

## BATTLE GROUP OPERATIONS: WAR AT SEA

Since World War II, Naval Battle Groups have been formed around the nucleus of an aircraft carrier (or carriers) and her supporting ships and aircraft. These supporting ships and aircraft perform various functions, but their basic role in critical combat situations is to protect the carrier and her striking power from opposing forces. From this perspective, defense can be viewed as a subset of offense; the two fuse together whenever war at sea is conducted.

The last major naval battle of World War II was conducted in support of the landings on Okinawa. Those landings were the first and only time the U.S. Navy faced a major battle against an antiship guided missile — the Japanese Kamikaze airplane. Although the U.S. Navy prevailed in that battle, it was at a terrible loss of ships and men. The inhuman element of warfare was typified by the guidance system employed in these missiles — young men. Technology has long since replaced the manned missile, and in the course of doing so has given antiship missiles much higher capabilities. Failure to defend effectively against these missiles can mean the difference between winning and losing in a major conflict.

Although the conflicts in Korea and Vietnam were heavily supported by the U.S. Navy, the Naval Battle Group as an entity was never seriously challenged. The antiship missile (which has become the principal weapon of the navies of the world) was not employed against U.S. forces in those conflicts. If such a weapon had been employed, it is likely that the requirements of our Navy would have become much more obvious to the U.S. public, and a more modern Navy would have resulted from a national commitment to maritime superiority. As it is, we have witnessed a steady decline in the size of the U.S. Navy and a steady increase in the age of its warships. About 70% of the Navy's principal anti-air warfare ships have been in service for two decades or more. In the meantime, the Soviet navy has emerged as a major naval power that rivals and can challenge the U.S. Navy throughout the world.

War at sea for a U.S. Naval Battle Group is based on mutual support of all elements in the group (air, surface, and subsurface) and on the principle of defense in depth (i.e., different weapons are used to engage targets at various distances from the Battle Group). Defense in depth prescribes three zones in which various systems are normally employed to achieve attrition of enemy forces. These zones and the weapons generally employed in them are the following:

- *Outer defense zone*—carrier-based air interceptor aircraft and strike aircraft (employed at ranges from 100 to 300 nautical miles). Newer

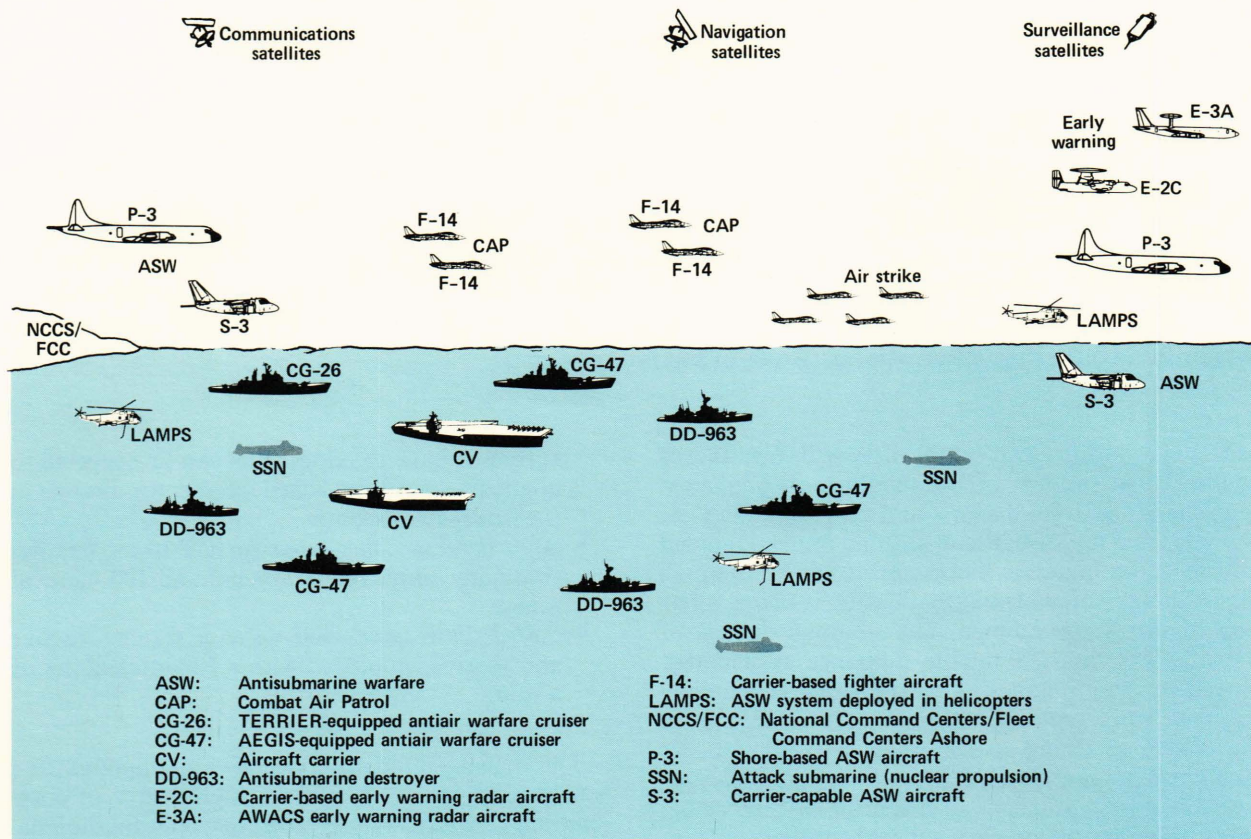
surface missile developments can be expected to augment the carrier-based interceptor aircraft in the future in this zone.

- *Area defense zone*—area surface-to-air missiles (normally employed between 2 and 100 nautical miles).
- *Self-defense zone*—self-defense systems (active and passive, employed within 5 nautical miles of a ship).

The defense-in-depth concept, when applied to a war-at-sea scenario, requires a high degree of coordination across all zones. However, coordination has its greatest significance in the zones that are covered by multiple ship-launched missiles and carrier-based aircraft. The distributed nature of the Battle Group and the overlapping weapon coverage of its ships and aircraft, coupled with large differences in the anti-air warfare capabilities of the various systems, result in a weapons coordination problem; e.g., a situation in which several systems engage the same target is unacceptable because it wastes ammunition and reduces Battle Group engagement capability. Reaction times, equipment malfunctions, battle casualties, altitude and speed of the threat and its identification, performance limitations of specific defensive systems, and electronic countermeasures require that weapon allocations to targets be coordinated in real time to meet the anti-air warfare threat.

A U.S. Naval Battle Group may consist of one to four aircraft carriers, each with about 100 aircraft (see Fig. 1). About one-third of these aircraft are nominally devoted to air defense roles (i.e., E-2C airborne surveillance aircraft, F-14 and F-18 air interceptors, EA-6B electronic countermeasures platforms, and KA-6 tankers). Three to six anti-air warfare cruisers and destroyers of various types per aircraft carrier (such as TERRIER CG-16 or CG-26 class ships; TARTAR DDG-2, CGN-38, or DDG-993 class ships; and the AEGIS CG-47 class ship) are normally deployed to protect against antiship missiles and attack aircraft. Other ships and aircraft of the Battle Group are dedicated (i.e., assigned) to subsurface warfare and surface warfare. The Battle Group is also supported by land-based systems such as the P-3 antisub-





**Figure 1** — Naval Battle Groups are complex ensembles of ships, aircraft, and submarines employed in strike, antisubmarine, antisurface, and anti-air warfare. They are assisted in their missions by shore facilities and satellites.

marine warfare aircraft, the E-3A Airborne Warning and Control System (AWACS) air surveillance aircraft, and the various space assets, including communication and navigation satellites.

Deployment and application of the Battle Group in a coordinated and dynamic battle plan is a massive organization and control problem. In the course of an air battle, the critical considerations include: engagement doctrine, identification of friends and threats, and determining which unit should engage each threat and with what weapon. These questions must be dealt with very rapidly in tactical situations.

A typical surface-to-air missile engagement sequence can be represented by examining a hostile air-to-surface missile launched against the Battle Group from a range of 100 nautical miles. Such a missile can fly the 100 nautical miles to its target in about 3 minutes, traveling at Mach 3. Assuming the missile is detected by the Battle Group at 100 nautical miles, it is necessary to establish a radar track, identify that radar track as a target, evaluate its threat, decide whether or not to engage the target, decide which unit within the group should engage the target, communicate the order for an engagement, acquire the target on the assigned fire control radar, compute a fire control trajectory, launch a missile, guide the defensive missile to intercept, evaluate the engagement

success, and launch another missile if the target is not destroyed on the first attempt. This total sequence of operations must occur in less than 3 minutes — the flight time of the enemy missile used in the example. Considering the potential threat environment in which the Battle Group operates, it can be seen that many sequences like the one described would have to be carried out in parallel for each threat that simultaneously attacks the group. This can make it necessary to coordinate several dozen concurrent engagement processes, which, in turn, requires complete confidence in the data employed to make defense decisions. Good decisions cannot be based on poor data.

From the perspective of the APL's involvement in surface warfare and surface-to-air missile defense, the significant surface warfare defense capabilities required for a modern war at sea against an antiship missile threat are contained in the AEGIS Combat System. This system will first be introduced in the Fleet in 1983 in the TICONDEROGA (CG-47 class) guided missile cruiser. Designed "from the keel up" to support the need for effective defense against the antiship missile, TICONDEROGA represents one of the most important developments in combat system capability in two decades. One CG-47 class ship will more than double the anti-air firepower of a typical present-day Battle Group; moreover, firepower will

be far more effective because of the superior detection, tracking, and weapon control capabilities of AEGIS.

The Battle Group Anti-air Warfare Coordination Program is the hub of the initiative to exploit the capability of AEGIS. Justification of such a program rests on an analytic base of Fleet exercise results and operational analyses. The following article by R. S. Farris and R. J. Hunt, "Battle Group Air Defense Analysis," provides an overview and some detail on such analysis activities at APL. The keys to the exploitation of AEGIS are treated in the article by C. C. Phillips and E. C. Prettyman entitled "Battle Group Anti-air Warfare Coordination." One of the signifi-

cant keys has been the development of continuous automatic gridlock (i.e., alignment of remotely sensed target data with the receiving ship's or aircraft's reference system). This work is discussed in the article, "Battle Group Gridlock Demonstration," by J. T. Miller and E. W. G. David.

In the final article of this section, D. P. Serpico provides details on the Combat Systems Evaluation Laboratory. This laboratory has been developed primarily to support the AEGIS program. It contains the development models of the Battle Group Anti-air Warfare Coordination displays to be deployed in TICONDEROGA and is used for computer program development and validation.