DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
WASHINGTON, D.C. 20380

IN REPLY REFER TO

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From: Commandant of the Marine Corps

Subj: REQUIRED OPERATIONAL CAPABILITY (ROC NO. MOB 1.13A) FOR THE PRODUCT IMPROVEMENT OF THE LVT7A1 FAMILY OF VEHICLES AND THE DEVELOPMENT OF AN LVTE7A1 VARIANT

Ref: (a) MCO 3900.4C

Encl: (1) ROC NO. MOB 1.13A (LVT7A1 PIP)

1. In accordance with the procedures set forth in the reference, ROC NO. MOB 1.13A is hereby promulgated.

2. This ROC supercedes ROC NO. MOB 1.13. NH

3. Points of contact regarding inquiries relative to this ROC are:

a. Headquarters, U.S. Marine Corps, POG, and RDD.

b. Marine Corps Development and Education Command, Development Center, Firepower Division.

c. Naval Sea Systems Command (PMS310), Program Manager, Marine Corps Amphibious Assault Vehicle.

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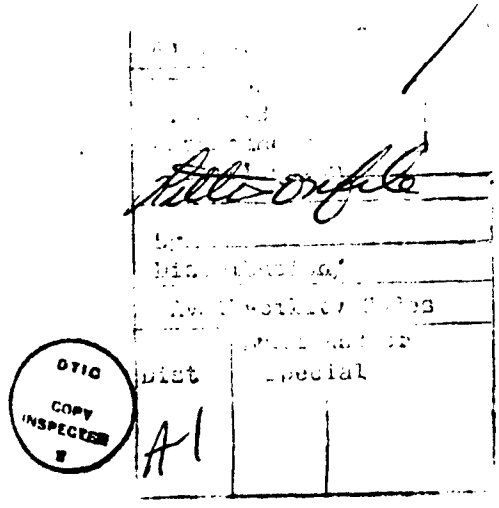

REQUIRED OPERATIONAL CAPABILITY (ROC) NO. MOB 1.13A

FOR THE PRODUCT IMPROVEMENT OF THE LVT7A1 FAMILY OF VEHICLES

AND THE DEVELOPMENT OF AN LVTE7A1 VARIANT

1. STATEMENT OF THE REQUIREMENT

a. The LVT7 family of vehicles (LVTP7, LVTC7, and LVTR7) was fielded in 1972 with a designed service life of 10 years. In order to maintain an assault amphibian capability for the years between the end of the LVT7 planned service life and the introduction of the LVT(X), the Marine Corps established the LVT7A1 Service Life Extension Program. This comprehensive rebuild effort incorporated a variety of engineering improvements designed to increase vehicle reliability, maintainability, and durability. Because of the urgency involved in fielding a replacement vehicle for the LVT7, many technological advances in firepower, armor protection, NBC, and mobility were not available for integration into the LVT7A1 configuration. The requirements, characteristics, and capabilities stated herein are established as guides for a systematic product improvement effort to increase the combat capability and survivability of the LVT7A1 on the modern battlefield during its life cycle.

b. The product improved LVT7A1(PI) will be subject to worldwide employment in all levels of conflict and environments. A requirement exists to provide an up-gunned weapons station on all of the LVTP7A1(PI) in order that offensive operations may be conducted with matching threat vehicles to include the BMP. While the LVTP7A1(PI) is not intended to be a combat fighting vehicle, an improved .50 caliber/40mm machine gun weapons station will significantly improve offensive weapon capabilities. Technological improvements are required to ensure that the LVTP7A1(PI) possesses upgraded capabilities which enhance overall system effectiveness. Additionally, a vehicle is required that can effectively enhance combat mobility by obstacle reduction. The LVTE7A1 will provide an obstacle and counterobstacle capability which will provide greater combat effectiveness. The LVT7A1(PI) family of assault amphibians will be utilized during amphibious operations to land in a single lift the surface assault elements of the landing force from assault shipping to a hostile shore. Once ashore, the LVT7A1(PI) will be utilized in mechanized operations and various other combat support and service support missions.

c. The LVT7A1(PI) will be assigned to the assault amphibian and tracked vehicle battalions.

d. The initial operational capability (IOC) for the LVT7A1 was FY84.

e. The IOC for the LVT7A1(PI) in the areas of firepower, survivability, waterborne mobility, communications, and obstacle clearing will be from FY85 to FY88. Firepower enhancements will improve combat capabilities of the LVT7A1(PI). There is a continuing requirement to provide for a .50 caliber weapon capability on all vehicles. However, to ensure that in the threat environment the LVT7A1(PI) can provide an improved offensive capability, a requirement exists to enhance the firepower of all of LVTP7A1(PI) vehicles with a .50 caliber/40mm machine gun weapons station.

f. Additionally, the Marine Corps requires a nonexplosive obstacle breaching capability during amphibious assaults through surf and beach areas. An engineer variant of the LVT7 was developed and tested but not procured. The requirement to provide combat support mobility enhancement to the ground element of a MAGTF remains critical. The required IOC for the LVTE7A1 is fourth quarter of FY88.

2. THREAT AND OPERATIONAL DEFICIENCY

a. Statement of General Threat

(1) The principal motivation in pursuing a product improvement program is the threat to landing force operations during the ship-to-shore movement and in subsequent operations ashore. The threat confronting the mechanized combined arms task force (MCATF) spans a wide spectrum of military capabilities from dissident/guerrilla forces to sophisticated, heavily armed conventional forces that possess an offensive nuclear, biological, and chemical capability as well as directed energy weapons that pose a threat especially to optical systems. These threats are outlined in the Marine Corps Long Range Plan (MLRP) of May 1982, the Marine Corps Midrange Objectives Plan (MMROP) of 29 April 1983, and the Development Threat Assessment; LVT(X)/MPWS (U); MCDEC 4 Feburary 1980. Under all threat environments, Marines embarked in LVT7A1's (PI) can expect to encounter opposition forces equipped with rocket-propelled grenades and antitank guided missiles, light and medium machine guns, small arms including vehicle and helicopter mounted weapons, and a full spectrum of land mines. In addition to the above mentioned weapons, Marines operating in the middle to high threat environments may expect to encounter a highly sophisticated enemy organized into motorized/armored regiments and equipped with a full range of organic and supporting arms. Accordingly, the principal threats to the LVT7A1(PI) are fragment producing munitions (both conventional and improved conventional munitions (ICM)) fired from heavy mortar, rocket, and artillery systems up to and including 152mm-HE (fuze quick and VT), as well as vehicle mounted weapons; (i.e., 73mm smooth bore gun, 30mm gun, and 12.7mm and 14.5mm machine guns). The LVT7A1(PI) can be expected to confront a variety of enemy fighting vehicles (i.e., the Warsaw Pact BTR, BRDM, and the BMP) on the battlefield. It is considered imperative that the LVT7A1(PI) be capable of

defending itself against the BMP type armored fighting vehicle with the assurance of some degree of survivability.

(2) In addition to the above threat data, Science and Technology Objective 215 (STO 215) discusses the requirements for obstacle reduction and survivability of Marine ground forces on the modern battlefield. An analysis of the threat discussed in these documents reveals a modern, highly mobile military force which utilizes obstacles and mines extensively in all phases of both offensive and defensive operations. The threat will organize units specifically to perform counter-mobility functions. These "mobile obstacle detachments" rely heavily on the installation of hasty minefields and the preparation of expedient nonexplosive obstacles such as craters, logs, steel and concrete obstacles as well as wire. Threat doctrine specifies that all obstacles will be covered by both direct and indirect fires. Threat forces have an extensive capability to enhance their own mobility in the areas of explosive and nonexplosive obstacles. "Route opening detachments" are the threat response to enemy obstacles and are highly organized, well-equipped, combat engineer teams normally located just behind the advance guard during movement to contact, and behind the first echelon during the battle. Their primary mission is to prepare routes and reduce obstacles for the next echelon. The threat places the highest importance upon its ability to conduct high speed moves while impeding the mobility of the enemy force. Threat doctrine is to continue the momentum of the attack by by-passing and isolating enemy strong points and leaving them to follow-on echelons. The threat will attempt to impede enemy units being bypassed and fix them in place through the use of explosive and nonexplosive obstacles. Threat offensive and defensive operations are always supported, to the extent possible, by their engineers. Sophisticated threat target acquisition capability, weapon accuracy, and weapon response time will require that Marine Corps efforts to breach threat obstacles (especially in the surf and beach area) be accomplished without loss of momentum. Furthermore, Marine Corps efforts to install obstacles should also be accomplished as expeditiously as possible, due to the probability of being engaged by threat fires during the mission,

b. Statement of Deficiency. There exist several deficiencies within the LVT7A1 family of vehicles which will be corrected through this product improvement program:

(1) Firepower. The LVTP7A1 is presently armed with the M-85 .50 caliber machine gun which has been plagued by low reliability. After reviewing the threat as well as the operational need of the fleet Marine forces (FMF's), it is obvious that the .50 caliber machine gun is totally inadequate as the primary armament for the assault amphibian vehicle. The M-85 machine gun is incapable of defeating the present generation threat infantry fighting vehicle (the BMP).

(2) Survivability

(a) Armor Protection. The armor plate of the LVT7 family of assault amphibians was designed to protect the embarked Marines against .30 caliber AP at 300 meters as well as against 105mm HE (VT fuze) at 50 feet. Though adequate for fleet needs when first introduced in 1972, the increased lethality of threat weapons may effectively limit the tactical utilization of the LVT7A1 in the mechanized assault creating loss of momentum and shock action contributing to personnel and vehicle losses. The primary Soviet artillery threat will be scenario dependent. Threat artillery assets span the spectrum from 122mm to 152mm. In addition, the Soviets are capable of employing modern MLRS's in large numbers. Also the Marine Corps is presently phasing out the 105mm in favor of the 155mm M198 Howitzer. This may limit the use of overhead fire during the conduct of the mechanized assault unless additional armor is applied to the LVT7A1.

(b) Fire Suppression System. Although both engine and troop compartments are protected, the fire suppression system must be manually activated. In order to protect the lives of the embarked troops and vehicle crew against a catastrophic fire resulting from the destruction of the fuel cell, an automatic fire detection and suppression capability must be provided for retrofit in kit form for the LVTP7A1, LVTR7A1 and LVTC7A1.

(c) Nuclear, Biological, and Chemical (NBC) Defense. Public Law 95-79 established the requirement that all armored vehicles be equipped with a collective protection system to provide a common means of protecting the vehicle crew and embarked troops against the threat use of nuclear, biological, and chemical weapons. The LVT7A1 offers only an air particulating unit which assists in prolonging the filter life of the crew's M-25A1 field protective masks. The LVT7A1 also lacks an NBC detection/monitor capability which would be required during operations in an NBC environment.

(3) Waterborne Mobility. Due to the increased weight forward of the vehicle's longitudinal center of gravity, the LVTP7A1, and LVTC7A1 experience a significant bow negative trim problem when combat equipped and troop loaded. During water operations, these vehicles exhibited a tendency to "nose dive" under forward propulsion. This tendency precludes the safe operation of the vehicles over 2500 rpm, (due to water over the driver's vision blocks) and reduces maneuverability in that the propulsion units are not fully under water. In addition to the above deficiencies, the increased volume of seawater washing over the intake plenums increases engine compartment leakage and may jeopardize the vehicle in the event of a plenum failure.

(4) Communications. Although the LVTP7A1 will have a secure voice capability, it does not provide the embarked troop commander with a pre-set channel selection capability or the ability to monitor more than one frequency from the troop commander's station. In addition, the troop commander and

vehicle crew do not share a common intercom circuit. The infantry commander cannot communicate directly with the vehicle crew (and vice-versa), unless the troop commander's control box is in the intercom position.

(5) Obstacle Clearing. The Marine Corps currently does not possess a vehicle capable of breaching nonexplosive obstacles in the surf and beach area so as to enhance and preserve the mobility and maneuver capabilities of the Marine Air Ground Task Force (MAGTF) assault elements. Marine Corps units today have to rely on slow, unarmored commercial engineer equipment and manpower intensive, time-consuming procedures to reduce or install obstacles. Marine Corps combat engineers do not possess suitable equipment for providing close combat support to the elements most needing it--the lead elements. Marine Corps engineer support is not capable of reducing or bypassing nonexplosive obstacles such as anti-tank ditches, road craters, and rubble from nuclear or conventional explosions in sufficient time to influence favorably the tactical situation. Moreover, Marine Corps combat engineers cannot accompany the maneuver elements and possess equipment unsuitable for close combat engineer tasks. This deficiency severely restricts the capabilities and, therefore, the tactical options of the ground combat element of the MAGTF.

3. OPERATIONAL AND ORGANIZATIONAL CONCEPTS

a. Operational Employment

(1) The LVT7A1(PI) will operate approximately 20 percent of the time on water and 80 percent on land. Utilizing the high speed, underway launch technique, the assault amphibians will move the surface assault element of the landing force and their supplies from amphibious shipping through rough sea and the surf zone, to inland objectives for the conduct of subsequent operations ashore. Among other missions once established ashore, the LVTP7A1(PI) will become the primary armored personnel carrier for the conduct of Mechanized Combined Arms Task Force (MCATF) operations. In accordance with developing employment concepts practiced by FMF assault amphibian units and in accordance with FMFM 9-1, the LVTP7A1(PI) will not be employed solely as an "approach march" vehicle. The LVTP7A1(PI) will actively participate in the assault phase, ideally following closely behind tank units to provide suppressive fires against enemy infantry and anti-armor weapons. The infantry will be carried forward by the LVTP7A1(PI) in order to maintain the momentum of the attack and dismount/remount as required by the tactical situation. Although optimally employed as a troop carrier in tactical situations, the LVTP7A1(PI) may be called upon to support the combat service support effort as a logistics carrier when mission requirements permit.

(2) The LVTE7A1, with a combat engineer team, will normally accompany the assault elements during amphibious

operations and will be capable of providing limited engineer support during subsequent operations ashore. The team will be assigned missions associated with enhancing the mobility of Marine Corps maneuver elements and disrupting the mobility of threat forces. The LVTE7A1, with its hinged blade and grabber arm, would breach nonexplosive obstacles in the surf and beach area. Furthermore, it will work in conjunction with LVTP7A1(PI) vehicles equipped with the M-59 mine clearance system kit (MCSK). The MCSK will enable lanes to be explosively created through minefields in the beach area. The LVTE7A1 will travel with lead elements and will employ its hinged blade and grabber arm in concert to provide an obstacle reduction capability. Additionally, the LVTE7A1 will transport a combat engineer team with its equipment and demolitions. It will also be equipped with tools powered by the vehicle's hydraulic system to perform pioneer tasks. The combat engineer team will use these tools and explosive charges to complement the dozer blade and grabber arm devices in the reduction of nonexplosive obstacles and for the installation of hasty protective positions such as crew served weapons/vehicle positions in the beach area. The vehicle will also be capable of preparing near and far shores incident to hasty wet gap crossing operations.

(3) The LVTE7A1 mission must encompass the following mobility, countermobility, and survivability tasks:

(a) Mobility Tasks

1. Fill craters and ditches.

2. Remove roadblocks, trees, and rubble.

3. Prepare access/egress for fording sites and river crossings.

4. Prepare/maintain expedient LZ sites.

5. Tow/pull bridging.

(b) Countermobility Tasks

1. Construct anti-armor obstacles.

2. Demolish fords and bridge bypasses.

3. Demolish LZ, airfields or sites.

(c) Survivability Tasks

1. Dig hull defilade positions for armor.

2. Construct earth berms for protection.

b. Organizational Concept

(1) Organizational Concept for LVTP7A1(PI), LVTR7A1(PI) and LVTC7A1(PI). The vehicles will be organic to assault amphibian and tracked vehicle battalions. Sufficient vehicles will be provided within each battalion to lift the assault elements of a regimental landing team. During the midrange period, the assault elements of a regimental landing team will require space for 2,700 personnel and approximately 260 tons of combat equipment and supplies.

(a) Manpower

1. Personnel. There is no anticipated change required to the MOS structure.

2. Training. Present institutional and unit training curricula for vehicle operators and tracked vehicle repairmen shall require updating to incorporate the unique systems characteristics.

(b) Logistics. The addition of the product improvements will not significantly impact logistics. The existing Marine Corps supply installations and procedures will be adequate.

(2) Organizational Concept for the Employment of the LVTE7A1. The anticipated requirement is for 12 LVTE7A1's per Assault Amphibian Vehicle (AAV) battalion which could provide four LVTE7A1's per infantry regiment. These vehicles will also be available to support the tank and light armored vehicle battalions on a task organized basis. The additional assets required to support PWR, ORF, training, and MPS are to be determined. The 12 LVTE7A1's will constitute a platoon in H&S Company of the AAV battalion and may be temporarily attached to the units they are supporting. The embarked combat engineer team will be provided by the division combat engineer battalion. A crew of three Marines will operate the LVTE7A1. Marines assigned to crew the LVTE7A1's will possess the same MOS as LVTP7 crew members; i.e., 1833 MOS. Upon completion of the basic 1833 course, a selected number of students would receive additional training on the LVTE7A1 and receive a special MOS designator. The fielding of the LVTE7A1 will require the following personnel increases for each AAV battalion in the active force:

Quantity	Grade	MOS	BILLET
1	First Lieutenant	1803	Platoon Commander
1	Gunnery Sergeant	1833	Platoon Sergeant
3	Staff Sergeant	1833	Section Leader
12	Sergeant/Corporal	1833	Crew Chief
24	Lance Corporal/Below	1833	Crewman
3	Sergeant/Below	2141	Tracked Vehicle Repairman

Additional facilities are not required.

4. ESSENTIAL CHARACTERISTICS. The below listed essential characteristics pertain to the LVT7A1(PI) family of vehicles to include the LVTE7A1. Essential characteristics unique to the LVTP7A1(PI), LVTC7A1(PI), LVTR7A1(PI), and LVTE7A1 variants are contained at annexes A, B, C, and D respectively.

a. Speed

(1) Water. The LVT7A1(PI) must have a minimum acceptable forward speed of eight mph (10 mph desired) and a reverse speed of 3.5 mph (both with rated payload).

(2) Land. The vehicle must be capable of 40 miles per hour on improved roads with minimum damage to road surface and possess cross-country mobility and speed equal to or greater than the current LVT7. The vehicle must be capable of operating at a minimum sustained speed of five mph on hard level terrain. A reverse speed of eight mph on hard level terrain is required.

b. Range

(1) Water. The LVT7A1(PI) must be capable of operating at a minimum of seven hours at eight mph in calm water.

(2) Land. The LVT7A1(PI) must have a minimum range of 300 miles at an average speed of 25 mph on hard level terrain.

c. Surfability. The LVT7A1(PI) must be capable of negotiating a six-foot plunging surf with or without a full payload on both seaward and inland headings and survive passage through 10-foot plunging surf without sustaining mission failure.

d. Stability

(1) Water. The LVT7A1(PI) must be laterally stable under all conditions of loading, capable of righting from a 90 degree roll port or starboard, capable of operating in a seastate 3 condition, and capable of surviving in seastate 5. A retractable bow flap will be required for the LVT7A1(PI) to increase vehicle speed and stability during waterborne operations. The bow flap, if hydraulically actuated, will be compatible with the vehicle hydraulic system. A readily accessible check valve would be required to isolate the bow flap hydraulic system in the event of failure. The bow flap will be lightweight in construction and procured in kit form capable of installation at third echelon or below. The bow flap will not impede the function of the vehicle or its subsystems in the event of a failure and will be capable of being rapidly removed. All components will be fully compatible with the marine environment. The anticipated IOC is FY86.

(2) Land. The LVT7A1(PI) must be capable of executing a 90 degree turn with full payload on a 60 percent side-slope at 2.5 mph.

e. Terrain Capabilities. The LVT7A1(PI) must negotiate a 60 percent slope in both forward and reverse from a standing start on the grade, cross a 60 percent side-slope, climb a vertical wall 36 inches in height, span a trench 8 feet wide and 4 feet deep, and have a minimum of 16 inches ground clearance.

f. Size

(1) The LVT7A1(PI) external dimensions will be the minimum practicable, and design agencies must take cognizance of the tactical use of this vehicle as well as the size limitations imposed by amphibious shipping and surface transportation. The design agent must bear in mind that a lightweight, highly mobile, and maneuverable vehicle is required for land operations; however, it will attain the other characteristics prescribed herein. It is required that the overall vehicle length not exceed 26 feet 9 inches when configured for land operations. The maximum overall nonreducible height will not exceed 10 feet 1 inch. The permissible maximum vehicle width is 10 feet 9 inches.

(2) Troop Compartment (Unobstructed Area)

(a) Length. Maximum practicable, not less than 13 feet.

(b) Width. Maximum practicable, not less than 6 feet.

(c) Height. 5 feet 6 inches minimum acceptable, 6 feet desired.

(d) Capacity. A maximum of 25 seated troops with normal weapons and equipment plus the crew in accordance with U.S. Army Ordnance Human Engineering Laboratory standards. Packs and other equipment may be stowed or hung in spaces easily accessible to the individual. No more than 18 to 20 combat-equipped Marines plus the crew will normally be carried during sustained land operation.

(e) Payload. 10,000 pounds exclusive of crew, fuel, and collateral equipment. Addition of applique armor will have a corresponding reduction in payload capability of the vehicle.

g. Weight. Minimum practicable weight, including crew, fuel, collateral equipment, and payload, should not exceed 53,000 pounds gross weight.

h. Human Engineering Characteristics. The equipment will be designed to conform to human factors engineering principles. Particular attention will be directed to the design and location of controls and instruments at the operator's station.

1. Safety Features. This vehicle will possess:

(1) At least four bilge pumps of 100 gpm capacity and capable of operating continuously when the vehicle is waterborne. Bilge pump suction lines will be arranged so that severe list to either side or a severe down by the bow or stern trim will not adversely affect the operation of the bilge pumps.

(2) An automated fire detection and suppression system (AFDSS) for the vehicle troop compartment will be required in kit form utilizing bromotrifluoromethane. The automatic system will have a discriminatory sensing capability which will only allow the system to function upon detection of a major hydrocarbon fuel or oil fire. The vehicle will also have a manual capability with pull handles located outside the vehicle and at locations accessible to vehicle crew members. The engine compartment will be protected with a manual suppression system. The AFDSS will meet appropriate operational and safety specifications accepted by the Department of Defense and will have supply commonality with fielded U.S. Army systems. Furthermore, a portable 2 ½ pound fire extinguisher is required within the vehicle. The projected IOC for the AFDSS is FY86.

(3) Forced ventilation of the crew and cargo compartment is required for the comfort of personnel during operations in cold, tropic, and temperate zones, afloat and ashore.

(4) Safety rails and grab handles are required both inside and topside for the safety of crew and for use in embarking and debarking.

(5) Nonskid deck surfaces are required on the inside decks and on the topside of the vehicle.

(6) The engine aspiration system must provide a fresh air supply as well as an engine exhaust system capable of venting gases while the vehicle is temporarily submerged so as to prevent the accumulation of carbon monoxide in the crew and passenger spaces.

(7) Separate stations are required for the driver, crew chief, and troop commander.

(8) Service and parking brakes capable of stopping and holding the vehicle in a stationary position when parked on a 60 percent grade, headed either up or down grade are required.

(9) Safety engineering for personnel and equipment during vehicle operation, storage, transportation, and maintenance phases is required. Built-in injury potentials will be avoided where possible. If injury potentials do exist, adequate warning signs, placards, or decals will be provided.

(10) A non-integral fuel cell (mounted so that operational residual stress is not induced into tank walls) will be installed.

j. Environmental Operational Capabilities

(1) The vehicle will be capable of efficient operation in temperatures ranging from -25 degrees Fahrenheit to +125 degrees Fahrenheit, and will be capable of operating in temperatures to -65 degrees Fahrenheit with the use of kits or with minor modification. References for these and other climatic requirements are specified in pertinent sections of DoD document MIL-STD-210A.

(2) The vehicle will be capable of operating to the maximum extent practicable in any climatic zone, in fresh or salt water, and over all types of terrain to include tundra, snow, swamps, reef, and sand.

(3) Troop compartment temperatures will meet the criteria of Human Engineering Laboratory standards.

k. Armor Protection

(1) The LVT7A1(PI) will be provided with an applique armor kit to provide increased crew and troop survivability against threat small arms, heavy machine guns, and fragment producing weapons. The projected IOC for the applique armor kit is FY87.

(2) The armor kit will incorporate the following required characteristics:

(a) It is required that the armor kit provide a .9 probability of no penetration by 155mm high explosive airbursts 50 feet above the vehicle. The kit will also be required to provide a .9 probability of no penetration by 12.7mm AP at muzzle velocity.

(b) The armor kit will be capable of being installed at the lowest possible echelon (crew installation desired).

(c) The armor kit will be suitable for a marine environment and will not preclude accomplishment of the vehicle's primary mission.

(d) The armor kit will not exceed 4,400 pounds and will not adversely affect the vehicle's stability as well as static and dynamic trim. The kit must be removable to allow the lift of a 10,000-pound payload when required.

l. Nuclear, Biological, and Chemical (NBC) Survivability. The vehicle crew and embarked infantry will be capable of surviving in an NBC environment. It is required that a

collective protection system for the crew and embarked troops be provided for increased survivability. The vehicle will also be capable of withstanding decontamination solutions both internally and externally to the maximum extent feasible. Radiological protection will be only that provided by the ballistic hull, and the vehicle will be unaffected by initial neutron and gamma radiation levels below those capable of causing significant human casualties. The LVT7A1(PI) will also be capable of mounting a chemical agent automatic alarm system, a tactical survey meter, a vehicular radiac set to measure radiation levels both inside and outside, and a chemical agent detector kit to provide for chemical identification. The anticipated IOC is FY88.

m. Other Required Characteristics

(1) A stern ramp will be provided for ease in loading and unloading troops, supplies, and equipment. The ramp must be power operated and capable of being raised and lowered by an auxiliary method in case of power failure. Controls for the ramp must be situated so as to be operable by the driver. Ramp will be the full width of the troop compartment and provide the shallowest possible angle between the vehicle and ground consistent with the other requirements. A personnel door in the ramp of sufficient dimensions to permit rapid passage of a combat equipped Marine (ALICE pack, body armor, and weapon) is required.

(2) Troop seats, where required, must be of the quick foldaway type.

(3) Watertight headlights and taillights are required.

(4) Troop compartment hatches will be provided with a minimum opening of 5 feet by 9 feet to facilitate loading and unloading. The hatches will be secured by vibration proof dogs operable from both inside and out. Dogs are to have an inside lock arrangement for security of vehicle while in storage or during shipment. The cargo hatches will have positive locking, vibration proof dogs and dual cargo hatch supports that will enable the vehicle to be operated over rough terrain with the cargo hatches fully opened.

(5) Crew hatches will be located to accommodate access to and egress from the top of the vehicle. These hatches will be secured by positive locking vibration-proof dogs capable of being operated from inside and outside.

(6) All hatches and topside openings will be capable of being sealed to minimize the entry of water.

(7) Vision devices will be provided to allow maximum practicable all-around visibility for the driver, crew chief, and troop commander from positions with direct access to intravehicle communications. Passive night vision viewing equipment will be provided for the vehicle operator.

(8) Towing Devices

(a) A quick-release water tow hitch is required on the stern. This hitch will be operable by a crewman from both topside and inside the vehicle.

(b) Pad eyes will be provided to enable towing on land through the use of a tow bar or tow cables.

(c) The vehicle will have the capability of towing direct support artillery, trailers, M58 line charge, and the bulk liquid transporter. The tow hitch provided for this purpose will be of the quick-release type and operable from inside the vehicle. The vehicle should also be capable of employing cleared lane marking system, the vehicle magnetic signature duplicator, the VOLCANO mine dispensing system and the CATFAE.

(d) A clevised towing cable, readily accessible from topside, mounted externally, will be provided.

(9) Lifting eyes will be compatible with Marine Corps slings and must be capable of lifting the vehicle at gross weight.

(10) A mooring bit is required on each quarter for mooring and towing the waterborne vehicle.

(11) Snatch block rings and tiedown fittings will be provided at each end of the cargo compartment.

(12) A portable, waterproofed searchlight will be provided. This light will normally be carried inside the vehicle.

(13) Both white and blue/green filter lights are required to provide suitable illumination of the crew, troop, and engine compartments.

(14) Boarding steps forward on each side of the vehicle are required. These steps are to be recessed into the hull and are to be of such design that sand, debris, and extraneous matter cannot collect in them.

(15) A remote magnetic heading system will be installed.

(16) An arctic cupola is required for the driver. This may be provided in kit form.

(17) The vehicle will have facilities for stowing collateral equipment needed for normal operation and crew maintenance. Also, stowage for crew members' individual equipment, rifles, two five-gallon oil cans and five gallons of water is required.

(18) The vehicle is to be equipped with a NATO standard detachable cable and a receptacle so that in the event of dead batteries, the cable can be plugged into another vehicle to start the engine.

(19) The vehicle will be capable of being rapidly refueled on land and in the water.

(20) Controls will be the simplest possible; controls to suffice for both land and water operations.

(21) Warning devices as listed below are the minimum required:

(a) Speedometer - (to include recording odometer).

(b) Tachometer - (to include recording hours of operation).

(c) Fuel level gauge.

(d) Generator no-charge warning light/or gauge.

(e) High coolant temperature warning light devices/ gauge.

(f) Engine/transmission oil pressure warning devices/gauge.

(22) A standard military electrical system of sufficient capacity to handle the maximum electrical accessories is required. A waterproof alternator is required.

(23) In selecting major components such as power plant, power train, and suspension, special considerations will be given to new developments and materials.

(24) Provisions must be made for installation of communication-electronics and ancillary items to include secure voice communication systems. This equipment will be splashproof in the operating condition and watertight in the transport condition. All electrical components of the vehicle will be suppressed as necessary for compliance with standard military radio-interference suppression requirements.

(25) Maximum use of lightweight materials such as fiberglass and high impact plastics for interior covers, separators, boxes, and bulkheads should be considered.

(26) The engine will be the multifuel type, provided that fuel economy approaches that of a diesel engine; otherwise, it will be a diesel engine.

(27) The engine and transmission fittings will be readily accessible and be capable of being removed with standard tools and vertical hoist. Petcocks to facilitate oil sampling are desired.

(28) Adequate bilge drain plugs are required.

(29) Fuel system and oil/hydraulic reservoir drains are required and will drain to the exterior of the vehicle.

(30) Design should provide that the engine be started without damage to electrical, communications, and electronic accessories.

(31) The vehicle will have a minimum angle of approach and angle of departure of 35 degrees for compatibility with ramps of amphibious ships.

(32) The vehicle will be designed for minimum reflection of infrared and radar illumination as well as a minimum of infrared emission.

(33) The vehicle will be readily camouflaged and have the maximum practicable security against visual and audible detection. The vehicle shall be capable of starting and operating without generation of excess exhaust smoke.

(34) All members of the LVT7A1(PI) family and the LVTE7A1 variant will be capable of mounting the position location reporting system (PLRS) and the global positioning system (GPS).

(35) The vehicle will be capable of producing a defensive smoke screen.

(36) The vehicle will have durable, vibration proof plenum dogs that are not susceptible to failure.

n. Maintenance Characteristics

(1) The vehicle will be designed such that maintenance will be conducted in accordance with the maintenance categories (organization-depot levels) and echelons (first-fifth) as defined in MCO P4790.1A, Marine Corps Integrated Maintenance Management System (MIMMS) Introduction Manual. In addition, the following maintenance characteristics will be designed into the vehicle:

(a) Minimum maintenance will be required for vehicles preserved for long term (over 90 days) storage.

(b) Requirements for special maintenance skills will be kept to a minimum.

(c) A minimum requirement for special tools is desired.

(d) Simplified maintenance at first, second, and third echelons to permit servicing and maintenance by personnel wearing cold weather clothing is required.

(e) Maximum practicable accessibility for servicing and inspection of component systems is required.

(f) Maximum practicable use of modular or throw-away components is required.

(g) The NBC survivability requirements outlined in paragraph 4.1. shall not be degraded by corrective or scheduled maintenance/support.

(2) Permanently lubricated (lubricated-for-life) components or units not requiring lubrication will be utilized, where practicable, to increase reliability and reduce the maintenance effort. Installation of grease and oil seals will provide maximum accessibility for replacement and service.

(3) Components will be so located and installed in the vehicle to permit ready removal without the necessity of draining liquids and coolants or removal of other components in accordance with good engineering practice. Use of shutoff valves to permit disconnecting without draining will be considered.

(4) Where practicable, interchangeability of parts with other combat, tactical, and transport vehicles will be achieved.

o. Reliability. The vehicle system will have a probability of 0.75 or greater of completing a 12.5-hour mission throughout the first 600 hours of vehicle service life with a 90 percent confidence level.

p. Durability. The vehicle system will be designed to achieve a 90 percent or better probability of operating 600 hours without depot level maintenance.

q. Compatibility. The product improvements will not preclude the installation, employment, and transportation of planned or fielded systems for the LVT7A1; i.e., LVT7A1 Mine Clearance System Kit.

5. OTHER WARFARE AREAS CONCERNED

a. Mission Areas 211.1 (Infantry Weapons) and 211.2 (Armor). The universal weapons pintle and tri-weapons mount (see annex A) have potential for application in other tactical vehicles. The mount will enable the employment of the 7.62mm machine gun family; the M-2, .50 Cal HB machine gun; the Mark 19, Mod 3 40mm machine gun as well as the TOW and Dragon antitank missiles from any vehicle offering a stable platform. The addition of the increased firepower improvements will greatly enhance the combat capability of the landing force and will

impact on supporting arms employment of infantry weapons systems. Development of a lightweight applique armor would have obvious operational utility on light armored vehicles (LAV's).

b. Mission Area 215.2 (NBC). The collective protection system and NBC alarm/detector mounts may have application on the M60A1 Tank and LAV Programs. The development of a common collective protection system and associated NBC alarm/detector mounts would have obvious advantages for both commonality of supply and operational capability.

c. Mission Areas 211 (Close Combat), 215 (Land Combat Support), and 214 (Mine Warfare). The LVTE7A1 will allow assault units to move through obstacles quickly, before the threat has the full opportunity to bring massive fires or establish his defense. Infantry and armor units will be able to move quickly through areas where before they had to pause while combat service support engineer equipment or manpower moved forward and cleared the route. This will result in a significant increase in the mission success rate within the Close Combat (211), Land Combat Support (215), and Mine Warfare (214) Mission Areas.

6. RELATED EFFORT

a. Landing Vehicle Tracked (Experimental) [LVT(X)]. The LVT(X) is the scheduled follow-on family of assault amphibians with an approved IOC of 1997.

b. Light Armored Vehicle (LAV) Program. The LAV program is currently undergoing prototype testing and is related to the LVT7A1 product improvement program in that the above mentioned firepower and survivability projects have potential application to the LAV.

c. Obstacle Reduction Vehicle Programs. The Army developed and fielded the M728 combat engineer vehicle (CEV) in the early 1960's; however, it does not meet the requirements of the LVTE7A1 and is no longer in production. It is limited to minor earth-moving with its dozer blade, reduction of strong points and obstacles with its 165mm demolition gun, and lifting with its A-frame hoist. It does not possess a hinged blade, grabber arm, or interior space for combat engineers and equipment. Also, the Army has developed the M-9 armored combat earthmover (ACE). It is a one-man operated vehicle which has the capability to accomplish armor protected earthmoving in the forward tactical zone of combat operations. The M-9 ACE can meet Marine Corps requirements for an armored combat excavation system capable of developing protective positions during subsequent operations ashore. However, it has no amphibious capability through a plunging surf. The U.S. Army and Israeli Defense Force counter obstacle vehicle (COV) development effort is centered around an M88 tank retriever chassis with the addition of a pair of telescoping arms and a dozer blade. This vehicle can provide the capability to reduce explosive and nonexplosive obstacles during

subsequent operations ashore while relieving tanks of some of these functions. However, it is not amphibious and its IOC is forecasted for FY90/92.

7. TECHNICAL FEASIBILITY, ENERGY-EFFECTIVENESS IMPACT, AND COST FORECAST

a. Technical Feasibility. The concept and goals as stated in the ROC are within the state-of-the-art. The risk of fulfilling the operational deficiencies as set forth in the ROC are minimal.

b. Energy-Effectiveness Impact. None.

c. Cost Forecast for LVT7A1(PI) Family Less LVTE7A1

(1) RDT&E (In FY85 Dollars)

FY 84	FY 85	FY 86	FY 87	FY 88
4,651K	4,899K	4,981K	4,866K	4,477K

(2) Exact unit production costs are unknown at this time; however, procurement estimates for planning purposes are listed below in FY 85 dollars. Unit cost estimates are based on procurement for retrofit of the complete LVT7A1 inventory when applicable.

Product Improvement Item	Cost	IOC
Up-Gun Weapon Station	$85.5K	FY-86
Universal Weapons Mount	$ 4.0K	FY-87
Applique Armor Kit	$20.0K	FY-87
AFDSS	$11.0K	FY-85
NBC Protection	$10.0K	FY-88
Bow Flap	$ 9.1K	FY-88

(3) The following annual PMC funding profiles are forecasted ($000's):

Product Improvements Item	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90
Up-Gun Weapon Station	$11,676	$14,500	$626	$11,932	$67,290	$71,340	$217
Universal Weapons Mount	-	-	-	$2,000	$2,600	-	-
Applique Armor Kit[1]	-	-	-	$7,500	$6,000	$5,300	-
AFDSS[2]	$8,700	$2,600	$1,980	-	-	-	-
NBC Protection	-	-	-	-	$5,000	$5,000	$3,170
Bow Flap	-	-	-	$4,500	$3,500	$4,100	-

NOTE 1 - Does not include 114 training and 89 fifth echelon ORF vehicles.

NOTE 2 - Does not include 110 kits purchased in FY 83.

(4) It is anticipated that the LVT7A1 product improvements will not substantially raise the overall maintainability costs of the LVT7A1 family of vehicles.

d. Cost Forecast for LVTE7A1

(1) RDT&E (FY85 Dollars). It is estimated that the following funding is required for the FYDP:

FY	FYDP Amount (Millions)
84	2.2
85	2.2
86	0.3

(2) PMC. The anticipated unit cost of the LVTE7A1 is $1.3M. Production of the LVTE7A1 could be completed in a single year. The projected total PMC cost is $61.8M in FY85 dollars.

(3) OMMC. LVTE7A1 funding is to be determined. It is estimated to be similar to that of other members of the LVT7 family of vehicles.

Annex A: Essential Characteristics Unique to LVTP7A1(PI)
Annex B: Essential Characteristics Unique to LVTC7A1(PI)
Annex C: Essential Characteristics Unique to LVTR7A1(PI)
Annex D: Essential Characteristics Unique to LVTE7A1
Annex E: Life Cycle Cost Estimate for Upgunned Weapon Station

ANNEX A

Essential Characteristics Unique to the LVTP7A1(PI)

1. Firepower

a. Weapon System. The LVTP7A1(PI) will be required to have a weapon system capable of defeating dismounted enemy personnel, light materiel, and threat infantry fighting vehicles (i.e., BMP) to a range of 2,000 meters and will share commonality of ammunition with fielded weapon systems. The number of weapons systems to be procured is 1147. The weapon system will possess the following physical/functional characteristics:

(1) The weapon system, if power driven, will have a full manual backup capability.

(2) The weapon system will be capable of a one-to-one replacement of the present weapon station without major modification to the LVTP7A1 vehicle's hull or onboard systems.

(3) The weapon system will not adversely affect the LVTP7A1(PI) vehicle's water trim or amphibious capability.

(4) The weapon system will be compatible with the existing LVTP7A1 turret's 34-inch ring size.

(5) The weapon system will be capable of firing while the LVTP7A1(PI) vehicle is moving on land or in the water. All components will be suitable for an amphibious environment.

(6) The weapon system will allow for the installation and proper employment of the M-257 Smoke Grenade Launcher System.

b. Universal Weapon Mount

(1) A weapons mounting system that will allow the exterior mounting of infantry weapons and anti-tank guided missiles is required. This system will be capable of providing a stable mounting and firing structure for the following weapons:

(a) 7.62mm M-60 Machine Gun Family

(b) .50 Cal, HB M2 Machine Gun

(c) Mark 19 Mod 3, 40mm Machine Gun

(d) Dragon Antitank Missile

(e) TOW Antitank Missile

(2) The Universal Weapon Mount will incorporate the following required design characteristics:

(a) The weapon mount will be capable of installation on the LVT7A1(PI) in kit form at second echelon.

(b) The weapon mount will allow for maximum fields of fire for each weapons system mounted.

(c) The weapon mount will allow for ease of weapons installation by individual gunners within 5 minutes.

(d) The weapon mount will provide the necessary brackets for accepting ready ammunition.

(e) No modification to the infantry weapon systems will be required.

(f) The weapon mount will be suitable for a salt water amphibious environment.

2. Communications. The LVTP7A1(PI) communications suite will incorporate the following required characteristics:

a. The troop commander and vehicle crew will be able to communicate with each other over the intercom system without changing selector positions to a specific intercom channel on individual control boxes.

b. The vehicle crew will have direct access to one dedicated multi-frequency, pre-set capable receiver/transmitter (i.e., RT 246) and one receiver. The vehicle commander, located in the armament station, will retain access to a frequency selector; driver access is desirable but not required.

c. The troop commander will have direct access to one dedicated multi-frequency, pre-set capable receiver/transmitter (i.e., RT 246) and one receiver. The troop commander will also have access to a frequency selector.

d. The LVTP7A1(PI) shall have the capability of linking a forward observer (FO) and forward air controller (FAC) into the vehicle intercom system. In addition, a through-the-hull antenna and associated cabling will be provided to enable employment of FO and FAC organic, manpack radios and allow for the interface of Digital Communications Terminals (DCT's).

3. M-59 LVTP7A1 Mine Clearance System Kit (MCSK). To create lanes in explosive obstacles (mines) within the surf zone to the high water mark, the M-59 internally configured MCSK line charge kit will be utilized. For subsequent operations ashore, the Trailer Mounted M-58 Line Charge will be employed by armored vehicles to accomplish this obstacle reduction task.

ANNEX B

Essential Characteristics Unique to LVTC7A1(PI)

1. General. The command vehicle will provide the commander with the capability of communicating with subordinate, adjacent, and senior maneuver units, all supporting arms units, and logistical support units. In order to satisfy the requirements of the troop commander, to provide the maximum flexibility, and to stay within the space limitations of the amphibian vehicle, the required mix of communication equipment will provide capability for simultaneous use of the following radio sets, in conjunction with the appropriate secure voice system:

a. Radio Requirements

Radio	Secure Voice System	Quantity
(1) RT-1209/PRC104	TSEC/KY-65	1
(2) RT-246/VRC	TSEC/KY-57	5
(3) R-442/VRC	TSEC/KY-57	4
(4) RT-976A/PRC75	TSEC/KY-57	1

b. Switchboard - SB-3614 (supplied by using unit) - Qty 1.

c. Provisions will be made to allow the use of five TSEC/KY-67 combinations in place of the five RT-246 VRC and associated KY-57's. The above capability includes communications for the crew of the LVTC7A1(PI). It will replace the present command vehicle on a ratio of one for one.

2. Essential Characteristics

a. The size, weight, and configuration of this system will be dependent upon the configuration and modernization of the present assault amphibian personnel carrier (LVTP7A1). The assault amphibian command vehicle (LVTC7A1(PI)) will transport a driver, crew chief, crewman, and a minimum of nine communications and/or command personnel.

b. The command communication system will contain the following:

(1) State-of-the-art tactical radio equipment that will provide the embarked troop commander a capability for simultaneous utilization of the following radio sets:

(a) RT-976A/PRC75

(b) RT-1209/PRC104

(c) RT-246/VRC

(d) R-442/VRC

(2) Cabinets (when required) that ensure the radio equipment will be splash-proof in the operating condition and watertight in the transport condition.

(3) A folding table and seats to accommodate the commander and three members of his staff.

(4) Seats and working positions for five communications personnel.

(5) A separate intercommunication system to include individual communication helmets for the commander and his staff (the intercommunication system will permit simultaneous intercommunication use and monitoring of any selected radio set. It will also permit entry to any selected radio net and the vehicle intercommunication system).

(6) A separate intercommunication system to include individual communication helmets for the communications personnel.

(7) Seat belts.

(8) Blackout provisions for all openings.

(9) A 24-hour clock for communications and operations reference.

(10) An auxiliary power unit to provide power when the vehicle is used as a stationary command post (the auxiliary power unit will be mounted in the engine compartment and will have the capability of providing 27 to 29 volt DC at standard operating speed, and an output capability of 300 amperes. The auxiliary power unit will operate on the same fuel as the power plant).

(11) Additional lights to provide adequate illumination for all stations.

(12) Mounting brackets for the installation of map boards along the starboard side of the staff positions.

c. A master control box will be provided and located on the starboard side of the vehicle commander's station, designated Staff Master Control Box Number 1. In addition to the Staff Master Control Box, another master control box will be located on the port bulkhead in between the driver and troop commander's stations, designated Troop Commander Master Control Box Number 2. These stations will be equipped with an intercommunication control box and a radio position selector. The signal level from the selected radio and/or intercommunication system will be 12dB higher than simultaneous incoming signals.

d. All radio equipment will be mounted so that it will not interfere with normal operation of the vehicle.

e. All components will be suitably shock-mounted to withstand normal shipping, handling, and field and amphibious use.

f. Internal mounting for the MX-6707 antenna matching unit is required.

g. The present antenna for the RT-1209 will be replaced with a lower profile (HF) antenna, which will provide equal or improved performance.

h. The UHF antenna, AS-1404/PRC, will be centerline mounted aft of the cargo hatch.

i. The present AS-1729/VRC antenna will be capable of being replaced with the AS-2731/VRC antenna when available without further modification.

j. Fully extended antennas must withstand wind velocity of 60 knots with gusts to 80 knots. Antennas will be easily removable and stowable on board the vehicles. Antennas with minimum visibility are preferred, if available, without detracting from the communication system mission.

k. The audio signal level to the earphones will be increased.

l. Communications equipment will be designed and installed for compatibility with CVC helmets (DH132A series) without degrading the secure voice qualifications.

m. Immersion which occurs during waterborne operation will not interfere with normal operation of communications equipment.

n. Acceleration which occurs during overland operation will not interfere with normal operation of communications equipment.

o. The installation will be capable of meeting the specifications as set forth in Military Standard MIL-E-16400.

p. The communications equipment will perform satisfactorily, continuously or intermittently, for a period of at least 1000 operational hours without the necessity for readjustment of any controls which are inaccessible to the operator during normal use.

q. Necessary special tools and test equipment, peculiar to this installation, to perform organizational field and depot maintenance will be developed. However, only the necessary equipment for first echelon maintenance will be installed.

r. No special maintenance techniques which vary from ordinary procedures or techniques will be required to maintain the radio equipment installed in this vehicle.

s. Maximum use of lightweight materials such as fiberglass and high impact plastics must be made in the fabrication of the installation. Technical development will incorporate the latest techniques in ensuring simplicity, reliability, and maintainability.

t. The system will provide external and internal telephone terminals for field phones when used as a stationary command post.

u. The Command/Communication System will operate with Secure Voice Systems (SVS) of the BANCROFT (TSEC/KY-67) and/or VINSON (TSEC/KY-57) design.

v. SVS will meet TEMPEST requirements of NACSEM 5100 and 5112.

w. System Reliability. The system installation, less GFE, will have a total operating life of 10,000 hours with reasonable servicing and replacement parts. Parts requiring scheduled replacement will be specified by the contractor and approved by the procuring activity. The system installation, less GFE, will have a 2,500-hour Mean-Time-Between-Failure (MTBF).

3. Characteristics Desired but not Required. The system should have:

a. Antenna multicoupler in order to limit the number of antennas and aid in reduction of radio interference.

b. Use of VHF wide band antenna is desired.

4. Radio Frequency Compatibility. The equipment will be capable of normal operation in the electromagnetic environment encountered in amphibious operations.

ANNEX C

Essential Characteristics Unique to LVTR7A1(PI)

1. General. The LVTR7A1 is a fully tracked assault amphibian vehicle designed to provide recovery and field maintenance support for the LVT7A1 family of vehicles during the amphibious assault and subsequent operations ashore. The recovery vehicle will be designed to recover similar or smaller sized vehicles, provide an overhead crane capability for the removal of AAV power packs, as well as provide the necessary welding equipment and tools for the conduct of organization maintenance in the field.

2. Essential Characteristics

a. The size, weight, and configuration of the LVTR7A1(PI) will be dependent upon the configuration and modernization of the present assault amphibian personnel carrier (LVTP7A1). The assault amphibian recovery vehicle (LVTR7A1(PI)) will transport a driver, crew chief, and a minimum of two additional tracked vehicle repairmen and one welder.

b. Hydraulic Crane

(1) The crane will be power operated and controlled requiring no manual actions (other than operation of controls) for placing in either the working or storage (vehicle travel) state except for replacement of the hook. The controls for the crane and fold away seat will be provided at the crane. The controls and seat will rotate with the crane, and a metal protective cover for the controls will be provided. No part of the crane will extend over the ends or sides of the vehicle when in the stowed (vehicle travel) state. To prevent complete loss of the hydraulic system in the event of damage to the crane, manual shutoffs will be provided. The crane hook will have a safety closure device. The fluid swivel will be redesigned for a more positive seal. Delete the current crane base bolt-on cover.

(2) The crane will be capable of lifting and holding with negligible creep by independent motion of either the hook or the boom, a 10,000 pound working load at any vertical angle and boom length from a horizontal position to 65 degrees boom elevation with the vehicle level. The traverse of the crane boom will be 360 degrees at a minimum speed of 1.5 RPM's. The crane with a variable boom reach will be located to permit lifting of the working load at varying distances from one foot to at least 5 feet 10 inches (7 feet desirable) from the side, front, and front corners of the amphibian with a minimum hook height sufficient to allow a one-foot clearance over the maximum non-reducible height of the LVTP7A1(PI) and LVTC7A1(PI) when lifting the power pack.

(3) The crane swing-moment capacity will be 14,000 foot-pounds with a crane moment rating of 129,000 foot-pounds. The crane winch line speeds will be as follows:

(a) First layer 25.6 FPM.

(b) Second layer 31.2 FPM.

(c) Third layer 36.7 FPM.

(4) The wire rope will be 85 feet of 1/2-inch 6x19 steel cable with a minimum breaking strength of 23,000 pounds.

c. Recovery Winch

(1) The recovery winch will be capable, at low speed, of producing a working load of 30,000 pounds pull with four wraps of wire rope around the drum (which constitutes a bare drum) and 18,200 pounds pull on a full drum. At high speed the winch will be capable of producing 6,830 pounds of pull with a bare drum and 4,140 pounds of pull on a full drum. The low line speed on a bare drum will be 22 FPM and 36 FPM on a full drum. The high speed on a bare drum will be 97 FPM and 160 FPM on a full drum.

(2) The wire rope will be 3/4 inches in diameter, 250-300 feet long and will have a breaking strength of 48,600 pounds. The winch will be capable of lifting, holding, and lowering either end of an LVT7A1(PI) amphibian vehicle to or from a minimum vertical height of 30 inches.

d. Power Source

(1) Hydraulic Power Source

(a) The hydraulic power source for the winch/crane of the LVTR7A1(PI) will consist of an engine driven hydraulic pump capable of attaining 2200 PSI. The pump delivery rate at 1800 engine RPM will be as follows:

1. Section 1 (Vehicle Winch): 32.0 GPM.

2. Section 2 and 3 (Vehicle Crane and Exterior Station): 20.0. GMP.

3. Section 4 (Vehicle Winch Brake): 9.0 GPM.

(b) Winch/Crane Hydraulic System Requirements. The LVTR7A1(PI) unique hydraulic lines and systems will be designed to include quick disconnects in adequate locations for rapid maintenance actions including as a minimum, fluid temperature, flow and pressure checks. The main hydraulic pump clutch will be simplified for ease of maintenance, disassembly, and adjustment.

(2) Electrical Power Source. The electrical power source will be an engine driven alternator capable of producing 12.5 KVA, 0.8 PF (60 cycles), 3 phase with an output of 220 VAC reducible to 110 VAC.

e. Vehicle, Field Maintenance Support Equipment. In order to provide the necessary field maintenance support for the LVT7A1(PI) family of vehicles, the LVTR7A1(PI) will incorporate the following on vehicle support equipment.

(1) Air Compressor. The air compressor will be a 2 stage reciprocating compressor with a piston displacement of 14.4 CFM. The operating pressure will be 145 PSIG to 175 PSIG with an operating speed of 720 RPM. The compressor will be capable of operating all collateral air driven tools and will be able to support associated pneumatic requirements.

(2) Welding Capability. The vehicle will be provided with permanently installed welding and cutting equipment and accessories capable of permitting welding and cutting operations on the various types and sizes of metals used in the AAV family. An oxy-acetylene welding capability is desired.

(3) Battery Charging Capability. A battery charging capability will be provided by the APU.

(4) Collateral Equipment. Necessary special tools and test equipment peculiar to maintaining the LVT7A1(PI) family of vehicles in the field will be provided as collateral equipment with the vehicle.

ANNEX D

Essential Characteristics Unique to LVTE7A1(PI)

1. General. The Marine Corps requires an LVTE7A1 which is equipped to breach nonexplosive obstacles in the surf and beach areas by creating lanes and establishing cross country mobility routes of egress. The LVTE7A1 must possess speed and survivability equal to the other LVT7A1(PI) vehicles and be capable of breaching obstacles such as craters, blast rubble, and emplaced log, steel, and concrete obstructions. The LVTE7A1 will be organic to the assault amphibian vehicle battalion. An IOC in FY88 is required.

2. Essential Characteristics. In order to provide essential support to the lead elements of the MAGTF, the LVTE7A1 will include the below capabilities and equipment which, when added or integrated therein, will not adversely affect or preclude the vehicle's safe water operation.

a. Mount a hinged blade capable of hydraulic or manual position changes to allow it to assume a wedge or bulldozer configuration. The vehicle will be capable of moving a minimum of 170 cubic meters of earth per hour.

(1) The wedge configuration will breach a lane through blast rubble. With the addition of a scarifying teeth attachment bit to the blades, it is desired that the wedge will proof and widen lanes created in minefields by explosive breaching systems.

(2) The bulldozer blade configuration will breach a tank ditch 1.5M deep X 3.5M wide in sand in less than 20 minutes, or prepare a tank hull defilade position within 30 minutes. It can also prepare expedient landing zones or sites.

b. Possess a grabber arm such as those used in forestry operations, which will traverse 360 degrees. It must be capable of lifting objects weighing up to 12,000 pounds with diameters up to 32 inches within a radius of up to 12 feet from the starboard side of the vehicle.

c. Be capable of powering special attachments and pioneer tools by using the vehicle's hydraulic system. It will have one hydraulic power connection on each side of the vehicle plus one on the end of the grabber arm.

d. Be capable of mounting by hand a hydraulically powered earth auger, up to 16 inches in diameter and eight feet long, and its auger rotating unit on the grabber arm. The auger is required for hasty demolitions and the installation of log/steel posts.

e. Be capable of transporting a minimum of four combat engineers (engineer team) and a minimum of 64 cubic feet of engineer-provided equipment in chests and kits to include:

(1) Four chests, capable of accommodating 200 pounds each.

(2) Two portable squad demolition kits, 100 pounds each.

f. Be capable of towing, activating, and firing the M58 trailer mounted line charge from within the vehicle for the assault/hasty breaching of minefields.

g. Be capable of towing conventional minelaying equipment.

h. Be capable of mounting by hand a .5 cubic yard earth bucket on the grabber arm which can assist in preparing near and far shore slopes for hasty river crossing operations.

i. Be capable of mounting the LVTR7A1 recovery winch for use in nonexplosive obstacle clearance operations.

j. Have independently functioning hydraulic connections.

k. Possess the following pioneer hand tools and attachments:

(1) One earth auger 16" X 96".

(2) Chain saw (2).

(3) Impact wrench (1).

(4) Hydraulic hose reel (20 feet).

(5) One-half cubic yard earth bucket.

(6) One Scarifying Teeth Attachment Kit.

l. Have sufficient interior space to mount a portable oxygen/acetylene cutting torch, its tanks, and ancillary equipment as well as a metallic inert gas (MIG) welding unit.

m. The LVTE7A1 will incorporate to the maximum extent possible the hydraulic, electric, and power systems of the LVT7A1 (PI) family. Where practical, the LVTE7A1 will utilize other components and equipments of fielded USMC tactical and engineer system.

ANNEX E

Major System: Ungunned Weapon Station Date: 03-27-1985 at 13:03:46

LIFE CYCLE COST ESTIMATE

(In Thousands of FY85 Constant Budget Dollars)

20 YEAR LIFE CYCLE

PHASE/CATEGORY	SUBCATEGORY	CATEGORY	PHASE
I. ROTLE PHASE			2,226
II. INVESTMENT PHASE			228,403
1. SYSTEM PRODUCTION/PROCUREMENT		139,001	
A. Major End Item (Contractor)	134,411		
B. Initial Provisioning/Spares, Repair Parts	3,306		
C. Government Furnished/Added Equipment	0		
D. Other Direct System Costs	1,284		
2. SUPPORT EQUIPMENT PROCUREMENT		89,402	
A. Ammunition	89,402		
B. Weapons and Tracked Combat Vehicles	0		
C. Guided Missiles	0		
D. Comm-Elec Equipment	0		
E. Support Vehicles	0		
F. Engineer and Other Equipment	0		
3. MILITARY CONSTRUCTION		0	
III. OPERATIONS AND SUPPORT PHASE			503,763
1. OPERATIONS		324,104	
A. Operator Personnel/Training	174,418		
B. Material Consumption	149,686		
C. Energy Consumption	0		
2. MAINTENANCE		144,712	
A. Organizational Maintenance	81,594		
1) Personnel/Training	62,554		
2) Maintenance Materia.	0		
3) Repair Material	1,686		
4) Other	17,154		
B. Intermediate Maintenance	17,152		
1) Personnel/Training	6,671		
2) Maintenance Material	0		
3) Repair Material	10,575		
4) Other	0		
C. Depot Repair	37,482		
D. Depot Overhaul	8,350		
E. Unprogrammed Losses	10,734		
F. Software Maintenance	0		
3. INSPECT SUPT. BASE OPS & MAINT. OTHER O/M COSTS		34,947	
A. Base Operations	8,178		
B. Other Overhead Costs	26,769		
4. SUPPORT EQUIPMENT O&S		0	
TOTAL LIFE CYCLE COSTS			734,393

O&S PHASE--Reserves				46,524
1. OPERATIONS			31,218	
A. Operator Personnel/Training		16,800		
B. Material Consumption		14,418		
C. Energy Consumption		0		
2. MAINTENANCE			13,939	
A. Organizational Maintenance		7,851		
1) Personnel/Training	6,029			
2) Maintenance Material	9			
3) Repair Material	163			
4) Other	1,650			
B. Intermediate Maintenance		1,642		
1) Personnel/Training	643			
2) Maintenance Material	0			
3) Repair Material	1,000			
4) Other	0			
C. Depot Repair		2,609		
D. Depot Overhaul		516		
E. Unprogrammed Losses		1,322		
F. Software Maintenance		0		
3. INDIRECT SUPT, BASE OPS & MAINT, OTHER O/H COSTS			3,366	
A. Base Operations		788		
B. Other Overhead Costs		2,578		
4. SUPPORT EQUIPMENT O&S			0	

ANNEX E

1. O&S PHASE--Turret&Aux Systems				262,279
1. OPERATIONS			157,617	
A. Operator Personnel/Training		157,617		
B. Material Consumption		0		
C. Energy Consumption		0		
2. MAINTENANCE			78,337	
A. Organizational Maintenance		28,446		
1) Personnel/Training	11,641			
2) Maintenance Material	86			
3) Repair Material	1,238			
4) Other	15,480			
B. Intermediate Maintenance		12,859		
1) Personnel/Training	3,515			
2) Maintenance Material	0			
3) Repair Material	9,335			
4) Other	0			
C. Depot Repair		23,433		
D. Depot Overhaul		4,838		
E. Unprogrammed Losses		8,772		
F. Software Maintenance		0		
3. INDIRECT SUPT, BASE OPS & MAINT, OTHER O/H COSTS			26,324	
A. Base Operations		6,160		
B. Other Overhead Costs		20,164		

2.	O&S PHASE--Drive				12,752
	1. OPERATIONS			0	
	A. Operator Personnel/Training		0		
	B. Material Consumption		0		
	C. Energy Consumption		0		
	2. MAINTENANCE			11,530	
	A. Organizational Maintenance		11,497		
	1) Personnel/Training	11,263			
	2) Maintenance Material	0			
	3) Repair Material	234			
	4) Other	0			
	B. Intermediate Maintenance		12		
	1) Personnel/Training	3			
	2) Maintenance Material	0			
	3) Repair Material	9			
	4) Other	0			
	C. Depot Repair		21		
	D. Depot Overhaul		0		
	E. Unprogrammed Losses		0		
	F. Software Maintenance		0		
	3. INDIRECT SUPT. BASE OPS & MAINT. OTHER O/H COSTS			1,222	
	A. Base Operations		288		
	B. Other Overhead Costs		934		

3.	O&S PHASE--Sight				18,589
	1. OPERATIONS			0	
	A. Operator Personnel/Training		0		
	B. Material Consumption		0		
	C. Energy Consumption		0		
	2. MAINTENANCE			16,981	
	A. Organizational Maintenance		11,263		
	1) Personnel/Training	11,263			
	2) Maintenance Material	0			
	3) Repair Material	0			
	4) Other	0			
	B. Intermediate Maintenance		2,487		
	1) Personnel/Training	2,487			
	2) Maintenance Material	0			
	3) Repair Material	0			
	4) Other	0			
	C. Depot Repair		1,022		
	D. Depot Overhaul		0		
	E. Unprogrammed Losses		2,208		
	F. Software Maintenance		0		
	3. INDIRECT SUPT, BASE OPS & MAINT, OTHER O/H COSTS			1,608	
	A. Base Operations		376		
	B. Other Overhead Costs		1,232		

4. O&S PHASE--40mm				121,331
1. OPERATIONS			108,023	
A. Operator Personnel/Training		0		
B. Material Consumption		108,023		
C. Energy Consumption		0		
2. MAINTENANCE			12,120	
A. Organizational Maintenance		11,206		
1) Personnel/Training	11,176			
2) Maintenance Material	0			
3) Repair Material	30			
4) Other	0			
B. Intermediate Maintenance		37		
1) Personnel/Training	1			
2) Maintenance Material	0			
3) Repair Material	36			
4) Other	0			
C. Depot Repair		0		
D. Depot Overhaul		0		
E. Unprogrammed Losses		877		
F. Software Maintenance		0		
3. INDIRECT SUPT, BASE OPS & MAINT, OTHER O/H COSTS			1,208	
A. Base Operations		283		
B. Other Overhead Costs		925		

5.	O&S PHASE—50Cal				40,266
	1. OPERATIONS			27,245	
	A. Operator Personnel/Training		0		
	B. Material Consumption		27,245		
	C. Energy Consumption		0		
	2. MAINTENANCE			11,805	
	A. Organizational Maintenance		11,242		
	1) Personnel/Training	11,218			
	2) Maintenance Material	0			
	3) Repair Material	24			
	4) Other	0			
	B. Intermediate Maintenance		22		
	1) Personnel/Training	22			
	2) Maintenance Material	0			
	3) Repair Material	0			
	4) Other	0			
	C. Depot Repair		0		
	D. Depot Overhaul		0		
	E. Unprogrammed Losses		541		
	F. Software Maintenance		0		
	3. INDIRECT SUPT, BASE OPS & MAINT, OTHER O/H COSTS			1,218	
	A. Base Operations		285		
	B. Other Overhead Costs		93[illegible]		

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