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Shoot 'em All Down -- Let God Sort 'em Out: Effective Command and Control for the LAV/AD

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Thesis: Despite aviators misgivings, existing technology and procedural controls will be sufficient to provide effective command and control to the Light Armored Vehicle/Air Defense (LAV/AD). This paper analyzes need for an air defense weapons platform for the Marine Corps. Additionally, command and control issues are surfaced for review.

USMC; Command and Control; C2; C3; C4I; Joint Command and Control; Air Defense; Air Control; IFF; MANPADS; ADCP; SAM; LAV; LAV/AD; MACCS

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SHOOT 'EM ALL DOWN -- LET GOD SORT 'EM OUT: Effective Command and Control for the LAV/AD

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SHOOT 'EM ALL DOWN -- LET GOD SORT 'EM OUT:
Effective Command and Control for the LAV/AD

OUTLINE

Thesis statement: Despite aviators' misgivings, existing technology and procedural controls will be sufficient to provide effective command and control to the LAV/AD.

I. Why do we NEED an LAV/AD?
   A. MAA-32 and -35 identified weaknesses in USMC air defense capabilities.
   B. Some weaknesses can only be corrected by LAV/AD.

II. Why aren't we working with the Army on the LAV/AD?
   A. The Army is the primary agent responsible for surface-to-air missile systems.
   B. The Army is not interested in the LAV/AD.
   C. A joint Army/Marine AD turret is possible.

III. What are the strengths/weaknesses of the LAV/AD?
   A. LAV/AD has better IFF abilities than Stinger MANPADS.
   B. LAV/AD has multiple Stinger pods and a GAU-12 gun.
   C. LAV/AD has LAV's mobility and armor protection.
   D. Training of LAV/AD gunners will be an issue.
   E. The main weakness of LAV/AD is communications.
   F. Putting LAV/AD section leader in a modified LAV/L might solve this problem.
   G. There is limited space for the crew of an LAV/AD.
   H. The LAV/L option might also solve this problem.

IV. Why does doctrine call for GCE control of the LAV/AD?
   A. The GCE currently controls all LAVs.
   B. Putting the LAV/AD with the GCE allows LAV/AD crews to train with ground units.
   C. Air defense and ground COs must work together.

V. How will the LAV/AD get its queuing from the MACCS?
   A. When stationary, LAV/AD receives MACCS cueing.
   B. When maneuvering, LAV/AD will operate under ROE.
   C. This is the same way Stinger units operate now.

VI. Command, Control, and the Future
   A. The ADCP will be a key to decentralizing command and control within the MACCS.
   B. Until the ADCP is available, we will rely current technology and existing procedural controls.
   C. We must educate aviators, ground commanders, and air defenders on the capabilities of the LAV/AD.

VII. Bibliography

SHOOT 'EM ALL DOWN -- LET GOD SORT 'EM OUT:

Effective Command and Control for the LAV/AD

The Marine Corps has been authorized to purchase 21 light armored vehicle air defense (LAV/AD) variants in fiscal year 1994. The LAV/AD should correct many deficiencies in MAGTF air defense identified in Mission Area Analysis Number 32 (MAA-32) and MAA-35. This is a new weapons system, and the Marine Corps needs to give serious thought to providing command and control to the operator of the system. An LAV/AD is shown in figure 1.

There are some who feel that the doctrinal issues of how to command and control this new weapons system have been resolved. The LAV/AD project manager works at the Requirements Division of the Marine Corps Combat Development Center. He feels that command and control problems will be solved by the application of new technology to existing doctrine.(10) Problems in autonomous operations will be solved by adding passive sensors to the LAV/AD and using existing procedural controls. New communications technology will enable the LAV/AD to be integrated into the Marine Air Command and Control System (MACCS) during static defensive operations.

Others, aviators in particular, feel that the LAV/AD will be a dangerous liability during a conflict, particularly to friendly aircraft. Its high mobility on the

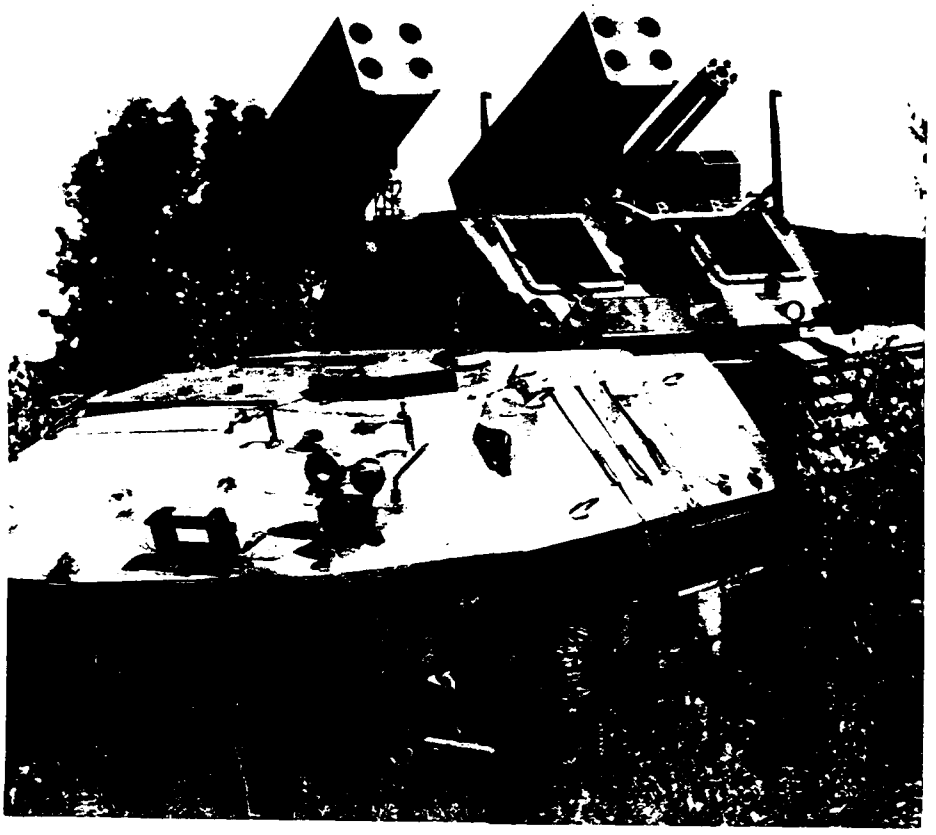
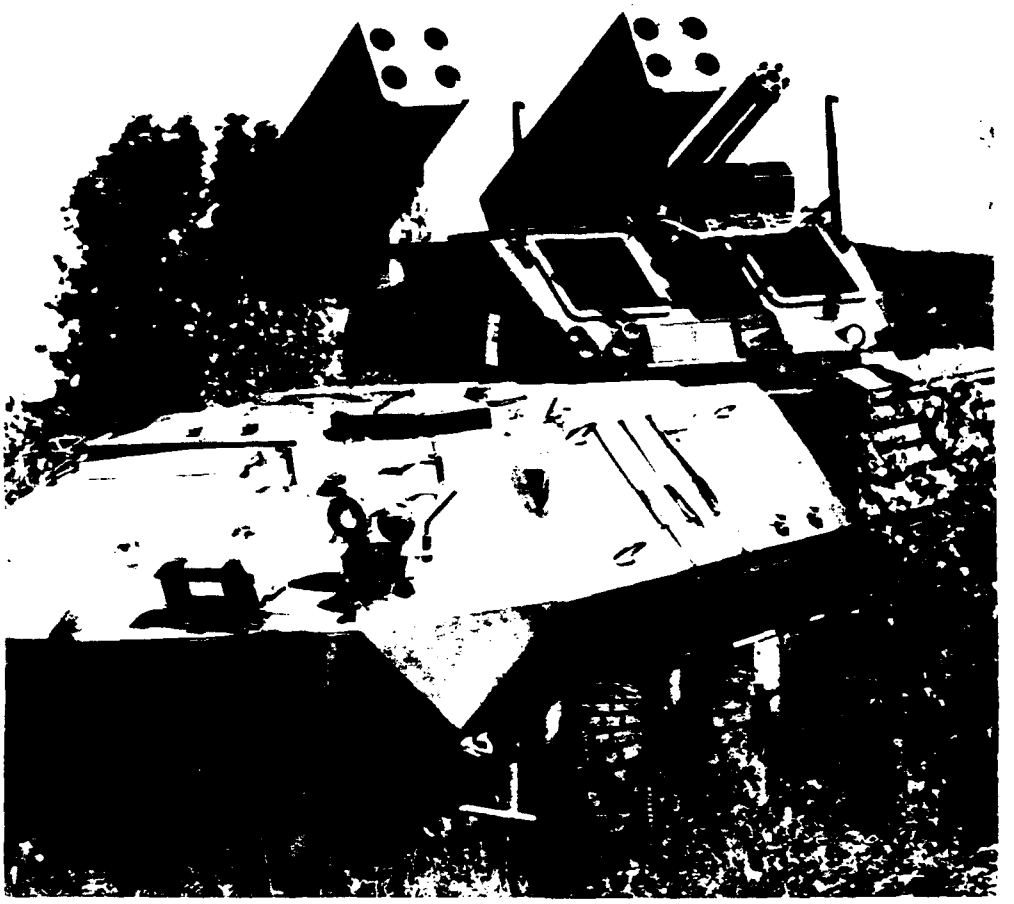


Figure 1. Light armored vehicle, air defense (LAV/AD).

battlefield, coupled with the rapid response required to engage fast-moving targets, degrades its already limited identification friend or foe (IFF) capability. Aviators are concerned that, since the LAV/AD will be operating forward of main forces and in conjunction with armored units, it will be out of range of MACCS cueing. For these reasons, pilots are uncomfortable with the status of command and

mobility as other LAVs, but is the cheapest LAV variant.



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control aspects of the LAV/AD.

Aviators and ground-based air defense specialists disagree on several points. However, they agree on one thing: until the passive sensors and advanced communications platforms mentioned above become available, there will be deficiencies in effective command and control of the LAV/AD. Are these problems insurmountable? We think not. Our view is that, despite these and other deficiencies, **existing technology and procedural controls will be sufficient to provide effective command and control to the LAV/AD.**

How can we prove this point? First we need to answer some questions:

1) Why do we NEED an LAV/AD?

2) Why aren't we working together with the Army on the development of the LAV/AD?

3) What are the strengths and weaknesses of the LAV/AD, and when is it preferable to Stinger Man-Portable Air Defense Systems (MANPADS)?

4) Why does proposed doctrine call for the LAV/AD to be under ground combat element (GCE) control? and

5) How will the LAV/AD get its cueing from the Marine Air Command and Control System (MACCS)?

The real key to solving the command and control issues for the LAV/AD is solving the problem with the MACCS itself. Major Robert J. Bozelli summarized the solution succinctly in an article in the Marine Corps Gazette:

dictate the effectiveness of its MACCS cueing. While the

"The MACCS should adopt a refined concept of employment stressing mobility, survivability, integration with the entire combined arms network, and above all, optimum decentralization." (2:22-23)

The Requirements Division is developing doctrine for use of the LAV/AD which incorporates this mobility, survivability, and integration; the only element missing is command and control decentralization. With existing technology and proper procedural controls, the Marine Corps CAN provide decentralized command and control for LAV/ADs, and fulfill Bozelli's requirements for effective command and control.

WHY DO WE NEED AN LAV/AD?

The "Air Defense" and the "Control of Aircraft and Missiles" studies pointed out a shortfall in air defense capabilities, particularly in providing air defense support to mobile armored forces. These forces, mounted in high-speed wheeled or tracked vehicles, typically outran their air defense coverage. The solution proposed by these studies is the air defense variant of the light armored vehicle, or LAV/AD. The LAV/AD is under development and currently undergoing operational testing and evaluation. While the LAV/AD weapons system is being developed, air defense specialists are working to develop doctrinal

dependent on SINCGARS for its cueing, control, and warning.

concepts for the LAV/AD's integration into the Fleet Marine Force. Many view this parallel development as a weakness and feel that doctrine should be developed first, and the equipment developed to support the doctrine. This parallel development is probably the main reason that some question the need for the LAV/AD. The truth is that equipment funding and development of doctrine many times do not have matching timetables.(14) Sometimes a shortfall can be corrected by simply changing or adding a procedure. Such was not the case here, however. Two separate work groups within the Requirements Division of the Warfighting Center, Marine Corps Combat Development Command determined that a new weapons system was the only solution to some of the problems. The LAV/AD is that weapons system, and it has a major role in Marine Corps air defense of the future.

WHY AREN'T WE WORKING TOGETHER WITH THE ARMY ON THE LAV/AD?

The Army is the primary agent responsible for development of surface-to-air weapons systems, and the program manager for the LAV program is the U.S. Army Tank and Automotive Command (TACOM) in Warren, Michigan. It seems natural that the Army would take the lead on this project. Initially, the Army was working jointly with the Marine Corps to develop an armored air defense vehicle.

However, the Army opted for a different weapons system, and we stayed with the LAV. The Army built its requirement around the Air Defense Anti-Tank System, or ADATS. This was a truly multi-purpose weapons platform, designed to go toe-to-toe with armor. This requirement meant that the envisioned vehicle would be very heavy and very expensive. Since the Marine Corps always tries to have tactical and strategic mobility, and since budgetary considerations are always important, the LAV/AD was our logical choice.

Today the Army is looking at another solution, since the ADATS program is defunct. High maintenance, low reliability, and prohibitive cost ($18 million per firing unit, vice $2.25 to 2.5 million for an LAV/AD) were contributing factors to the ADATS' demise. The Army is now testing four weapons systems as possible solutions to the ADATS requirement. These systems are based on the Army's Bradley Infantry Fighting Vehicle (IFV). The Army was allotted $7.5 million in fiscal year 1993 to conduct a turret study; this study will determine which of the candidate turrets will be installed on an IFV to become the Army's ADATS replacement. The four turrets being considered include the General Electric air defense turret which is on the LAV/AD, an Avenger turret, an FMC turret which was considered for the LAV/AD but rejected, and a Bradley-developed air defense turret. The Army obviously intends to use its Bradley heavy-armor vehicle as the chassis for its

ADCP consists of a heavy HMMWV with a Standard Integrated

own air defense variant. The Marine Corps' classical tradeoff is swapping heavy armor for speed, hence our choice of the LAV for our chassis. Therefore, although the Marines and the Army may develop a common air defense turret, a joint AD weapons system seems out of the question.

WHAT ARE THE STRENGTHS/WEAKNESSES OF THE LAV/AD?

The LAV/AD has some extremely desirable technical characteristics. (See figure 2.) It provides the MAGTF an air defense system with greater mobility and tactical flexibility than existing Stinger MANPADS. There is also some ballistic protection for the crew. The original design requirements called for multiple sensor systems: IFF equipment, a radio frequency interferometer, infrared search and track system (IRST), and daylight television/forward looking infrared system (TV/FLIR). Because developmental time was short and associated costs were high, the radio interferometer and IRST were not included in the initial versions, but were envisioned as part of a later product-improvement program. An acoustic sensor is now planned to be the primary sensor addition on follow-on LAV/ADs. The first LAV/ADs will have IFF and TV/FLIR capabilities, enabling the LAV/AD gunner to differentiate between friendly and enemy aircraft despite being confined

Combat Weight	Less than 29,000 lbs. (13182 kg)
Turret Weight	5900 lbs. (2676 kg)
Crew	Driver, Gunner, and Commander
Armament	GAU-12/U, 25mm Gatling Gun
	8 Stinger missiles (ready to fire)
Total Ammunition	
25mm Ammunition	990 rounds
Stinger Missiles	16
Firing Rate	1800 shots per minute
Turret Azimuth	Unlimited
Gun, Stinger elevation	-8 degrees to +65 degrees
Sight	FLIR/TV/Eye-safe laser range finder
Digital Fire Control	Full solution fire-on-the-move
Sensors	Temperature/Pressure/Wind/Vehicle Tilt

Figure 2. LAV/AD Technical Characteristics.

within the air defense turret of the LAV/AD.

The LAV/AD will have two primary weapons to use against aircraft -- the Stinger missile system and the GAU-12 gatling gun. The follow-on to the Hydra 70 2.75-inch hypervelocity rocket was also tested as a possible weapon which the LAV/AD would bring to the battlefield. Hydras will not be included in the initial program, but remain a definite possibility for a follow-on program. The mounting

points used for the Hydra are identical to those used by the Stinger pod on the universal mount, and in the future could be used to mount the Hydra on the turret. The Hydra 70 follow-on can be used in its current configuration without modification. It is available in the inventory and compatible with the fire control system on the vehicle. The fire control computer will be used in conjunction with the sensor data from the TV/FLIR to accurately produce a firing solution for whichever weapon is selected. These capabilities make the LAV/AD more desirable than the MANPADS for use with armored maneuver elements.

The operational capabilities of the weapons system itself are more than adequate for the near term. The increased mobility and protection provided to the Stinger team mounted on an LAV will allow mechanized and motorized forces to have a self-protection capability against hostile aircraft. Additionally, the LAV/AD can supposedly survive grazing fire from a .50 caliber weapon. The capability to fire on the move is a definite improvement over having Stinger teams mounted in high mobility multi-purpose wheeled vehicles (HMMWVs) or other vehicles. The commonality of systems for the LAV family of vehicles, the GAU-12 gatling gun, and the Stinger missile ensures availability of logistics support and better operating costs over time.

A weapons system is only as good as its operator. Who will operate the LAV/AD? Currently, the table of

organization (T/O) for the LAV/AD Company in the Light Armored Reconnaissance (LAR) Battalion shows Stinger gunner (7212) billets. These billets were converted from infantry billets, so the 72 field will gain more billets when the LAR concept becomes reality. Current plans call for a common training pipeline for Stinger gunners in the future. Military Occupational Specialty (MOS) 7212s will be trained to operate man-portable Stingers. Current plans call for fol`ow-on training to be provided to qualify Stinger gunners to operate both the Avenger and the LAV/AD fire control systems. The Avenger is a similar weapons system with a turret similar to the LAV/AD's but mounted on a HMMWV. This training is supposed to ensure that, no matter what vehicle the weapons system is on, a 7212 will be able to employ the entire weapons system to its full capability. Plans currently being developed will allow all Stinger gunners to fire a live missile once per year, further improving the skills of Stinger gunners. Finally, an often overlooked yet vitally important skill for an operator is the ability to quickly and accurately identify aircraft. This is arguably THE most important skill for a Stinger gunner and cannot be overemphasized during training. For an LAV/AD section operating autonomously, visual ID will probably be the ONLY method available for identifying incoming bogies.

At least one air defender has doubts as to whether or not a single Marine can be trained to employ all three

weapons systems effectively.(1) While the missiles are the same, the firing procedures for each system are not. If actual experience shows that it is not feasible to train a Marine to operate all three systems effectively, the Marine Corps will have to consider the possibility of having three separate Stinger gunner MOSs. This lack of a common MOS for all three weapons systems will probably be a weakness.

The main cause of concern for LAV/AD critics is its weak communications capability. Voice communication will be possible via either HF radio or single channel ground-air radio system (SINCGARS) VHF radio; however, the LAV/AD cannot talk HF while moving since it has to travel with its HF antenna in the horizontal position. (See figure 3.) While moving, the LAV/AD will be totally dependent on SINCGARS for its cueing, control, and early warning. Until the planned installations of the interferometers and IRSTs becomes a reality, the gunners on the LAV/AD will have to rely mostly on their ability to visually identify targets before shooting them. The TV/FLIR system on the LAV/AD increases the operator's capabilities to identify bogies.

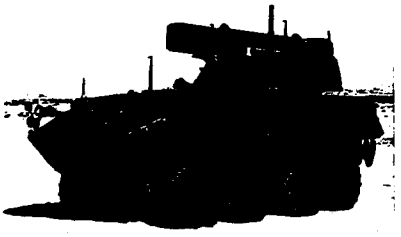

Figure 3. The HF antenna on the LAV/AD (front right of chassis) must be secured in the horizontal position when the LAV/AD moves.

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Figure 3. The HF antenna on the LAV/AD (front right of chassis) must be secured in the horizontal position when the LAV/AD moves.

However, this method is still viewed as inadequate by pilots, who could be unknowingly closing on an LAV/AD at 600 knots. From the front, an F/A-18 looks like a MIG-29. In this situation, with only visual means of identifying aircraft, an isolated gunner has a tough decision to make. If he makes the wrong decision, his unit suffers casualties or he shoots down a friendly aircraft. This problem is not limited to the LAV/AD; all Stinger gunners are faced with these difficult decisions. The LAV/AD's ability to fire multiple missiles quickly makes the problem more menacing for aviators operating near an LAV/AD section.

The LAV/AD's strengths are in danger of being negated by its communications weakness, but we feel a procedural fix could balance the equation. Current doctrine calls for an LAV/AD Company in the Combined Arms Regiment of the near future. The smallest unit of the LAV/AD company is the section, composed of four LAV/ADs. Given the weak communications capabilities of LAV/ADs, it seems that the section leader should be mounted in some other vehicle. A standard LAV-25 or an LAV command and control variant (LAV/C2) both offer better communications than the LAV/AD. Marine Corps Systems Command has an even better idea: mount the section leader in an LAV logistics variant (LAV/L).(1) We feel that mounting the section leader in an LAV/L is a

plausible solution to offset the communications problem. An LAV/L has space enough to mount HF, UHF, and SINCGARS VHF radios, and they should be able to be used while moving. Communications would be greatly improved in this case. The section leader could tie into MACCS agencies via HF, UHF, or VHF for cueing. This cueing information would then be passed to his firing units via SINCGARS. A data link via HF data communications terminal (DCT) would further augment the air picture for the section leader and would rival the one provided to HAWK and Stinger teams today. With this improvement in voice and data connectivity, the LAV/AD section can overcome the communications problems inherent in the LAV/AD.

Another weakness of the LAV/AD is the limited space available to the crew of the weapons system. Marines currently testing LAV/AD prototypes find that they must hang their packs on the outside of the LAV; there is not enough room inside the chassis for pack storage. Once again, the LAV/L offers a solution. Because it is a logistics vehicle, the LAV/L has ample room inside the chassis for crew packs, extra Stinger missiles, food, and water. All this extra gear can be loaded into an LAV/L without degrading the section leader's capability to use his vehicle for command and control of his section. In fact, command and control could be enhanced by putting the section leader's command post (CP) inside the vehicle. The LAV/L offers the same

mobility as other LAVs, but is the cheapest LAV variant. Also, the LAV/L is already in the Marine Corps inventory. These benefits plus the extra room offered make the LAV/L an ideal choice for an LAV/AD section CP. Adding an LAV/L and subtracting one LAV/AD from the T/E for an LAV/AD section is the best way to solve the problem of limited communications and storage capabilities in the LAV/AD.

WHY DOES DOCTRINE CALL FOR GCE CONTROL OF THE LAV/AD?

The Ground Combat Element (GCE) currently has control of all LAVs. The doctrine being developed also calls for the LAV/AD to be under GCE control. When the LAR Battalion concept becomes reality, this battalion will be responsible for maintenance and operation of all LAVs. This does not mean that the ACE will have no control over the system through MACCS, however. The same rules of engagement will apply to this system as apply to Stinger teams operating with the GCE. The LAV/AD firing units will be integrated into the MACCS in the same manner as elements of the Low Altitude Air Defense (LAAD) Battery are now. The GCE commander will not be authorized to change rules of engagement, but he will never be denied the right of self-defense.

GCE control of the LAV/AD involves operational

training. Air defense officers complain that ground units do not know how to use their attached Stinger assets properly. Part of the problem lies in the difficulty of being able to train together; Stinger teams rarely get a chance to conduct exercises with the ground units they are tasked to support. If the LAV/AD is permanently assigned to the GCE, mutual learning will take place. The GCE commander will have his LAV/AD commander available to advise him on how best to use the assets, and the LAV/AD commander will be able to train often with the supported command. The effectiveness of this relationship will be dependent on these two commanders. If the two are willing to learn more about each other's jobs, then the incorporation of the LAV/AD into GCE units will go smoothly and be a great benefit to both commanders.

HOW WILL THE LAV/AD GET ITS CUEING FROM THE MACCS?

The LAV/AD is more effective when it receives early warning, or cueing, from the MACCS. If a gunner knows from which direction an enemy aircraft will appear, he can turn to face the target and acquire a firing solution quicker than if he had to search a large area. If he knows what type of aircraft he will be engaging, he has a better chance of defeating the threat. The employment of the LAV/AD will

dictate the effectiveness of its MACCS cueing. While the proposed change to the LAV/AD Company T/E would provide better MACCS connectivity to the LAV/AD, we will assume that the T/E will remain as is. The LAV/AD will be employed in either a defensive or an offensive role, and effective command and control of the LAV/AD will vary accordingly.

Marine ground units, though primarily offensive-minded, sometimes establish static defensive positions. When the LAV/AD is relatively stationary for periods of time, it could be tied in via existing communications paths to HAWK or Stinger assets using the Weapons Direction Unit (WDU) so it gets a data link air picture. This does not mean that the WDU will be a part of the LAV/AD; initial attempts at installing a WDU in an LAV/AD have failed. Instead, a WDU at a HAWK Battery Command Post (BCP) or Stinger section CP should be close enough to provide cueing to the LAV/AD via voice channels.

When units are operating in offensive maneuver warfare, MACCS cueing is not usually available. During offensive operations, the LAV/AD will have to rely on procedural control and use the Rules of Engagement (ROE) to determine whether or not it can fire on an aircraft. Minimal voice communication will be possible via either HF radio or SINCGARS VHF radio. However, the LAV/AD probably cannot talk HF on the move since the antenna is tied down while moving. During such times, the LAV/AD will be totally

dependent on SINCGARS for its cueing, control, and warning. As there is no data link air picture available in either the defensive or offensive scenarios, the LAV/AD crew members will rely on manual cross-tell procedures to pass information on targets.

Obviously, initial production models of the LAV/AD will have a real problem being integrated into the MACCS. The LAV/AD's limited communications assets restrict its capability to perform its primary mission and introduce a greater risk of possible fratricide. As one Marine aviator put it, "It's a loose cannon out on the battlefield."(6) Experience in the Gulf War, however, suggests that this fear is unfounded. No friendly aircraft were engaged or shot down by Stinger MANPADS or any other ground-based system during Desert Storm. The IFF capability and the TV/FLIR on initial LAV/ADs will give gunners the basic ability to distinguish between friendly and enemy aircraft. Also, current plans to upgrade the sensor capability include passive sensors which will give the crew a way to positively identify target aircraft using noncooperative identification (NCI) procedures. This upgrade will give the firing unit more time to react to enemy aircraft and will help prevent them from firing upon friendly targets. The system will still not be tied directly into the MACCS, but it will be operating under rules of engagement. The unit supported by the LAV/AD will have an air defense bubble moving with it on

the battlefield, and aviators and air defense units will be required to operate under the ROE written into the Air Control Order. While this uncertain situation is not ideal, it is the same one a Stinger MANPADS team could find itself in today. Procedural control based on the ROE was used in the Gulf War of 1991, and we feel that procedural controls will be adequate to control the first LAV/ADs off the assembly line in 1994. Although no Marine Stingers were launched in the Gulf War, the possibility of such a launch existed. There was also the possibility that a Stinger team would have little or no cueing from MACCS, but procedures were in place to cope with just such an occurrence. These procedures were judged adequate to deal with a Stinger engagement during the Gulf War; they will be just as applicable when the LAV/AD joins the Fleet Marine Force.

COMMAND, CONTROL, AND THE FUTURE

The real key to solving the command and control issues for the LAV/AD is solving the problems with the MACCS. A partial solution to one of these problems -- that of decentralization of command and control -- might rest with new technology. The development and fielding of the Air Defense Communications Platform (ADCP) will be a key to decentralizing command and control within the MACCS. The

ADCP consists of a heavy HMMWV with a Standard Integrated Command Post Shelter (SICPS) mounted on the back, able to be task organized for a variety of missions requiring communications interfaces.

The SICPS can hold a variety of voice and data communications gear. It can be configured with both single channel and multichannel radio terminals. It will possess a data link interface with the HAWK Battery CP. This data link will give a near real-time picture of the air situation to the section leader via the ADCP. Also, the ADCP will be able to incorporate a Joint Tactical Information Display System (JTIDS) terminal, which is the replacement for existing tactical data link (TADIL) terminals within the MACCS. The ADCP as planned will provide either a TADIL-A or TADIL-J interface as well. ADCPs will be resident in both Marine Air Defense (MAD) and LAR Battalions in the future. In short, the ADCP will provide both procedural control over voice nets and positive control via data links to the lowest level of air defense commands, the firing units. This command and control decentralization will make the LAV/AD, as well as any other short-range air defense weapons connected to the ADCP, more responsive to the air threat.

Until the Marine Corps acquires the ADCP, though, we will have to rely on current technology and existing procedural controls for command and control of the LAV/AD. In spite of these problems, we feel that current procedures

will be adequate to effectively employ the LAV/AD on the battlefield as soon as it rolls off the production line. Whenever possible, the LAV/AD will be integrated into the MACCS to get cueing and early warning on incoming aircraft. When not in contact with the MACCS, the LAV/AD will operate under strict rules of engagement, which restrict the system's ability to engage targets and greatly reduce the possibility of the LAV/AD shooting down a friendly aircraft. In either case, the LAV/AD will provide the supported ground commander a powerful air defense weapon that can go anywhere that an LAV can go. Education is the key to successful employment of the LAV/AD. Aviators, ground commanders, and air defense specialists alike need to learn more about the LAV/AD, not only to be aware of its strengths and weaknesses, but also to be able to work with it, or at least coexist with it, on the battlefield of tomorrow.

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