

A
CONCEPT
OF
ANTIAIRCRAFT ARTILLERY DEFENSE
AGAINST
MULTIPLE AIRPLANE ATTACKS

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SCOPE

The development of a more effective air warning system together with closer coordination between the Air Force and Antiaircraft Artillery in relation to release of AA fire. Doctrine and procedure for all types of Antiaircraft Artillery units and recommended improvements for a surveillance radar.

A CONCEPT OF ANTI-AIRCRAFT ARTILLERY DEFENSE

AGAINST MULTIPLE AIRPLANE ATTACKS

If you shoot 'em in the rudder,

You only make 'em shudder.

If you shoot 'em in the prop,

You make the bastards drop.

There has always been and will probably be for some time to come, studies, discussions, projects and conferences in anti-aircraft artillery circles on how to most effectively combat by anti-aircraft artillery means normally available, hostile aircraft attacks by a large number of airplanes. By a large number of planes is meant high, medium or low attacks, conducted successively or simultaneously, attacks from various directions at the same time or at successive times and saturation attacks when the number of planes within range at any one time exceeds the number of fire units which can be brought to bear upon the attacking aircraft.

This particular phase of anti-aircraft artillery combat requires consideration of four separate subjects. It is my purpose to recommend improved tactics and operations in order that the primary mission of the anti-aircraft artillery commander in the field may be more effectively accomplished with less confusion when he is subjected to a multiple airplane attack. These subjects are: The development of a more effective air warning system; closer co-

ordination between the air force and antiaircraft artillery, especially in relation to the release of antiaircraft fire; a more sound and simple procedure and doctrine for antiaircraft artillery fire units; and, improvement in the surveillance radar currently employed. I have selected these four subjects because my experience in the field has shown that when the enemy conducts a multiple plane attack, the greatest confusion and lack of coordination to combat this attack lies in improper air warning to the fire units of each and every flight as to range and location with respect to altitude and azimuth, the lack of coordination on the part of the air force to release the area for antiaircraft artillery engagement, absence of doctrine and procedure at the gun site as to selection, designation, and assignment of targets, and the inability of the organic surveillance radar to cope with the situations that arise in a multiple plane attack.

Confusion under attack breeds certain defeat. We must know the methods of defense to meet these attacks. If this is accomplished, our victory is assured. The employment of antiaircraft artillery differs somewhat from that in other combat units in that the enemy must come to the site, the site cannot seek out the enemy. It can only reach out as far as the projectile can travel. Having seen service with an antiaircraft artillery battalion in Africa, Italy, France and Germany during World War II, my experience has indicated certain improvements in the defense against multiple

plane attacks that could be made to accomplish the primary mission of antiaircraft artillery.

MORE EFFECTIVE AIR WARNING SYSTEM

The time-space factor in destroying hostile aircraft before they reach vital targets necessitates rapid decision, maximum use of adequate communication facilities and aggressive action. Since the fire unit must know the attack is coming, the subject of an effective air warning system (early warning) is paramount. In many cases, no serious thought in location of the Antiaircraft Artillery Operations Room (AAOR) was exercised. The physical location of the AAOR with regard to the defended area should be centrally located and on the axis of communication whenever possible. It should be situated as close as possible to the tactical air control center and whenever the situation permits, in the same room, tent or building. This would minimize the communication difficulties and personnel requirements as well as increase the efficiency of the air defense through closer cooperation. Locating the AAOR centrally in the defended area distributes equally the responsibility of all units to maintain communications.

Antiaircraft Artillery Operations Room Detachments (AAOR Detachments) proved their worth in World War II by furnishing early warning, but in many situations were not available to all units. There is one way that this problem can be overcome. Present AAOR detachments, who normally operated separately, should be discon-

tinued and the tables of organization of each antiaircraft artillery battalion be provided with an AAOR team. This team, when properly trained, would be capable of furnishing necessary early warning to the fire units of the battalion twenty-four (24) hours a day when the battalion is operating alone. When the battalion is employed with additional units, this AAOR team could be integrated with AAOR teams of other battalions in the defense into a group or brigade AAOR, as the scale of the defense increased. These teams should have sufficient long range early warning radar assigned organically. The type of radar that is required will be covered in more detail in a later paragraph.

Every means of identification must be furnished the AAOR. Since final identification of aircraft rests with the controller in the tactical air control center, it is imperative that the air forces place more emphasis on the use of Identification-Friend or Foe (IFF) equipment and procedure. This particular point was more clearly realized after the airborne mission flown by C-47 type aircraft in the early stages of the Sicilian Invasion. The aircraft and those aboard suffered greatly when brought under fire by the friendly army and navy antiaircraft artillery guns. When challenged by ground units, aircraft must have the means to meet this challenge and the time factor in receiving the proper recognition signals is of utmost importance.

With the use, in the later stages of the war, of the MEW and V-Beam type radar searching, the problem of detection was greatly simplified but still requires improvement, training and coordination, especially when aided with the current SCR-270 and SCR-271. Filtering information obtained from these radars requires constant attention, since errors of personnel, equipment and time lag have to be considered. This system embodies a highly trained individual to determine whether or not a number of plots or readings from numerous sources are one and the same target. This has a greater importance when dealing with multiple plane attacks. To help compensate for the human error, radio transmissions of air warning should be by FM instead of AM and the commander at all antiaircraft artillery command posts should have a system of two-way amplification such as "Voice-call" as used by the navy aboard ships. In future wars, speed of attacks will require transmission of information and firing orders by television. It is my firm belief that for antiaircraft units to successfully engage supersonic aircraft, tests should be conducted to determine the practicability of televised data presentation and the use of remoted FPI scopes to the gun sites.

Regardless of the tactics employed, visual observation posts are a requirement in every defense. These outposts play a vital part in the automatic weapon defense because radar equipment is not organic in this type unit. Additional reasons for employment of outposts are that low-flying aircraft can reach the defended area

undetected even with the radar of heavier antiaircraft artillery units being employed and jet-type aircraft make it necessary for the guns of automatic weapons to be pointed in the direction of the hostile approach. To insure prompt "pick-ups" these outposts should be located not more than five miles from the outer guns of the defense and spaced about five miles apart depending on terrain features and limitations. Using currently authorized radio equipment, radio flashes should be broadcasted by the SCR-694 at the outpost, received at the AAOB on the SCR-543 and at the same time at the gun sites on the SCR-593. As mentioned in the preceding paragraph, these AM sets should be replaced by suitable FM sets for greater dependability.

Experience in combat has produced many difficulties in the proper functioning of outposts. One of these has been in the establishment and operation. It requires four enlisted men to organize and operate a single observation post. Formerly only two men were stationed at each position and there was no requirement that they be trained radio operators. This training was the responsibility of the unit intelligence officer who commanded the Antiaircraft Artillery Intelligence System (AAIS) section in the battalion headquarters. Other points that should receive consideration by boards set up for this purpose are more adequate facilities to quarter these men at the outpost position and proper cooking equipment suitable for use over long periods of time.

COORDINATION BETWEEN ANTI-AIRCRAFT ARTILLERY AND AIR FORCE

As long as conventional aircraft are employed, there will be certain areas that can be more effectively defended by anti-aircraft artillery than by aircraft. This is accomplished by restricting the operation of friendly aircraft within the effective range of the anti-aircraft artillery weapons of the defense. The continued use of restricted areas is considered necessary in this respect. For simplification of rules for anti-aircraft fire as well as limits placed on air force operations, it is recommended that the current instructions regarding restricted areas be revised so that there be only one type of area in which operation of friendly aircraft is restricted. This area would therefore be known as a "Restricted Area".

The size of the restricted area should be determined from the center of the gun defended area to a distance beyond the outer ring of guns. This distance must include the effective range of the weapons in the defense. The actual boundaries are defined as a circle of specific radius measured from the center of the defense which exceeds the maximum range of anti-aircraft guns and marked by prominent terrain features easily visible from the air. Altitude restriction should be the effective ceiling of the gun defense based on the effective range of the largest caliber weapon. Normally 20,000 feet is considered the minimum altitude with a safety factor of 2000 feet for fighter type aircraft. Within this area, air force units can exercise only negative control on the release of anti-aircraft

fire. It must be understood by all concerned that antiaircraft units will engage aircraft within range that are not positively recognized as friendly except that the control officer at the tactical air control center may order "hold fire" when he considers that friendly aircraft would be endangered. By so doing, he assumes responsibility for the defended area.

Under many circumstances, the safety of friendly aircraft is dependent upon the identification and/or recognition of that aircraft by the antiaircraft artillery gunners. This is true even in restricted areas as operational difficulties or the pursuit of hostile aircraft will at times bring friendly aircraft within range of the antiaircraft weapons. The responsibility for the recognition lies primarily with the antiaircraft artillery and it is deemed essential that aircraft recognition be continuously emphasized even when the units are occupying combat positions.

Identification of aircraft within a restricted area should be the responsibility of the air force and any aircraft flying in a restricted area that is not promptly identified should be considered hostile and taken under fire by the antiaircraft artillery units. Unseen aircraft operating in other than restricted areas should not be engaged by antiaircraft artillery unless identified as hostile by the air force controller.

DEVELOPMENT OF A MORE SOUND AND SIMPLE DOCTRINE AND

PROCEDURE FOR ANTI-AIRCRAFT ARTILLERY FIRE UNITS

This phase requires different considerations for each type of weapon organic in the anti-aircraft artillery units. The first that will be considered is the 40 mm automatic weapon.

Due to the limited range and the short time that appropriate targets are presented, fire direction is normally exercised by the individual section commander even in a static defense. Only under special conditions or circumstances should fire direction be controlled by a higher command and then it should be required to pass through the unit operations room.

In combating multiple attacks it is essential that all fire units have separate targets and that no two fire units engage the same aircraft. Rules must be set up which can be applied most of the time but would not be considered standard. Fast close in enemy attacks may preclude the application of concrete rules and anti-aircraft artillery commanders must prescribe rules to meet the local requirements and the type of aircraft it is expected the enemy will use.

Each fire unit must have a primary and secondary sector of responsibility and it is in the center of the primary sector that the weapon will be pointed when it is not engaging a target elsewhere.¹

1. A Practical Manual for Anti-aircraft Artillery Officers, Hq., AAC, ADC, 15 June 1942, p. 105.

For targets that enter the sectors of a fire unit a priority for engagements must be standard and understood by the gun commander. Some of the considerations for this priority are that when two or more targets enter the primary sector of a fire unit, that target which offers the most dangerous threat to the mission of the defense should be taken under fire. Further, when two or more targets offer an equally dangerous threat, that target which is not under fire of another unit should be engaged first. In a multiple plane attack the greatest number of hostile planes possible must be taken under fire. Fire units should not engage a target in its secondary sector, if a target is within range in its primary sector. Targets must be engaged until they are destroyed or out of range or until other possible targets present a more dangerous threat.

Aircraft flying over a defended area present different course characteristics to fire units due to the gun position on the ground. In the same defense, a crossing course to one fire unit will appear as an incoming course to another. Also a V formation to one section appears as a column formation to another section. This does not present any problem to the gunners because they will take under fire the aircraft that indicates a threat by its relative position in the formation and its maneuver characteristics.

For the selection of targets by a fire unit commander, it has been found very successful to designate each aircraft by its relative position in the formation. To more clearly define this, let us

consider a flight of aircraft flying over the defense in a line formation. The leading plane would be the number one plane and the one immediately behind it would be the number two and so on through the formation. When the flight is in a V formation the leading plane is number one and is the plane designated by fire units that view the formation as an incoming course. When this same formation appears as a crossing course to fire units, the planes are numbered from front to rear but only in the near wing of the formation. In this case, the leading plane is number one to fire units on both flanks of the formation.

Target selection by fire unit commanders must be rapid and without hesitation in multiple plane attacks. Targets not already engaged by an adjacent section should be taken under fire in preference to those being fired on. Those fire units that observe the formation on an incoming course should fire on the leading plane, for it is this plane that usually carries the bombardier. For fire units that see this same flight as a crossing course they should fire on the near wing beginning with the third plane in line. If this aircraft is heavily engaged by down course fire units, then fire should be shifted to the number five plane unless the plane is already being engaged by other unit or tracers seem to be passing through it. Fire units on the incoming leg follow the same plan but engage only even numbered aircraft such as number two, number four or number six.

Barrage fire by automatic weapons units is designed to provide protection in situations where normal fire control methods cannot be applied. This type of fire relies mainly on the deterrent effect of the tracer ammunition on the pilots. Barrage fire should not be employed when it is possible to engage targets with positive fire control. It requires an excessive expenditure of ammunition and a great deal of coordination. If fired too early, it is worthless and permits the enemy time to take evasive action. Barrage planning requires careful consideration of the expected routes of hostile approach, the bomb release line to effectively strike the objective and the altitudes the enemy might bomb from. Barrage fire is not considered effective in combating multiple plane attacks and therefore will not be dealt with further.

The second type weapon available to the antiaircraft artillery are those of high caliber ranging from the 90 mm to the present 120 mm. One of the chief characteristics that make this weapon differ from those of the automatic type is that it is fired in battery. That is, it is employed in groups of four guns using a central fire control system. It is natural, therefore, that the tactics used in multiple plane attacks by these larger guns are different than those used with the smaller type weapons.

Selection, designation and assignment of targets should be by a raid number that is announced by the AAOR. It should be the responsibility of the AAOR to select that target that offers the greatest hit

expectancy. This is based on the premise that the mission of these guns is to destroy enemy planes and not to deter personnel. Since the fire control instruments of heavy antiaircraft artillery guns are predicted on the target flying a straight course at a constant speed and altitude for a time equal to the time of flight of the guns projectile, there is little chance of getting a hit while the target is free to maneuver. This introduces a difficult problem in multiple plane attacks since all the four guns of a battery must be engaged at a single target whereas in the automatic weapons battery, each gun is free to engage a separate target. This characteristic makes the heavy guns not effective against multiple airplane attacks but could be effective when sufficient guns are employed. The principle normally used and considered the best is to engage a target until it is destroyed or out of range of the gun. To most effectively combat multiple plane attacks, heavy guns should be employed with the automatic weapons to cope with those that remain at high altitudes or are preparing for a second run on the objective and the automatic weapons to engage those planes that are immediately in the defended area.

IMPROVEMENTS IN THE SURVEILLANCE RADAR

A surveillance radar by definition is a radio instrument designed to detect a target within a definite range from its position, independent of altitude or azimuth. The SCR-584, which is currently organic in the heavy gun battery has proven itself inadequate. It has certain

limitations which make it non-effective against various type of targets. If modified to eliminate these limitations, better performance would be obtained. Installing a moving target indicator which would produce only moving targets and not fixed echoes that appear on the PPI scope would increase its capabilities. Also, a solid search parabola to increase the beam width of the antenna in elevation, thereby giving more complete coverage. An increase in range is required and could be obtained, if the pulse repetition frequency could be decreased and the pulse width increased. Finally, a sector scan control device is desirable to enable the radar to scan in the expected direction of attack. This would increase the efficiency of both the radar and the operator.

With the modifications mentioned above, it is felt that a more efficient radar is required. It should have the following characteristics:

1. A range to exceed 100 miles.
2. Capable of detecting targets at zero feet elevation thirty miles away.
3. The elevation angle of coverage (or the beam width in elevation) should be at least ten degrees.
4. A moving target indicator.
5. Sector presentation using off center PPI.
6. Be limited to present mobility, space and weight of the SCR-584.

Conventional aircraft are still the only available type planes that an enemy could mass in strength in an area to offer a threat of an attack or carry out an actual attack on this country. The development of faster type aircraft than those used in World War II is still in experimental stages. We must, therefore, be prepared to defend ourselves today with what we have, while preparing to defend ourselves tomorrow with what we know we must have.

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