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U.S. MARINE CORPS FY 82 EXPLORATORY DEVELOPMENT PROGRAM,(U)
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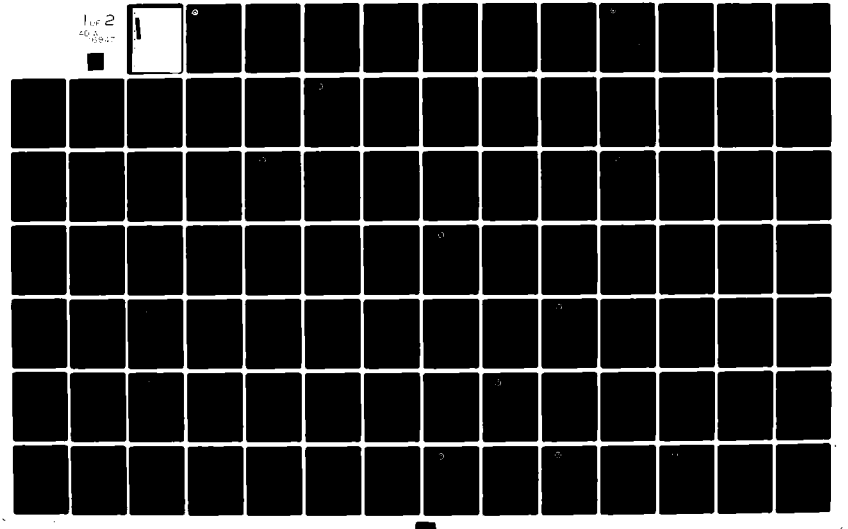

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16 February 1982

From: Director
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Subj: U.S. Marine Corps FY 82 Exploratory Development Program

Ref: (a) DirDevCtr ltr D 038/FAN:pac of 25Jan82 Subj: FY 82 Exploratory Development Program

1. It is requested that the cover of the reference be pen changed to reflect "FY 82" vice "FY 81".

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Exploratory development programs of Marine Corps interest

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

Synopsis of all current exploratory development programs in which the Marine Corps has expressed an interest; includes program outline, performing agency, POC, and phone number.

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D038/FAN:pac
25 Jan 1982

From: Director
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Subj: FY-82 Exploratory Development Program

1. This document has been prepared to acquaint the reader with the tasks that make up the total FY 82 U.S. Marine Corps Exploratory Development Program. For each Marine Corps Block Program, a one page general description is provided followed by a summary of each Marine Corps task associated with that program. Included are programs within Marine Corps primary interest areas as well as separate interests which are navy primary interest areas.

2. Where a General Operational Requirement (GOR) is mentioned in the text of program summaries, the GOR will in the future be replaced by the Science and Technology Objective (STO). The STOs will provide Marine Corps guidance for technology base programs which develop concepts, systems and equipment required for future Marine Corps operations.

3. More detailed information on any specific project can be obtained by contacting the Block Program Manager or Task Manager identified at the bottom of each page.

H. G. GLASGOW

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TABLE OF CONTENTS

II. SEPARATE MARINE CORPS PROGRAMS

BLOCK PROGRAM TITLE: MARINE CORPS AVIATION PROGRAM
(FY82 Funding: $1532K)

PROGRAM ELEMENT NUMBER: Individual tasks are listed below under their appropriate element and Subproject Program Plan numbers.

OBJECTIVE: Identify and meet Marine Corps unique aviation requirements. Provide a central point of contact for Marine Corps aviation related problems and a ready source of technological solutions to such problems. Monitor other Services Exploratory Development programs of interest to Marine Corps aviation.

TASKS:

ELEMENT NUMBER:

62241N CF41.411 (Aircraft)

- o Airborne Battlefield Jammer
- o Pyroelectric Vidicon Camera
- o Laser Fire Control System
- o Night Marker
- o Plume Reduction
- o Marine Corps Aviation Systems Investigation
- o Broadband Obscurant
- o Night Angular Rate Bombing System
- o Sidearm
- o Hypervelocity Rocket
- o Missile Roll Isolation Joint

62332N CF32.393 (Strike Warfare Weaponry)

- o Mobile Hawk

BLOCK PROGRAM MANAGER: Mr. P.H. Amundson
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AIRBORNE BATTLEFIELD JAMMER
(FY82 Funding: $147K)

NEED: Close in air support requires electronic countermeasures deployed in the field by both ground support troops and airborne units.

OBJECTIVE: Defense suppression. Demonstrate effectiveness of a new lightweight, simple, broadband jammer against threat radars.

TECHNICAL APPROACH: Modify existing airborne electronic countermeasures equipment; flight test after static testing. Assess measure of effectiveness (MOE) by measuring jammer-to-signal ratios and missile miss distances. Use conventional jammer as a baseline for comparison.

BACKGROUND: A limited number of in-house tests were run against Soviet replicas at EWTES and showed good potential. Displayed video was recorded, but no quantification of MOE was attempted.

PROGRESS: The laboratory model has been designed, assembled and has undergone limited static testing. Results to date are very positive with significant improvement over existing jammers projected.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$150K	$200K	$150K	0	0

Transition to Advanced Development: FY86

TASK MANAGER: Richard Gagliardi
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PYROELECTRIC VIDICON CAMERA
(FY82 Funding: $65K)

NEED: Current night vision equipment either does not have much capability (night vision goggles) or is high priced (forward looking infrared). The pyroelectric vidicon camera offers potential to provide greatly enhanced capability over the night vision goggles while maintaining high reliability and a much reduced cost of ownership.

OBJECTIVE: To demonstrate that the pyroelectric vidicon camera has adequate night vision sensitivity and range to provide a viable alternative to existing systems.

TECHNICAL APPROACH: Two modifications will be made to the existing electric vidicon camera and the system will be tested. A new vidicon tube will be utilized and a stabilization system will be modified and tested.

BACKGROUND: This work has been supported by internal exploratory development funding at the NWC since the mid-1970s. Technology has developed to the point where it has the potential to meet Marine Corps requirements for night vision equipment on helicopters and RPVs. The system is ready for limited field demonstration testing.

PROGRESS: The electronic processor has been incorporated and limited testing has taken place.

PLANS: The system will be modified and tested to determine the capability to meet USMC requirements.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$90K	$100K	0	0	0

The pyroelectric vidicon camera will be available for transition to Advanced Development in FY85.

TASK MANAGER: William Woodworth
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LASER FIRE CONTROL SYSTEM
(FY82 Funding: $80K)

NEED: Existing Marine Corps helicopter gun systems have large aiming errors which place these aircraft in jeopardy during unplanned encounters with either the Soviet ZSU-23-4 anti-aircraft vehicle or the HIND helicopter. Additionally, these large errors limit the effectiveness of the guns against the full spectrum of anticipated targets.

OBJECTIVE: To satisfactorily reduce the aiming error of Marine Corps helicopter guns systems.

TECHNICAL APPROACH: Conduct an analysis to determine the optimum fire control system specifications. Design, fabricate, and test a system to these specifications.

BACKGROUND: There are two primary errors associated with gun system accuracy; aiming error and ballistic error. The ballistic error is a function of the projectile and its characteristics. The aiming error is a cumulative measure composed of boresight and pointing inaccuracies. Of the two, the aiming error is substantially larger. This error can be reduced significantly when the target's position and movement relative to the host helicopter is known. In particular, three parameters must be available: range, line-of-sight (elevation and azimuth), and angular rate. The technology being addressed by this effort is the accurate but affordable measurement of these three parameters.

PROGRESS: The system specifications were developed in FY81.

PLANS: The FY82 effort will be devoted to design and fabrication of the fire control system, followed in FY83 and beyond with its test and evaluation.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$100K	$100K	$100K	0	0

Transition to Advanced Development: Expected in FY86.

TASK MANAGER: Dick Gould
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NIGHT MARKER
(FY82 Funding: $25K)

NEED: Night close air support operations require a means of marking targets for delivery of conventional ordnance. There are many other uses for a night marker on the battlefield, e.g., marking landing zones, marking evacuation points for wounded or extraction of landing teams. The mark should be visible to the unaided eye and distinctive from the fires of the night battlefield.

OBJECTIVE: Develop state-of-the-art chemical light formulations and demonstrate their night target marking capabilities.

TECHNICAL APPROACH: Review research funded by Office of Naval Research and ARO over the past 5 years and develop current chemiluminescent (CL) formulations. Review USMC night target marking requirements to identify candidate warheads for marker development. Develop marking systems for proof of principle demonstrations.

BACKGROUND: The Naval Weapons Center (NWC) has for some years proposed the use of CL materials for night marking. These materials produce light in various colors with little heat evaluation and they can be disseminated to form large diameter signals. The night delivery of conventional ordnance on or offset from the signal has been demonstrated. Utilization of such marks for other purposes is to be demonstrated.

PROGRESS: Material evaluation is complete and the marking systems are nearly complete.

PLANS: Evaluate USMC night marking requirements and develop candidate CL formulations to meet them. Plan and conduct a night demonstration of CL marking capabilities in which the payload from selected warheads will be simulated.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$75K	0	0	0	0

Transition to Advanced Development: FY84

TASK MANAGER: H. P. Richter
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PLUME REDUCTION
(FY82 Funding: $75K)

NEED: The Harrier aircraft employs vectored thrust for VTOL lift with the four poster thrust concept. Separate flows (fan bypass flow in the forward swivel nozzles and hot turbine core exhaust gas in the aft nozzles) allow a simple successful thrust vectoring arrangement. An IR signature problem, however, does exist in the conventional flight mode because there is no opportunity for internal tailpipe mixing of fan air and turbine hot gas with the separate flow Pegasus engine cycle. Other current fighter and attack aircraft have plume IR problems also, and steps are underway for alleviation by tailpipe mixers, rectangular nozzles, or obscurants. The plume-seeking missile threat is especially severe because missile attacks can be launched from forward quadrants of the target aircraft, making countermeasures and tactics less effective.

OBJECTIVE: To markedly reduce the IR plume signature of vectored thrust V/STOL aircraft.

TECHNICAL APPROACH: Using recently developed computational fluid dynamics techniques, analytically model tandem jet exhaust flows to calculate flow mixing between the forward fan flow discharge and the rear exhaust nozzle plume, and entrainment of free stream ambient flow. Calculate flow mixing for various means for hastened mixing, and estimate the new IR plume signature.

BACKGROUND: The Harrier has a unique engine exhaust system designed to meet vectored thrust V/STOL requirements. A separate flow engine is employed where the fan bypass is discharged through forward nozzles. Since the turbine exhaust gas is undiluted by fan before discharge, the exhaust plume is at a high temperature and causes a major IR plume signature problem.

PROGRESS: A contract was issued late in FY81 to Boeing Company. The initial work is just being started.

PLANS: The FY82 effort will employ analytic investigation of the possibility of improved mixing of cold (fan air) and hot (turbine core) exhaust plumes (tandem jets). In FY81 and FY83 analysis of the tandem jets in the aircraft wing flow field will be conducted. Airplane effectiveness in terms of improved survivability with reduced plume signature will be estimated. In FY84 model design and fabrication for small-scale wind tunnel model tests will be started.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$75K	$100K	$190K	0	0

Transition to Advanced Development: Expected in FY86 after tests in FY85.

TASK MANAGER: Les Throndson
Code 3383, Naval Weapons Center
Systems Survivability Branch
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MARINE CORPS AVIATION SYSTEMS INVESTIGATION
(FY82 Funding: $80K)

NEED: Marine Corps aviation is based on a unique set of operational requirements and technology needs. Those needs must be correlated with the systems investigations being pursued in the Marine Corps aviation program to provide the Marine Corps viable technology options for meeting those requirements.

OBJECTIVE: To (1) assess the feasibility and effectiveness of advanced technology concepts for future Marine Corps aviation systems, and (2) formulate goals for technology developments to support future Marine Corps aviation needs.

TECHNICAL APPROACH: To (1) analytically assess future Marine Corps aviation needs, (2) define advanced technology weaponry system concept alternatives to meet projected needs and cite areas of technology deficiencies where they exist, and (3) provide analytic assessment of advanced technology concepts as appropriate.

BACKGROUND: An initial report has been completed summarizing threat, requirements, other service technology programs and preliminary technology concepts.

PLANS: Identify critical technology gaps, formulate technology systems investigations, analyze the effectiveness of the potential system, and begin technology developments where feasible.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$75K	$80K	$85K	$85K	$90K

Transition to Advanced Development: Specific technology concepts will enter exploratory development as funding becomes available.

TASK MANAGER: Paul Amundson
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BROADBAND OBSCURANT
(FY82 Funding: $40K)

NEED: Marine ground forces currently face a multitude of threat sensors which include Infrared (IR), Visual (EO) wavelength, and possible millimeter wave systems. This spectrum of sensor coverage enables the enemy to pursue functions such as target acquisition and identification, weapon guidance, and early warning, under all weather conditions. Significant resources are currently being expended to counter individual threat sensors. The need is for a broad spectrum countermeasure effective against all frequencies or wavelengths.

OBJECTIVE: Developing technology suggests the possibility of a broad spectrum countermeasure effective against all frequencies or wavelengths. Application of this technology to tactical warfare ashore and amphibious warfare operations should significantly enhance the Marines ability to counter enemy locations, identification, targeting and weapons guidance efforts.

TECHNICAL APPROACH: Conduct field test demonstrations of the broadband obscurant as applied to Marine Corps amphibious and land warfare operations. The demonstrations will consist of a series of two types of tests. One will be a land test using a portable and mobile in-site obscurant generator. The other will be air delivered demonstration tests utilizing existing airframes, hardware and the FAE technology to deliver and disperse "pre-manufactured" obscurant material.

BACKGROUND: The Naval Weapons Center, China Lake, has been conducting an exploratory program to develop a broadband obscurant. The obscurant material is produced in a generator. A variation of the laboratory developmental generator, with increased mass flow rates, has been recently fabricated and tested at NWC. This alternate generator with the necessary design refinements, can be made into a portable or mobile generator for the in-situ generation of the obscurant for field demonstrations.

PROGRESS: This was a new start in FY81.

PLANS: The FY82 effort will be to complete fabrication, assembly and field testing of the in-situ generator and the preparation of material. The FY83 effort will be to test the flight test hardware and conduct flight tests to demonstrate the feasibility of delivery and dispersion of the "pre-manufactured" material.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$150K	0	0	0	0

Transition to Advanced Development: Expected in FY84.

TASK MANAGER: L. D. Bare
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NIGHT ANGULAR RATE BOMBING SYSTEM
(FY82 Funding: $125K)

NEED: Marine Corps aviation has a long standing need for autonomous night target attack capability. Implementation of the Angular Rate Bombing system with a forward looking infrared (FLIR) will provide the night attack capability.

OBJECTIVE: To demonstrate proof of principle both analytically and with a hardware demonstration.

TECHNICAL APPROACH: Design, fabricate and test a miniature FLIR and incorporate this into the ARBS to demonstrate night capability.

BACKGROUND: NAVAIRSYSCOM has funded the development of the ARBS system with laser designated night capability. Incorporation of a FLIR into the ARBS has been investigated to the extent of determination that it is a feasible concept.

PROGRESS: This is a new start in FY82.

PLANS: The FY82 effort will focus on the development of a systems specification that will lead to hardware and proof of principle.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$150K	$150K	$500K	$400K	0

Transition to Advanced Development: FY87

TASK MANAGER:

SIDEARM
(FY82 Funding: $60K)

NEED: There is currently no defense suppression weapons for either the AH-1 or the AV-8. Because of the emphasis the Soviets has placed on Air Defense Systems it is imperative that the Marine Corps have self-defense capability for the AH-1 and AV-8 aircraft.

OBJECTIVE: To demonstrate proof of principle for putting an ARM seeker on the Sidewinder airframe.

TECHNICAL APPROACH: Design, fabricate and test the ARM seeker in conjunction with the Sidewinder airframe. Also to ensure the avionics on the existing aircraft will be compatible with the Sidearm.

BACKGROUND: The Navy Erase program has funded the program in FY81 with significant follow-on funding planned. The Marine Corps funding is to ensure that the program can be carried through.

PROGRESS: This will be a new start for the aviation program in FY82, however, Erase has funded the program in FY81 with significant progress. Preliminary tests have taken place with early brassboard hardware.

PLANS: The FY82 program effort funded from this source will be primarily directed at the missile/aircraft avionics interface.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$72K	$100K	$150K	0	0

Transition to Advanced Development: FY85

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HYPERVELOCITY ROCKET
(FY82 Funding: $60K)

NEED: With the Soviet emphasis on Air Defense Systems, it is imperative that USMC aircraft minimize exposure time. A very fast rocket system permits a very rapid launch, assessment and leave option for friendly aircraft. The Hypervelocity Rocket System is potentially a very lightweight system that could easily be utilized and resupplied in the forward areas.

OBJECTIVE: To evaluate the utility and effectiveness of a Hypervelocity Rocket System in the Marine Corps mission both analytically and through proof of principle hardware testing.

TECHNICAL APPROACH: Analytic definition of the requirements for the Hypervelocity Rocket. Design, fabrication and testing of the rocket and launch system.

BACKGROUND: The Marine Corps has been long interested in a very quick response, lightweight weapons system that could be utilized in the forward areas. The division elements of the Marine Corps are also interested in having a quick response direct fire weapon and are also funding this at a modest level.

PROGRESS: This is a new start, however, Vought Corporation has been investigating the Hypervelocity Rocket concept for several years.

PLANS: Most of the FY82 efforts will be directed at developing the Flechette warhead package. The work will culminate in proof of principle tests in a wind tunnel or in a live firing. Some effort will be directed toward investigation of the rocket pod.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$70K	$150K	$750K	$1500K	$1000K

Transition to Advanced Development: FY87

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MISSILE ROLL ISOLATION JOINT
(FY82 Funding: $25K)

NEED: The Zuni rocket motor nozzle contains a series of flutes which causes the missile to spin rapidly during motor burn and for a short time thereafter. A laser guidance unit placed on the front of a Zuni missile could not tolerate this high rate of spin. A method of decoupling the missile airframe spin from the laser guidance unit is needed.

OBJECTIVE: To isolate the rocket motor burn induced roll from the laser guidance unit on the Zuni airframe.

TECHNICAL APPROACH: Define the requirements for a roll isolation joint. Design, fabricate, and test the joint to these requirements.

BACKGROUND: The Marine Corps has signed an Operational Requirement, designated "Laser Zuni", for a precision guided, antiarmor, standoff weapon. The concept employs a laser semiactive guidance unit attached to the Zuni missile.

PROGRESS: Previous testing of the Zuni warhead has already demonstrated that its antiarmor capability will meet the Marine Corps requirement. Analysis indicates that the ranges can be achieved. Test of similar guidance units support the contention that the terminal accuracy required can be met. A preliminary roll isolation joint has been developed and will be tested in FY82.

PLANS: The second roll isolation joint will be tested early in FY82. The work will then be documented.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	0	0	0	0	0

Transition to Advanced Development: FY83

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MOBILE HAWK
(FY82 Funding: $750K)

NEED: The Marine Corps currently utilized the Improved HAWK (IHAWK) missile system as its primary method for low and medium altitude air defense. This sytem was procured on an interim basis and is scheduled for replacement in the early 1990 time frame. Due to high cost, personnel requirements and limited mobility, the Army PATRIOT system is not considered a suitable alternative for Marine Corps air defense in the early 1990s.

OBJECTIVE: Identify and enhance technology areas most critical to the development of integrated air defense systems that satisfy joint service requirements

TECHNICAL APPROACH: Identify subsystems and system components currently under development that have Marine Corps applications. High risk areas or applicable technologies not being investigated elsewhere, will be developed for use on the future Marine Corps system.

BACKGROUND: Efforts were begun during FY77 under the Mobile Surface-to-Air Missile System (MSAMS) Work Unit. The origin of need is (1) MMROP, (2) USMC GOR-AAS-1, (3) USMC ROC-AAS-1.01 and (4) Amphibious Warfare Technical Strategy, Strategy Group Task 5-5-6.

PROGRESS: The ROC for the MSAMS has been evaluated and recommendations forwarded that are commensurate with the current state of technology. A draft Mission Element Need Statement for the MSAMS has been prepared that is currently being staffed at HQMC. Techonology efforts are being addressed toward interfaces with the Tactical Air Operational Central (TAOC-85) as well as the Marine Corps unique aspects of transportability and mobility. Mobile Hawk is planned to be an evolutionary modification of the IHAWK system to meet the major MSAMS requirements.

PLANS: FY82 will continue to address the Marine Corps unique command and control interfaces in general. More specifically, we will look at methodology and technology required to marry an IHAWK with a unique phased array radar which may have the effect of reducing manpower while expanding target engagement capacity. FY82 or FY83 should lead to a demonstration of this system.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$800K	$800K	$900K	$1050K	$1150K

Transition to Advanced Development: Contingent upon other service participation.

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BLOCK PROGRAM TITLE: MARINE CORPS WEAPONRY TECHNOLOGY
(FY82 Funding: $2,320K)

PROGRAM ELEMENT NUMBER: 62332N (Strike Warfare)

SUB-PROJECT PROGRAM PLAN NUMBER: CF32.393

OBJECTIVE: To expand the technology base in areas applicable to Marine Corps weapon systems.

TASKS:
- o Field Artillery Technology
- o Military Operations in Urban Terrain Technology
- o Infantry Weapons Systems Technology
- o Amphibious Armored Vehicle Armament Technology
- o Special Purpose Weapons Technology

BLOCK PROGRAM MANAGER: Major Kenneth E. Roberts
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FIELD ARTILLERY TECHNOLOGY (FAT)
(FY82 Funding: $200K)

NEED: The continuing need to improve Field Artillery through technology exploitation is clearly documented by MMROP, GOR-SPA-1, and PEDE 5-79-SPA. Improvements are specifically required in the areas of mobility, manning, responsiveness, effectiveness, survivability, and supportability.

OBJECTIVE: To develop the technology that will respond to the needs in a timely, cost effective manner.

TECHNICAL APPROACH: For FY82, the primary approach will be one of technical monitoring of programs funded by other services, industry, or other Nations.

BACKGROUND: This area of work has produced the greatest return on investment in the Weaponry Block. Technology transfer has included more efficient muzzle brakes, lightweight howitzers, and material development. Work units within this task were: Rapid Fire Artillery Support System (RFASS), 203mm Howitzer, 155mm Howitzer, Direct Support Artillery Battalion Study, and North Seeking Module (NSM) Applications.

Due to limited funding for the Weaponry Block the decision was made to place this task in a "caretaker status" during FY82 except for monitoring related programs, maintaining currency and points of contact in the field, and wrapping up work units from FY81 which appeared prudent to do.

PROGRESS: The 203mm Howitzer was fired successfully thus proving the feasibility of all major areas of concern. The Field Artillery Rocket System (FARS) (formerly RFASS) was transitioned to 6.3 after successful verification testing.

PLANS: The primary efforts in FY82 will be providing engineering support to those contracts which were begun in FY81 and in monitoring development efforts of other services and Nations. This includes evaluation of Direct Fire Artillery Sight units being delivered under FY81 contracts; completion of laminated cylindrical metallic composites contract which was begun in FY81; and monitoring other contracts in materials technology which were let during FY81.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$900K	$1000K	$1150K	$1000K	$800K

TRANSITIONS: No transitions anticipated for FY83.

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MILITARY OPERATIONS IN URBAN TERRAIN TECHNOLOGY (MOUT)
(FY82 Funding: $305K)

NEED: Combat in the urban environment presents unique weapons requirements as outlined in the Mid Range Objectives Plan as well as in Marine Corps PEDE 1-79-INS, and the Marine Corps Study Catalog No. 30-77-1, "Concept of Operation for Landing Force in Urban Environment," Sep 78.

OBJECTIVE: The objective of this Exploratory Development program is to conduct investigations and studies to identify and solve USMC weaponry needs and requirements in MOUT, and to develop the various weapons/materials/techniques and technologies for use in the MOUT environment.

TECHNICAL APPROACH: The specific approach varies with each work unit, but in general it is to respond to an identified need by specifying the existing technology void, followed by an appropriate solution to the void. The solution is usually an engineering solution, but may be one of doctrine or tactics.

BACKGROUND: MOUT currently has two work units. These are Breaching Systems, and Fuel-Air Explosives (inside structures).

PROGRESS: Work in all units continues at a satisfactory though delayed pace due to some funding redistribution but strides are expected especially in wall breaching techniques using field expedient measures.

PLANS: Pursue goals of the two identified work units. Continue to identify technology gaps through mission analysis. Provide technical interface for the solution of tactical problems in MOUT.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$850K	$850K	$850K	$1000K	$1000K

TRANSITIONS: No specific transition anticipated at this time.

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INFANTRY WEAPONS SYSTEMS TECHNOLOGY (IWST)
(FY82 Funding: $995K)

NEED: The need for this task is documented in a variety of GOR's and technical strategies as this task includes a variety of work units relating to infantry primary missions.

OBJECTIVE: To provide the technology required to ensure that the infantryman is armed with weapons systems which effectively address the ever changing threat in a manner consistent with Marine Corps Policy and Doctrine.

TECHNICAL APPROACH: The battlefield of the future, as predicted by the threat analysis, will be examined as a system consisting of Mission, Enemy, Equipment Available, and Technology voids which prevent the Marine Corps from accomplishing their mission against the enemy with equipment available. Voids will be identified and bridged through feasibility demonstrations.

BACKGROUND: Emphasis during FY82 is being placed on four work units which involve Fire and Forget Anti-Tank Technology, Millimeter Wave Technology, man-portable flame weapon, and a unique stable element which has broad battlefield application. The fourth work unit is a new start which involves a feasibility demonstration of a potential product improvement to the Dragon MAW system.

PROGRESS: Progress on the all weather, mm wave Fire and Forget seeker is highly satisfactory though it has been delayed due to equipment failure. Satisfactory progress is also being made on the VYRO with the most significant advances being in a better understanding of the manufacturing and performance limits of the device as a sensor. The follow-through warhead work unit was successfully completed as a Joint Army/Marine Corps program and the future effort is to be picked up by the Army.

PLANS: An improved man-portable flame thrower using current technology will demonstrate a significant weight reduction over current, out-of-production models. Advanced concepts of propelling flame compounds will be addressed. The FFAT seeker will be available for transition to 6.3 if sponsored. Manufacturing and performance limits will be established for the VYRO and a tri-service demonstration of a type stabilized seeker platform will be demonstrated.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$900K	$850K	$950K	$1000K	$1000K

TRANSITIONS: Fire and Forget Anti-Tank Technology in FY82.

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AMPHIBIOUS ARMORED VEHICLE ARMAMENT TECHNOLOGY (AAVA)
(FY82 Funding: $520K)

NEED: Increased threats to amphibious vehicles during landing operations in conjunction with extensive exposure during land assault operations intensify the need for an effective suppressive and destructive armament system.

OBJECTIVE: To support the armament technology needs of future armored/-amphibious vehicles (LVT (X), MPWS, etc.) in the area of armament technology enhancement and product improvement for vehicle weapons systems which will significantly improve mobility, lethality, survivability and maintainability.

TECHNICAL APPROACH: This task will consist of four major work units and one additional contracted work unit. The FY81 efforts to develop the analytical and engineering tools required to marry large guns with light vehicles will be continued. In addition, a hit avoidance scheme will be evaluated because the ability to avoid hits might be a critical issue in the definition of "light" vehicle.

BACKGROUND: This is a technology support effort that began in 1978 and continues to provide valuable technological assessment and direction in the development of acquisition strategy for armored amphibious vehicle armaments.

PROGRESS: Verification of impulse loading model for tracked vehicles.

PLANS: Develop and maintain evaluation and consultant expertise for the Marine Corps in the area of weapon/vehicle/fire control/warhead effectiveness interface for all future development, and identify technology gaps for same. The vehicle response model begun for the M68 cannon on a light track vehicle will be completed and will be extended to include the MC LVTP family of vehicles. A variable muzzle brake will be investigated. A hypervelocity anti-armor rocket concept will be evaluated in an all-up test.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$1110K	$1150K	$1200K	$1200K	$1200K

TRANSITIONS: Transitions of developments will take place as they become available rather than as being identified by a specific product.

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SPECIAL PURPOSE WEAPONS TECHNOLOGY (SPWT)
(FY82 Funding: $300K)

NEED: The need for this task is documented in the Marine Corps Development and Education Command Proposed Exploratory Development Effort (PEDE) 4-81-FPW.

OBJECTIVE: The overall objective of this task is to develop technologies to support the fielding of incapacitating weapons, riot control weapons/devices, and special non-explosive/non-conventional weapons.

TECHNICAL APPROACH: This task will contain two work units each with multiple subdivisions of work. We will further refine the mechanisms that offer the greatest potential for weaponization through additional laboratory and field analysis and experimentation. Basically we are still in the process of cataloging and evaluating what the state-of-the-art is.

BACKGROUND: Current weapon system development efforts are directed, almost exclusively, at increasing the destructive ability or lethality. Unique Marine Corps missions often require that destruction be minimized and these casualties avoided. This Work Unit was established in order to investigate these non-conventional/non-explosive weapons/devices technology areas in order to provide the individual Marine unique capabilities to perform a multiple of special and non-special missions. Some of the special missions may include riot control, providing safe passage, hostage removal, embassy security, ship security, clandestine operations, etc., where death of the hostile may not be desired.

PROGRESS: The FY81 efforts have served to narrow down the field of investigation into technologies that offer promising approaches to the problem solutions. A bibliography of sources and a roster of personnel knowledgeable in the field has been developed to facilitate future efforts.

PLANS: Efforts for FY82 will concentrate on the evaluation of specific electromagnetic devices, wave generators, and chemical blends.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$750K	$750K	$750K	$750K	$750K

TRANSITIONS: Potential exists to transition two concepts into 6.3 in FY84.

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BLOCK PROGRAM TITLE: SURFACE MOBILITY
(FY82 Funding: $3,654K)

PROGRAM ELEMENT NUMBER: 62543N (Ships, Submarines and Boats Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF43.455

OBJECTIVE: To improve upon the capability of the Marine Corps to move its personnel and material in the amphibious arena and other related environments in which it may be required to operate.

TASKS:
- o Hydraulic Drive Train
- o Lightweight Track
- o Retractable Suspension
- o Composite Components
- o Clear Armor Inserts
- o Improved Water Performance Components
- o Advanced Amphibian Assault Vehicle (A^3V)
- o Advanced Amphibious Small Vehicle (A^2SV)
- o Band Track Demonstration
- o Family of Weapon Stations

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HYDRAULIC DRIVE TRAIN
(FY82 Funding: $285K)

NEED: A conventional tracked amphibian design has front sprocket drive with relatively fixed positions of components, shafts and drive points. An electric or hydraulic drive train would allow the drive sprockets to be repositioned at the rear of the vehicle. Since future amphibians may have 15 or more requirements for power from the prime mover, an electric or hydraulic system will allow greater flexibility, control and prioritization of power distribution.

OBJECTIVE: Demonstrate the hardware feasibility of an electric and a hydraulic power distribution system (including transmission).

TECHNICAL APPROACH: Follow a parallel approach for electric and hydraulic. Perform design syntheses to determine the initial feasibility of electric and hydraulic drive trains. Develop items which are unavailable. Design a final system. Construct and operate the system in the laboratory. Transfer the system to a technology demonstrator. Test and evaluate.

BACKGROUND: Electric and hydraulic drive trains are currently used for many types of commercial vehicles, thus much, but not all of the technology is available.

PROGRESS: Conceptual designs for both electric and hydraulic systems have been completed. Major critical components required have been targeted for development. Industry and TACOM input has been solicited and received. Procurement processes have been initiated with both Requests for Authority to Negotiate (RAN) and RFP packages.

PLANS: FY82: Phase I - Systems Design and Analysis.

FY83: Phase II - Key Component Development.

FY84: Phase III - Technology Demonstration.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$320K	$350K	$400K	$600K	$400K

Transition to Advanced Development: FY86, 89

TASK MANAGER: M.S. Rice
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LIGHTWEIGHT TRACK
(FY82 Funding: $490K)

NEED: Present amphibian tracks are relatively heavy, susceptable to corrosion, and need to be improved from a maintainability and lifetime standpoint. Lighter weight tracks would result in either lesser vehicle weight or greater armor protection for the same vehicle weight. Increased lifetime of tracks would result in a significant system cost reduction.

OBJECTIVE: Demonstrate the feasibility of new tracks and track components designed to reduce weight and extend operational life, constructed of a) silicon carbide/aluminum metal matrix, b) aluminum only, c) aluminum with wear inserts, and d) track life extending elastomers for track pads and bushings.

TECHNICAL APPROACH: Identify material technology that could be applied to the requirements for an improved track. Design and construct sample track blocks. Test sample blocks in the laboratory and on full scale vehicles. Design and construct complete track. Test and evaluate on LVTP7.

BACKGROUND: In the past, the heavy nature of the amphibian vehicle forced vehicle designers to consider only steel tracks. With recent advancements in material technologies, there are now other potential candidates for track construction.

PROGRESS: A complete aluminum track was tested to 1400 miles on LVTP7; sample blocks of two types of aluminum/silicon carbide metal matrix were designed for an LVTP7 and an M113.

PLANS: FY82: Test aluminum track on LVTP7 to destruction; test and evaluate metal matrix track blocks in laboratory and on vehicles. Determine laboratory feasibility of urethanes for use as track pads and bushings; if feasible, construct samples and test. Examine hard coatings for wear areas in track; if feasible, construct sample blocks.

FY83: Construct and test complete track made of one type of metal matrix.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$535K	$306K	$400K	$400K	$300K

Transition to Advanced Development: FY84, 88

TASK MANAGER: Richard Swanek
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RETRACTABLE SUSPENSION
(FY82 Funding: $485K)

NEED: From a vulnerability standpoint, a combat vehicle like the amphibian needs to have a minimum height. Another requirement is maximum water speed. A potential way to help meet both requirements is to reduce the vehicle height through the use of a hydropneumatic suspension system and, when the vehicle is in the water, reduce drag by retracting the track.

OBJECTIVE: Demonstrate the hardware feasibility of a low silhouette retractable suspension consisting of a) affordable hydropneumatic, and b) variable tension idler.

TECHNICAL APPROACH: (same for both items) Perform design syntheses, analysis, and scale model tests to determine initial feasibility. Design and construct one full scale item. Test on LVTP7. Modify design. Construct full set of full scale hardware. Install and test on LVTP7.

BACKGROUND: Up to now, hydropneumatic designs have been complex and expensive. It now appears possible to simplify the design and thus make it an improved and affordable suspension component. A variable tension idler will enable the track to be retracted.

PROGRESS: Lab testing of a simplified hydropneumatic suspension unit has been completed. Feasibility of using small roadwheels with torsion bar type suspensions shown undesirable due to ride quality degradation. Concept design of a variable tension idler completed.

PLANS: FY82: Construct complete hydropneumatic suspension system for a 14 ton vehicle (M113); construct 2 hydropneumatic suspension units for a 25 ton vehicle (LVTPX12); obtain loads data for a variable tension idler and final design idler.

FY83: Test 14 ton hydropneumatic suspension system; test 25 ton suspension system units; build complete hydropneumatic suspension system for 25 ton vehicle with variable tension idler.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$325K	$320K	$350K	$350K	$300K

Transition to Advanced Development: FY84, 86, 88

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COMPOSITE COMPONENTS
(FY82 Funding: $400K)

NEED: A cost effective way to reduce the weight of some vehicle components without sacrificing structural strength, armor protection, etc. is the use of composite technology. This weight reduction will translate into either a lower vehicle weight or greater armor protection for the same vehicle weight.

OBJECTIVE: Demonstrate the hardware feasibility of a) composite cargo doors, b) composite stern ramp, and c) composite hull material which will have lighter weight and increased armor protection.

TECHNICAL APPROACH: Perform analyses and design syntheses. Construct and test full scale cargo doors. Construct sample panels for armor, environmental, etc. testing. Construct and test a full scale stern ramp. Construct large size hull section and test. Construct a full size hull.

BACKGROUND: U.S. Army funded programs in composite technology have developed this class material to the point where it can be applied to the above tasks for the Marine Corps.

PROGRESS: Two sets of fiberglass reinforced plastic (GRP) cargo doors have been designed for an LVTP-7. One set will have overhead protection equal to the existing vehicle. The other set will have a steel facing and will provide armor piercing protection.

PLANS FY82: Complete construction of both sets of cargo doors and design, construct and test a GRP LVTP-7 driveshaft. Design a GRP LVTP-7 stern ramp.

FY83: Construct a GRP LVTP-7 stern ramp. Construct other GRP components.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$400K	$520K	$900K	$1400K	$1200K

Transition to Advanced Development: FY83, 85, 87

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CLEAR ARMOR INSERTS
(FY82 Funding: $194K)

NEED: Visibility from current and near-term amphibian vehicles operating in the buttoned-up condition is severely limited for the vehicle personnel (troop commander, driver, and gunner). Overhead vision is nonexistent. High water speed vehicles will require visibility for safe water operations.

OBJECTIVE: Demonstrate the feasibility of clear armor inserts which significantly increase the visibility from all hatch stations while providing ballistic protection equal to that of the improved hulls for future vehicles.

TECHNICAL APPROACH: Identify candidate designs. Construct and ballistically test sample inserts. Install sample inserts on an LVTPX-12. Test and evaluate. Evaluate the feasibility of installing inserts in other hull locations. Construct and install inserts on the ALAAVS technology demonstrator.

BACKGROUND: This task has been supported under the Marine Corps Surface Mobility Program.

PROGRESS: Results to date have shown that curved clear armor inserts are feasible for existing threat. Sample inserts were ballistically tested in FY81.

PLANS: FY82: Install sample inserts in an LVTPX-12 test and evaluate; construct sample inserts for the higher threat of the future. Ballistically test the inserts.

FY83: Construct, install and test increased protection inserts in an LVTPX-12.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$250K	$350K	$300K	0	0

Available for transition to an Advanced Development Program: FY86

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IMPROVED WATER PERFORMANCE COMPONENTS
(FY82 Funding: $350K)

NEED: The water speed of present amphibian vehicles is ow (about 8 mph) in calm water and lower (about 6 mph) in waves. This roblem is caused by several factors - short vehicle length, typical bowdown static attitude, and a poor hydrodynamic form. Increased horsepower alone will not result in much improvement and would be difficult owing to the lack of a waterjet which will absorb the increased power.

OBJECTIVE: Increase the water speed of amphibian vehicles by demonstrating the feasibility of a) a bow flap, b) stern flap, c) increased power waterjet, d) air in track cavity, e) canted waterjet, and f) retracted tracks.

TECHNICAL APPROACH: Perform analyses, design syntheses, and scale model testing to determine laboratory feasibility. Design and construct full scale hardware. Test hardware in laboratory and on full scale vehicles.

BACKGROUND: Previous efforts under other programs have investigated, to a limited extent, some of the items proposed here. However, this task will result in full scale hardware tested in consonance with other suitable components to take advantage of their synergistic benefits.

PROGRESS: Full scale bow flap tests were conducted at Camp Lejeune, North Carolina, and Camp Pendleton, California. Testing indicated an operational speed advantage when using the bow flap in the light and troop loaded condition. Operational speed increases on the order of 1 to 1½ MPH were recorded and were directly attributable to improved vehicle trim which permitted safe, full utilization of engine power and RPM. Full scale tests of two vehicles in tandem were also conducted at Camp Lejeune. The results indicated that improved vehicle trim could be achieved, again having a positive impact on safe maximum operational speeds. Scale model testing involving blowing air into the track cavity was conducted. Results indicate that this approach appears to be of limited value in improving water performance.

PLANS: FY82: Develop bow flap kit; conduct model tests on candidate technology demonstration vehicles; investigate and provide designs for high speed delivery systems; design improved/-affordable composite waterjet.

FY83: Construct and initiate full scale tests on improved composite waterjet; initiate model tests on high speed delivery systems. Refine and scale test technology demonstration vehicles to achieve improved water performance.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$250K	$150K	$100K	$200K	$400K

Transition to Advanced Development: FY83, 84, 85, 86, 87

TASK MANAGER: S.S. Scharf
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ADVANCED AMPHIBIAN ASSAULT VEHICLE (A^3V)
(FY82 Funding: $680K)

NEED: The Marine Corps will require a new amphibian in the year 2000 time frame. The concept formulation for such a vehicle must begin now, followed by designs and demonstration test beds, in order to insure that the new vehicle will possess characteristics superior to its predecessors.

OBJECTIVE: Develop and demonstrate the feasibility of an advanced amphibian assault vehicle (A^3V) which will have an Initial Operational Capability (IOC) in the year 2000, will be 30% lighter, will have 15% better armor protection, and will have 25% better mobility than its predecessor vehicles. The armor efforts are so intertwined with the vehicle aspects that they will be treated as a single task.

TECHNICAL APPROACH: Formulate new vehicle concepts. Quantify projected payoffs/costs of new vehicles and of developing the required new technology. Identify technology shortfalls. Generate tasks to address these shortfalls. Perform continuing design tradeoffs to evaluate developing technology. Test and evaluate full scale new components to evaluate their synergistic effects and their design impacts on new vehicles. Design and construct a technology demonstrator. Evaluate and modify.

BACKGROUND: Evolutionary and incremental changes in subsystem technology will seldom result in large increases in vehicle capabilities; likewise, even revolutionary changes in subsystem technology must be integrated into a revolutionary vehicle to demonstrate the ultimate worth of the concept.

PROGRESS: Conceptual designs of POST-LVT(X) vehicles were performed. Analysis of these designs showed that the greatest potential impact on the vehicle was lightweight armor. No Surface Mobility efforts were underway in this area; therefore efforts were commenced in developing and applying lightweight armor technology (not pure development, which is covered in numerous other programs) to specific applications - i.e., repairability, manufacturability, salt water corrosion, etc.. The second largest impact was an advanced drivetrain and a lightweight suspension. Efforts in these areas are already underway.

PLANS: FY82: Continue design concepts and evaluation; continue steel/aluminum efforts; investigate other armor candidates for future vehicles.

FY83: Complete armor investigations. Complete design efforts; design an actual hull.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$750K	$839K	$1200K	$1800K	$800K

Transition to Advanced Development: FY85, 87

TASK MANAGER: E.D. Wolfe
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ADVANCED AMPHIBIOUS SMALL VEHICLE (A^2SV)
(FY82 Funding: $420K)

NEED: The Marine Corps is presently pursuing three (3) new vehicle programs. The Light Armored Vehicle (LAV), the Mobile Protected Weapon System (MPWS) and the Landing Vehicle, Tracked (Experimental) (LVT(X)). These vehicles systems will have IOC's from FY84 to FY92. A possible solution to the follow-on vehicles for these systems could be a single small vehicle family which is fully amphibious and helicopter transportable.

OBJECTIVE: To determine the feasibility of the concept of a family of vehicles fulfilling the Marine Corps needs by demonstrating the synergistic benefits available due to judicious integration of the successful Marine Corps Surface Mobility developments in the components and subsystem areas into a Technology Demonstrator.

TECHNICAL APPROACH: Conduct conceptual design syntheses exploring the system benefits achievable because of ongoing component developments. Formulate designs, construct a mockup, and construct a Technology Demonstrator which will be subjected to a series of tests to demonstrate the synergistic effect of the component developments.

BACKGROUND: Recognizing a need to provide the infantry with more mobility and fire support the USMC has ongoing the LAV and MPWS vehicle programs. These vehicles have an upper weight limit of about 14 tons in order to be helicopter transportable. These vehicles are envisioned to be used in addition to the conventional LVT's which provide the mobilization and insertion means for the surface launched portions of an amphibious assault. The successful completion of the SURFMOB component developments may allow the design of a single family of follow-on vehicles which can fulfill all three missions.

PROGRESS: Initial designs of personnel variants of the family, have been initiated.

PLANS: FY82: The initial design syntheses for the family will be completed. Hydrodynamic model tests will be conducted. Initial designs of personnel variant will be quantified for performance.

FY83: A preliminary design of the technology demonstrator will be conducted and a full scale mockup of the personnel version will be constructed.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$530K	$785K	$885K	$1135K	$1000K

Transition to Advanced Development: FY86

TASK MANAGER: W. Zeitfuss
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BAND TRACK DEMONSTRATION
(FY82 Funding: $250K)

NEED: Advanced Marine Corps Vehicles have the requirement to achieve improved combat capability ashore. Improved agility, related to acceleration, is enhanced by fielding vehicles with greater installed horsepower per ton, which can be achieved by a combination of weight reduction and/or higher installed power. Future Marine Corps tracked vehicles will continue to be weight critical, and the band track offers the potential of significantly reducing the suspension weight and at the same time enhancing survivability and reliability.

OBJECTIVE: Demonstrate the hardware feasibility of a high speed lightweight band track system which will enhance the combat capability of future Marine Corps vehicles.

TECHNICAL APPROACH: Design, fabricate and test components of a band track; integrate and test the band track in a test vehicle to establish system feasibility; exercise optional procurement for vehicle technology demonstrator if initial testing is successful.

BACKGROUND: Previous efforts under other programs have investigated the potential application of band tracked systems in military vehicles. However, full scale construction and testing of these systems for high speed, high weight applications has not been accomplished. This task will result in full scale hardware tested in consonance with other components to take advantage of their synergistic benefits.

PROGRESS: New start.

PLANS: FY82: Prepare documentation for the competitive procurement of a band track for target award the 4th Quarter of FY82. Initiate design of band track components.

FY83: Complete component design and test components. Modify M113 as surrogate vehicle for initial full scale tests and procure full track set for installation and field tests.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$300K	$350K	$250K	0	0

Transition to Advanced Development: FY86

TASK MANAGER: S.S. Scharf
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FAMILY OF WEAPON STATIONS
(FY82 Funding: $100K)

NEED: The Marine Corps is planning to field a variety of combat vehicle systems which will provide mobility to the various elements of a MAGTF combined arms team. Each vehicle system will have its own unique weapon station design and its own armament suite. More than likely each will have a unique conventional turret/cupola.

OBJECTIVE: Demonstrate the feasibility (cost, size and complexity, etc.) of a family of weapons stations capable of accepting a variety of weapons and reducing the armor enclosed volume and presented area.

TECHNICAL APPROACH: Design syntheses and tradeoffs will be conducted in order to quantify effectiveness and address physical, structural, cost and environmental problems. The design and construction of a bread board test station is anticipated, and will be integrated into the ALAAVS Technology Demonstrator.

PROGRESS: New start.

PLANS: FY82: Concept exploration design sytheses will be conducted and the best concept selected.

FY83: Preliminary design effort conducted and a full scale mockup constructed.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$500K	$600K	$500K	0	0

Transition to Advanced Development: FY86

TASK MANAGER: W. Zeitfuss
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BLOCK PROGRAM TITLE: USMC SURFACE/AEROSPACE TARGET SURVEILLANCE
(FY82 Funding: $1955K)

PROGRAM ELEMENT NUMBER: 62712N (Surface/Aerospace Target Surveillance)

SUB-PROJECT PROGRAM PLAN NUMBER: CF12.134

OBJECTIVE: Develop integrated battlefield surveillance and target acquisition systems to detect and classify targets that use cover and concealment to mask their movements or location.

TASKS:
- o Seismic/Acoustic Passive Surveillance Systems
- o Signal Identification Techniques
- o Multi-Sensor Correlation
- o Air-Droppable Soil Penetrometer
- o EW Operational Deception Techniques
- o Robotic Assessment
- o Electro-Optic Doppler Surveillance
- o Advanced Teleoperator Technology

BLOCK PROGRAM MANAGER: Mr. Dan Leonard
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SEISMIC/ACOUSTIC PASSIVE SURVEILLANCE SYSTEMS
(FY82 Funding: $490K)

NEED: Official requirements documents for this task are listed in: STO-AW, 8-A-10; STO-TW, 9-B-2; and the draft Marine Corps STO R&D Objectives for EW-Counter C^3I, No. 257. This task addresses the critical need to passively detect, classify, and locate land launched weapons such as artillery and mortars, vehicles such as tanks and APCs, and low flying aircraft.

OBJECTIVE: Determine the feasibility of developing a low cost, light-weight (less than 75 pounds) passive surveillance capability with a range of five to twenty km for use in detecting, classifying, and locating enemy guns, vehicles and low flying aircraft.

TECHNICAL APPROACH: Perform field experiments to obtain seismic signatures of weapons, vehicles, and aircraft. This signature data is then used to develop signal processing algorithms and propagation models which will then be tested in further field experiments.

BACKGROUND: This task was started in FY78 and is performed in coordination with investigators funded by Defense Advanced Research Project Agency (DARPA) and Office of Naval Research (ONR).

PROGRESS: A system analysis of the field equipment was performed and reported on in December 1978. Field equipment was built and the first field experiment conducted at Twentynine Palms Marine Corps Base in June 1980. Data tapes have been distributed to other investigators. Preliminary evaluation of the data was performed and additional tests using an expanded sensor array were performed in FY81.

PLANS: Report the results of data analysis from the FY80 field experiment. Analyze data and report results from the FY81 field experiment. Improve field equipment and conduct a third field experiment as a rehearsal for a final field demonstration in FY83.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$450K	$300K	$250K	$200K	$150K

Transition to Advanced Development: Portions will transition in FY85.

TASK MANAGER: John G. Hoffman
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SIGNAL IDENTIFICATION TECHNIQUES (SIT)
(FY82 Funding: $150K)

NEED: Official requirements documents for this task are listed in: STO-SW, 10-C-5; STO-AW, 8-A-7; and in the draft Marine Corps STO for Tactical Surveillance, Reconnaissance, and Target Acquisition No. 255. This task addresses the need to detect, locate, and classify enemy command control RF transmissions for targeting by EW or indirect fire assets.

OBJECTIVE: Demonstrate the feasibility of intercepting, sorting, identifying, and tracking unidentified tactical communications transmissions on a real time basis.

TECHNICAL APPROACH: The approach is to build upon technology developed under the sponsorship of Naval Air Systems Command (NAVAIR) for development of a high speed rf detection capability. The NAVAIR work has been aimed at different frequencies and signal types and designed for different platforms. However, some of the processing techniques are applicable. Initial efforts under this task have addressed narrow band signals and planned efforts will address spread spectrum signals.

BACKGROUND: This task was started in FY79 as a joint effort with NAVAIR.

PROGRESS: A capability to detect and classify narrow band tactical signals has been developed and demonstrated in the laboratory. Improvements have been made and the modified unit will be field tested early in FY82. This system is expected to be incorporated into the Integrated Signal Intelligence System (ISIS). Development of a spread spectrum system is under investigation.

PLANS: Field tests of the modified narrow band unit will be conducted. Two approaches to the spread spectrum detection problem will be followed; first, techniques for adding a spread spectrum capability to the narrow band system will be investigated and second, development of a whole new approach will be analyzed. The more promising of these two approaches will be continued in later years.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$175K	$225K	$150K	$100K	0

Transition to Advanced Development: Narrow band portions of this task will transition into the Integrated Communications Collection System in FY82. Remaining 6.2 work will be completed by FY86.

TASK MANAGER: Gene Stohrer
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MULTI-SENSOR CORRELATION
(FY82 Funding: $200K)

NEED: Official requirements documents for this task are listed in: STO-AW, 8-A-10; STO-OS, 13-A-2; and Ocean Surveillance Technical Strategy Objectives 4.2 and 4.3. This task will provide improved automated aids for processing data from various sources, thereby improving the long term intelligence estimates of the AOA prior to assault.

OBJECTIVE: Develop techniques and procedures for processing multi-sensor battlefield surveillance data.

TECHNICAL APPROACH: Utilize the Essential Elements of Intelligence identified in the Integrated Tactical Intelligence Support System and Shore-Based Intelligence Support to Command Study, together with data regarding the family of sensors that were identified and characterized in FY79 to develop the functional relationships between the two. Also, identify any data deficiencies and suggest ways to rectify the problem. Produce a concept and preliminary set of procedures for processing the data from surveillance sources. Develop a model of a battlefield sensor integration process that is compatible with the Reconnaissance and Surveillance Center Concept developed by Marine Corps Tactical Support System Activity (MCTSSA) and the Mobile Command Concept developed by NOSC.

BACKGROUND: This task began in FY79 in response to a Marine Corps Proposed Exploratory Development Effort.

PROGRESS: Command control systems under development for post-1985 Marine Corps operations were identified and their relationship to battlefield surveillance characterized. Principal sensor systems have been identified and characterized. The functional data deficiencies have been identified and preliminary processing requirements are being defined.

PLANS: Complete definition of processing requirements. Evaluate previously developed multi-sensor techniques, adapt and test required processing mechanisms, and demonstrate the performance of these techniques. Identify other processing deficiencies and produce a preliminary set of procedures for processing and integrating data within the functional framework. Develop a preliminary system specification to incorporate multi-sensor correlation techniques with other procedures in a manner suitable for a battlefield system.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$200K	$200K	$225K	$250K	$250K

TASK MANAGER: Dave Ramey
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AIR-DROPPABLE SOIL PENETROMETER
(FY82 Funding: $210K)

NEED: Official requirements documents for this task are listed in: STO-SW, 10-C-2; STO-AW, 8-A-9; O.S. STO 1.1 & 1.7. Soil trafficability analysis is a critical parameter in any amphibious assault. A great deal of relative trafficability data can be obtained from remote sensing systems; however, absolute calibration points are required. Successful completion of this task will provide those calibration points without having to send human recon teams onto the beach to get them.

OBJECTIVE: To develop a technique for obtaining soil trafficability parameters in real-time. Active laser/passive multispectral sensing developments show promise of partially fulfilling this requirement by 1984. This task covers development of air dropped soil penetrometers for: (1) obtaining trafficability data in areas where active/passive remote sensing methods cannot be used reliably, and (2) obtaining check points for calibration active/passive sensing systems for optimum data collection and processing.

TECHNICAL APPROACH: Study existing air-droppable soil penetrometers to determine the optimum configuration. Determine factors to relate penetrometer data such as cone index and resistivity to soil trafficability. Design and test a penetrometer model and determine its capability to measure and report the appropriat arameters.

BACKGROUND: This effort was initiated in FY79.

PROGRESS: A theoretical relation between soil trafficability and the properties of electrical resistivity of the soil and cone index has been shown. Field experiments have been conducted to determine the exact nature of that relationship for various types of soils.

PLANS: Design and fabricate a breadboard droppable penetrometer able to measure cone index and soil resistivity. Begin testing of the model from a fixed platform.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$100K	0	0	0	0

Transition to Advanced Development: FY83

TASK MANAGER: Jim Kirkland
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EW OPERATIONAL DECEPTION TECHNIQUES
(FY82 Funding: $125K)

NEED: Official requirements documents for this task are listed in: STO-AW, 8-A-14; STO-CC, 14-A-13; and the draft Marine Corps STO for Communications, No. 256. This task addresses the need to deceive the enemy as to Marine Corps intentions prior to battle and thereby increase the chance of success.

OBJECTIVE: Develop techniques to provide the enemy with false information about the intentions of the Marine Air Ground Task Force (MAGTF). Such techniques should cover all phases of the cover and deception plan.

TECHNICAL APPROACH: Investigate the operational deception problem, identify useful technologies, conceptualize a system and integrate it into an overall deception effort.

BACKGROUND: This effort was started in FY81 in response to a Marine Corps Proposed Exploratory Development effort.

PROGRESS: An analysis of the problem was completed and several general problem areas defined.

PLANS: Technical solutions to identified deception problems will begin in FY82 beginning with RF radiation deception. Other general problem areas will be addressed in future years.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$150K	$225K	$250K	$300K	$350K

TASK MANAGER: John Miniuk
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ROBOTIC ASSESSMENT
(FY82 Funding: $300K)

NEED: Official requirements documents for this task are listed in: STO-OS, 13-A-1 and 13-A-3; STO-AW, 8-A-14 and 8-D-2; STO-CC, 14-B-3 and in the draft Marine Corps STO for Tactical Surveillance, Reconnaissance, and Target Acquisition. This task addresses the need to perform deep surveillance and operational deception tasks without risking lives, thereby providing critical time perishable surveillance information to the tactical commander within minutes after it is collected.

OBJECTIVE: Assess and demonstrate, if possible, the feasibility of employing remotely operated devices (RODs) with robotic characteristics for intelligence gathering purposes.

TECHNICAL APPROACH: Seven technical disciplines must be employed on this problem. They include: (1) structural and mechanical engineering, (2) energy handling, (3) sensor and instrumentation, (4) effector and control, (5) data communications, (6) data processing hardware, and (7) data processing software. An analysis of USMC operational surveillance problems will be undertaken to identify critical elements of intelligence and information which seem most appropriate for ROD solutions. A technical system analysis will be performed, identifying the relationship of each of the seven basic disciplines to the proposed solutions. Representive RODs will then be developed and field tested.

BACKGROUND: This task combines the related work of two previously funded efforts, Robotics and AOA Assessment.

PROGRESS: Mission analyses were performed and two candidate systems identified for demonstration, a ground surveillance robot (GSR) and a lighter than air tethered (LAT) vehicle. The system requirements were defined and all necessary features described and top level functional specifications developed for both systems. This work and the analyses leading to the conclusions are described in reports to be published in FY82.

PLANS: During FY82 a testbed GSR vehicle will be procured, a detailed design of the tethered platform will be completed, and platform development will begin. This vehicle will be modified and outfitted with the sensor packages needed to determine if it can be made to perform the selected mission.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$300K	$350K	$350K	$400K	$400K

TASK MANAGERS: Scott Harmon
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ELECTRO-OPTIC DOPPLER SURVEILLANCE
(FY82 Funding: $240K)

NEED: Official requirements documents for this task are listed in: STO-AW, 8-A-10; STO-AW, 8-D-2; STO-CC, 14-A-13; and the draft Marine Corps STO R&D Objectives for Tactical Surveillance, Reconnaissance, and Target Acquisition, No. 255. This task addresses the critical need to develop less detectable sensors and thereby reduce the tendency of the surveillance sensors and their operators to become targets. Use of this technology will allow detection of stationary and moving targets based on target Doppler structure and its relationship to ambient background Doppler. In addition, visibility in darkness and in the presence of diffusive media such as fog, smoke, and dust, will be improved.

OBJECTIVE: Develop a laboratory testbed Electro-Optic Doppler Surveillance (EODS) sensor which has the capability to generate a realtime two dimensional spatial Doppler map of targets in an area of interest. Demonstrate that such a system can be built in a configuration suitable for field use.

TECHNICAL APPROACH: A coherent active imaging approach will be pursued. For this approach, the return image light field is coherently mixed with a local oscillator light field on the face of a television sensor tube in a manner which superimposes "fringes" or contours of equal Doppler over the image. The sensor's output signal is subsequently electronically processed to enhance fringe contrast.

BACKGROUND: This task is a new start in FY81 and is based upon work done under an NOSC Independent Exploratory Development (IED) program.

PROGRESS: All principle subsystems of the test bed unit have been built. Subsystem testing has not been completed nor has the entire test bed been assembled.

PLANS: Complete assemble of the laboratory test bed and run through tests of its capabilities in the laboratory. Assuming successful tests, develop and test a field testable unit.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$225K	$250K	$100K	0	0

Transition to Advanced Development: Portions of this technology will be ready for Advanced Development in FY84.

TASK MANAGER: Dr. Steve Moran
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ADVANCED TELEOPERATOR TECHNOLOGY
(FY82 Funding: $240K)

NEED: Man's sensory and motor capabilities are often needed in hostile environments. The substitution of the physical presence of man with generic remote systems will significantly impact military operational capabilities by: (1) removing the environmental, physical, and psychological constraints that limit man's effectiveness in hostile environments and (2) extending the operator's sensory inputs and increasing his remote manipulative capability.

OBJECTIVE: Define and demonstrate the limits of remote presence control techniques for a remotely operated device employed in a tactical surveillance role.

TECHNICAL APPROACH: Using a top-down approach, identify the deficient technology areas and work on them to first develop a stationary capability which can provide a remote presence at distances of up to five (5) km from the operator and then demonstrate that the same capability can be provided on a mobile platform at the same distances.

BACKGROUND: This project was initiated in FY80 using Navy funds and is being transferred to exclusive Marine Corps funding this year.

PROGRESS: This task was previously funded under P.E. 62759N where a systems analysis of the problem was conducted and advances were made in the development of stereo vision and binaural hearing as well as in development of a remote hand and arm manipulator.

PLANS: During FY82 development of a stereo vision capability will be completed, an extension device for the manipulator arms will be completed, a three degree of freedom spine manipulator will be completed, and a 5 km control link will be developed.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$250K	$350K	$400K	$450K	$450K

Transition to advanced development cannot be identified at this time.

TASK MANAGER: David C. Smith
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BLOCK PROGRAM TITLE: USMC COMMAND CONTROL TECHNOLOGY
(FY82 Funding: $1320K)

PROGRAM ELEMENT NUMBER: 62721N (Command and Control Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF21.245

OBJECTIVE: Improve USMC C^3 capability by attacking the issues of survivability, reliability, and connectivity.

TASKS:
- o Landing Force Integrated Communications System (LFICS) Survivability
- o Auto-Tuned RF Distribution System
- o Mobile Command Concept
- o Fault Tolerant Technology
- o Decision Aid Technology
- o Passive Identification, Friend or Foe

BLOCK PROGRAM MANAGER: Mr. Dan Leonard
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LANDING FORCE INTEGRATED COMMUNICATIONS SYSTEM (LFICS) SURVIVABILITY
(FY82 Funding: $335K)

NEED: This task will identify and address technology issues which will allow the LFICS to continue to fulfill its mission in a changing threat environment through the end of the century. Major emphasis areas are electronic warfare (EW), reliability, responsiveness, and mobility.

OBJECTIVE: Pursue those technologies which will lead to improved reliability and survivability of the LFICS with emphasis on protection against increased EW and radio frequency interference (RFI). Develop new technologies that aid the transition from analog to digital systems.

TECHNICAL APPROACH: Low data rate digitized voice techniques, capable of high intelligibility over poor radio channels, will be implemented and tested over VHF and HF voice channels. Interoperability with digital terminals will be demonstrated. FY81 measurements of tactical digital VHF channels will be evaluated for system and network implications. Tactical network capability and survivability will be analyzed from a topological and from a component reliability standpoint. Ultra-violet (UV) communications also will be studied for their possible inclusion into advanced network concepts.

BACKGROUND: This effort began in 1977.

PROGRESS: Tactical digital VHF channel characteristics have been measured and completed for a variety of East Coast and West Coast terrain and vegitation conditions. A low data rate voice recognition system has been completed and demonstrated to have high intelligibility in a laboratory environment with negative signal to noise ratios. Tactical VHF antennas with their associated metal structures have been successfully modelled.

PLANS: Complete laboratory tests and conduct field demonstrations of the low data rate voice techniques over tactical radio links. Conduct VHF testing in desert conditions for tactical link analysis. Analyze tactical network capabilities in light of reliability analysis, modelled antenna analysis, and HF/VHF channel characteristics. Determine the utility of UV links for tactical ground use.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$350K	$375K	$375K	$400K	$435K

Subprojects of this task will transition to advanced development as completed.

TASK MANAGER: Mr. Gerald A. Clapp
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AUTO-TUNED RF DISTRIBUTION SYSTEM
(FY82 Funding: $175K)

NEED: Official requirements documents for this task are listed in: STO-CC, 14-A-8; STO-TW, 9-A-8; and in the draft Marine Corps STO R&D Objectives for Communications No. 256. This task addresses the need to reduce the number of antennas on the LVT(X) command vehicle and at tactical command posts. The command tractor is readily identifiable by its many antennas. By coupling all radios into one or two antennas this problem will be eliminated.

OBJECTIVE: Develop and demonstrate the technology which provides an automatically switchable multi-channel communications and RF distribution system for fixed or mobile command posts.

TECHNICAL APPROACH: Two approaches have been followed. First, Electron Bombarded Semiconductor (EBS) amplifier technology has been pursued as a solution to the transmit side problem. Second, a distributed multi-coupler approach has been pursued. After initial evaluation, the most promising approach will be developed and demonstrated.

BACKGROUND: This task was started in FY78 in response to a Marine Corps Proposed Exploratory Development Effort.

PROGRESS: After months of waiting we were unable to obtain a suitable EBS amplifier from the manufacturer. Consequently, that approach has been abandoned, since no other comparable source can be found. Under the distributed multi-coupler approach, suitable filters were ordered but did not meet specifications and had to be modified. Design of a signal partitioning unit has been completed.

PLANS: Upon completion of the filter modifications, assemble the entire system and perform tests.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$75K	0	0	0	0

Transition to Advanced Development: FY84

TASK MANAGER: Joe Kershaw
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MOBILE COMMAND CONCEPT
(FY82 Funding: $335K)

NEED: Official requirements documentation for this task is located in: STO-CC, 14-A-1; and in the draft Marine Corps STO R&D Objectives of Tactical Command and Control, No. 254; and Communications, No. 256. This task addresses the need for improved reliability, capability, and flexibility in Marine Corps command control systems. The immediate need is to identify those technologies which will be critical to the development of a post MTACCS command control system which will allow the battlefield commander to make his decisions based upon purely tactical considerations and without regard to technical constraints imposed by his command control system.

OBJECTIVE: The objective of this task is to identify the technologies which must be developed if the Marine Corps is to develop a Mobile Command Concept (MCC) capability which is highly reliable, easy to operate, lightweight, and will degrade gradually in the face of battle damage.

TECHNICAL APPROACH: Perform a complete system engineering analysis, beginning with a baseline requirements definition and moving through a functional analysis, operational requirements analysis, technical requirements analysis, trade-off studies, and finishing with technology development recommendations.

BACKGROUND: This effort began in FY79.

PROGRESS: Documents detailing the baseline assumptions, command and staff functional analysis, functional interface analysis, operational node analysis, and information exchange and traffic analysis have been published. A draft of the technical requirements is in publication.

PLANS: Publish documents on the technical requirements and defining the needed technical capabilities. Complete a draft executive summary and a plan for technology development.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$375K	$410K	$425K	$450K	$490K

Transition to Advanced Development: Selected areas of technology will transition as appropriate.

TASK MANAGER: Dan Leonard
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FAULT TOLERANT TECHNOLOGY
(FY82 Funding: $200K)

NEED: Official requirements documents for this task are located in: STO-CC, 14-A-16; STO-CC, 14-A-17; and the draft Marine Corps STO R&D Objectives for Tactical Command and Control No. 254. This task addresses the need for improved reliability in Marine Corps electronic equipment. A ten to one improvement in reliability over presently planned LFICS and MTACC equipment is the goal of this task.

OBJECTIVE: Demonstrate that electronic systems can be built which have a greatly reduced dependence on technical and logistic support at the organizational level. Those failures which do exist should result primarily from physical abuse or battle damage. Demonstrate further that fault tolerant design concepts and VLSI technology can achieve these improvements within size, weight, and life cycle cost constraints.

TECHNICAL APPROACH: Develop an electronics test bed which will demonstrate the application of fault tolerant technology. As a specific example, the functional capabilities of the Unit Level Message Switch (ULMS) will be simulated in the test bed. Fault tolerant techniques will be employed and the circuits will be partitioned so that VLSI technology could be employed if desired.

BACKGROUND: This effort was started in FY79 in response to a Marine Corps Proposed Exploratory Development Effort.

PROGRESS: A system design has been completed which incorporates principles of fault intolerant as well as fault tolerant design. The architecture is chosen to make maximum use of VLSI technology. Hardware subassemblies have been completed for the main processors, memory switch control, memory, and line termination unit sections of the test bed. Software design for the test bed is nearing completion.

PLANS: During FY82 the software design for the test bed will be completed. Integration of the hardware units and software will be accomplished and system testing will commence.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$200K	$150K	$75K	0	0

Transition to Advanced Development: Some portions of this technology will be ready for transitioning to the MTACCS after FY82.

TASK MANAGER: Harris Quesnell
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DECISION AID TECHNOLOGY
(FY82 Funding: $200K)

NEED: Official documents are located in: Navy Science and Technology Objectives (STO) STO-CC, 14-A-11; STO-CC, 14-B-1; and in the draft Marine Corps STO R&D Objectives for Tactical Command and Control No. 254. The ability to make good, rapid decisions under pressure is a continuing need of any tactical commander. This task will identify and develop automated aids which will assist the tactical commander to improve the quality and responsiveness of his decision making function.

OBJECTIVE: Identify and develop those elements of decision aid technology and artificial intelligence (AI) which can be of particular aid to the MAGTF commander and his staff in the performance of their duties.

TECHNICAL APPROACH: Evaluate and develop areas of AI technology that can be applied to selected Marine Corps tactical decision problems. Techniques selected for development will be programmed on Laboratory computers and tested by Laboratory investigators and Marine Corps personnel. Several tactical decision problem areas will be successively investigated in this manner.

BACKGROUND: This task was initiated late in FY80. A particular Marine Corps operational problem was to be selected for demonstration of decision aid technology. Selection of supporting arms was selected and work begun on this problem in FY81.

PROGRESS: Nine general areas of AI have been outlined and evaluated for their applicability to Marine Corps problems and technical implementation difficulty. A rule based system is being developed for assistance with selection of supporting arms. The present system is designed to select between various pieces of artillery. The present algorithm appears capable of being implemented on the IBM System One computer.

PLANS: The present algorithm will be modified to accept inputs in a format which is compatible with the Digital Communications Terminal (DCT), evaluated by Marines and modified as needed. Optional selections of 16" naval gun fire or ship launched cruise missiles will be added and evaluated. The last addition to the algorithm will be the option for selecting close air support.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$200K	$250K	$250K	$275K	$275K

Pieces to this technology will transition to Advanced Development as available.

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PASSIVE IDENTIFICATION, FRIEND OR FOE (IFF)
(FY 82 Funding: $75K)

NEED: With the increasing range of weapons and increasing pace of modern warfare, the human eye is no longer keen enough to properly identify all potential targets as friend or foe. Automated aids are required if fratricide on the tactical battlefield is to be prevented. Passive or at least non-cooperative systems are needed since radiating sources quickly become targets.

OBJECTIVE: Define USMC requirements for a non-cooperative IFF capability, monitor similar efforts of other services, identify the most promising technology and recommend appropriate developments.

TECHNICAL APPROACH: This effort must be closely coordinated with related work being pursued by the Army and Air Force in the NATO environment. The approach is to examine Marine Corps equipment and tactics to document Marine Corps IFF requirements and identify appropriate system technologies. Recommendations for development of candidate technologies will be made when possible.

BACKGROUND: This task began in FY81 in response to a Marine Corps Proposed Exploratory Development Effort.

PROGRESS: Marine Corps equipment, tactics and doctrine have been examined and IFF needs identified. Techniques of other services have been monitored and new technologies identified. A draft report has been written and will be submitted to MCDEC for review.

PLANS: Continue monitoring the work of other services and new technology developments in the field with particular emphasis on mm wave radiometer work at Georgia Tech University. Complete an interium report of the state-of-the-art.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$100K	$100K	$125K	$125K	$150K

Transition to advanced development has not been identified at this time.

TASK MANAGER: Jeane Stillwell
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BLOCK PROGRAM TITLE: U.S. MARINE CORPS LAND MINE COUNTERMEASURES
(FY82 Funding: $1238K)

PROGRAM ELEMENT NUMBER: 62734N (USMC Land Mine Countermeasures)

SUB-PROJECT PROGRAM PLAN NUMBER: CF34.393

OBJECTIVE: This project area encompasses the development of technology for land mine countermeasures, obstacles and booby traps used against U.S. Marine Corps forces engaged in amphibious assaults on hostile shores and during establishment of beachheads. This technology development will provide a capability to breach minefields at maneuver speeds with a minimum loss of tactical vehicles and the development of techniques to remotely detect the presence of minefields so that tactical operations can be planned more effectively.

TASKS:
- o Landing Force Land Mine Countermeasures Concept Formulation
- o Advanced Explosive Clearing Techniques
- o Land Mine Countermeasures Simulation and Analysis
- o Main Charge Destruction of Land Mines for Amphibious Assault
- o Countermine Concepts for Amphibious Assault in Extreme Climates
- o Concepts for Forward Marking and Detection

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LANDING FORCE LAND MINE COUNTERMEASURES CONCEPT FORMULATION
(FY82 Funding: $110K)

NEED: The U.S. Marine Corps will likely encounter a substantial land mine threat in future amphibious assaults and must develop an appropriate countermine response for anticipated situations.

OBJECTIVE: To determine the technical capabilities required and identify essential operational system concepts for Marine Corps landing forces to detect and breach enemy land minefields used against amphibious assaults.

TECHNICAL APPROACH: Conduct continuing assessments of enemy land mine threats to potential amphibious assault landing force operations. Develop scenarios which include concepts of operations, types of threats, mid- and long-range time frames and existing and potential capabilities of the U.S. Marine Corps. Surveys of present and future land mine countermeasures programs, capabilities and concepts are being conducted.

BACKGROUND: Technology forecasts project continuing substantial development of the traditional enemy land mine threat including new mine types and tactical deployment. Complex fused, explosive resistant mines and scatterable mines are being introduced. Marine Corps countermine capabilities presently limited to M58A1 line charges must be designed/developed to neutralize potential land mine impacts on amphibious assault operations.

PROGRESS: Investigations to identify appropriate land minefield detection systems and development of computer programs for systems evaluation, interactive capability and graphic display have been conducted. The Marine Corps Combat Analysis Model (MCAM) has been established and is in operation. Efforts for acquisition of foreign land mine ordnance will continue.

PLANS: Analysis effort will be directed to increasing threat areas and evaluation of advanced detection and neutralization concepts for countermeasure resistant mines, scatterable and chemical/nuclear mines. Items of foreign ordnance now planned for acquisition will be obtained; additional items will be designated for acquisition. MCAM will be upgraded to facilitate barriers and obstacles.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$130K	$130K	$130K	0	0

This task has recommended identified system concepts for advanced development. Additional systems with substantial countermine potential will also be recommended as they are identified.

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ADVANCED EXPLOSIVE CLEARING TECHNIQUES
(FY82 Funding: $398K)

NEED: Capability for clearing land mines compatible with vehicle/troop speed of advance for amphibious operations over the beach and sustained operations ashore.

OBJECTIVE: Identify, develop, and investigate advanced explosive materials, charge configuration, and techniques suitable for minefield clearance. This will include improved line charges and Fuel Air Explosives (FAE), explosive liquids or slurries and improved means of employment of equipment now available.

TECHNICAL APPROACH: Identify current technology directed toward improvements in explosives. Monitor these investigations and identify those that show potential improvements in the explosive yields. Conduct exploratory tests of advanced explosives identified and/or concepts for mine clearing techniques. Analyze and report results.

BACKGROUND: The need for this effort is supported by S&TO MW-7(14), AW 8(2), SW-10(10) and GOR No. MOB-1, Mobility. The U.S. Marine Corps Landing Force requires more optimum equipment, techniques and system configurations for explosive clearance of AT/AV land mines in the surf zone and beach areas during amphibious landing operations. At present, technological investigations are in process that explore techniques and materials that can provide improvements in explosive yields and dispersion mechanisms.

PROGRESS: Buffered burster charge modifications have resulted in successful cloud dispersions and detonations of Heptane/RDX/nPN using a conventional PO FAE cloud as the detonator. PO with cab-o-sil added to produce a gel mix resulted in a cloud of uniform thickness with a resultant increase of 60 percent in area covered was successfully detonated. The Halliburton Company nozzle and fluorocarbon surfactant for testing was tested with PO. The PO fluorocarbon surfactant resulted in a residue buildup on the nozzle which reduced its foaming effectiveness.

PLANS: Continue technological investigations into FOAM-FAE and LIQUID-DUST FAE feasibility and provide additional documentation, analysis, and planning support for project CATFAE. Improve coordination and liaison between U.S. Navy/Marine Corps, U.S. Air Force and U.S. Army high explosive developments and/or applications.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$398K	$450K	$450K	$450K	0

Initiate Advanced Development FY87.

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LAND MINE COUNTERMEASURES SIMULATION AND ANALYSIS
(FY82 Funding: $240K)

NEED: There is a continuing need to assess and evaluate land mine countermeasures concepts so as to provide focus and definition to (1) the prioritization of concepts, (2) critical experiments which must be made, and (3) generation of requirements for advanced systems developments.

OBJECTIVE: Develop and utilize simulation and analysis capabilities to study land mine countermeasures concepts in the context of 1980 and 1990 Marine Corps operational scenarios.

TECHNICAL APPROACH: A land mine countermeasures simulation and analysis capability will be developed, beginning with a laboratory test bed, implemented in a minicomputer and resulting in algorithms and specifications that can be implemented in a desk top or microcomputer. Emphasis will be placed on developing a design for an end product that will have a multi-purpose capability including: landmine countermeasures simulation, training aid, and planning aid.

BACKGROUND: Scenarios and the land mine threat to amphibious operations typical of mid-range and long-range time frames have been defined, both in terms of Soviet defensive tactics and Marine Corps landing strategy.

PROGRESS: Existing models are either too complex (require large computer capacity and knowledgeable, trained operators), completely ignore land mines as a part of land combat, or treat them too simplistically to be satisfactory for this task. MCAM (Marine Corps Combat Analysis Model) will be used to support analysis and simulation of land mine countermeasures operations. The Lane Segment Analysis Model (LSAM) will be used as one of the basic building blocks for the Laboratory Test Bed for Land Mine Countermeasures Analysis and Simulation System (LAMCASS). The Integrated Assault Model (IAM) is another major building block for the laboratory test bed for Land Mine Countermeasures Analysis and Simulation.

PLANS: Completion of the LSAM development is the first major milestone for this task.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86
	$240K	$150K	0	0

ASC prepared in FY82 for Advanced Development start in FY84.

TASK MANAGER: A. DeLoach
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MAIN CHARGE DESTRUCTION OF LAND MINES FOR AMPHIBIOUS ASSAULT
(FY82 Funding: $130K)

NEED: Capability to neutralize or destroy land mines by main charge destruction, regardless of firing train design.

OBJECTIVE: Identify current and developmental technologies necessary to destroy the main charge of the mine regardless of firing train. Design, fabricate and conduct exploratory evaluation of these devices.

TECHNICAL APPROACH: Main charge destruction device/concepts will be designed and fabricated based on available technology. Field tests of these exploratory devices/concepts will be conducted to determine their effectiveness in destroying the main charge of land mines at various plant depths.

BACKGROUND: Threat nations have within their knowledge and capabilities the ability to easily and inexpensively fabricate firing trains for their mines that are highly resistant to our demolition devices. The common denominator of threat mine capability is the main charge which remains vulnerable despite significant increases in firing train sophistication and complexity.

PROGRESS: Procured Israeli track width plows for M-60 tank and modified fuze for U.S. M-15 anti-tank mines. SOW changed to reflect requirement for installation kit and tools along with maintenance support. Analysis of submunitions and warhead ranges indicates need to develop limitations on submunitions physical sizes and delivery method through additional operational analysis.

PLANS: Continue to identify current and developmental technologies. Main charge destruction device/concepts will be designed and fabricated based on available technology and operational analysis. Field tests of these exploratory devices/concepts will be conducted to determine their effectiveness in destroying the main charge of land mines at various plant depths.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$259K	$401K	$480K	$480K	$500K

An Advanced Systems Concept will be submitted during FY85 for Advanced Development start in FY88.

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COUNTERMINE CONCEPTS FOR AMPHIBIOUS ASSAULT IN EXTREME CLIMATES
(FY82 Funding: $210K)

NEED: Capability to breach and clear minefields in extreme climates.

OBJECTIVE: Identify the technology and methodology for effective countermine operations in extreme climatic conditions. Design, fabricate and test equipments necessary to provide this capability.

TECHNICAL APPROACH: Identify operational problems created in countermine operations by climatic extremes. Evaluate alternative concepts for overcoming these problems. Design, fabricate and test these concepts as necessary.

BACKGROUND: Effects of extreme climates on countermine equipment is not known. Need for this effort is supported by GOR No. MOB-1, Mobility, GOR No. LOG-1, Logistics, current contingency missions assigned to the Marine Corps, Amphibious Warfare Strategy and Annex F to the Countermeasures Exploratory Development Substrategy.

PROGRESS: Report on mine behavior in surf zone prepared. Replicated full-scale geometric facsimilies of selected mine types.

PLANS: Conduct tests of current countermine equipment to identify problems in extreme cold and hot environments. Develop concepts to optimize capabilities for countermine operations in these environments. Design, fabricate and test these concepts. Priority of effort will be directed toward solving countermine problems in extreme cold in conjunction with U.S. Army Cold Regions Research Laboratory.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$210K	$300K	$300K	$300K	$450K

This work unit will provide input to other advanced system concepts planned in the U.S. Marine Corps Land Mine Countermeasures Program.

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CONCEPTS FOR FORWARD MARKING AND DETECTION
(FY82 Funding: $150K)

NEED: Capability to detect, localize and mark AT/AV land mines forward of Marine landing forces (vehicles and/or troops) engaged in amphibious assault over the beach and sustained operations ashore.

OBJECTIVES: The overall objective of this effort is to investigate and establish feasibility of training, controlling, and using free bio-sensors to detect, localize and mark AT/AV land mines along the assault beach area as well as subsequent inland operating areas.

TECHNICAL APPROACH: Operant conditioning techniques will be used to train bio-sensors first in a closed environment and subsequently in a variety of open environments. Tests will be designed and directed at providing information for the design, development and production of prototype systems to meet the Marine Corps landing force requirements. Initial efforts will be retricted to technological investigations to determine if (1) free behavior can be reliably controlled, (2) reliably detect on-the-surface land mines, and (3) reliably deposit a marking or neutralization device on the mine.

BACKGROUND: The need for this task is supported by GOR No. MOB-1, Mobility, GOR No. LOG-1, Logistics, Amphibious Warfare Strategy and Annex F to the Countermeasures Exploratory Development Substrategy.

The ability of bio-sensors to perform complex visual tasks has been tested in the laboratory.

PROGRESS: This is a new start for FY82.

PLANS: In FY82, initial facilities will be established and training initiated to determine if free bio-sensors can be reliably controlled in an open environment at ranges of up to 100 yards from the point of release and if bio-sensors can reliably detect and mark exposed land mines.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$150K	$200K	0	0	0

Advanced Systems Concept prepared in FY83 for Advanced Development in FY85.

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BLOCK PROGRAM TITLE: AMPHIBIOUS/ADVANCED BASE MOBILITY
(FY82 Funding: $1932K)

PROGRAM ELEMENT NUMBER: 62760N (Logistics Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF60.536

OBJECTIVE: The objective of this Block Program is to support the Logistics Facilities and Amphibious Warfare Exploratory Development Strategies by exploring concepts and selectively advancing the technology base for POL, logistics mobility, construction, facilities and utilities support in Amphibious and Advanced Base Operations. The desired result is improved support at reduced manpower, investment and operating costs.

TASKS:
- o Services and Support
- o General Construction
- o Horizontal Construction
- o Logistic Mobility
- o Marine Corps POL Program

BLOCK PROGRAM MANAGER: Mark E. Hollan
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SERVICES AND SUPPORT
(FY82 Funding: $425K)

NEED: In general, the modern battlefield will be characterized by mechanized forces that will employ mobility as an offensive tactic. The combat engineers will remain critical the success of the operation as it is their mission to support the MCATF in the scheme of maneuver with such activities as breeching of obstacles and providing utilities.

OBJECTIVE: There are areas of generalized service support to amphibious operations that require modernization and harmonization with future force structures, tactical concepts, and support needs. This exploratory effort proposes to examine: (1) methods of enhancing combat effectiveness through improved combat engineering support and other service support functions, as appropriate; (2) new, improved utility facilities that provide reliable mobile support to amphibious forces both on board ship as well as in the field.

TECHNICAL APPROACH: Accomplish this objective while reducing logistics requirements and the need for highly skilled operators. The approach to the MCATF effort is to conceptualize, develop and field the necessary equipment to ensure the continued capability of combat engineers in support of such operations.

BACKGROUND: Adequate sanitation is obviously essential to reduce disease-induced casualties. Generation of potable water for troops, afloat or ashore, in the latter case especially where there is rapid advance, has always been characterized by high logistics burdens.

PROGRESS: Desert water distribution equipment and capabilities relative to Marine Corps requirements were identified. Alternate concepts were developed with emphasis on large volume storage, cooling and temperature control. An experimental model pretreatment unit for reverse osmosis water purification was designed, fabricated and tested. NCEL designed an auxiliary instrumentation package with an automatic valve control for implementation with the ROWPU.

PLANS: Design, fabricate and test a physical cleaning instrumentation package for the Marine Corps ROWPU. Develop RDT&E objectives to meet desert water supply requirements. Conduct exploratory development of promising technologies, concentrating on active and passive cooling concepts. Plan and develop technical requirements for combat engineer support RDT&E program.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$672K	$569K	$825K	$620K	$656K

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GENERAL CONSTRUCTION
(FY82 Funding: $420K)

NEED: Currently, the time required to respond, i.e., deploy and construct, general (vertical) construction that allows MAF or Fleet combat service elements to become operational has been measured in months. The use on on-site construction of non-relocatable buildings in a support area or advance base does not satisfy the requirements for future response times.

OBJECTIVE: Develop concepts to provide contingency structures (facilities) that will improve system mobility and that are characterized by rapid deployability, installation and subsequent retrievability; and to investigate concepts for improving equipment for construction; and materials and equipment for Marine Corps operations.

TECHNICAL APPROACH: Emphasis has been placed on general construction concepts and technology related to climate extremes. However, specific concepts relating to the logistics of urban warfare operations have been addressed. This includes the identification and development of specialized support capabilities essential to effective support of forces operating largely in urban, built-up areas.

BACKGROUND: In a MAF level amphibious operation, approximately 50,000 personnel and numerous sophisticated weapons systems will be placed ashore in a foreign, hostile environment. Under certain conditions some facilities may exist in the area which can be captured and converted to use. Under other conditions, the objective area may be denuded and require the creation of all support areas.

PROGRESS: Reviewed engineering requirements and evaluated intelligence data available for on-site engineering decisions for construction in the AOA. TM M-63-81-05 was issued on the results of foamed-in-place insulation on a vehicle at MCAGCC Twentynine Palms, CA. The Army TACOM report confirmed some existing commercial equipment might be adapted to the tactical five-ton vehicle family for sand and snow removal. Final development plan received on desert construction RDT&E and is in review.

PLANS: Validate and establish priorities for the desert construction RDT&E plan. Review the previously defined explosives safety and operational requirements for ASPs and develop alternate concepts for expedient storage of ammunition. Initiate Phase II of offensive/defensive schemes of maneuver applied to operational missions to identify CS and CSS requirements.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$420K	$480K	$430K	$450K	$650K

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HORIZONTAL CONSTRUCTION
(FY82 Funding: $667K)

NEED: Major improvements are needed in techniques for expeditious construction engineering and land management in an objective area. An improved capability would enable the force commander to accomplish advanced planning for logistic support efficiency and effectiveness that could result in significant savings in expenditure of material assets, manpower and time.

OBJECTIVE: Provide improved horizontal construction techniques and equipments for engineering control, earthwork, and prepared surfaces in support of Marine Corps operations.

TECHNICAL APPROACH: Recognizing that development efforts are underway in the Army, Air Force and industry, all research and development efforts directed toward this objective must ensure proper coordination. Therefore, an important part of this effort is provision for a broad base of coordination for technology and an active pursuit of interservice support in the areas of engineering control, and earthwork and prepared surfaces.

BACKGROUND: Planning for optimum siting of facilities is critical to minimize construction effort. Simultaneous requirements for airfield, roadway, and logistic support area construction does exist. A MAGTF has insufficient engineering capability to start all priority earthwork projects simultaneously. In the more demanding scenarios there is up to 50% shortfall of manpower and equipment.

PROGRESS: Obtained existing software packages from Naval Aeronautic and Space Administration (NASA), the Jet Propulsion Laboratory (JPL) and the University of California at Santa Barbara (UCSB) designed to integrate multiple sources of digitized data. Ensured compatibility of programs and computers to produce the specific engineering data needed for MARCORPS construction in the AOA. Successfully traffic tested prefabricated Fiberglass Reinforced Plastic (FRP) patch on bomb damaged runway with an instrumental F-4 aircraft.

PLANS: Develop an automated aid for facility placement, engineering management, project planning, design and the estimating of engineer logistic requirements. Monitor contract for twin-dozer blade control kit and fabricate small scale model of twin-dozer blade. Refine concept of using FRP membranes for bomb damaged conventional runways and continue coordination with the Air Force.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$600K	$700K	$500K	$575K	$700K

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LOGISTIC MOBILITY
(FY82 Funding: $140K)

NEED: The modern battlefield requires greater dispersal and mobility of forces, which generates a necessity for demanding and timely logistic support response. The recently established Rapid Deployment Force (RDF) calls for highly mobile, prepositioned logistic systems capable of supporting brigade level combat, yet flexible enough to support a wide range of power projection scenarios.

OBJECTIVE: Establish feasibility of new concepts, methodology, techniques and systems for cargo handling across undeveloped beaches and into distribution points in support of Marine Corps operations.

TECHNICAL APPROACH: Included are concepts, techniques, equipments and experimental designs for rapid emplacement of large container marshalling yards. Developments will be directed towards a technology base for the design, assembly and feasibility determination of all major components and equipment installation related to concepts, methodology and techniques for establishing cargo throughput to users.

BACKGROUND: Amphibious and advanced base operations must rely on (a) deployment of equipment and men by commercial ships and, (b) rapid and effective movement of cargo from ships offshore of undeveloped and often hostile beaches, to and across those beaches, and then inland to combat and support forces. Shortages of assault shipping in a future contingency may force the use of merchant shipping in assault operations. Driven by compatibility with merchant shippng, amphibious logistics is one of the most rapidly evolving technologies in the military. Similarly, the logistic requirements of a Marine Air Ground Task Force (MAGTF) have changed and grown significantly in recent years, i.e. the concept of mechanized combat demands that logistic systems be flexible and able to support a mobile scheme of manuever.

PROGRESS: Container marshalling yard configuration and vulnerability was assessed and alternatives were presented in the contractor's report. Main emphasis was on vehicle characteristics, weapons effects and vulnerability, earthworking and soil surfacing.

PLANS: Complete preliminary marshalling area layouts to reflect vulnerability considerations and relative construction burdens and documenting further research requirements. Conduct in-depth analysis of suitability of commercial straddle lifts for container handling in a hostile environment.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$100K	$150K	$300K	$564K	$325K

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MARINE CORPS POL PROGRAM
(FY82 Funding: $280K)

NEED: The basic operational requirements are:

a. To receive fuel ashore directly from several sources in the AOA.
b. To provide the necessary storage capacity ashore, consistent with usage, fuel demands and safety level requirements.
c. To provide the transport and movement of fuel from storage areas to tactical distribution points.
d. To efficiently distribute and dispense fuel supplies to tactical users throughout the objective area.
e. To be capable of rapid installation and displacement under tactical conditions.

OBJECTIVE: To investigate, define and develop the equipment devices, techniques and hardware essential to POL support for all Marine Corps operations.

TECHNICAL APPROACH: This task is being conducted as part of "Joint Navy and Marine Corps POL System", which considers all aspects of POL delivery from the tankers offshore to the Marine Corps users onshore. The result being the economic and operational optimim of Marine Corps and Navy POL assets. Close coordination is maintained between the joint project and other services.

BACKGROUND: The Joint Navy/Marine Corps POL System must provide rapid offload and storage of fuel (offshore and/or onshore) to enable rapid tanker turnaround and provide adequate fuel reserves. The FLS POL requirement is to provide the Marine Corps shoreside capability to receive, store, transport and distribute POL to the operating forces.

PROGRESS: Fire protection reports recommended elimination of MOGAS from bulk fuel handling systems. Government acceptance testing of 800-gpm pump set completed in FY81. Fabricated a portable berm frame section. Onshore storage developments for the NCF continue to be monitored. Related efforts monitored dealt with the Navy SPM synthetic leg tanker mooring, use of FRP pipe, and offshore fire protection.

PLANS: Conceptualize high mobility POL systems to support MAB and MCATF operations. Evaluate all-weather operational capability of AAFS/TAFDS components and develop modifications as necessary to ensure required capability. Provide fire protection and firefighting improvements for MARCORPS use in amphibious operations.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$140K	$130K	$100K	$80K	$100K

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BLOCK PROGRAM TITLE: USMC MANPOWER AND TRAINING TECHNOLOGY
(FY82 Funding: $1,352K)

PROGRAM ELEMENT NUMBER: 62763N (USMC Personnel and Training)

SUB-PROJECT PROGRAM PLAN NUMBER: CF63.500

OBJECTIVE: To develop improved methods for selecting, assigning, training, and retaining officer and enlisted personnel.

TASKS:

I. Training and Education
- o Infantry Land Navigation Training
- o USMC Urban Area Combat Training
- o USMC Professional Military Education

II. Acquisition and Assignment
- o USMC Computerized Adaptive Testing
- o Analysis of First-Term Attrition Among Women Marines
- o USMC Identification of Mitigating Variables in Enlisted Screening
- o USMC Special Assignment Battery Implementation
- o USMC Exit Survey System
- o USMC Optimal Classification Procedures

III. Organization and Retention
- o Organizational Interventions to Reduce Attrition
- o Motivational Approaches to Mission Accomplishment

IV. Manpower Forecasting and Requirements
- o Manpower Life-Cycle Cost Development

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INFANTRY LAND NAVIGATION TRAINING
(FY82 Funding: $200K)

NEED: Marine Corps personnel must operate over a range of terrains utilizing a wide range of map and photo products not limited to conventional Defense Mapping Agency military topographic maps. Personnel must be prepared to utilize these map products not only to navigate quickly and accurately but to make tactical decisions based on terrain considerations. The Marine infantryman requires land navigation skills as a basic tool for the performance of his mission.

OBJECTIVE: The development of a Land Navigation training program for Marine Corps and Army infantrymen.

TECHNICAL APPROACH: Knowledge of cartographic techniques and practices used in the preparation of maps is critical to their proper interpretation and use. Training programs are being developed which provide infantrymen with the necessary understanding of terrain, hydrographic, vegetation, and cultural features. Media is used extensively to permit training with real world visual representations of map portrayals and their terrain counterparts.

BACKGROUND: This task was initiated in FY77 in response to the HQMC FY77 Training Systems Task Area Plan. The U.S. Army identified related requirements and in FY79 began supporting the USMC development effort through the Army Research Institute.

PROGRESS: A front-end analysis of Marine Corps Land Navigation Training requirements has been completed. A contractor prepared prototype course with modules in topography, hydrography, vegetation and transportation lines was received. These materials are being revised in house for subsequent application. Additional modules covering cultural features and introductory map interpretation principles are being developed for inclusion in the course.

PLANS: Nov 82 Revision of prototype course.
May 83 Evaluation of training effectiveness with target population of Marine infantrymen.
Sep 83 Final recommendations.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$50K	0	0	0	0

Transition to operational use: FY84

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USMC URBAN AREA COMBAT TRAINING
(FY82 Funding: $125K)

NEED: Heavy urbanization of coastal regions and the reduced availability of amphibious shipping create situations where avoiding major urban complexes may not only be impossible, but where seizing port facilities may be necessary. Training of aircrews for operations in this unique environment is necessary if they are to provide necessary air support and mobility to Marine ground forces.

OBJECTIVE: The development of urban area aviation training programs for Marine aviators.

TECHNICAL APPROACH: Alternative means of simulating essential aspects of the urban visual environment are being evaluated for aircrew training in target acquisition and weapons systems use.

BACKGROUND: This effort was initiated in FY78 by a Work Directive from CG MCDEC, and it follows the recommendations set forth in the FY77 USMC study "Concepts of Operations for the Landing Force(s) in Urban Environments During the Midrange."

PROGRESS: An examination of aircrew requirements, aviation staff planning factors, and the available technology base was conducted. A report, "Urban Area Combat Training: Aviation Implications," has been published. Close air support target acquisition performance in urban areas, and probability estimates of first pass ordnance release have been determined. A report on close air support in urban areas has been prepared. Initial design and development of an urban area aviation training program is in progress.

PLANS:
- Dec 81 Development of urban area visual scene terrain requirements for training of aviation personnel. Definition of staff training requirements.
- Oct 82 Development of an urban area training program.
- Oct 83 Implementation/evaluation of urban area aircrew training.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$100K	0	0	0	0

Transition to Advanced Development: FY84

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USMC PROFESSIONAL MILITARY EDUCATION
(FY82 Funding: $127K)

NEED: The Resident and Extension Schools at MCDEC share responsibility for training all Marine Corps officers and senior enlisted personnel. Because different rates of instruction exist between the schools, a method of coordinating the two programs needs to be developed.

OBJECTIVE: Develop an instructional management system that will provide (1) individualized, self-paced courses without sacrificing professional interaction, and (2) an evaluation system that will allow instructors to track students who will be moving through course material at varying speeds, and that will provide data necessary for informed management decisions.

TECHNICAL APPROACH: The Personalized System of Instruction (PSI) and Criterion Referenced Instruction (CRI) will be used to individualize courses and to ensure professional interactions. This instructional management system generates data in a form (student-test transactions) easily summarized and graphically displayed to allow continuous feedback to instructors and management. Additionally, potential export media will be identified and tested for use in the Extension School.

BACKGROUND: Task started 1 Oct 1979. Marine Corps Education Center staff recognized a need for more efficient educational procedures to accomodate the demand for high quality professional military education. Meetings in Aug 1979, between Education Center staff and NPRDC personnel resulted in the development of a research plan addressing this need.

PROGRESS: An individualized instruction and evaluation system was developed and implemented at the Instructional Management School. An existing professional course has been selected for individualization and plans and materials are being developed for both resident and extension versions.

PLANS:
- May 82 Investigation of export media for use in Extension School. Development of training packages concerning management of an individualized system and of an evaluation system.
- Jul 82 Implementation of individualization and evaluation systems in one course at Resident School. Test export media in Extension School.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$125K	0	0	0	0

Transition to operational status: FY84

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USMC COMPUTERIZED ADAPTIVE TESTING (CAT)
(FY82 Funding: $295K)

NEED: All Services currently use the Armed Services Vocational Aptitude Battery (ASVAB) for enlisted personnel selection and classification testing. ASVAB has several shortcomings which include susceptibility to compromise, imprecise measurement at high and low ability levels, opportunity for random and malicious clerical errors in score computation and recording, and high cost/long lead time to develop replacement tests. Replacing the paper-and-pencil ASVAB with computer-administered, individually-tailored tests has the potential to eliminate these problems, and improve personnel selection.

OBJECTIVE: Develop and evaluate psychometric procedures for a computerized adaptive testing system.

TECHNICAL APPROACH: A prototype computerized system for adaptive test administration will be developed. Alternative procedures for tailored test administration will be compared in a series of analytic and computer simulation studies. Results will be verified in experimental live testing, after which an advanced prototype testing system will be developed and subjected to field test of its feasibility and usefulness.

BACKGROUND: Initiated in response to HQMC (MPI-20) Letter of Requirement dated 21 March 1977, this Marine Corps task led to establishment of a coordinated, joint service program to develop CAT and evaluate its potential as a replacement for the printed ASVAB in the Armed Forces Examining and Entrance System. This task is now a significant component of the joint services CAT program.

PROGRESS: A 4-terminal experimental CAT prototype facility has been developed under contract, and is now installed for experimental use at MCRD, San Diego. CAT analogues of the Armed Forces Qualification Test (AFQT) components have been developed. A micro-computer based advanced CAT prototype system has been developed. A software system for evaluation of CAT via computer simulation has been developed, and used to choose prototype CAT psychometric procedures.

PLANS FY82. Use the advanced CAT prototype system for preliminary evaluation of the usefulness of CAT test scores for personnel selection. Conduct simulation studies to refine CAT psychometric procedures. Identify theoretical and practical issues to be resolved prior to operational implementation of a CAT system.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$250K	$250K	$275K	$300K	$330K

Transition to operational status: FY84

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ANALYSIS OF FIRST-TERM ATTRITION AMONG WOMEN MARINES
(FY82 Funding: $115K)

NEED: To operate and maintain increasingly complex military systems with decreasing numbers of qualified males, the Marine Corps has expanded its use of females. First-enlistment attrition rates have been unacceptably high, however, about 50 percent. These rates must be reduced if the Marine Corps is to rely on women to help meet their personnel requirements.

OBJECTIVE: Identify factors affecting attrition among Women Marines during their first 36 months of service, and develop recommendations to address significant problem areas.

TECHNICAL APPROACH: Examine existing data sets (e.g., Recruit Accession Management System, Historical Master File, Recruit Background Questionnaire files) to obtain a better description of when, where, to whom, and for what reasons attrition is occuring. Develop and administer a survey of background variables, Marine experiences and coping techniques to Women Marines, including both attriters and non-attriters, and relate responses to attrition. From these results, develop specific recommendations for decreasing attrition, and pilot test one or more of these.

BACKGROUND: Because of the limited number of Women Marines and their unique position in the Corps, the factors causing attrition may be different for women than for men. Attrition because of pregnancy, the largest category for women, may have many complex causes in addition to contraceptive failure, and some of these may be amenable to Marine Corps intervention.

PROGRESS Existing data sets have been analyzed and preliminary recommendations prepared. Surveys have been developed and pilot-tested, and distributed to attriters.

PLANS:
- Jan 82 Distribute surveys to non-attriters.
- Mar 82 Prepare report on analysis of data sets.
- Sep 82 Prepare report on survey results.
- FY83 Develop and administer pilot tests for 1 or 2 recommendations.

FUNDING REQUIREMENTS:

FY83	FY84	FY85	FY86
$85K	0	0	0

Transition to operational status: FY84

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USMC IDENTIFICATION OF MITIGATING
VARIABLES IN ENLISTED SCREENING
(FY82 Funding: $50K)

NEED: Current enlistment standards based on aptitude test scores and educational levels may be unduly restrictive in a shrinking population of qualified male applicants.

OBJECTIVE: Determine if there are personal characteristics that can compensate for low mental ability and/or low educational achievement, and which could be used to increase the population of people available for enlistment in the Marine Corps.

TECHNICAL APPROACH: Design and administer experimental non-intellectual inventories (e.g., background, motivation, interest) to a population of marginally qualified enlistees; evaluate performance of these individuals in the Marine Corps. Develop and evaluate a selection model which optimally weights the available predictor information and estimates an applicant's chances of becoming a successful Marine.

BACKGROUND: Premature attrition (i.e., failure of an enlistee to satisfactorily complete a tour of obligated service) has been a serious problem for the Marine Corps. Examination of the cumulative three year attrition rate for the FY76 cohort of nonprior service personnel was 36%. This very high rate of premature attrition coupled with forecasts of a declining population of persons eligible for enlistment prompted HQ USMC (MPI-20) to request a study by NPRDC. Task start date was 1 Oct 1978.

PROGRESS: Two forms of the biographical inventory were developed and administered to applicants for enlistment at all CONUS AFEES. The inventory was validated against recruit training and 6 month in-service attrition criteria. At the 6-month point the inventory was found to be significantly related to attrition.

PLANS:
- FY82 Evaluate selection efficiency based on combination of existing and mitigating variables.
- FY82 Validate biographic inventory against one year in-service criterion.
- FY82 Evaluate for possible operational use.
- FY83 Validate inventory against two-year criterion.
- FY83 Final recommendations.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$31K	0	0	0	0

Transition to operational status: FY83

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USMC SPECIAL ASSIGNMENT BATTERY IMPLEMENTATION
(FY82 Funding: $25K)

NEED: Marine Corps recruiters and drill instructors fill important roles in the procurement and initial training of USMC recruits. The need to ensure that the most suitable personnel be assigned to these positions is of critical importance. To meet this need, the Marine Corps is improving selection procedures for recruiters and drill instructors.

OBJECTIVE: Implement and evaluate the Special Assignment Battery (SAB) for use in selecting personnel for assignment to recruiter and drill instructor duty.

TECHNICAL APPROACH: The SAB was developed for selecting individuals who will be effective recruiters and drill instructors. The SAB will be administered to Marine Corps personnel eligible for assignment to these duties. Scores on SAB will be reported to detailers and will be one factor in making such assignments. A follow-up study to evaluate the usefulness of the SAB will be conducted.

BACKGROUND: While this project has an FY80 start date, the need for such an effort was identified earlier, and was the impetus for two exploratory development projects. The first project, begun in 1976 and jointly sponsored by the Naval Recruiting Command and HQMC, developed techniques for identifying effective recruiters. The second, also a 1976 start, was sponsored by the Marine Corps and developed procedures for selecting drill instructors. The SAB incorporates results from both studies.

PROGRESS: SAB test booklets and answer sheets have been developed and printed. SAB testing of applicants for recruiting duty was begun in January 1981. The SAB was also administered to nearly 2000 Marines on recruiting duty in a concurrent validation study. Results from this study confirmed early findings that SAB scores were significantly related to recruiter production.

PLANS:

Nov 81	Begin gathering performance data.
May 82	Evaluate current scoring keys.
Oct 82	Devise additional scoring keys/revise original keys.
Mar 83	Validate additional scoring keys.

FUNDING REQUIREMENTS:

FY83	FY84	FY85	FY86	FY87
$30K	0	0	0	0

Task will be completed in FY83.

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USMC EXIT SURVEY SYSTEM
(FY82 Funding: $58K)

NEED: As part of the information needed for management to make decisions concerning policies and procedures that impact on personnel attrition, it is necessary to have information as to why personnel separate.

OBJECTIVE: Develop a separation information system which will provide management with the reasons personnel give for separating.

TECHNICAL APPROACH: The Navy Personnel Research and Development Center (NPRDC) has developed the methodologies for developing this type of information system. It is assumed that these methodologies will produce a worthy product when applied to this project.

BACKGROUND: Similar systems developed for Navy Officer and Enlisted personnel have been found to be of significant benefit to Navy managers.

PROGRESS: Aug 81 -- Completed draft of separation questionnaire.

PLANS:
- Dec 81 Complete software for optical scanning and computer analysis.
- Jun 82 Complete processing at NPRDC of initial completed questionnaire.
- Sep 82 Complete "operationalizing" of the system so that it is processed at USMC Headquarters.
- Jul 83 Complete monitoring and "fine tuning" the system.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86
	$30K	$20K	0	0

Transition to Operational Status: FY84

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USMC OPTIMAL CLASSIFICATION PROCEDURES
(FY82 Funding: $95K)

NEED: An automated assignment procedure is needed to improve the degree of correspondence between persons and jobs, to improve the extent to which desired Marine Corps policy can be incorporated within the recruitment process, and to increase the degree of applicant participation in the career decision process.

OBJECTIVE: To analyze Marine Corps recruit assignment policies, to determine mathematical representations of the policies, and to develop an assignment algorithm that incorporates the mathematical functions.

TECHNICAL APPROACH: The technology necessary to construct an assignment algorithm will be developed. Utility components that represent selected aspects of the assignment decision process will be derived using policy capturing techniques. Judgmental data required for the development of essential system indices (e.g., operational priorities) will be obtained from selected Marine Corps Officers. Computer simulation methodology will be employed to evaluate system characteristics.

BACKGROUND: In early 1981 LtCol Creel of MPI-20 became aware of NPRDC's work on CLASP (Classification and Assignment within PRIDE), the Navy's automated assignment system, and proceeded to explore the prospect of applying similar concepts to Marine Corps recruiting procedures. Meetings between HQMC and NPRDC representatives were conducted to clarify and delineate the objectives of the research programs. In July 1981, a briefing was conducted for the benefit of Gen Lukeman, MPA, and Gen Fulham, MR, at HQMC. At that time a decision was made to begin development of an algorithm to enhance the MCROC module of ARMS.

PROGRESS: Preliminary work has focussed on describing the operation of the models within the current version of the Automated Recruit Management System (ARMS) and identifying the linkages and requirements of the network.

PLANS: Delineate the requirements of, and develop the research plan for the enlisted accession module, which is to perform the automated assignment process within the Marine Corps Recruit Options Center (MCROC) module of ARMS. Develop, test, and evaluate the minority fill rate and program fill rate components to be included within the model.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$140K	$135K	$45K	0	0

Transition to operational status: FY84

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ORGANIZATIONAL INTERVENTIONS TO REDUCE ATTRITION
(FY82 Funding: $100K)

NEED: A need exists to reduce attrition and other military violations, especially during the period of transition between basic training and complete assimilation in an operating unit and while assigned to an operational unit.

OBJECTIVE: Identification of specific managerial acts that currently impact on military violations (both positively and negatively) and develop and test other managerial acts which may reduce violations.

TECHNICAL APPROACH: Identify comparable USMC units having high and low attrition rates (and military violation rates). The organizational structure and climate of such units will be analyzed to isolate those variables seemingly related to the different rates. Instances of military violations during transfers will be analyzed to isolate sources of stress and strain. Interventions will be developed and tested. Impact on attrition and military violations will be assessed.

BACKGROUND: Official documentation for this task is a letter dated 20 Jan 1978, in which the Deputy Chief of Staff for RD&S presented a proposed Marine Corps Exploratory Development Program for 1979 to the Chief of Naval Material. Among others, the following two tasks were presented: (1) Unit Analysis/Enlisted First-Term Attrition, and (2) Personnel Transfer Transitional Procedures. Statements of these two work units were received by NPRDC in Feb 1979. The tasks were combined to facilitate obtaining a contractor and to reduce administrative report requirements. The name given to the combined tasks is "Organizational Interventions to Reduce Attrition."

PROGRESS: Research design developed. Solicitation for bids prepared. Orientation and basic literature search completed. Contractor, "WESTAT" selected. Studies on (1) Qualitative Analysis of Transition, (2) Qualitative Analysis of Separation Decision Making, (3) Quantitative analysis of transition attrition, and (4) Evaluation of two Job Preview movies have been completed.

PLANS: FY82. Based on research findings completed in FY81, develop intervention and apply interventions at various test sites. Assess impact of interventions on attrition rates and military violations.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86
	0	0	0	0

Transition to operational status: FY82

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MOTIVATIONAL APPROACHES TO MISSION ACCOMPLISHMENT
(FORMERLY APPLICATION OF JOB SATISFACTION AND JOB ENRICHMENT METHODOLOGIES)
(FY82 Funding: $62K)

NEED: The Marine Corps has a requirement to maximize ways to more efficiently accomplish its mission. Research is necessary to investigate the impact of leadership training approaches upon unit missions. The selected approach should have general applicability, an easily understood theory base, and a set of generalizable principles that can be applied across a variety of occupational fields.

OBJECTIVE: The primary purpose of the research is to conduct an extensive diagnostic effort to identify the factors which influence enlisted Marines' job satisfaction, job performance, reenlistment intent, and mission accomplishment. This diagnostic data was used to design, implement, and evaluate an experimental Motivation Action Plan (MAP) in selected experimental and control units.

TECHNICAL APPROACH: Interview and survey data were used to identify whether job, leadership, and motivation factors were creating performance and reenlistment problems. Diagnostic data collected from two test sites (First Marines, Camp Pendleton, and Marine Air Group (MAG-11)) were than used to design and implement an experimental MAP. This MAP was based on 24 hours of data feedback and problem solving training administered to staff NCOs.

BACKGROUND: Headquarters, U.S. Marine Corps (Code MPU) administers the Marine Corps Task Analysis Program (MCTAP). The Job Diagnostic Survey (JDS) has been administered to personnel in a variety of occupational fields. Other studies conducted in both military and civilian sectors indicate that the JDS usefully predicts satisfaction and performance criteria.

PROGRESS: Group interview and survey data were analyzed. The MAP was completed and end-of-training critiques demonstrated that the training program was effective.

PLANS: A technical report will be completed by 31 December 1981 describing the diagnostic data gathered and an assessment of the impact of the MAP. Further implementation of the MAP is not anticipated.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86
	0	0	0	0

TASK MANAGER: Dr. Alan Lau
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MANPOWER LIFE-CYCLE COST DEVELOPMENT
(FY82 Funding: $100K)

NEED: Personnel and billet costing has become an increasingly important tool in guiding and assessing manpower planning/programming decisions in recent years. In addition, life cycle costing is required for all proposed acquisitions. The importance of manpower costing is significant, since the costs of creating a billet are for the most part incurred in the future, as the occupants receive compensation and cause expenditure of funds. These costs often represent an investment which exceeds that incurred for development, acquisition, and support of hardware the billet may use or support during the operational life of the system.

OBJECTIVE: Construction of a billet cost model (BCM) for the USMC enlisted community. The model would determine the economic and budgetary costs of enlisted billets. The model will provide cost data to budget analysts assessing the impact of alternative manpower levels, and to others involved in systems acquisition and hardware/manpower trade-off analysis.

TECHNICAL APPROACH: To accommodate the different cost information required by budgetary and systems acquisition users, the BCM will be designed to reflect marginal (vice average) costs -- but in two distinct forms. This two-state model will portray cost in terms of strict budget outlays and as economic costs -- the estimation of foregone opportunities. An entirely new BCM will be constructed not only to meet the dual user requirements, but also to overcome certain conceptual difficulties found in existing (Navy) billet cost methods.

BACKGROUND: A BCM is developed to provide the user with a means for computing manpower costs on the basis of standard cost formulae. The BCM computes the cost of manning the billets with personnel having requisite skills. This would be provided in terms of the investment and operations cost to the government for a given MOS and paygrade.

PROGRESS: N/A

PLANS:
- o Model development contract to be let — Jan 82
- o Model software tested — Sept 82
- o Final Report (User's Documentation) — Dec 82

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	0	0	0	0	0

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PROGRAM TITLE: TRAINING DEVICES AND SIMULATION TECHNOLOGY
(FY82 Funding: $40K)

PROGRAM ELEMENT NUMBER: 62757N (Human Factors and Simulation Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF57.526

OBJECTIVE: Improve training methodology, training devices and simulation technology necessary to support advanced and engineering developments.

TASKS: o U.S. Marine Corps Manual Wargames Project

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USMC MANUAL WARGAMES PROJECT
(FY82 Funding: $40K)

NEED: The requirements throughout the Marine Corps to reduce training costs while simultaneously increasing force readiness has increased the demand for alternative methods of training. The Corps is particularly concerned with the need to provide effective and efficient training for leaders. Use of wargames to provide or enhance this type of training has been demonstrated by the U.S. Army and Navy.

OBJECTIVE: Contribute to increased combat effectiveness by developing a family of manual wargames as training vehicles for exercises designed to improve line and staff decision-making (e.g. C^3I) at all levels of command. Use of these wargame-based training packages will provide leaders opportunity to practice USMC tactics and doctrine as well as logistical and combat support procedures. These systems will also provide a means for rapid dissemination and assimilation of new doctrine; to introduce and instruct leaders in Threat organization and tactics, and to allow experimentation, at the local level, with new ideas.

TECHNICAL APPROACH: An analysis of USMC training needs was conducted which indicated a requirement for at least four separate systems which would address training for leaders at various levels. Sequential research will be conducted on systems for the company, battalion, regiment, and division. Attention will also be given to training leaders of Marine Air Ground Task Forces at those levels. Each game will be researched, designed, developed and validated as a separate entity however, a directed effort will be made to maximize transfer from one system to another. This will result in a family of wargames designed specifically to train Marine leaders at the squad through the Marine Amphibious Force level.

BACKGROUND: This effort began in FY80. Prior effort resulted in formation of a development team and identified development strategies for the initial wargames.

PROGRESS: Contract for 30 final prototypes of company level wargame based training system has been let. The analysis for the battalion level system is in progress.

PLANS: Distribute and evaluate final prototypes of company level system. Complete analysis and develop initial prototype of battalion level system. Commence analysis of regimental level system.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86
	$50K	$50K	$50K	$50K

Parts of this program will transition to Advanced Development in each of the above years.

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PROGRAM TITLE: USMC AIRBORNE TACTICAL REMOTE SENSING
(FY82 Funding: $216K)

PROGRAM ELEMENT NUMBER: 62759N (Ocean and Atmospheric Support Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF59.553

OBJECTIVE: Improvements in technology for determination of beach traversability in coastal regions.

TASKS: o Airborne Tactical Remote Sensing

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USMC AIRBORNE TACTICAL REMOTE SENSING
(FY82 Funding: $216K)

NEED: Present technologies for pre-amphibious assault survey are slow, labor-intensive, and risk compromise of the landing point. A technique is needed for airborne survey which will acquire the information needed and convey it to the users when it is needed.

OBJECTIVE: The objective of this task is to develop electro-optic survey technology to meet naval and Marine Corps requirements for beach traversability determination in coastal regions.

TECHNICAL APPROACH: Systematic investigation is made of promising means for generating electro-magnetic radiation, illuminating areas and objects of interest, of separating the return signals from unwanted noise, and of deriving useful information from the return signals. Attention is now being focused on development of a self-illuminated multispectral scanner which will use a copper vapor laser for illumination.

BACKGROUND: The technique of active/passive hydrographic survey was refined at Panama City in 1977 and demonstrated at Exercise READEX 1A-79 in 1979. Remotely sensed data was used to drive Army mobility models in 1978. The technology for self-illuminated survey was identified in 1980. A high-resolution experiment was conducted in 1981.

PROGRESS: The copper vapor laser procured in FY 1980-81 has been completed. An air-capable power supply for the laser is now being built. The high resolution experiment was performed in August-September, 1981. High quality data was gathered and is now being processed.

PLANS: It is planned to complete analysis of the high resolution test data by January 1982 and to deliver the copper vapor laser by May 1982. Procurement of the self-illuminated multispectral scanner will be initiated.

FUNDING REQUIREMENTS	FY83	FY84	FY85	FY86	FY87
	$230K	$240K	$240K	$259K	$275K

Transition to Advanced Development will occur in FY85.

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PROGRAM TITLE: BIOMEDICAL TECHNOLOGY
(FY82 Funding: $408K)

PROGRAM ELEMENT NUMBER: 62758N (Biomedical Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF58.527

OBJECTIVE: This project area is directed toward providing improved methods for disease prevention, techniques and equipment for the care of the sick or injured, effects of extreme environments on human beings, medical and physical aspects of human effectiveness and the psychophysiological aspects of reliability and performance.

TASKS: COLD WEATHER MEDICINE

- o Development of a Hypothermic Primate Model in Hemorrhagic/Hypovolemic Shock
- o Development of Methods to Decrease Tissue Injury Due to Cold
- o Development of a Prototype Electromagnetic Device For Warming Hypothermic Cardiac Tissue
- o Modification of Cold-Related Water Losses in Marine Corps Personnel During Cold Weather Operations

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DEVELOPMENT OF A HYPOTHERMIC PRIMATE
MODEL IN HEMORRHAGIC/HYPOVOLEMIC SHOCK
(FY82 Funding: $125K)

NEED: Treatment modalities must be developed for combat casualties suffering from traumatic injuries and hypothermia.

OBJECTIVE: Develop optimal means to resuscitate trauma casualties in hemorrhagic shock and varying stages of hypothermia.

TECHNICAL APPROACH: A hypothermic/hypovolemic baboon model will be developed to determine the effects of exchange transfusions with red blood cells with normal and elevated 2,3 diphosphoglycerate (2,3 DPG) content on regional and systemic oxygen transport and myocardial function. Normothermic and hypothermic baseline measurements of limb and total body oxygen consumption, blood gases, myocardial function, *in vivo* and *in vitro* P_{50}, pulmonary shunt and deadspace, lactate, 2,3 DPG, ATP and oncotic pressure measurements will be made on healthy anesthetized baboons. The animals will be bled until they are in hemorrhagic/hypovolemic shock. Exchange transfusions of compatible blood will be initiated, each baboon receiving 4 units of blood containing normal or high levels of 2,3 DPG. The baseline measurements will be made again at this time and upon warming of the resuscitated animal.

BACKGROUND: It is anticipated that the Marine Corps will be called upon to fight in cold weather environments where medical evacuation will be difficult and time consuming. Optimal attention must be given trauma/hypothermic casualties to ensure their survival until they reach the next echelon of medical care. Red blood cells with elevated 2,3 DPG levels have been shown to attenuate the effects of temperature on red cell-oxygen affinity state. This study is designed to determine if elevated levels of 2,3 DPG will improve oxygen delivery under conditions of hypothermic hypovolemia.

PROGRESS: The development of a primate model which will emulate a hypothermic casualty in hemorrhagic and hypovolemic shock has begun.

PLANS: The baboon model will be used to evaluate various methods to resuscitate combat casualties during cold weather operations. It will also be used to determine if the casualty should be resuscitated before or after warming.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$90K	$85K	Transition		

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DEVELOPMENT OF METHODS TO DECREASE TISSUE INJURY DUE TO COLD
(FY82 Funding: $43K)

NEED: Marine Corps personnel operating in cold weather environments will be continually exposed to the possibility of cold injury. Therapeutic means to limit the extent of tissue injury due to cold exposure must be developed.

OBJECTIVE: Develop methods to treat cold injuries and prevent further tissue damage by pharmaceutical intervention.

TECHNICAL APPROACH: The shaved ear of anesthestized rabbits will be subjected to cold injury. Levels of white blood cells and complement and evidence of chemotaxin and leucocyte aggregation will be measured before and after tissue injury. Pharmaceuticals selected for their ability to neutralize the injurious factors released at the site of injury will be administered topically and/or intraveneously. The extent of tissue injury of untreated and treated animals will be assessed.

BACKGROUND: One reason that the treatment of cold injury remains unsatisfactory is the lack of understanding of the cause of injury. The dynamics of blood vessel spasm, blood flow characteristics, erythrocyte clumping and sludging, and endothelial leak have been documented, but still do not explain how the tissue is damaged. High-energy oxygen ions (hydrogen peroxide, singlet oxygen, super-oxide and hydroxyl ions) combined with halides are now known to play an important role in tissue damage caused by inflammation. Drugs which neutralize the toxicity and subsequent damage caused by these chemical moieties should be helpful in decreasing the extent of tissue damage caused by cold injury.

PROGRESS: Contract to develop animal model let May 1981.

PLANS: Develop a cold weather tissue injury animal model and test new therapeutic modalities for the management of cold weather injury.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$80K	$90K	Transition		

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AD-A116 947 MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND QUANT--ETC F/G 15/7
U.S. MARINE CORPS FY 82 EXPLORATORY DEVELOPMENT PROGRAM.(U)
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DEVELOPMENT OF A PROTOTYPE ELECTROMAGNETIC DEVICE FOR
WARMING HYPOTHERMIC CARDIAC TISSUE
(FY82 Funding: $50K)

NEED: Many cases of hypothermia can be expected during cold weather operations. Field-compatible equipment and techniques must be available to properly rewarm the casualty suffering from hypothermia alone or from hypothermia plus traumatic injury.

OBJECTIVE: To develop a field-compatible device for fast, controlled and effective rewarming of the heart in victims of profound hypothermia.

TECHNICAL APPROACH: The basic electromagnetic device specifications will be derived from (1) tissue volume to be heated, (2) desired rate of temperature elevation, (3) dielectric properties of cardiac and intervening tissues, and (4) heat loss due to thermoregulatory effects. The antenna configuration which is suitable for heating hypothermic cardiac tissues will be identified and the prototype device fabricated. The prototype device will then be tested for its ability to warm cardiac tissues of hypothermic animal models.

BACKGROUND: It is recognized that fast, effective, and controlled warming of cardiac tissue must be an integral part of the emergency treatment for profoundly hypothermic casualties. However, current techniques for accomplishing this warming are, at best, only marginally successful. A new technique using electromagnetic energy as the heat source has emerged and appears to be attractive because electromagnetic fields can deposit controlled amounts of heat in selected core tissues non-invasively. It is anticipated that this device will withstand the rigors of field/shipboard use.

PROGRESS: Developed specifications for the device and let a contract with Georgia Institute of Technology to commence fabrication of a prototype. Development is on schedule.

PLANS: Deliver device to Naval Aerospace Medical Research Laboratory for preliminary test and evaluation of the prototype on a non-human primate.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$80K	Transition			

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MODIFICATION OF COLD-RELATED WATER LOSSES IN
MARINE CORPS PERSONNEL DURING COLD WEATHER OPERATIONS
(FY82 Funding: $190K)

NEED: Many metabolic changes will occur in Marine Corps personnel during cold weather operations. Knowledge of these changes is essential in order to maintain optimal performance and determine proper medical treatment procedures when these personnel sustain combat injuries.

OBJECTIVE: Develop recommendations for fluid supplements which will modify or minimize fluid and electrolyte losses experienced during cold weather operations.

TECHNICAL APPROACH: Various food rations and fluids of varying electrolyte and mineral compositions will be given to human volunteers during actual cold weather training exercises or in environmentally controlled test chambers. Physiological data to be collected before and during cold exposure include: whole body water content, tissue water distribution, fluid intake and urine excretion, serum and urine electrolytes and lipid, carbohydrate and protein metabolism indices.

BACKGROUND: One of the characteristic responses to low temperatures is an alteration in fluid and electrolyte balance. Such metabolic changes may lead to decreased performance in terms of physical work activity and increased susceptibility to cold injury. Furthermore, personnel who are dehydrated with pre-existing electrolyte imbalance may present different clinical symptoms when they arrive at medical aid stations and make diagnosis and treatment more difficult.

PROGRESS: Preliminary testing of 29 Marine Corps volunteers in the Cold Weather Research Facility, Natick, MA has been carried out. Three liters of water are required to maintain normal hydration and electrolyte balance in test personnel consuming the new arctic ration. This is approximately two times the amount required to hydrate personnel eating the standard ration.

PLANS: Marine Corps volunteers will be exposed to -10°F for five days in a controlled environmental chamber. During the test period they will be given various food and fluid regimens.

FUNDING REQUIREMENTS:	FY83	FY84
	$158K	Transition

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PROGRAM TITLE: MATERIALS TECHNOLOGY
(FY82 Funding: $336K)

PROGRAM ELEMENT NUMBER: 62761N (Materials Technology)

SUB-PROJECT PROGRAM PLAN NUMBERS: CF61.541, CF61.544

OBJECTIVE: To provide basic materials for multipurpose Navy and Marine Corps use.

TASKS:
- o Tribology and Corrosion Control Development
- o V/STOL
- o Light Weight Structural Armor

PROGRAM MANAGER: Mr. D.A. Vaughn
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TRIBOLOGY AND CORROSION CONTROL DEVELOPMENT
(FY82 Funding: $40K)

NEED: Extend service life and reduce maintenance in U.S. Marine Corps equipment by reducing wear and corrosion damage.

OBJECTIVE: Provide improved lubricating grease and engine lubricating oil to protect working parts from seawater contamination. Recommend improved bearing designs. Recommend filtration and purification methods for lubricating and hydraulic systems. Recommend score resistant coatings for exposed sliding surfaces.

TECHNICAL APPROACH: Field trial of existing products with properties superior to those in current Marine Corps use. If existing materials provide the desired improvement, recommend their adoption. If desired improvement is not obtained, recommend development of new improved products.

BACKGROUND: U.S. Marine Corps amphibious landing vehicles (LVTP-7), tanks (M-60), self propelled artillery, and motor transport have experienced early failure of lubricated parts due to seawater or dirt contamination in service. The failures are primarily due to inadequacies in the lubricating grease and oil in current Marine Corps use.

PROGRESS: A field trial of a Navy grease which resists water wash off and Navy diesel engine oil which is capable of protecting engine parts from seawater has been completed. The grease trial was run on LVTP-7, M-60 tanks and M-35 trucks. The oil trial was run on LVTP-7 vehicles only. Both trials were run in Second Marine Division equipment at Camp Lejeune, NC and were completely successful.

PLANS: Extend field trials to Pacific Coast operation at Camp Pendleton, CA and Desert Operation at Twenty Nine Palms, CA. Arrange for a field trial of sealed, lubricated anti-friction bearings in U.S.M.C. equipment.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$45K	$25K	$5K	$5K	0

Transition to Advanced Development in FY85

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V/STOL
(FY82 Funding: $96K)

NEED: There is a strong likelihood that existing nuclear-powered aircraft carriers will be augmented by smaller ships operating a mixture of conventional and V/STOL aircrafts. Adequate pavements will be needed to accommodate those seaborne V/STOL aircraft for training, repair, and other occasions when they are ashore. The adverse effects resulting from V/STOL aircraft exhaust blast include damage to aircraft by flying pavement debris, reduced operational availability, and increased pavement maintenance. Material and design technologies which can alleviate the exhaust blast effects of future V/STOL aircraft on pavements are needed.

OBJECTIVE: To evaluate and develop materials for construction of V/STOL pavements which are resistant to effects of current and planned V/STOL aircraft.

TECHNICAL APPROACH: Quantify the blast effects of near future V/STOL aircraft on pavement and other ground support materials. Conduct a study to select candidate materials which are resistant to V/STOL blast effects. Fabricate test panels from selected heat resistant concrete and asphalt concrete. Perform exhaust blast test on test panels under actual or simulated conditions. Construct test pads for field validation.

BACKGROUND: The Naval Air Engineering Center has identified that future V/STOL aircraft will have a projected maximum exhaust gas temperature of 2800°F to 3200°F and an exhaust velocity of 3,300 ft/sec. In comparison, the present V/STOL Harrier has a maximum exhaust temperature of about 1,500°F and an exhaust velocity of 1,800 ft/sec. Experience with the current V/STOL Harrier aircraft has shown that conventional asphalt concrete pavement is inadequate for V/STOL aircraft in vertical take-off and landing modes.

PROGRESS: The exhaust flow characteristics of the planned V/STOL aircraft has been identified. Completed a conceptual design of a power check facility for AV-8A and AV-8B aircraft. Evaluated heat resistant concrete and modified asphalt concrete. Fabricated test panels from selected heat resistant concrete and asphalt concrete. Identified methods for construction of V/STOL pads.

PLANS: Blast-test concrete and asphalt panels under simulated V/STOL-B jet exhaust. Select the most promising material(s) for the construction of V/STOL test pad(s). Evaluate construction techniques and procedures for V/STOL pavements. Evaluate modified asphalt concrete materials for use on AV-8A runways. Prepare draft technical memorandum.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$240K	$100K	0	0	0

TASK MANAGER:
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LIGHT WEIGHT STRUCTURAL ARMOR FOR AAV APPLICATIONS
(FY82 Funding: $200K)

NEED: Improved mobility and survivability for Marine Corps AAV's.

OBJECTIVE: Develop armor with structural capability that is 30-50% lighter than 5083 A1 with equivalent or superior ballistic protection.

TECHNICAL APPROACH: Five candidate armor candidates using metal/ceramic combinations are being evaluated for ballistic, mechanical and corrosion, properties. Cost producibility factors are also being considered. The two best candidates will be selected for further development and development of a more complete data base. Upon completion of this program, a test vehicle will be designed and evaluated using the best candidate armor under Marine Corps Surface Mobility funding.

BACKGROUND: Ceramic materials, due to their high hardnesses, are extremely effective in defeating fragments and projectiles for a one shot basis. Since they are also very brittle, they offer little in the way of a multi-hit capability. It has been shown that if the ceramic can be confined, it is possible to obtain a multi-hit capability with ballistic protection levels approaching that of the single shot case. Composite technology has been shown to be a viable solution to the problem of achieving multi-hit capability with high ballistic protection levels.

PROGRESS: A preliminary mechanical property ballistic property and corrosion data base has been obtained for five candidate armor/material concepts. In two cases, multi-hit capability and excellent ballistic protection has been demonstrated. Corrosion does not appear to be a problem.

PLANS: Complete mechanical, ballistic and environmental data base for two candidate materials, complete cost/producibility study. Select candidate for design vehicle. Two contracts will be awarded by end of January 1982. Armor for ballistic evaluation will be completed by end of August 1982. Ballistic and mechanical/corrosion data base will be complete by end of October 1982. Reports by contractors will be provided at end of contract period.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$200K	$200K	$328K	$350K	$372K

Transition to Advanced Development: FY84

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PROGRAM TITLE: CHEMICAL/BIOLOGICAL (C/B) DEFENSE TECHNOLOGY
(FY82 USMC Funding: $144K)

PROGRAM ELEMENT NUMBER: 62764N (C/B Defense Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF64.561

OBJECTIVE: To develop technology directed toward the protection of personnel from chemical or biological attack. It includes, detection and protective measures, devices and protective structures.

TASKS:
- o Remote Automatic Chemical Agent Identification System
- o Chemical/Biological (C/B) Decontamination/*Defense*

PROGRAM MANAGER: Mr. P.H. Amundson
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REMOTE AUTOMATIC CHEMICAL AGENT IDENTIFICATION SYSTEM
(FY82 Funding: $84K)

NEED: Current and projected automatic chemical agent detection systems have two primary deficiencies: identification of the chemical agent present is not made; and concentration levels are not specified. Positive, quantitative detection of chemical agents in terms of identity and concentration provides ground tactical commanders greater flexibility in tactical maneuvers as well as a reduction in casualties.

OBJECTIVE: Develop the technology necessary to produce an automatic chemical agent identification system which discloses agent identity and concentration.

TECHNICAL APPROACH: Specific chemical agent identity is to be established through solid state technology which matches measurable aerosol physical properties to the characteristic physical properties of specific chemical agents. A remote detector measures the necessary physical properties and relays that information to an analyzer. The analyzer performs the actual data reduction and chemical agent identification.

BACKGROUND: The current and projected automatic chemical agent detector technology utilizes various means of signifying agent presence: chemical reagents in reaction; ionization; and infrared to name but a few. The methods planned and in present use can be combined in a single measuring device which will read and relay the physical properties required to determine agent identity and concentration.

PROGRESS: The contract for this task was let late in FY81. Thus far element concentration units have been defined and relaxation times have been determined.

PLANS: Program efforts are directed toward identification of the sensitivity thresholds required for effective system performance and brassboarding of the processing electronics for proof of principle.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$84K	0	0	0	0

Transition to Advanced Development: FY84

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CHEMICAL/BIOLOGICAL (C/B) DECONTAMINATION/DEFENSE
(FY82 Funding: $60K)

NEED: Soviet doctrine dictates the use of biological and chemical weapons in future military encounters. The Marine Corps aviation forward-basing concept requires lightweight, mobile aircraft decontamination equipment to reduce the logistics burden in forward areas.

OBJECTIVE: To investigate technology options that would lead to meeting the stated need for aircraft and personnel decontamination and protection capabilty in the forward areas.

TECHNICAL APPROACH: The Army has the lead in C/B contamination protection and decontamination. The approach in this area is to investigate ongoing rear echelon decontamination technology and new concepts that could be applied to decontamination/defense in the forward areas.

BACKGROUND: There exists a broad technological base on which to proceed on this task. Eight months of vigorous investigation has led to a number of items that show great potential.

PLANS: Investigate specific innovative decontamination and protection technologies that potentially have relevance to the stated need. Specific systems investigations will be done to lead to technology development where feasible.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$60K	$70K	$80K	$90K	$100K

Transition to Advanced Development: Not anticipated at this time. Specific technologies will transition as the task matures.

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PROGRAM TITLE: COLD WEATHER CLOTHING
(FY82 Funding: $150K)

PROGRAM ELEMENT NUMBER: 62758N (Biomedical Technology)

SUB-PROJECT PROGRAM PLAN NUMBER: CF58.523

OBJECTIVE: Development of light weight cold weather clothing and equipment suitable for use by ground forces in an amphibious cold weather environment.

TASKS: o Cold Weather Clothing

PROGRAM MANAGER: Major S.N. Allen
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COLD WEATHER CLOTHING
(FY82 Funding: $150K)

NEED: Current cold weather clothing and equipment systems were designed in the late 1950s and early 1960s. They were designed basically for cold-dry environments such as Alaska and, as a result, are heavy, bulky, and if they become wet, cannot be dried in the field in a reasonable period of time. A fully cold weather equipped combat Marine is currently burdened with approximately 114 pounds of individual clothing and equipment and must assist in pulling over 300 pounds of squad equipment in a sled.

OBJECTIVE: To examine commerically available fabrics/materials and through laboratory measurements determine insultating values versus weight; and, to fabricate waterproof, lightweight cold weather clothing and equipment for concept/feasibility evaluation.

TECHNICAL APPROACH: Investigate clothing and equipment weight versus durability; clothing bulk versus insulation requirements; and, waterproofness versus permeability index.

BACKGROUND: This program is a new development effort which began in 4th quarter FY81. It is a generic program which addresses a unique Marine Corps need for lightweight cold weather clothing and equipment suitable for use by ground fources in an amphibious cold weather environment.

PROGRESS: During FY81 a preliminary review of current off-the-shelf clothing and equipment was conducted.

PLANS:
1 QTR Identify candidate materials and equipment

2 QTR Measure/assess physical properties and characteristics of materials and designs

3 QTR Select designs and materials. Begin procurement of materials and equipment for evaluation

4 QTR Continue with 3 QTR activities.

FUNDING REQUIREMENTS:	FY83	FY84	FY85	FY86	FY87
	$150K	$200K	0	0	0

Transition to advanced development: FY85

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