d, 9; 18.6
Field Fortifications	- 5.2e; 9.2; 10.5
Fuels and Lubes* (partial)	- 5.7e; 18.6
Physical Security	- 14.13
OCE/RDO	
Cold Region---combat engineering	9.3, 5, 10; 18.9
Construction of permanent military facilities	- 18.1, 2, 4, 5, 6, 7, 10
Environmental Impact of military operations	- 19.1, 2, 3, 4, 5
Energy sources---fixed facilities	- 18.6
OM&R of military facilities	- 18.1, 3, 3, 7
Protective Structures	- 18.2
Temperature base construction	- 9.2, 6

TABLE 1

ADDENDUM
MILITARY WORTH MODEL

MILITARY WORTH OF CAMOUFLAGE

A persistent problem in the camouflage program has been to determine the "military worth" of camouflage; or what is the measurable contribution of camouflage to increasing enemy casualties and/or reducing friendly casualties. To provide an answer or partial answer, methodology (computer aided wargames) has been developed/acquired to relate effectiveness of camouflage hardware and techniques to military worth (see Figure 1).

The output from this methodology has three broad uses:

Technical	- Help establish required technical performance - Derive signature threshold requirements
Management	- Provide input for allocation of R&D resources - Provide input for logistic/procurement decisions
User	- Provide input for force mixture and force effectiveness

The methodology has two significant parts--one for examining camouflage in close combat or direct fire situations. The other part for examining camouflage in rear areas where indirect fire (artillery, missiles, etc.) are used.

For information contact:

Commander
MERADCOM
ATTN: DRXFB-O
Fort Belvoir, Virginia 22060

Phone: Autovon - 354-5047 or 354-5990
Commercial - (703) 664-5047 or 664-5990

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PUBLICATION/FORM NUMBER	DATE	TITLE
(STOG-77)	FY 1977	Science & Technology Objectives Guide, FY 77

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
4	E.13					Under "Lessons Learned", add the following paragraphs: 1. Adequate field latrine and waste disposal facilities are necessary today to meet environmental requirements when conducting field training exercises. Such facilities can be even more important under combat conditions to maintain the morale, physical fitness, and combat readiness of troops in the field. Current practices are primitive and present not only a pollution problem but also a serious health threat. Morale suffers since conditions can become loathsome. 2. There is a tremendous range of shelter items in the supply system, many dating back to WWII requirements. There is wide spread dissatisfaction with the degree to which they meet current field functions. Completely new concepts of shelters are required to provide improved habitability and a better match to field shelter requirements as well as a marked reduction in the total number of items fielded in order to reduce the logistical support requirements. 3. The present field laundry system has limited transportability, requires considerable time to set up and strike the ancillary tentage, and requires large amounts of water and fuel. The large water demand requires its employment at or near to the water source. Reason: Not included in STOG 77.
6	E.14					Under "Prioritized S&T Objectives (STOs)", add the following objectives: 1. Field laundry/dry cleaning, bathing, and latrine facilities are required to maintain the

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE AUTOVON, PLUS EXTENSION	SIGNATURE

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PUBLICATION/FORM NUMBER	DATE	TITLE

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
						morale and health of troops in the field. Future systems must be highly mobile, minimize water and energy requirements and adequately meet waste disposal requirements. 2. Develop improved clothing and equipment repair facilities for field use (as required) to be compatible with new clothing and footwear materials and configurations. Field shops of the future should be configured for greater mobility and for servicing smaller groups. 3. An integrated family of field shelters is needed to provide environmental protection for the performance of essential military functions. The shelters will be used Army-wide by combat and combat support organizations throughout a theater of operations. The family will comprise three basic shelter units: (a) Man Portable Shelter; (b) Transportable Container-Shelter; and (c) Transportable Component System with sufficient unit flexibility to accommodate all military shelter requirements except where Theater-of-Operations (T.C.) construction or Military Construction-Army (MCA) items provided through construction service are required. The basic units will be designed for use individually in combination with identical units, by modification with additional components, and in combination with other basic units. Transportability is a primary criterion for establishing the design and construction of each basic unit. Compatibility with available transport equipment of all modes current and projected will be assured. Specifically, the objectives for this family are to provide the general purpose shelter needs of an integrated field shelter system within the minimum number of basic modules (with provisions for expansion) so as to: (1) Reduce number of total items and repair parts; (2) Increase multi-purpose use of

*Reference to line numbers within the paragraph or subparagraph.

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ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Exact wording of recommended change must be given)*
						individual items; (3) reduce logistical support -- maintenance and supply; (4) reduce present financing investments by effecting (1), (2), and (3) above; (5) increase mobility by improving transportability and decreasing reaction times; (6) improve the habitability for accomplishment of required field functions to the extent consistent with maintaining high mobility. Reason: These technical objectives were not included in STOG 77. NARADCOM MISSION - Should read "field shelters" rather than "tenting." Reason: More correct wording.
	F.7		4			

*Reference to line numbers within the paragraph or subparagraph.

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PUBLICATION/FORM NUMBER	DATE	TITLE
NA	6 May 76	STOG 77

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Exact wording of recommended change must be given)*
1	D.5	5.12				Add as additional para: Develop flash/noise simulator device capability for AT/AD weapons to increase survivability of real items. Rationale: Provide for the development of close combat system decoys as appropriate.
2	D.8	6.4	7			Add after "survivability": including reduction of detection probability using camouflage and deception. Rationale: Improves survivability by addressing the reduction of the systems "total" signature.
3	D.9	6.6d				Add as additional para: Improved countersurveillance capabilities to minimize counterfire and enhance survivability. Rationale: Self-explanatory.
4	E.7	12.10				Raise objective priority to 12.7. Rationale: A more significant objective than current priority listing.
5	E.11	13.16				Add as additional para: Develop passive countersurveillance materiel and employment techniques, which will be integral with the equipment and will act directly to defeat hostile sensors and related systems. Rationale: Provides for the camouflage of appropriate equipment in the design phase of equipment development instead of as an add on at increased cost.

*Reference to line numbers within the paragraph or subparagraph.

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NA	6 May 76	STOG 77

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON *(Exact wording of recommended change must be given)*
6	E.14	14.5				Add the words "and equipment" after "clothing." Rationale: Appropriate equipment, as well as clothing, must meet or exceed these characteristics.
7	E.28	18.2				Add after "operational criteria": camouflage techniques. Rationale: increases the probability of survivability against the threat.

*Reference to line numbers within the paragraph or subparagraph.

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The Army Scientific Advisory Panel (ASAP) conducted Summer Study '76 at the Armed Forces Staff College, Norfolk, VA, during the period 19-30 July 1976. The Panel examined the compatibility of the Science and Technology Objectives Guide (STOG), which delineates desired operational capabilities, and the system development plans of the various Army Laboratories to determine if the laboratory programs include the appropriate technology efforts to achieve the desired systems capabilities. The Panel made the examination through the efforts of the six subgroups of Armament, Aviation, Electronics, Missiles, Mobility, and

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