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Future Helicopter Force Requirements Analysis

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Summary

Over the next ten years, implementation of the Navy's Helicopter Master Plan will reduce the Navy helicopter force from its current seven types of aircraft to just two, the SH-60R and the CH-60S. At the same time, other Navy forces will be undergoing significant "mission-shedding," with many of the shed missions being assumed by the helicopter force. In light of these changes, the Navy is reexamining its helicopter force size and organization. N88 asked CNA to study future helicopter force requirements. At the same time, Commander, Second Fleet has been studying future helicopter force organization. CNA's work has been coordinated with that of Second Fleet.

This "requirements analysis" examines the effects of the coming changes in helicopter missions and capabilities on the need for helicopters in the battlegroup and other operational units. It examines the size and disposition of the helicopter force in approximately 2010, after the neckdown to the SH-60R and CH-60S has been completed.

For both types of helicopters, we determine the number of aircraft needed to meet stressing contingencies that might arise during routine forward operations. We then determine the infrastructure (non-deployed operations, workups, training, maintenance, etc.) needed to support a given level of forward operations to obtain the required force size. Finally, we check to see whether this force is adequate to surge to two major theater wars (MTWs). We will first discuss the requirements for SH-60Rs, then turn to the requirements for CH-60s.

SH-60R requirements

The SH-60R is a remanufacture of existing SH-60B (LAMPS Mk III) and SH-60F (CV helo) aircraft that will replace these aircraft. The 60R is a multimission aircraft, capable of contributing to many warfare and support missions. The focus of our requirements analysis is

on battle space dominance (BSD) tasks, particularly antisubmarine warfare (ASW) and surface warfare (SUW), because we believe that these are the missions that will drive the SH-60R force requirements.

Battlegroup requirements

The number of SH-60Rs per battlegroup depends on a number of factors. The drivers are (1) whether there is a simultaneous surface and submarine threat, (2) environmental conditions, including acoustic conditions and surface traffic density, and (3) the availability of other assets for SUW and ASW, particularly the P-3 and E-2. Our analysis shows that a complement of about 14 SH-60Rs per battlegroup (6 on the carrier; 8 on escorts) permits the battlegroup commander to keep two helicopters airborne continuously: one for close-in screening and planeguard, and a second for search in the middle zone. In addition, the force would be able to provide about ten reactive sorties per day for surface contact identification or ASW contact investigation. Coupled with the assistance of an on-station P-3, the force would provide an adequate SUW and ASW capability against a wide range of surface and submarine threats.

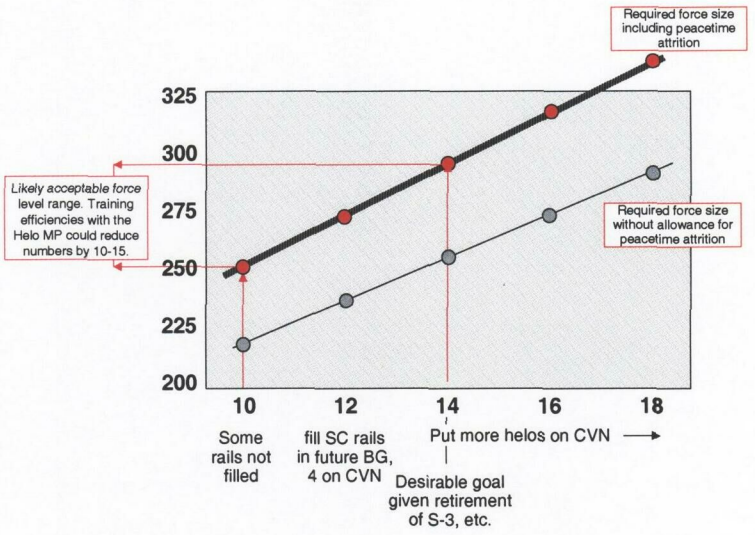
Required force size

In 1995, CNA developed a method for deriving helicopter force levels from forward operational requirements. Briefly, we first determine the number of helicopters required for peacetime forward-deployed operations, and then apply standard planning factors to calculate the infrastructure needed to support the deployed units.

The figure summarizes our SH-60R requirements assessment.[1] It relates the number of 60R helicopters in deploying battlegroups (the horizontal axis) to the total number needed to sustain the force. The arrows identify what we believe to be the likely range for "acceptable" requirements that balance operational risks and fiscal necessity.

1. The upper line in figure 1 includes an allowance for peacetime attrition at a rate of 1.1 percent of the force per year for 15 years. The lower line makes no allowance for peacetime attrition.

Figure 1. SH-60R force level vs. number per battlegroup



Observations and conclusions on SH-60R requirements

Helicopter demands will vary with circumstances, but in any situation where a deployed battlegroup or surface group faces ASW and SUW threats, SH-60 resources will be stressed. This observation has several clear implications.

(1) The Sea Combat Commander will need to take advantage of the total SH-60R resources in the battlegroup. This does not require any specific organizational structure, but probably will involve more flexible use of aircraft, crews, and maintenance resources.

(2) Based on the needs of the battlegroup as a whole and the increasing frequency of independent surface combatant operations, there is a clear rationale for deploying all helicopter-capable surface combatants with a full complement of two SH-60Rs.

(3) There is a strong case for four to six SH-60Rs on forward-deployed carriers and an argument for increasing that number by one to two more to deal with cases where combatants may operate separate from the main battlegroup, or where the ASW/SUW threat is high.

A desirable goal is 270-300 SH-60Rs, to fill the rails on surface deployers and put 4–6 on deploying carriers. Realistically, the Navy is unlikely to acquire more than the 240 envisioned in the Helicopter Master Plan. This makes it even more important to achieve neckdown training efficiencies, and efficiently employ all helicopter resources within the battlegroup, including the SUW capabilities of the CH-60S.

CH-60S requirements

Our approach to CH-60S requirements is also based on determining the number needed to support battlegroup and other forward-deployed forces, then adding those required for nondeployed operations, training, and maintenance. Our estimate for requirements to support deployed operations starts with the helicopter missions and tasks that will be inherited by the CH-60Ss when they replace current helicopters. Within the battlegroup, these are logistics, SAR, and CSAR/NSW. The CH-60 will take on the new mission of organic (assigned) AMCM in the battlegroup, and will contribute to SSC and, if properly equipped, SUW attack.

Estimating requirements

We start with a base case for estimating requirements, and then consider several variations. Our base case is based on converting all current missions, and then adjusts for changes in the future

Table 1 presents our resulting base case estimate for the future CH-60S force level in a battlegroup/amphibious ready group. CH-60s replace the CH-46s on a one-for-one basis on LHA/LHD, CLF, and MSC ships and replace the two HH-60s on the carrier that are now tasked with the CSAR/NSW missions.

MCM Force-21 recommends assigning four CH-60s as forward deploying assets for AMCM, two with the CV and two with the LHA/D. Although CV-based organic AMCM is still far from certain, we have included all four of these with the CV in our base case, not only because of the need for AMCM but also to help with the potentially increasing requirements for SSC and logistics tasks in the battlegroup. Because MSC support for battlegroups in the Pacific is regionally based, we account for this separately (and assume that PAC-deploying battlegroups have only ten CH-60s).

Table 1. Base case CH-60 battlegroup/amphibious ready group force level

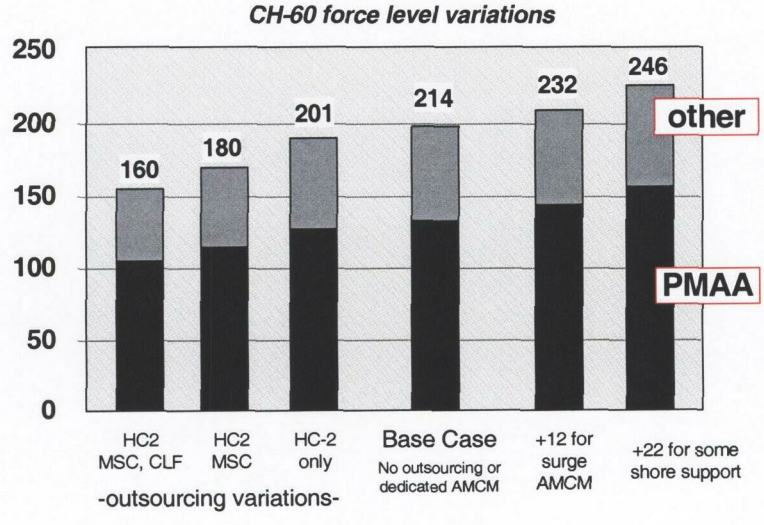
Location	Aircraft	Missions
CVN (2 might be deployed elsewhere in the BG)	6	CSAR/NSW, LOG, SUW, SAR, plane guard (replace HH-60) AMCM (major new mission)
LHA/D	2	SAR, LOG, SSC (replace H-46)
CLF	2	LOG, SSC, SAR (replace H-46)
MSC	2	LOG, SSC, SAR (replace H-46)
Total	12	(Pacific Fleet MSC support is regionally based and does not deploy with the BG from CONUS)

The above requirements, and our standard assumptions regarding numbers needed for non-deployed operations, workups, training, maintenance support, and peacetime attrition, lead to the base case force requirement of **214** aircraft.

Variations on the base case

In addition to the base case, we explored several potential excursions. One group of excursions would reduce the CH-60S requirement through outsourcing land-based fleet support functions, MSC, and CLF functions (either separately or in combination). We also examined two excursions that increase the number of CH-60s in the force. Figure 2 shows a summary of these comparisons.

Figure 2. Comparison of base case and excursions



This study did not conduct an independent assessment of the advantages and disadvantages, or analyze the detailed cost issues associated with potential outsourcing of these missions. We do note that the potential flexibility of using CH-60s in the battlegroup and its synergism with the SH-60R are new arguments that could weigh against outsourcing helos on fleet support ships.

Observations and conclusions on CH-60 requirements

In addition to the above force-level estimates, we draw the following conclusions from our analysis of CH-60 requirements.

(1) Providing logistics and SAR support throughout the fleet accounts for the major effort by today's HC/HM force and will likely continue to be the principal role for CH-60. This includes both the afloat support to the battlegroup and ARG, as well as the shore-based and Fleet Commander/CINC requirements. The CH-60 will assume these missions in the future.

(2) Organic AMCM creates a significant new requirement for CH-60s in the battlegroup. There are important unresolved factors in the total CH-60 numbers: the basing within the battlegroup of the CH-60s to fulfill this role, their resulting flexibility to contribute to other battlegroup missions, and the appropriate mix of assigned and supporting AMCM helicopters .

(3) Outsourcing of the logistics mission is currently being tested for MSC ships supporting the Atlantic Fleet. Whether this is deemed successful from a cost-effectiveness standpoint and, if so, whether civilian helicopters can replace additional CH-60 logistics tasking on CLF ships and shore bases remains to be resolved. A significant factor in the CLF issue may be the loss of the CH-60 multi-mission flexibility within the battlegroup when replaced by commercial helicopters.

(4) There is an opportunity for synergism in SH-60 and CH-60 operations. A prime example of this potential synergism is the ability of CH-60s to contribute to SSC. If armed, they can also contribute to SUW attack missions in coordination with SH-60R and fixed-wing assets.

(5) There is also an opportunity to take advantage of total CH-60 assets in the battlegroup, employing them for different tasks, possibly from different places, as circumstances dictate. The potential payoff from this operational flexibility justifies the effort to meet the associated challenges in training crews for multiple tasks and for managing CH-60s in the battlegroup.

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Background and approach

Over the next ten years, with the implementation of the Helicopter Master Plan, the Navy plans to reduce its helicopter force from seven types of aircraft to just two, the SH-60R and the CH-60S. At the same time, the helicopter force is taking on increased responsibility for battle space dominance missions due to the increased capabilities of new helicopters and "mission shedding" by other forces. For example, the S-3 is slated to retire without replacement, and new surface combatants will not have Harpoons or a towed array. In addition, airborne MCM tasks will be shifted from the current dedicated MH-53 squadrons to CH-60s deployed aboard carriers and amphibious ships. In light of these changes, the Navy is reexamining helicopter force structure and organization.

The Director, Air Warfare Division, N88, asked CNA to study future helicopter force requirements. At the same time, Commander, Second Fleet began a study of helicopter force organization. CNA's work has been coordinated with the Second Fleet study. Portions of this work have been incorporated into the Second Fleet effort. This paper presents the findings of CNA's requirements analysis.

The purpose of this work is to examine the effects of the changes in helicopter missions and capabilities on the need for helicopters in the battlegroup and other operational units. We will look at the size and disposition of the helicopter force in approximately 2010, after the neckdown has been completed. We will not look at the transition from the present force to the future force.

There are two general approaches to estimating requirements for naval forces:

- Surge operations: the forces that would be needed to fight two nearly simultaneous major theater wars when the full fleet is mobilized and surged to the theaters of war.

- Day-to-day operations: the forces needed to sustain day-to-day operations, particularly rotational deployments and forward-based forces.

This study has adopted the rotational requirements approach for two reasons: First, the Navy emphasizes the importance of overseas presence and forward-deployed operations, and justifies many of its forces on this basis. Second, the helicopter forces needed to sustain rotational deployments should be adequate for two MTWs. After examining the rotational requirements, we will check to see how the resulting helicopter forces would outfit the fleet for a wartime surge.

The calculations in this paper are based on current deployment patterns and the QDR force level of carriers and surface combatants. The Navy is proposing to increase surface combatant force levels by some 20 ships by retaining FFGs in the fleet and ultimately building more DDGs. If successful, this plan would likely generate a requirement for additional helicopters beyond the numbers discussed in this paper.

This analysis is presented in two parts. First we discuss the requirements for SH-60Rs, then turn to the requirements for CH-60s. In each case the assessment looks first at the helicopters needed to meet operational tasking, starting with support to rotationally deployed and forward-based forces. Then we estimate the additional helicopters needed to sustain non-deployed operations, workups, training, and maintenance.

SH-60R requirements

The starting point for this assessment of SH-60R requirements is the missions and tasks assigned to forward deployed SH-60Rs and the number of SH-60Rs needed to carry out these tasks. The SH-60R is a multimission aircraft, capable of contributing to a number of warfare and support missions. We focus on battle space dominance (BSD) tasks, particularly antisubmarine warfare (ASW), tasks against enemy submarines; and surface warfare (SUW), tasks against enemy surface threats. We believe that these are the missions that will drive the force requirements.

Once the deployed operational requirements have been determined, the next step will be to examine the number of helicopters needed for nondeployed operations, and the training and maintenance pipelines necessary to sustain the required forward-deployed forces.

Finally, we look at the resulting force to see whether it would be adequate to surge to two MTWs.

SH-60R weapon system

The SH-60R is the Block II Upgrade to the LAMPS Mk III weapons system. It is a remanufacture of existing SH-60B (LAMPS Mk III) and SH-60F (CV helo) airframes. The remanufacture provides a service life extension of 20,000 flight hours and includes the following system improvements:

- A common cockpit with the CH-60S
- A multi-mode inverse synthetic aperture radar (ISAR) with search, tracking, and classification capabilities, including periscope detection
- The advanced low-frequency dipping sonar (ALFS)

- Advanced sonobuoy processing
- New electronics support measures (ESM) for passive detection, localization, and identification of emitters
- Armed helicopter modifications, including Hellfire missile capability and FLIR.

The 60R will be a multi-mission aircraft, capable of participating in a wide variety of missions. A recent briefing by the SH-60R Fleet Introduction Team lists the following missions:

- **SSC.** Surface surveillance
- **ASUW.** Antisurface warfare
- **ASW.** Antisubmarine warfare
- **C2W.** Command and control warfare
- **OTH-T.** Over-the-horizon targeting
- **AMCM.** Airborne mine countermeasures
- **MIO.** Maritime interdiction operations
- **NSFS.** Naval surface fire support
- **LEO.** Law enforcement operations
- **SAR/MEDEVAC.** Search and rescue, medical evacuation
- **MOS.** Missions of State.

The helicopter master plan envisions converting all existing SH-60B and SH-60F airframes, about 240, into SH-60Rs. There are no plans to procure additional SH-60Rs.

ASW and SUW concepts of operation

We begin with a discussion of the concepts of operation for battlegroup ASW and SUW. We look first at how these missions are conducted today and then at the changes in fleet composition that will necessitate changes in the future.

The threat

To keep the discussion unclassified, we discuss the threat only in general terms. Details on the future threat are available from the usual intelligence sources and will not be presented here.

With the demise of the Soviet Union, the fleet no longer faces the threat of a large, capable Soviet submarine force. The submarine forces of some other potential adversaries are getting smaller as well. Nevertheless, ASW will remain an important mission, because even a modest number of submarines, if competently operated, could pose a serious threat to U.S. shipping and naval forces. This is particularly true in the littoral regions that figure prominently in current U.S. naval operations.

The surface threat has also changed dramatically from its Cold War focus on major Soviet warships with long-range anti-ship missiles. The predominant threat today is from fast patrol boats and small combatants. Some of these are equipped with anti-ship missiles, usually short to medium range. Although individually much less threatening than Soviet cruisers, these smaller ships can be a serious threat in littoral regions. Operating in groups, they can pack sufficient firepower to threaten U.S. combatants—if they can get within range.

The challenge: separating the wheat from the chaff

In both ASW and SUW, the threat that a battlegroup will face is likely to be numerically small. Dealing with this threat would not be overly taxing, if it were not masked by a myriad of other contacts. In the case of ASW, the few genuine submarine contacts are likely to be masked by numerous false contacts. For SUW, the threats will be hidden among the normal background shipping traffic.

The prevalence of false contacts is one reason why ASW is so difficult and asset-intensive. A classic example is the Falklands War, where the presence of one Argentine submarine caused British forces to launch 203 ASW weapons, almost all against false targets. Experience in U.S. ASW exercises is similar. Typically about 80 percent of ASW contacts in fleet exercises turn out to be false contacts. The frequency of false

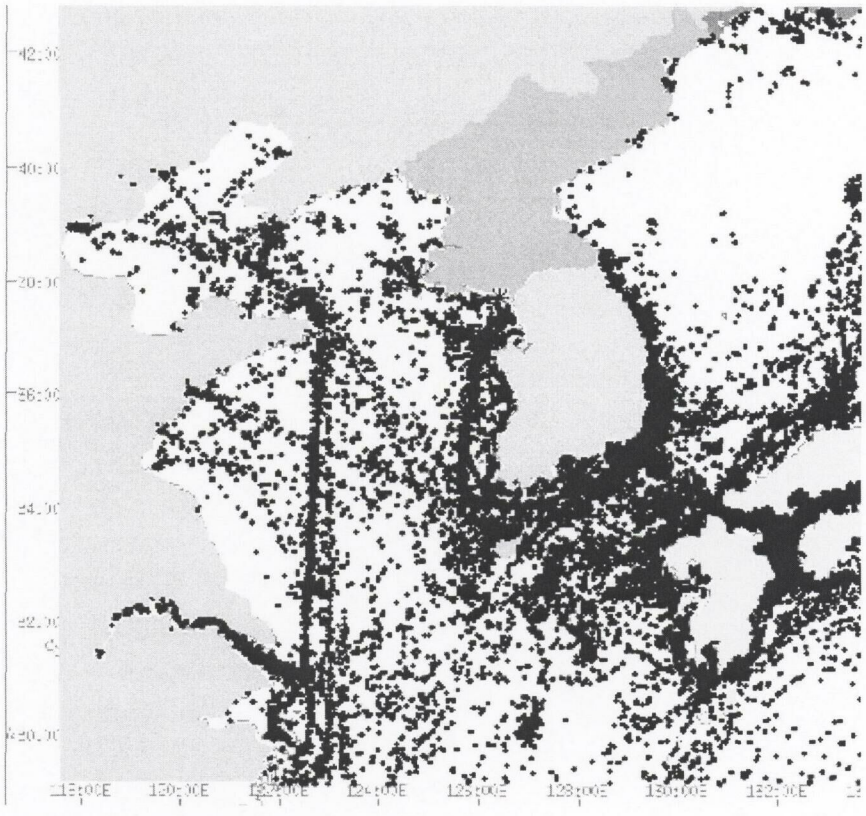
contacts varies widely depending on environmental conditions, the types of sensors employed, and defenders' anticipation of a threat. During intensive battlegroup ASW operations, false contact rates could reach 10–20 per day, especially in shallow water where false contact rates are generally higher.

This will create a significant demand on the SH-60R force for contact investigation. When the prosecution moves to the attack phase, a second SH-60R is highly desirable so that one helicopter can maintain contact with ALFS while the second helicopter positions for the attack against a maneuvering target.

For surface warfare in littoral regions, the central challenge is to keep track of the large number of surface contacts. The problem is more demanding than in the open ocean, where the density of shipping is generally lower, and there is usually space and time to detect and attack enemy ships before they get within firing range. In littoral areas, however, there is less battle space, often places for small ships to hide, and significant background shipping that complicates identifying and tracking surface contacts. As an example, figure 3 shows the shipping traffic around the Korean peninsula on a typical day.

The goal is to identify contacts as they enter the surveillance region and then maintain track. The P-3 and SH-60Rs play key roles in the identification process. Some P-3s will use an electro-optical (EO) sensor and ISAR radar. SH-60Rs will also use their capable ISAR radar for contact identification at longer ranges. In some cases, the helicopter will need to close the target for visual or IR detection. (UAVs with appropriate EO/IR sensors could also contribute to this identification process in the future.) The E-2C could contribute to maintaining the tactical picture, but its radar is not appropriate for identifying surface contacts.

Figure 3. Shipping traffic around the Korean peninsula[a]



a. Illustration supplied by N84.

The contact identification and tracking process works fairly efficiently so long as the density of new contacts is modest and the battlegroup is able to maintain the tactical picture. Operational experience shows, however, that maintaining the tactical picture is a challenging task, especially at night or in poor weather. And once the tactical picture is lost, reestablishing it often involves identifying many contacts. F/A-18s may be able to help in the identification role as a collateral task during other missions. In some cases, the battlegroup commander may need to allocate several F/A-18 sorties at the beginning of the flight day to help reestablish the tactical picture that was lost during the night.

Figures 4 and 5 provide a schematic illustration of this central problem of littoral warfare: The biggest drain on battlegroup assets for ASW and SUW missions is not the enemy order of battle per se, but

rather the challenge in establishing and maintaining the tactical picture in the face of false contacts and background shipping.

Figure 4. Illustrative modeling picture of ASW/SUW

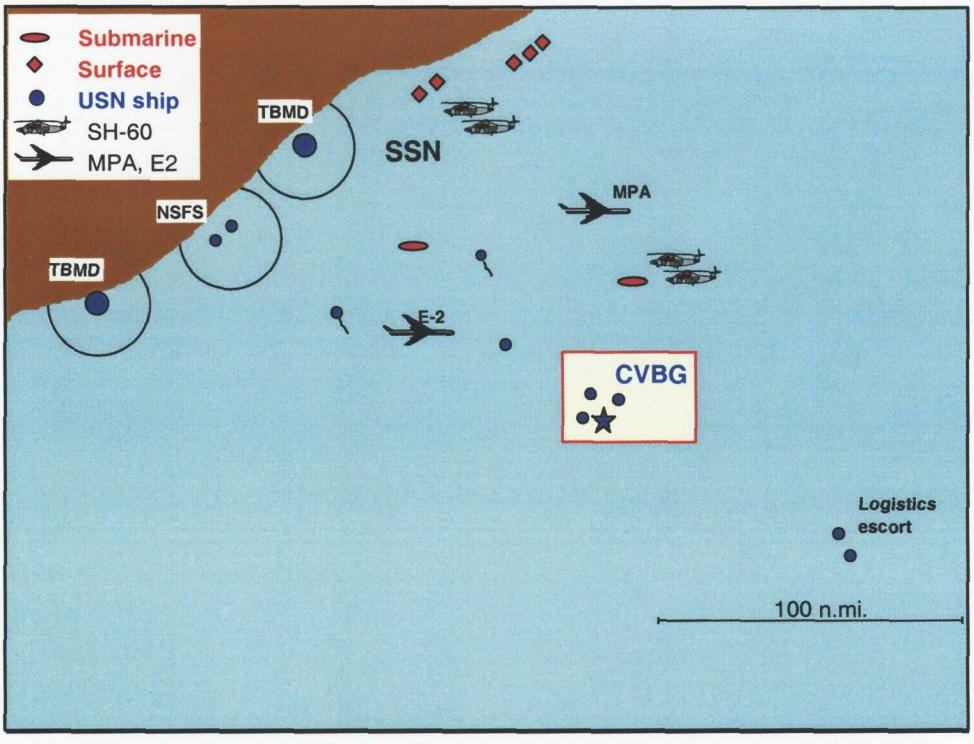
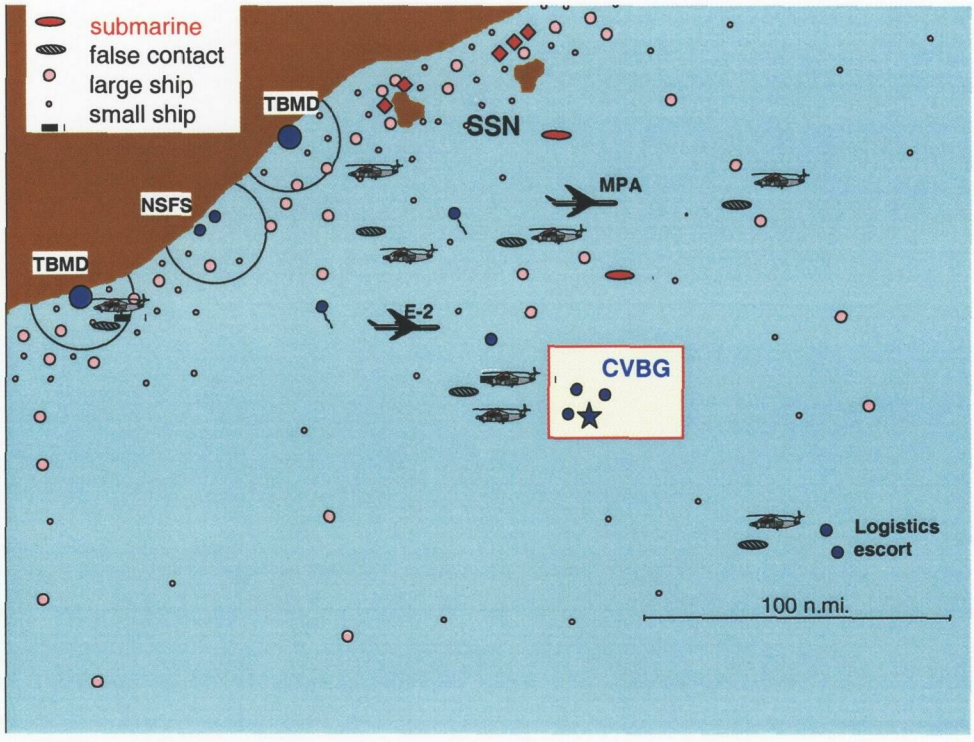


Figure 4 depicts an illustrative situation in which a battlegroup is conducting operations in support of forces ashore in the face of modest enemy opposition at sea—in this illustration, two submarines and five missile patrol boats. Based on the theoretical detection and attack capabilities of the battlegroup, this threat might pose a modest problem and would not stress the resources of the battlegroup. For example, in this illustration four helicopters are adequate to deal with threat surveillance and initial prosecution—so long as the tactical picture is as clear as it is in this diagram.

Unfortunately, the tactical picture is likely to look much more complicated, particularly in littoral regions, as illustrated in figure 5.

Figure 5. Illustrative tactical picture of ASW/SUW



This second chart is more representative of the typical tactical picture in littoral regions. A number of factors, including background shipping, islands, and false contacts, greatly complicate the picture and severely stress battlegroup resources.

For the situation in figure 5, eight helicopters are airborne—rather than four, as in the idealized picture of figure 4. Four of the five helicopters prosecuting potential ASW contacts in the general vicinity of the battlegroup and the logistics escorts are actually pursuing false contacts. One contact is not being investigated, and the prosecution of the submarine is by just a single helicopter due to lack of sorties, vice two in our idealized picture. Meanwhile, the helicopters and P-3 looking for enemy missile patrol boats must deal with background shipping and offshore islands. As a result of these types of factors, even a modest threat could seriously stress the resources of the battlegroup.

Shaping the battlespace

The figures above are only illustrative snapshots. The actual tactical picture will depend on the detailed scenario and will change over time. The naval commander will make every effort to shape the battlespace to reduce the threat prior to moving into an area—for example, by striking enemy ships and submarines in port, or by using submarines and theater surveillance assets to locate and attack enemy submarines prior to the arrival of the battlegroup.

If the enemy submarine force is very small, these precursor actions might be successful in eliminating the entire submarine threat, which would greatly reduce the demand on the helicopter force. In other cases the threat will be larger, or the operational circumstances might not provide sufficient time, or the enemy might take steps to disperse forces and lie low until the battlegroup arrives on scene to begin strike operations. So long as only one or two subs survive (or are thought to possibly survive), ASW operations will be essential and there will likely be a significant number of contacts to investigate, most of which will turn out to be false alarms.

For surface warfare, the issue is whether the cluttered tactical picture that is common during peacetime and low-level crises will persist as the crisis intensifies. Because of the uncertain course of many crisis situations, significant background shipping appears likely until the shooting starts. In fact, the problem may be most difficult at the edge of war, particularly in cases where the U.S. does not control the flow of events, and the possibility and timing of conflict are unknown. Once the real shooting starts, background shipping seems likely to diminish, but the precise effect will be scenario dependent.

Defense in depth

The Navy's current concept for force defense, as promulgated in the Navy-wide standing OPGEN[1] and OPTASKs ASW[2] and SUW,[3] is a

1. Commander, Second Fleet, NAVY-WIDE STANDING OPGEN (U), Message DTG 011745Z Jun 98, Confidential.

layered defense in depth. The concept defines the following zones around the mission essential units (MEUs) of the force:

- **Surveillance area.** Area under systematic observation to detect any object, event, or occurrence of possible military concern.
- **Classification, identification, and engagement area.** Area in which all objects must be [detected], classified, identified, and monitored, and the ability maintained to escort, cover or engage.
- **Vital area.** Designated area around MEUs (usually the threat weapons range) to be defended by the force.

The size and shape of the zones differ by warfare area, but the underlying approach is the same for both ASW and SUW.

Today's practice

This is a brief description of how the Navy employs air assets for battlegroup ASW and SUW today. The surveillance area is covered by long-endurance fixed-wing aircraft: an onstation P-3 from a convenient land base, or carrier-based S-3 or E-2 aircraft.

Within the middle zone, LAMPS helicopters based on surface combatants, as well as P-3 and S-3 aircraft, are used to identify surface contacts and investigate ASW contacts. The onstation P-3 and E-2 maintain track of identified surface contacts. Attack aircraft from the carrier air wing would be used against major surface threats. The LAMPS helicopter also provides over-the-horizon targeting for surface-launched Harpoons. Armed helicopters can attack more modest threats with Hellfire or Penguin missiles.

Within the vital area, surface combatants and carrier-based helicopters with dipping sonar are used to screen the carrier and other mission essential units.

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2. Commander, Second Fleet, NAVY-WIDE OPTASK ANTI-SUBMARINE WARFARE (ASW) (U), Message DTG 300050Z Jan 99, Confidential.
3. Commander, Second Fleet, NAVY-WIDE OPTASK SUWC (U), Message DTG 291300Z Jan 99, Confidential.

What's changing?

Looking toward the future, a number of changes are planned that will affect the force employment concept just described.

- **S-3 retires without replacement.** The S-3s are scheduled to be retired. No replacement is planned. This will leave the battlegroup without the high transit speed and long time on station that make the S-3 a particularly useful platform for surface and ASW search and ASW contact investigation.
- **60R replaces 60B/F.** The 60R will be a significant improvement in both ASW and SUW capabilities over the platforms it replaces.
- **No Harpoon on new surface combatants.** Surface Harpoon capability is being omitted from new surface combatants. As a result, they will rely on their embarked helicopters to engage over-the-horizon surface threats.
- **No towed arrays on new surface combatants.** Current plans are for new surface combatants to have less organic ASW capability, reducing their usefulness as ASW search and screening platforms.
- **Greater overland role for P-3s.** The P-3 is being given new missions supporting overland operations. This may lessen its availability for ASW and SUW surveillance.
- **Introduction of unmanned air vehicles (UAVs).** There is some chance that UAVs will be developed that can contribute to the surface surveillance and contact identification missions.

In light of these changes, we envision the following concept for ASW and SUW force employment in the future:

Fixed-wing aircraft, P-3s and E-2s, will continue to monitor the surveillance area. These aircraft will possibly be augmented with UAVs. Current Navy planning assumes that a P-3 will be available for this mission. In those situations when P-3s are unavailable (e.g., due to higher-priority tasking for overland support, or lack of access to suitable land bases), SH-60s would be required to cover the surveillance

area. Based on radar coverage alone, we estimate that about four 60Rs on station would be required to replace the search capability of one P-3. This is clearly impractical given the 60R's endurance, transit speed, and likely number in a battlegroup.

With the retirement of the S-3, the lion's share of the middle zone tasks—ASW search, ASW contact investigation, and surface contact identification—will fall to the SH-60R. The P-3 can also contribute, but generally there will be tactical incentives not to divert the P-3 from its high-altitude surveillance role. These tasks are likely to lead to a requirement for an SH-60R continuously airborne in the middle zone for ASW search and alert helicopters for contact investigation and identification. Engagement of surface targets would be done with attack aircraft from the carrier air wing or a pair of SH-60R/CH-60S helicopters.

In the Vital Area, carrier-based 60Rs will be used for screening. Vertical-launch ASROC or alert helicopters will conduct urgent attacks, as needed.

Summary of SH-60 roles in ASW and SUW

ASW

Search and surveillance. Although the P-3 will be the primary wide-area search platform, the SH-60 will play an important role in the middle zone using its advanced low-frequency active dipping sonar and employing its radar in a periscope detection mode. It can also deploy sources for IEER detection, with towed arrays on the surface combatants serving as the receivers.

Contact investigation and attack. The SH-60R will have a primary role in prosecuting ASW contacts. The ALFS dipping sonar should be very effective for contact investigation. When a contact has been identified as valid, a second SH-60 will likely be called in so that a pair of helicopters is on scene to track and attack a maneuvering, evading target.

Close-in screening. Carrier-based 60Rs will be used for screening when there is a submarine threat. The SH-60R will also remain the

only carrier-based asset for rapid response to immediate submarine threats.

SUW

Surveillance and contact ID. A key SUW role of the 60R will be investigating and identifying contacts. The SH-60R's excellent ISAR radar will be its primary identification sensor, which in many (but not all) cases should also be able to identify larger contacts from standoff ranges. In other cases, the helicopter will need to come in closer to identify the target with its capable FLIR or perhaps even visually. There will be a steady demand, depending on the density of background shipping, to identify new contacts that enter the surveillance area, plus peak demands in cases where the tactical picture deteriorates due to poor environmental conditions or for other reasons.

Other forces can help in this task, particularly in cases of peak demands. For example, CH-60s can participate in the contact identification mission using their FLIR or visual. F/A-18s can also contribute to the identification process under visual conditions. The battlegroup commander will usually not want to divert F/A-18s in this role, but would do so under special circumstances—for example, at first light if the surface picture was lost overnight.

Attack. SH-60Rs or a SH-60R/CH-60S pair armed with Penguin or Hellfire will also assume a more prominent role in attacking SUW threats, along with P-3s armed with Maverick and Harpoon. F/A-18s can also be used for surface attack if necessary, but the goal is not to divert F/A-18s from their strike role unless necessary. The most likely case in which F/A-18s would be used is if the surface targets possessed surface-to-air missiles that posed a serious threat to the attacking helicopters.

What is the operational requirement?

Above, we discussed the concept for employing SH-60Rs in the battlegroup. Now we look at how many helicopter sorties this concept might require.

The following are the key factors that will drive SH-60R sortie requirements:

- **Simultaneous submarine and surface threat.** It appears that, in the future the Navy must be prepared to deal with simultaneous ASW and SUW threats.
- **Availability of P-3s.** According to Navy plans, in most situations a P-3 will be available to support battlegroup surveillance operations round the clock. If a P-3 is not available, there would be an increased requirement for SH-60 sorties and some added risk would be inevitable because the battlegroup simply could not maintain a comparable surveillance posture.
- **ASW false contact rate.** The ASW false contact rate is key, because the SH-60R will be the primary prosecution platform. The number depends on environmental conditions, operator skill levels, and perceptions of the threat, but is not directly linked to actual threat levels. It appears that the battlegroup should be prepared to deal with at least ten ASW contacts per day. At least one 60R sortie will be required to resolve each false contact.
- **Surface contact density.** For SUW, the key factors are the surface contact density and the likelihood/frequency of losing the tactical picture that requires re-identifying some of the targets.
- **Other tasking for surface combatants.** Another important consideration is the likelihood that some surface combatants may be detached from the battlegroup to conduct theater missile defense or surface fire support operations. These ships would depend heavily on their helicopters for local ASW and SUW ops. Depending on the tactical geometry, these helicopters might not be in a position to support the battlegroup, placing an increased demand on the remaining battlegroup helicopters.
- **Plane guard.** Under what circumstances will the SH-60R be required to contribute to plane guard operations?

Requirements for ASW and SUW

As discussed above, simultaneous submarine and surface threats lead to considerable tasking for SH-60Rs for both ASW and SUW. A key question is: Are SH-60R requirements for ASW and SUW missions additive? Or, is the overlap in time and place so great that one helicopter can fulfill ASW and SUW tasks at the same time? If the latter is true, the number of helicopters needed for both ASW and SUW is only the number needed for the most demanding task.

As usual, the real situation is somewhere between these two extremes. The SH-60R is a multi-mission aircraft that provides significant capabilities for ASW and SUW (and other missions). This multi-mission capability is enhanced by a very capable data link that allows transmitting sensor data to ships in the battlegroup for additional processing and correlation.

On the other hand, there are limitations on effectiveness when doing ASW and SUW tasks at the same time. For example, effective surface surveillance with radar requires the SH-60 to operate at altitudes of several thousand feet, which is not an appropriate altitude for ASW surveillance. The SH-60R should be below 1,000 feet for radar search versus periscopes and to deploy its advanced low-frequency dipping sonar. Similarly, the SH-60R can carry a torpedo and Hellfire at the same time, so conceivably onstation and alert helicopters could be outfitted to respond for both ASW and SUW prosecutions. But with the added weight of both weapon types, fewer weapons of each type can be carried and/or time on station will be limited. In some tactical situations these limitations may not be acceptable.

The bottom line is that the requirements for ASW and SUW will certainly exceed those of either mission alone. The result will be a serious stress on SH-60Rs in those cases with both ASW and SUW threats. One offsetting factor is the capability of CH-60s in SUW. Though lacking the radar of the SH-60R, the CH-60 will have a good IR sensor, and it will be able to carry Hellfire. CH-60s could contribute to contact identification and join SH-60Rs for coordinated attacks on surface targets.

Plane guard

Operational safety for carrier flight operations dictates that a surface combatant or airborne helicopter be in the immediate vicinity to provide search and rescue in response to an operational flight emergency during launch and recovery. In many situations, tactical circumstances dictate that this task fall to helicopters on the carrier. Today this task is shared by the SH-60Fs and HH-60Hs on the carrier.

The CH-60 is well suited to this task, but it would be desirable to use SH-60Rs to contribute to plane guard, particularly during close-in ASW operations when the SH-60R could do plane guard as a collateral task. There is some question about using SH-60Rs for plane guard because of their space and weight limitations. These limitations mean that, unlike the SH-60F, the SH-60R is intended to have only one air crewman. Current Navy policy calls for two air crewman aboard the plane guard helicopter, one of whom is a rescue swimmer. The sonar can be removed to provide more space and weight, but this would defeat the goal of doing plane guard and close-in ASW at the same time.

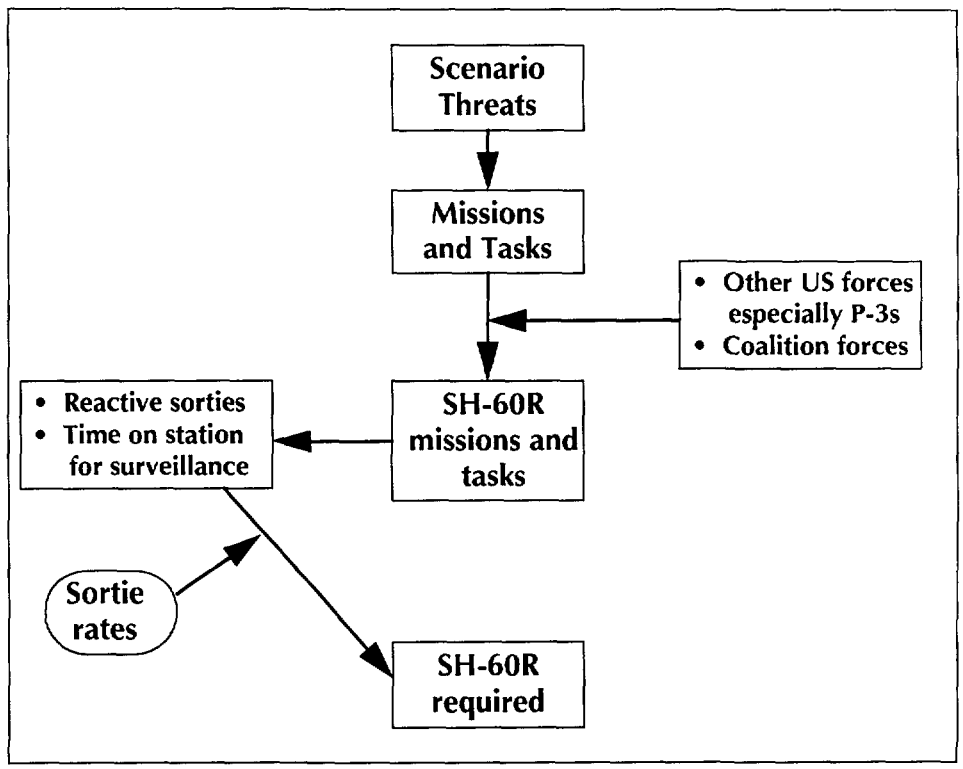
We assume that the SH-60R will be acceptable for plane guard, at least when there are heavy demands on the helo force in the battlegroup. The analysis assumes that in the presence of a submarine threat an SH-60R from the carrier would be kept airborne for ASW screening, but, like the practice today, during aircraft launch and recovery periods the screening helicopter would leave its screening position to function as plane guard.

Maintaining plane guard for a 15-hour flight day would require at least five helicopter sorties. If the 60R is judged not suitable for plane guard, the demand on CH-60s in the battlegroup would increase significantly. For example, three CH-60s would be required to fly the sorties, meet current policy that a second rescue helicopter be on alert in addition to the one that is airborne, and allow for maintenance problems.

Battlegroup requirements

Based on the preceding discussion, we are now ready to address the number of SH-60Rs "required" in a battlegroup. The logic follows the block diagram shown in figure 6 below. The scenarios and threats lead to ASW and SUW tasks for the battlegroup. Some of these will be carried out by other forces, particularly P-3s. The remaining tasks will fall largely to the SH-60Rs.

Figure 6. Operational requirements logic flow



For analytical purposes, the SH-60R tasks can be measured in terms of average daily **time on station** for surveillance plus the number of **reactive sorties** to prosecute ASW or SUW contacts.

In figure 6, this requirement estimate is depicted as a top-down linear process proceeding from scenarios and threats to helicopters

required. The calculation can also be reversed. For a given number of SH-60Rs, we can calculate the sustainable level of effort in terms of time on station and reactive sorties, and then compare the result to our notion of the demands of likely scenarios. In practice, it is useful to take both perspectives.

Table 2 shows several sample cases. In the "worst-case" situation, a single battlegroup faces a combined ASW/SUW threat, P-3 support is not available for extended periods of time, and there is a high rate of false contacts. This case would create a demand that would outstrip the practical number of helicopters in a battlegroup.

Table 2. Sample requirements cases

	Worst case	Average case	Non-stressing case
Own Force Size	Single BG	Single BG	Multiple BGs + coalition forces
Threat	ASW/SUW	ASW/SUW	ASW/SUW
Land-based support	no P-3	on-station P-3	two P-3s
ASW false contacts	high	moderate	moderate
Number on station	6+ on station 1 screening/plane guard 1 ASW search 4+ surveillance in outer zone	2 on station 1 screening/plane guard 1 ASW search	1 on station screening/plane-guard
Additional reactive sorties	high demand for reactive sorties	Moderate demand (~10/day)	Low to moderate demand
Number of 60R required in BG[a]	**32+ SH-60**	**12-14 SH-60**	**10 SH-60**

a. Based on high-intensity (surge) sortie rates from N88's Wartime Aircraft Utilization Planning Factors. The same planning factors indicate that maintaining this posture for more than a few days would require a 33-percent increase in the number of aircraft required.

The "average" case is somewhat more likely. It is a situation the Navy should be prepared to deal with, given its role in early crisis response. A single battlegroup with P-3 support could have to deal with a simultaneous submarine and surface threat in the face of moderate false

contacts and background shipping. This would lead to a demand for at least 12 to 14 SH-60s in the battlegroup.

When additional battlegroups, other U.S. forces, and coalition forces are on scene, the demands on a single battlegroup would lessen—though detaching surface combatants for other tasking might also be more likely. In addition, more P-3s are likely to be on scene and the area covered by each battlegroup would likely be smaller. In this case ten SH-60s per battlegroup should be adequate.

Table 3 looks at the problem from the other direction by showing the number of stations maintained and reactive sorties available per day as a function of the number of SH-60Rs in the battlegroup. These numbers are based on an average sustained sortie rate of two sorties per SH-60R per day. (Some helicopters may fly three sorties per day, while others fly only one or none due to maintenance considerations.)

Table 3. Capability vs. number in battlegroup

Total 60R in BG	10	12	14	16
On CVN	4	4	6	8
On surface combatants[a]	6	8	8	8
Sorties per day[b]	20	24	28	32
Reactive sorties available in addition to:				
1 SH-60R on station[c]	11	15	19	23
2 SH-60R on station[d]	2	6	10	14
3 SH-60R on station[e]	--	--	1	5

a. We assume the 2010 battlegroup will have four dual-helo combatants (eight rails) and one non-helo capable ship.
b. Each 60R flies an average of two sorties per day (high intensity sortie rate).
c. 9 sorties required to maintain one station.
d. 18 sorties to maintain two stations.
e. 27 sorties to maintain three stations.

The calculation assumes that nine sorties are needed to maintain one helicopter on station. The precise number will vary slightly depending on the range from the ships to the station and whether aircraft are relieved on station. In some cases, an additional sortie or two would be needed for 24-hour coverage.

Fourteen helicopters in the future battlegroup corresponds to equipping all helicopter-capable surface combatants with two SH-60Rs plus deploying six SH-60Rs on the carrier. (This assumes that one of the surface combatants in the battlegroup is a DDG-51 flight I/II ship that is not helicopter-capable.) The corresponding number for current battlegroups is ten SH-60s, four SH-60Fs on the carrier, and an average of six SH-60Bs on surface combatants. The reason for having fewer SH-60s on the surface combatants today is (1) there are still a few single-rail ships in the fleet, and (2) a typical battlegroup/MEF usually deploys with one fewer SH-60B than the number of rails. (One dual-rail ship deploys with only a single helicopter).

Our data indicate that the current battlegroups are limited to maintaining one helicopter on station and generating 11 reactive sorties per day, or maintaining two on station with only two additional reactive sorties. Neither of these will be sufficient to meet all tasking in situations where there is a combined ASW/SUW threat, potential close-in threats to the carrier, and some need for SH-60s to do plane guard. Fourteen helicopters in a battlegroup would be able to maintain two stations continuously and provide about ten additional reactive sorties (table 3).

Independent operations by surface combatants

So far the discussion has focused on battlegroup requirements, because the SH-60s are playing an increasingly crucial role in battlespace dominance operations for the battlegroup. But it's also important to consider that surface combatants do (and will in the future) operate independently from the battlegroup in some circumstances.

There are two specific cases where groups of surface combatants could face crises involving ASW and SUW threats: the Middle East Force, and surface combatants that remain in the Mediterranean when the CVN pulses to the IO. In other cases, surface combatants might be separated from the battlegroup for tactical reasons, such as theater missile defense (TMD), surface fire support (SFS), and logistics force or amphibious group escort.

These operations strengthen the arguments for filling the rails on deploying surface combatants in two ways. First, the independent surface combatants will depend heavily on their helicopters to detect and prosecute ASW and SUW threats beyond immediate self-defense ranges. Two SH-60Rs will be needed for any type of sustained operation.

Second, even though SH-60Rs have significant range, the tactical disposition may effectively preclude mutual support between the main battlegroup and surface combatants conducting TMD and SFS missions. This makes it even more important that the helicopter-capable surface combatants remaining with the battlegroup have two helicopters each to meet battlegroup needs.

Zero-based approach to BSD requirements

The SH-60R requirements discussion presented above is largely empirical. It is based on looking at how battlespace dominance missions are performed today and assuming that equivalent capability will be necessary in the future. Essentially, we took the battlespace dominance missions of the platforms being replaced by the SH-60R, the SH-60B, SH-60F, and S-3B, and then estimated the number of SH-60R required to provide an equivalent capability.

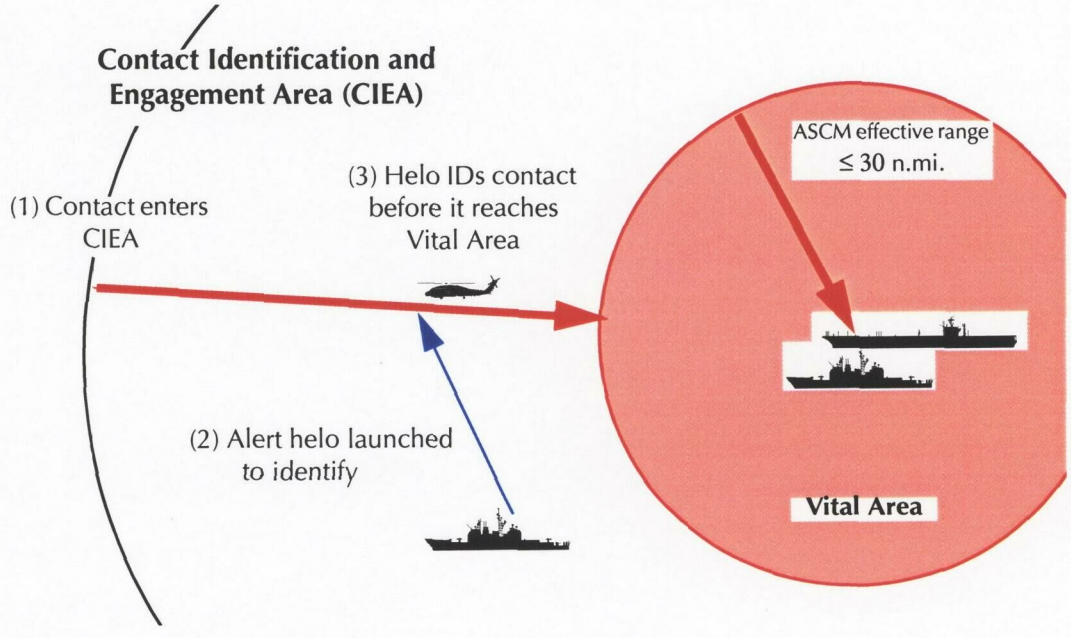
At the request of COMSECONDFLT, we also performed a more traditional threat-based requirements analysis to validate the results presented above. The results of that work are presented here. The details are given in appendix A, where we look at the battlespace dominance capability required by a battlegroup and then determine the number of SH-60Rs (and other battlegroup assets) needed to achieve that capability. We first look at the requirements for doing SUW and ASW tasks using helicopters only, and then look at how these requirements would be reduced when other platforms participate.

There are some important caveats for this work. Demand for SH-60R sorties is quite sensitive to environmental conditions and precise details of the scenario. As will be shown, reactive sorties (for contact investigation and identification) are a driving factor, but their rates are unknown and highly variable. In view of these uncertainties, only rough, simplified estimates are being made.

As with our empirical analysis, the concept of operations is layered defense. The Vital Area is the area within the threat weapons range of the protected unit(s). The Contact Identification and Engagement Area (CIEA) is the region surrounding the Vital Area. The CIEA is sized so that any threat entering the CIEA can be detected, classified, and engaged, if necessary, before it can penetrate the Vital Area. Our analysis focuses on helicopter requirements for the CIEA and Vital Area, the traditional employment area for rotary-wing aircraft. In general, helicopters will not have the speed or endurance to contribute to operations in the surveillance area.

The concept for sizing the CIEA against a surface threat is depicted in figure 7. The figure shows the following events: (1) a surveillance platform detects a new surface contact entering the CIEA. If the surveillance platform is not able to classify the contact as threat or non-threat, then (2) an alert helo is launched to identify the contact. The CIEA is sized so that if the contact is, in fact, a threat closing at maximum speed, the helicopter will have time to intercept and engage the contact (3), before it can enter the Vital Area.

Figure 7. Sizing the CIEA for SUW



Threats

The surface threat comes from small combatants (PTGs) armed with antiship cruise missiles and fast patrol boats (FPBs) with light weapons. Maximum cruise missile ranges are about 20 to 65 n.mi., but unless an opponent possesses an over-the-horizon targeting (OTH-T) capability, the maximum *effective* cruise missile range is 20 to 30 n.mi. The results given here assume no OTH-T capability, which is judged to be the case for most likely scenarios. The impact of an effective OTH-T capability is shown in appendix A. Maximum weapons range for fast patrol boats is 10 n.mi. PTGs are assumed to have a maximum sprint speed of 35 to 40 knots; FPBs have a maximum speed of 45 to 55 knots.

The submarine threat is taken to be a torpedo-firing conventional submarine. Maximum torpedo range is (generously) taken to be 10 n.mi. The submarine's maximum speed crossing the CIEA is assumed to be 3 to 8 knots.

SUW requirements

Sizing the CIEA. Table 4 shows the results of calculating the CIEA radius for cruise missile threats. The table shows that against a 30-n.mi. threat (the maximum effective range without a sophisticated OTH-T capability) the CIEA radius should be 55 to 60 n.mi. for helicopters on 30-minute alert, and 70 to 80 n.mi. for helicopters on 60-minute alert. Table 5 gives the CIEA radius against FPBs armed with light weapons. A comparison of the two tables shows that the ASCM threat is slightly more stressing; thus sizing the CIEA to handle the ASCM threat should also take care of the FPB threat.

Table 4. CIEA radius for ASCM threat

Helicopter alert posture	Threat speed (kt)	Effective threat weapon range (n.mi.)			
		25	30	50	65
Alert-30	35	47	55	79	98
	40	50	58	83	102
Alert-60	35	65	72	97	115
	40	70	78	103	122

Table 5. CIEA size for FPB threat

Helo alert posture	CIEA radius (n.mi.)[a]
Airborne	18
Alert-15	32
Alert-30	46
Alert-60	73

a. 55-kt speed; 10-n.mi. weapons range; 5-min. C2 delay.

The calculations shown above are for a stationary mission-essential unit. When we include maneuvering room for an aircraft carrier conducting flight operations, it adds another 20 to 30 n.mi. to the size of the CIEA. Thus, a CIEA with about a 100-n.mi. radius provides adequate reaction time against FPBs and 20- to 30-n.mi. ASCMs as well as maneuvering room for carrier flight operations.

Initializing the surveillance picture. The surface picture needs to be initialized (that is, every contact in the CIEA identified) when the battlegroup first arrives in the area, and any time the picture is lost thereafter. Past experience shows that this can be as often as every morning, because the picture is frequently lost at night, or as infrequently as every few days. Tactic S-1 of NWP-3-20.1 requires six aircraft sorties (helicopters or tactical aircraft) to visually identify every contact within a 100-n.mi. circle.

Maintaining the surveillance picture. As described in appendix A, a single SH-60R operating at 5,000 to 6,000 feet can maintain track on surface contacts within 100 n.mi. The imaging ISAR on the 60R should have a good capability to identify large (>1,000 tons) contacts entering the area. However, small contacts could be threats and could add significantly to surveillance and identification requirements.

In addition, there will still be some new contacts requiring visual identification. In appendix A, we estimate that for a contact density of 250 per 100,000 sq.n.mi., which is typical of the Mediterranean and high traffic littoral areas, there will be about ten new contacts per hour within a 100-n.mi. CIEA. Even if ISAR is able to classify 90 percent of these, there would still be one contact per hour requiring visual

identification. Some of these contacts could be identified by tactical aircraft which just happened to be in the area, and others by SH-60Rs already out on ASW missions—but some surface contact identification would require dedicated helicopter sorties. We assume that at least ten helicopter sorties per day would be required to visually identify new surface contacts; however, the exact number could be much higher or lower. These sorties could be flown by the CH-60, provided that it is armed and equipped with FLIR and the datalink.

Helicopters required for SUW. Table 6 sums up the helicopter requirements for surface warfare. Initializing the surface picture requires six armed helo sorties (R or S); these sorties could be flown by tactical aircraft, if they are available. Maintaining the surface picture requires nine SH-60R sorties to keep one aircraft continuously in the highboy position, plus at least ten additional armed helo sorties (R or S) for contact identification. The on-station, ISAR-equipped P-3 could also perform the highboy function. The E-2C, as well, could maintain the surface tracks, but the E-2 does not have ISAR's contact ID capability. So, if an E-2 were used to maintain the surface picture, there would be an additional demand for contact identification sorties. Tactical aircraft could also be used for contact identification, but that is fairly unattractive tasking as it would require diverting them from their primary mission of strike.

Table 6. H-60s for SUW

	Sorties	
	R	R or S[a]
Initialize picture[b]		6
Maintain highboy	9	
Contact ID[c]		10
Total sorties	9	10-16
Total aircraft	4.5–6	5–11

a. Assumes that CH-60S is armed and equipped with FLIR and datalink.
b. Assumed once per day.
c. Assumed ten per day.

ASW requirement

We looked at two types of ASW operations that battlegroup helicopters would contribute to: area sanitization prior to the arrival of the battlegroup, and the steady-state operations defending a battlegroup in a MODLOC. ASW sensor performance is highly variable and highly dependent on environmental conditions. Rather than making performance estimates for specific target/location/season combinations, we parameterized the ALFS sensor perfomance to cover the range of conditions that are likely to be observed.[4] We chose 2, 5, and 10 n.mi. as representative of detection ranges that might be obtained in real operations. When the helicopter's flight characteristics and typical search practices are factored in, these detection ranges correspond to search rates of about 90, 360, and 900 sq.n.mi. per hour.[5]

Precursor search. For precursor area sanitization, we look at three area sizes: 2,500, 5,000, and 10,000 sq.n.mi. These correspond to boxes ranging from 50 x 50 n.mi. to 100 x 100 n.mi. By the random search formula for estimating search effectiveness, searching the area with 90-percent confidence requires a coverage factor of 2.3. This means that to have a 90-percent probability of detection in a 5,000-sq.n.mi. area, we must apply 2.3 x 5,000 = 11,500 sq.n.mi. of search effort.

Table 7 shows the number of SH-60R sorties required to sanitize an area with 90-percent confidence.

This type of search is conducted prior to the battlegroup's entry into an area. It seems likely that at most two surface combatants with two SH-60Rs embarked on each would be dispatched ahead of the battlegroup for this operation The numbers in **bold** in table 7 show those cases where a force of four 60Rs could accomplish the search in one or two days.

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4. David M. Ruskin et al. *Capabilities of U.S. Tactical ASW Systems in Regional Conflicts (U)*, CNA Report 192, Secret/NOFORN, May 1992.

5. Appendix A contains the details of this calculation.

Table 7. SH-60R sorties for area sanitization

ALFS detection range (n.mi.)	Area size (sq.n.mi.) 2,500	5,000	10,000
2	23	52	127
5	**6**	**13**	33
10	**2**	**5**	**13**

MODLOC operations. The considerations for sizing the middle zone (CIEA) for ASW are the same as they were for SUW. The surveillance goal is to detect and engage any hostile submarine entering the middle zone before it can penetrate to within weapons range of the carrier. Thus, the middle zone must be large enough that ASW units will have adequate time to detect and prosecute a hostile submarine, but small enough that the area can be searched with the forces available. Table 8 shows how long it takes a submarine to cross a middle zone of a given size; table 9 shows how long it takes a single ALFS-equipped SH-60R to search various sized middle zones.

Table 8. Time required for submarine to cross CIEA (hours)[a]

Submarine speed (kt)	CIEA radius (n.mi.) 20	30	50
3	3.3	6.7	13.3
5	2.0	4.0	8.0
8	1.3	2.5	5.0

a. Assumes 10-n.mi. effective torpedo range, which is generous for daytime. Nighttime range would be much less.

Table 9. ASW revisit time for a single SH-60R (hours)[a]

ALFS detection range (n.mi.)	CIEA radius (n.mi.) 20	30	50
2	14	31	87
5	4	8	22
10	1	3	9

a. Time required for a single SH-60R searching with ALFS to cover the entire CIEA.

To search the middle zone effectively, the ASW revisit time should be no more than the submarine's transit time. For example, table 8 shows that a 5-knot submarine requires four hours to penetrate from 30 n.mi. to its 10-n.mi. firing range. Table 9 shows that with a detection range of 5 n.mi., one helicopter requires eight hours to cover a 30-n.mi.-radius CIEA. Thus, at least two helicopters would be required to achieve a revisit time less than the submarine's transit time. Table 10 shows the number of helicopters required in other situations.

Table 10. SH-60Rs required for middle zone search[a]

ALFS detection range (n.mi.)	CIEA radius (n.mi.)		
	20	30	50
2	7	8	11
5	2	2	3
10	1	1	1

a. Number of helicopters searching continuously needed to achieve the required revisit rate against a 5-kt submarine.

As in the case of precursor search, the answer depends strongly on the acoustic conditions. For poor conditions, the number of helos required—seven or more on station, which would require more than 30 helos in the force—is not practical. In these cases the tactical commander must rely more on close-in screening or some other approach. For better conditions, two helicopters on stations should be adequate.

Helicopters required for ASW. Table 11 totals up the helicopter requirements for ASW. We assume two continuously on station for middle zone search. One of these two also provides the close-in screening of the carrier. We assume an additional ten sorties per day for false contact resolution (about ten false contacts per day, with each requiring one sortie for resolution).

All of these aircraft must be SH-60Rs because all of these sorties require its ASW capabilities.

Table 11. H-60s for ASW

	SH-60R sorties per day
Screening	9
Middle zone search	9
Contact ID	10
Total sorties	28
Total aircraft	14

As noted earlier, the false contact rate is difficult to predict. The prevalence of false contacts has been demonstrated time and again in exercises and actual operations. Although historically in fleet exercises 80 percent of battlegroup ASW contacts are false contacts, the number seems to be related more to the perception of a threat than to actual threat levels. Environmental conditions also appear to play a role. We do not have a firm estimate for the false contact rate, but believe that the above number is reasonable and is *not* a worst case.

Battlespace dominance requirements

Table 12 adds up the helicopter requirements for battlespace dominace tasks. In this table we assume that no other assets help out with battlespace dominance tasks in the CIEA and that there is little or no sharing of ASW and SUW tasking on a given helicopter sortie. Under these harsh assumptions, the requirement is 19 SH-60Rs and eight additional aircraft which can be either SH-60Rs or CH-60Ss.

Table 12. H-60R/S for battlespace dominance (helos only)

	Sorties	
	R	R or S
SUW	9	16
ASW	28	0
Total sorties	37	16
Total aircraft	19	8

Sharing the load. Table 12 gave the helo-only solution to the problem of battlespace dominance in the middle zone. We now look at what other assets might be available to perform some of these tasks. This discussion is sumarized in table 13.

Table 13. Using other assets for BSD

		Sorties per day		
		R	R/S	Alternate platform
SUW	Maintain highboy	9		P-3/E-2, when available
	Contact ID		10	TACAIR (unlikely due to strike demands), UAV?
	Initialize picture		6	TACAIR (likely, if not needed too often)
ASW	Screening	9		Escorts, probably not adequate for full screen
	Middle zone	9		P-3, when available
	Contact ID	10		P-3 (unlikely, interferes with surveillance)

It seems quite likely that a P-3 or E-2 would be available most of the time to maintain the surface picture (although the E-2 would not have ISAR's contact ID capability, increasing the demand for contact ID sorties). If the surface picture needs to be initialized no more than once a day, Tacair would probably be available to do the job. Tacair would probably not be available for the steady-state surface contact ID sorties, although in the future UAVs might do some of this.

There is less availability of other assets for ASW. When acoustic conditions are very good, surface combatants may be able to handle the screening duties. The P-3 could be used for middle zone search, but it is probably better employed in the outer zone. The P-3 could also be used for false contact resolution, but it is probably better left at high altitude for surveillance.

The preceding discussion has given the requirements for helicopters when no other assets are taken into account, and a listing of the contribution that could be made by other units. We now present our best guess of which BSD tasks would be performed by other units and

which, for planning purposes, would be left for battlegroup helicopters. This estimate is summarized in table 14.

Table 14. H-60R/S for battlespace dominance using all available assets

	Sorties per day				
	R		R or S		
SUW	~~9~~	**0**	~~16~~	**10**	E-2/P-3 maintain picture; TACAIR initializes
ASW	28		0		P-3 outer zone; 60R middle zone
Total sorties	~~37~~	**28**	~~16~~	**10**	
Total aircraft	~~19~~	**14**	~~8~~	**5**	

The E-2 and/or P-3 would most likely be available to maintain the surface picture (reducing 60R sorties for SUW by 9). The P-3 would also provide outer-zone ASW. TACAIR would probably be available to initialize the surface picture, provided that such tasking is needed no more than once a day (reducing R/S sorties for SUW by 6). Helicopters would still be needed to identify surface contacts entering the area.

This leaves a requirement for two SH-60Rs on station for ASW surveillance in the CIEA and screening of the carrier plus additional sorties for ASW and SUW contact identification and prosecution. As noted earlier, the number of contact ID sorties is driven by false contact rates, shipping densities, and ISAR identification capabilities—all of which are variable and somewhat uncertain. We believe that a planning factor of ten per day for each is likely in some cases, and is a reasonable requirement. Thus, for situations where a battlegroup faces a combined ASW and SUW threat, this equates to a requirement for 14 SH-60Rs and 5 additional helos that can be either SH-60Rs or CH-60Ss (provided that the 60S is armed and equipped with FLIR and data link). Under certain circumstances one SH-60R might be able to do both ASW and SUW ID tasks on a single sortie, but the required coincidence of timing and geography cannot be counted on. If a third of the reaction sorties could do both, the requirement would be reduced to 14 Rs plus 2-3 R/S.

Required force size

We now turn to the second part of our requirements process: translating the number of rotationally deployed and forward based SH-60s into an overall force-level requirement. Since non-deployed helicopters account for roughly three fourths of the total, this part is important.

Some of the factors are a direct consequence of the deployed forces, but others could be affected by the shore organization and by potential efficiencies associated with the helicopter master plan.

In 1995, to support the Helicopter Master Plan, CNA developed a method for deriving force levels from forward operational requirements.[6] This method is described in detail in appendix B. Briefly, we first determine the number of helicopters required for peacetime forward-deployed operations, and then apply standard planning factors to calculate the infrastructure needed to support the deployed units.

CNA's method is task based rather than organization based. We assume that on any given day a particular aircraft is assigned to one of a number of mutually exclusive tasks. Summing over all the tasks gives the required force size. Another approach would be an organization-based method: The 60R force will be organized as x squadrons of y aircraft each. If the organization is designed to manage the resources efficiently, the two approaches will produce about the same results. If there are sound organizational reasons why efficiencies assumed in the task-based scheme cannot be achieved, then discrepancies will arise between the two methods.

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6. Gregory N. Suess et al. *Future Navy Helicopter Requirements: A Summary*, FOUO, Dec 1995 (CNA Annotated Briefing 95-108). Also, John V. Hall. *Method and Data for Calculating LAMPS Mk III Helicopter Requirements*, Unclassified, Mar 1995 (CNA Annotated Briefing 95-21).

The tasks we have chosen are the following:

- **Forward deployments.** Long (six-month) deployments with either a carrier battlegroup (CVBG) or the Mid-East Force (MEF).
- **Forward-based forces.** The helicopters based in the Western Pacific that deploy with the forward-deployed naval forces (FDNF) units homeported in the Western Pacific.
- **Other deployments.** Long deployments that require less than a fully combat ready capability. These include some counternarcotics operations, UNITAS, SNFL, and CARAT deployments.
- **Miscellaneous operational tasking.** Operations of less than 56 days that are not considered deployments under PERSTEMPO rules. These include some counternarcotics operations and some multinational exercises.
- **Final workups.** Units making final preparations for deployment. For forward deployers, helicopters mate up with their host platforms six months prior to the deployment. As a result, workups are the same length as the deployment and hence the same number work up as are deployed. For other deployments the workup period may be less than the deployment, requiring fewer units in workups.
- **Squadron training** of nondeployed crews.
- **Naval Reserve** training and operations.

Counting the aircraft in the above categories gives the number of Primary Mission Aircraft Authorized (PMAA). To get PAA, total primary aircraft authorized, we add the following to PMAA:[7]

- **Fleet Readiness Squadron** (FRS)
- **RDT&E aircraft**
- Miscellaneous support aircraft.

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7. Chief of Naval Operations, Management of the Naval Aircraft Inventory, OPNAV Instruction 5442.8, Unclassified, 18 April 1995.

The total aircraft requirement is PAA plus an allowance for the aircraft in the maintenance pipeline. We also estimate the effects of peacetime attrition.

This scheme is depicted in figure 8.

Figure 8. SH-60 force-level factors

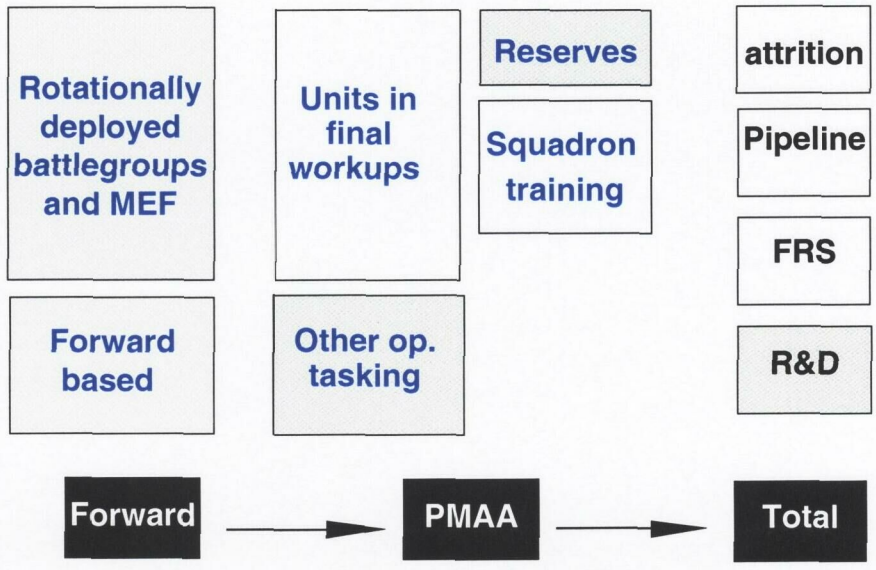


Figure 8 shows the major categories that make up our total requirement. The left-hand group of boxes represents SH-60s that are forward deployed or forward based (i.e., the battlegroup in Japan). The center group of boxes represents additional operational helicopters, including squadron training, workups for deploying forces, non-deployed operations, and the reserve helicopter airwing.

In addition to the primary mission aircraft authorized (PMAA), additional helicopters are needed to support the maintenance pipeline, fleet replacement squadron, R&D and other test activities, and aircraft attrition due to operational accidents.

The factors represented by the shaded boxes are determined from operational needs. Those in the unshaded boxes are derived from the shaded boxes based on support and training considerations.

We now present some specific numerical examples.

Table 15 shows our best estimates for the various factors for a case of 14 SH-60Rs per deployed battlegroup. Under current deployment patterns, two to three battlegroups with 28 to 42 SH-60Rs would be operating forward in the rotational deployment cycle. The arithmetic average is 2.2 battlegroups and 31 SH-60Rs, plus an average of 9 to fill the surface combatants in the Middle East Force. The carrier plus additional surface combatants homeported in Japan account for another 20 SH-60Rs. These figures sum to an average of 60 forward-deployed SH-60Rs.

Another 110 SH-60Rs are involved in workup, training, and other operations. We assume that helicopter detachments join their ships six months prior to deployment, so that the average number in workups equals the average number in rotational deployments (40 for BG and MEF + 7 for other deployed operational tasking such as SNFL and UNITAS). Squadron training is estimated from the throughput of pilots and the hours per pilot in the training syllabus. The details of the training calculations are given in appendix B. Miscellaneous tasking and reserves are based on recent historical data. (Note: estimates are based on overall workload and throughput and do not attempt to account for the specific wing/squadron organization of the future helicopter force. Minor variations from these numbers would be expected, depending on the details of the future shore structure.)

Table 15. SH-60R force level: 14 per BG

Category	Number of 60Rs
Rotationally deployed	**37-51 avg=40**
BG	28-42
MEF	9
Forward based	20
Total forward	60
Other deployments	7
Working up	40+7
Miscellaneous tasking	5
Squadron training	41
Naval reserve	10
PMAA	170
FRS	43
R&D	6
Misc support	7
PAA	226
Pipeline	28
Total force required	254
Peacetime attrition	42
Total plus allowance for peacetime attrition	296

The average numbers for the maintenance pipeline, attrition reserve, and Fleet Replacement Squadrons are based on standard planning factors.[8] We believe that modest reductions in the training numbers are likely in the future (circa 2010), due to organizational changes in the shore structure and completion of the neck-down envisioned in the Helicopter Master Plan. For example, the FRS number might be smaller by 10 to 15 SH-60Rs in the future if the common cockpit for the SH-60R and CH-60 allows a revamping of the training strategy, substituting cheaper CH-60s for SH-60s in part of the syllabus. In the

8. FRS is 25 percent of PMAA; maintenance pipeline is 12 percent of operational aircraft (PAA). Peacetime attrition is estimated at 1.1 percent of the force per year for 15 years.

near term, however, the conversion of Bs and Fs to Rs will increase the number of helicopters in the maintenance pipeline.

Table 16 shows the SH-60R force requirement as a function of the number of helicopters in each forward-deployed battlegroup. The column for ten per battlegroup shows the numbers our methodology would produce if we assumed the current deployed SH-60B/F forces.

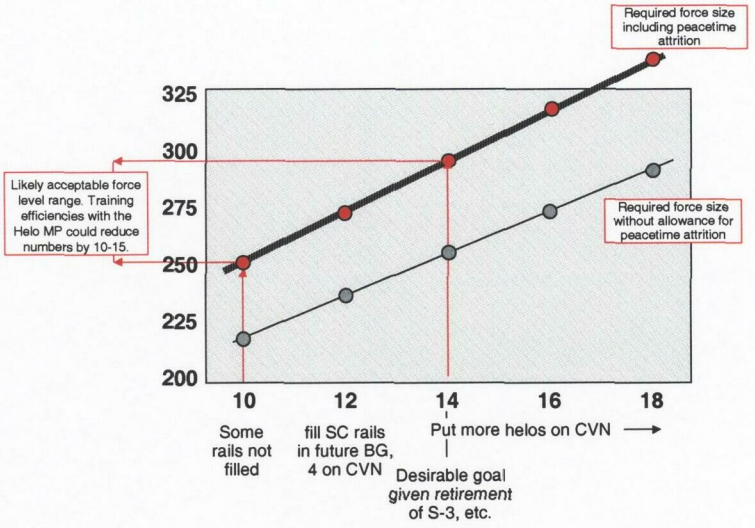
Table 16. SH-60R force levels required to support forward operations

	Number of 60R per Forward-Deployed Battle group				
	10	12	14	16	18
Rotationally deployed	31	35	40	44	48
Forward based	16	18	20	22	24
Total forward	47	53	60	66	72
Other deployments	7	7	7	7	7
Working up	38	42	47	51	55
Miscellaneous tasking	5	5	5	5	5
Squadron training	35	38	41	44	47
Naval reserve	10	10	10	10	10
PMAA	142	155	170	183	196
FRS	36	39	43	46	49
R&D	6	6	6	6	6
Misc support	7	7	7	7	7
PAA	191	207	226	242	258
Pipeline	23	25	28	29	31
Total aircraft required	214	232	254	271	289
Peacetime attrition	36	39	42	45	48
Total + attrition	250	271	296	316	337

The graph in figure 9 is one way of summarizing the numbers in this requirements assessment. It relates the number of helicopters in deploying battlegroups (the horizontal axis) to the total number of helicopters need to sustain the force.

The arrows identify what we believe to be the likely range for "acceptable" requirements that balance operational risks and fiscal necessity. The ultimate balance of these two factors requires operational judgments about the allocation of resources and which risks to accept.

Figure 9. Force level vs. number per battlegroup



Observations and conclusions on SH-60R requirements

Helicopter demands will vary with circumstances, but in any situation where a deployed battlegroup or surface group faces ASW and SUW threats, SH-60 resources will be seriously stressed. This stress will increase as the retirement of the S-3 and cutback in towed arrays and surface-launched Harpoons shift more tasks to helos and P-3s.

There are several clear implications from this observation:

(1) The Sea Combat Commander will need to take advantage of the total SH-60R resources in the battlegroup. This does not require any specific organizational structure, but probably will involve more flexible use of SH-60s, crews, and maintenance resources within the battlegroup.

(2) There is a clear rationale for deploying helicopter-capable surface combatants with a full complement of two SH-60Rs. (If capable maritime UAVs are eventually developed, substituting UAVs for one of the helicopters on one of the surface combatants in the battlegroup

may make sense for having some operations, but this action must wait until UAV capabilities have been proven.)

(3) There is a strong case for four SH-60Rs on forward-deployed carriers and an argument for increasing that number by one to two helicopters to deal with cases where some combatants are operating separate from the main battlegroup or the ASW/SUW threat is very demanding.

Incentive to find efficiencies in the training and workup cycle

There will be a strong incentive to get more SH-60Rs to sea on deployed battlegroups. As a practical matter, this is likely to happen only if the Navy can find ways to be more efficient in its shore operations, freeing additional helicopters for duty at sea. This challenge will be particularly severe during the nearly ten year transition period to the all SH-60R/CH-60 fleet.

The MTW requirement for SH-60Rs

This analysis has focused on the number of SH-60s needed to meet stressing contingencies that arise during normal deployed operations. We want to do a quick check to ensure that the numbers seem reasonable for a case in which the fleet is surged for two nearly simultaneous MTWs.

The basic arithmetic is as follows. Table 15 showed that if the Navy has sufficient 60Rs to support 14 SH-60Rs for each deployed battlegroup, that will provide 170 operating SH-60Rs (not counting the FRS) according to our estimate.

To fight two MTWs, we assume that the Navy will deploy 10 CVNs plus 85 percent of the surface combatants; this amounts to 99 surface combatants for the QDR level of 116. These forces will be assembled as follows:

- **Initially forward.** From the normal peacetime presence posture, one CVBG from each coast will already be forward, plus the Mideast Force group of about 5 surface combatants. In addition, the Japan-based forward-deployed naval force

(FDNF) units consisting of a carrier and 9 surface combatants are already forward. Following our recommended peacetime deployment scheme, each of these carriers will have six SH-60Rs embarked, and the surface combatants will have their helicopter rails filled with 60Rs.

- **Ready forces.** There is an additional ready battlegroup on each coast available to surge on short notice, plus working up MEF units. We assume that in response to a two-MTW crisis, these groups would be augmented with additional surface combatants, bringing the BG up to 8 surface combatants, and 11 MEF units. Because these units would be arriving at the crisis at a relatively early stage, they would also be full up with 60Rs: six per carrier and all surface combatant rails filled.

- **Follow-on forces.** The remainder of the force, 5 carriers and 48 surface combatants, would arrive after some delay. Because the surface and subsurface threats will be reduced by the time these forces arrive, they will not deploy with a full complement of 60Rs. We will continue to place six on each carrier, but only one on each helicopter-capable ship.

When we count the number of helicopter-capable ships projected for the Navy in 2010, and assume that deployment patterns will be similar to today's, we find that 173 SH-60Rs are required to support the surge deployment described above. The shortfall of three aircraft could come from the FRS, or the last three carriers could deploy with fewer than six 60Rs embarked. Table 17 shows the details of the arithmetic.[9]

If the preferred number of 60Rs were 12 per battlegroup rather than 14, the number of aircraft required for two MTWs would decrease by 20 (two for each carrier) to 153. Table 16 shows that if a total of 12 60Rs per deploying battlegroup is the peacetime requirement, then 155 operating aircraft would be available to surge to support two MTWs.

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9. Our calculations assume that all single-helo ships will be retired by 2010. The Navy currently plans to retain two single-helo ships, CG-47 and CG-48, beyond 2010. For simplicity, we have treated them as dual-helo ships in this calculation.

Table 17. SH-60Rs to support two MTWs (six 60Rs per carrier)

		Carriers	Surface Combatants	DDG-51 flt I/II	60R on carriers	60R on surface combatants	Total 60R
Forward							
	2 BG (CVN + 5)	2	10	2	12	16	28
	MEF (5 SC)		5	2	0	6	6
	FDNF (CV + 9)	1	9	2	6	14	20
Total forward		3	24	6	12	36	54
Ready							
	2 BG+ (CVN+8)	2	16	4	12	24	36
	MEF+ (11 SC)		11	3	0	16	16
Total ready		2	27	7	8	40	52
Total follow-on		5	48	11	30	37	67
Force required for 2 MTWs		10	99 (.85 x 116)	24 (.85 x 28)	40	113	173

We have not done detailed campaign calculations, but this level of SH-60 support appears adequate. It ensures that those units that arrive at the beginning of the conflict have a full complement of 60Rs. The late-arriving follow-on forces have fewer 60Rs. This occurs at a time in the conflict when U.S. forces are fully mobilized and mutual support from multiple battlegroups, P3s, and other U.S. forces plus support from allies will be at its greatest. If additional helicopters were needed at this stage of the conflict, some could be taken from the roughly 40 in the FRS.

Beyond these requirements, more helicopters might be needed if the Navy is able to increase surface combatant force levels to the mid-130s as currently proposed. But an equal or greater increase in helicopter requirements would be generated by the need to support the increase in surface combatant deployments.

What is the requirement?

This analysis provides a clear rationale for the planned conversion of the roughly 240 Bs and Fs to Rs. But what is the requirement? More SH-60Rs will improve success in a wider set of circumstances, but there will be diminishing returns as the number increases. Analysis cannot prove which number is the right one. That answer depends on judgments about the acceptable risk, which involves more than eyeballing some "knee on the curve."

Gauging the precise risk is difficult. There is tactical risk: if there are too few helicopters to prosecute all contacts, there is some chance that a submarine could slip through for an attack on the battlegroup that otherwise might not have occurred. Or the risk could come out at the operational level: The battlegroup commander might be forced to stand off further, divert F/A-18s to SUW missions, and/or wait for reinforcements, thereby slowing the pace of the operation. The exact effects will depend on circumstances.

In our view, a reasonable SH-60R goal is the estimated 270 to 296 needed over the long term to fill the rails on surface deployers and put 4 to 6 on deploying carriers (for an average of 12 to 14 SH-60Rs per deployed battlegroup) plus training, maintenance, and attrition. As a practical matter, the Navy is unlikely to have more than the 240 envisioned in the Helicopter Master Plan. This makes it even more important to: (1) achieve training efficiencies resulting from the helicopter neckdown, so that the available inventory will enable the Navy to get close to the lower part of the desired 12 to 14 SH-60s per battlegroup, and (2) use total helicopter resources in the battlegroup, including the SUW capabilities of the CH-60.

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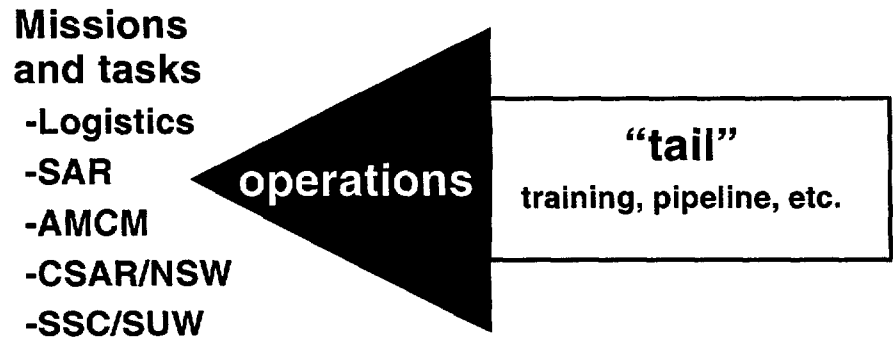
CH-60S requirements

The second half of this paper addresses requirements for the future CH-60S force. Our approach to CH-60S requirements is analogous to our portrayal of SH-60R requirements. We begin with the missions and tasks that would be assigned to the CH-60S in the future. Within the battlegroup, these are predominantly logistics, SAR, AMCM, CSAR/NSW, and SSC/SUW. From shore stations, logistics and SAR represent the primary CH tasking. We will assess the number of CH-60S helicopters to meet these requirements, together with the number of helicopters needed for training for, the maintenance pipeline, and for attrition over the lifetime of the aircraft. Figure 10 pictures this process.

Figure 10. Estimating CH-60S requirements



Planned transition to CH-60

Overview

The Helicopter Master Plan calls for the CH-60 to replace the four helicopter types: CH-46D, SH-3H, MH-53E, and HH-60H. Transition of the CH-46D and SH-3H to the CH-60S will be done first; it is slated to take place by the end of CY 01. MH-53Es will retire by the middle of the decade. Plans are to remanufacture the HH-60H, which has the longest remaining service life of the four types, for future use in possibly shore station support. Our estimate of future requirements starts with the current usage of these four helicopter types. Then we adjust these figures according to potential changes in mission tasking in the future.

Missions CH-60 will acquire

HC helicopters currently perform a variety of missions aboard the carrier, LHA/LHD, and CLF/MSC ships. These current afloat missions will be performed by the CH-60 in the future. All current CVBG/ARG mission requirements will remain in the future. (New battlegroup and ashore missions will be discussed later.)

CLF/MSC

Fleet logistics support is provided by the Navy Combat Logistics Force (CLF) and the Military Sealift Command (MSC). Air-capable ships of CLF and MSC ships (AOE, AE, TAE, TAFS) currently deploy with two-helicopter detachments, which provide a rapid method of distributing cargo from the logistics ship to other ships in the battlegroup. When not engaged in transferring cargo, the helicopters are available for other logistics tasking (e.g., passenger transfers) and SSC.

LHA/LHD

Navy helicopters are required in LHA/LHD-class ships to provide SAR support for USMC air operations. These aircraft also can perform logistics and SSC services for the ARG.

CVN/CV

Two to three HH-60s are currently assigned to each carrier-based HS squadron to perform combat search and rescue (CSAR) and Navy Special Warfare (NSW) support. These helicopters, along with the four assigned SH-60Fs, also provide plane guard for carrier flight ops. Recently, HH-60Hs have been modified with FLIR/Hellfire missile capability for SUW attack missions. (CH-60s will have similar armed helicopter capabilities for the CSAR/NSW mission.)

In addition to the afloat missions discussed above, Navy HC/HM helicopters currently perform a variety of missions from shore. The requirement for these missions will continue, but not all will necessarily be conducted by the CH-60.

Shore logistics support

Navy MH-53 helicopters are permanently deployed to both EUCOM and CENTCOM to provide heavy lift logistics support. The MH-53s in CENTCOM are also capable of conducting AMCM. Passenger helicopters (SH-3s) are also deployed to CENTCOM for logistics and passenger transport in what is called the Desert Duck operation.

Airborne mine countermeasures (AMCM)

The Navy maintains a dedicated rapidly deployable AMCM capability, currently performed by MH-53 helicopters. The Navy's emerging plan for MCM relies more on MCM capabilities that are integral to each battlegroup. As part of this concept, CH-60 helicopters deployed with the battlegroup will have an organic AMCM capability. This new AMCM tasking will affect CH-60 training, utilization, and force-level requirements.

Fleet support

Navy helicopters currently provide passenger and logistic services for numbered fleet commanders and Fleet CINCs.

Homeguard missions

Non-deployed elements of all HC squadrons provide logistic and SAR services at their home bases (Norfolk, North Island, Guam).

Squadrons CH-60 will replace

Table 18 summarizes the current HC/HM aircraft squadrons that will be largely replaced by the CH-60 and the primary missions they perform. These are discussed below.

Table 18. Current HC/HM aircraft and missions

HC/HM today	Squadrons & helos		Missions
H-46	HC-6	12	2 A/c per ARG
	HC-8	12	2 A/C per CLF
	HC-11	20+H-3	2 A/C per TAFS
	HC-5	14 (Guam)	+ two H-46 w/Sasebo ARG, interdeployment tasking, etc.
MH-53E	HC-4	9 (Sigonella)	VOD
	HM-14	10 (4 in Bahrain)	VOD/AMCM
	HM-15	10	VOD/AMCM
	RDT&E	3 (Panama City)	
SH-3	HC-2	9	Fleet support (VIP/Desert Duck)
	HC-85	8 Reserves	
	VC-8	6	
SAR station/range support		27 + 17 H-1s	logistics/SAR
FRS	HC-2	4 (SH-3)	
	HC-3	14 (H-46)	
	HM-302	5 (MH-53E)	

H-46

There are currently four fleet H-46 squadrons: HC-6 and HC-8 (both in Norfolk), HC-11 (San Diego), and HC-5 (Guam). These squadrons supply two-aircraft detachments to Combat Logistics Force AOE/AE ships and to Military Sealift Command TAFS/TAE ships to provide logistics support. They also supply two aircraft detachments for LHA/LHD class ships to provide SAR services for embarked Marine aircraft operations. When not deployed, aircraft and crews provide SAR and logistics support in the local area.

MH-53

The MH-53 force is organized into three squadrons: HC-4 (Sigonella), HM-14 (Norfolk), and HM-15 (Corpus Christi). HC-4 provides heavy lift logistics support to ships and bases throughout the

Mediterranean. HM-14 and HM-15 provide the entire AMCM capability as well as conducting VOD (logistics support) for the Navy. HM-14/15 are mixed active-duty and reserve squadrons, and maintain the capability to deploy worldwide on short notice. HM-14 is currently providing a forward-deployed detachment of four aircraft in Bahrain.

SH-3

The Navy H-3 inventory has shrunk rapidly in the past decade. There is now just one active SH-3 squadron, HC-2 (Norfolk), which furnishes forward-deployed detachments for numbered fleet commanders, detachments for support of Fleet CINCs, and a detachment to Bahrain for logistics support (Desert Duck) in the CENTCOM AOR. There are other H-3s in the active inventory, providing range support services and local area SAR at naval air stations, but there is no plan to replace these assets with CH-60s. Most likely, remanufactured HH-60s will assume this role when the SH-3s retire.

FRS

Four SH-3 aircraft from HC-2 are designated for the Fleet Replacement Squadron (FRS). For the CH-46, the FRS squadron (HC-3) is located in San Diego. Five USN MH-53s are with the FRS for USMC CH-53s in New River, NC.

HH-60

In addition to today's HC/HM squadrons, the CH-60 will also replace the two HH-60s in today's HS squadrons. The HH-60s provide CSAR/NSW support to the battlegroup, and they supplement the four SH-60Fs in the squadron for SAR and logistics requirements. Some HH-60 aircraft have been modified with FLIR and Hellfire missiles, making them capable of conducting limited SUW operations. There are two reserve HH-60 squadrons, HCS-4 and HCS-5.

AMCM CONOPS

The topic of mine countermeasures (MCM) is important in assessing the future CH-60S requirement, because the Navy is developing a new approach to MCM. The Fleet Mine Warfare Concept of Operations (MIW CONOPS) recently proposed by CINCLANTFLT and

CINCPACFLT[1] envisions both "assigned" and "supporting" elements of MCM.

Formerly known as "organic" MCM, "assigned" MCM refers to an integral capability in the battlegroup. The plan is for CH-60S helicopters to be the Navy's assigned airborne mine countermeasures (AMCM) component. The CH-60 will employ a variety of new MCM sensors and weapons in this mission. (Assigned MCM capabilities will also include remote mine hunting vehicles deployed from ships and submarines.)

Supporting MCM forces will be phased into an operation as dictated by the battlegroup commander, with eventual focus on the residual mine threat. Two types of supporting MCM forces are planned, forward based and CONUS based. Forward-based AMCM support would likely be positioned with the CH-60S squadrons in Guam and Sigonella. Currently, MH-53E helicopters in HM-14 and HM-15 provide CONUS-based AMCM supporting forces. One issue is whether these dedicated AMCM squadrons will be needed in the future.

The CLF/CPF CONOPS also provides for a mine warfare commander (MIWC) as part of the CWC structure. The MIWC will oversee the day-to-day direction of all assigned and supporting MIW-related functions. Figure 11 envisions how the MIWC might be incorporated within the composite warfare commander (CWC) concept.

In the concept pictured here, the MIWC is an equal partner with the other major warfare commanders. MIWC presence within the CWC organizational structure ensures that MIW is included in all planning and operations throughout the full deployment cycle. An alternative organization would place the MIWC, along with the ASWC and SUWC, subordinate to the Sea Combat Commander (SCC). The SCC would then coordinate the often-overlapping roles of the MIWC, ASWC, and SUWC.

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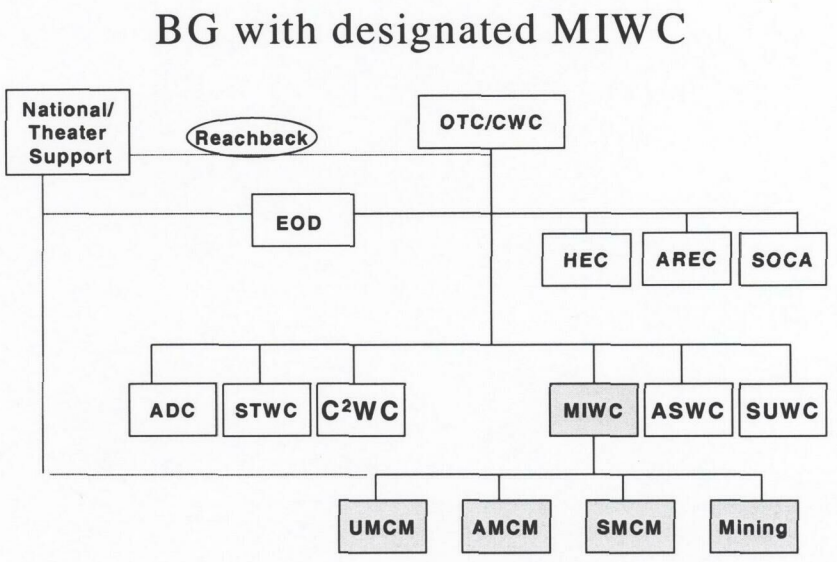
1. Fleet Mine Warfare Concept of Operations (MIW CONOPS), proposed, CINCLANTFLT and CINCPACFLT, 26 October 1999.

Figure 11. Mine warfare commander within the battlegroup

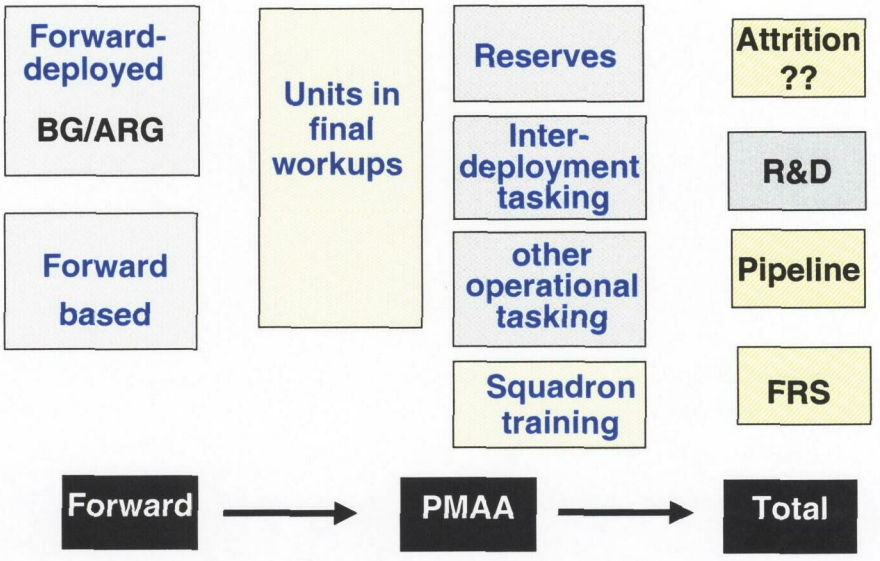


Estimating requirements

Based on the previous discussion of current and future CH-60 tasks, we now provide a range of estimates for CH-60S force-level requirements. We start with what a base case for CH-60S requirements, then consider several variations on this base case. One group of variations involves outsourcing some logistics tasks, thereby reducing CH-60 requirements. The other two excursions involve assumptions that increase CH-60 force levels. The first adds a dedicated (supporting) shore-based AMCM requirement, while the second assumes that some CH-60s will be needed to replace helicopters now assigned to station SAR/range support.

Figure 12 displays the major categories that form our estimate for the total CH-60S force requirement. The boxes on the far left represent the helicopters forward in the fleet—those forward deployed with the BG/ARG and those forward based in the Mediterranean and WESTPAC. The factors represented by the gray boxes are determined from operational needs. Those in the yellow boxes are derived from the gray boxes, based on support and training considerations.

Figure 12. CH-60S force-level methodology



The center boxes account for workup prior to forward deployment, helicopter reserve airwing operations, interdeployment cycle tasking other than final workup, other operational tasking outside of the battlegroup deployment cycle (for example, CINC/Fleet Commander/Desert Duck support), and squadron training. The sum of these seven boxes yields primary mission aircraft authorized (PMAA).

To maintain PMAA, additional aircraft are needed as indicated among the far right boxes: The FRS, to train new pilots; the maintenance pipeline; RDTE aircraft; and attrition aircraft.

We are not sure of the appropriate allowance for peacetime attrition that would be needed over the long term. It would depend on the proportion of complex, low-altitude missions in the CH-60S tasking. If, as anticipated, logistics and SAR are the dominant missions, then the 1.1-percent annual attrition rate estimated for the SH-60 (see appendix B) is probably too high for the CH-60. As a placeholder, we assume that CH-60 attrition will be roughly half that projected for the SH-60 and use 0.6-percent aircraft losses per year in our computations.

Base case

Figure 13 presents our *base case* estimate for future CH-60S force level in a battlegroup/amphibious ready group. CH-60s replace the CH-46s on a one-for-one basis on LHA/LHD, CLF, and MSC ships, and replace the two HH-60s on the carrier.

Figure 13. CH-60 with BG/ARG

	A/C	Missions
CVN	6*	**CSAR/NSW, LOG, SUW, SAR, planeguard** (replace HH-60) **AMCM** (major new mission)
Two of these might be deployed elsewhere in the battlegroup		
LHA/D	2	**SAR, LOG, SSC** replace H-46
CLF	2	**LOG, SSC, SAR** replace H-46
MSC*	2	**LOG, SSC, SAR** replace H-46
	12*	(PAC MSC support is regionally based)

*MSC support for battlegroups in the Pacific, is regionally based, rather than deploying with the battlegroup. In the numbers that follow, we account for the regional based support separately, and assume that PAC deploying battlegroups have only 10 CH-60s.

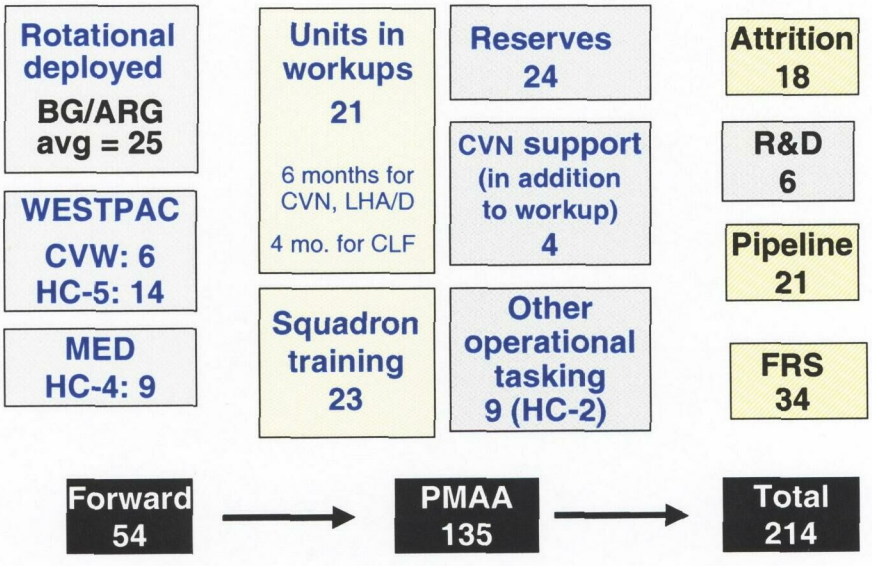
Based on MCM Force-21[2] recommendations, an additional four aircraft forward deploy to conduct AMCM, two with the CV and two with the LHA/D. Two, and perhaps all four, of these additional helicopters would likely be based aboard the carrier for the following reasons:

2. Sabrina R. Edlow et al., with Johns Hopkins University Applied Physics Laboratory; Naval Surface Warfare Center, Carderock Division; and the Naval Surface Warfare Center, Dahlgren Division, Coastal Systems Station. *MCM Force-21 Study Final Results* (U), Secret, June 1999 (CNA Annotated Briefing 99-37).

- HS squadrons are authorized only two HH-60Hs to conduct CSAR/NSW. There is broad consensus that this is insufficient, because actual missions require two fully mission capable aircraft, which argues at least three aircraft. Because of crew size limitations, SH-60Rs will be less capable in conducting this mission than the current aircraft assigned the CSAR/NSW mission, the SH-60F.
- CVN plane guard responsibilities are asset intensive. Because of crew size limitations, SH-60Rs will be less capable of conducting this mission than the current SH-60F. CH-60s may be required to significantly contribute to plane guard.
- CH-60s equipped with Hellfire and a FLIR, are less capable than SH-60Rs, but can contribute to surface surveillance and attack.

Figure 14 summarizes our base-case estimate for the overall CH-60 requirement, based on the base-case number of 12 CH-60s per LANT battlegroup and 10 per PAC battlegroup.

Figure 14. Base case force levels



The numbers in the chart for rotationally deployed helicopters are the arithmetic averages. The number of rotationally deployed battlegroups varies from 2 to 3, with an average of 2.23. The average number of CH-60s deployed on these battlegroups is 25. Regional support in the MED and WESTPAC are based on current HC/HM support levels plus six additional CH-60s for the battlegroup in Japan (two to replace the HH-60s and four assigned for AMCM). In the absence of an MIW threat, we suggest placing all four of the AMCM CH-60 helicopters on the CVN to contribute to short-handed missions such as plane guard. Of course, these, as well as any battlegroup helicopter, could be cross-decked to other ships in the CVBG/ARG as requirements dictate.

The numbers for training and workups are derived using the same method that we used for the SH-60s, although workup with the ship before deployment depends on the type of ship, as shown. Helos are assumed not to workup with the MSC ships before deployment, as is the present case. The reserve number is based on today's force level. Four additional aircraft are needed to support CVN workups before the six-month window in which CH-60s are assigned to the carrier. Other operational tasking accounts for the 9 A/C in HC-2 fleet support. The total for Primary Mission Aircraft Authorized is 135 aircraft.

Rounding out the inventory are the aircraft in the maintenance pipeline, the Fleet Replacement Squadron, RDTE, and peacetime attrition aircraft. Based on standard planning factors these would sum to 78 aircraft for a total of 214.

Variations on the base case

Figure 15 is the first of two figures showing potential variations on the base case estimate. It illustrates the effects of outsourcing some of the logistics tasks.

Figure 15. Decreases to the base case (through outsourcing)

CH-60 Force-Level Excursions (1)

	PMAA	*Total a/c*
Base case	**135**	**214**
Outsource some logistics tasks	See comments in the text on suitability of commercial helos	
– HC-2	**-9**	**-13**
– + MSC	**-22**	**-34**
– + CLF	**-35**	**-54**

One candidate for outsourcing is the type of fleet support tasking currently provided by HC-2, although it's uncertain whether numbered fleet commanders and CINCs would accept civilian manning of their helicopters. Nevertheless, figure 15 indicates that outsourcing HC-2 would decrease total CH-60 requirements by 13 aircraft. Another step in the direction of outsourcing land-based helicopter support would be to outsource some of the missions currently conducted by HC-4 at Sigonella. However, it seems clear that some missions currently supported by HC-4 would not be suitable for civilian-manned helicopters. One example is the recent operations in Sierra Leone.

Outsourcing helicopters on the MSC ships is the most likely case for helicopters at sea. CINCLANTFLT recently awarded[3] a two-year contract to Geo-Seis for outsourcing logistics missions for T-AFS supply ships. It remains to be determined whether a commercial concept is operationally workable, and whether this approach would provide sufficient cost-savings to justify a permanent change. The second

3. *Defense Daily*, October 27, 1999.

option shown in figure 15 assumes that MSC outsourcing is valid and applies to both LANT and PAC. Together with HC-2 outsourcing, this excursion reduces total aircraft by 34 from the base case.

Some studies[4] have gone a step further, by suggesting that the Navy outsource helicopter support for its CLF ships; they argue that it is analogous to helicopters on MSC ships. The Navy has been very reluctant to consider civilianizing AOEs or their helicopters, because of reduced operational flexibility. This could be especially true for the helicopters, because there is a potential to use helicopters on CLF for other battlegroup missions, such as SSC, in some situations. Applying outsourcing to helicopters on CLF ships, together with HC-2 and MSC outsourcing, would produce a 25-percent reduction in total aircraft requirements.

Figure 16 summarizes two potential variations that would add to the CH-60 requirement. The first concerns surge AMCM detachments. Although the official Navy program retires dedicated MCM squadrons without replacement, the MCM Force 21 study considers basing six CH-60s on each coast for surge AMCM support for contingencies such as post Desert Storm MCM ops in the Gulf. This would add 18 CH-60s to the required inventory. Alternatively, the Navy might choose to create this capability out of the AMCM helicopters in the base case. For example, adding two CH-60s per battlegroup rather than four would free up enough for the two detachments.

The second variation concerns future shore station support. The Navy is not currently planning to use CH-60s to replace the 44 H-3s and H-1s that provide shore station support. Some of these shore tasks would likely be picked up by remanufactured HH-60s. Nevertheless, maintaining some CH-60 support may be sensible for operational efficiency and flexibility. The above illustration is based on a one-for-two replacement, i.e., half of current shore station support is provided by CH-60s.

Figure 17 summarizes the force-level excursions above.

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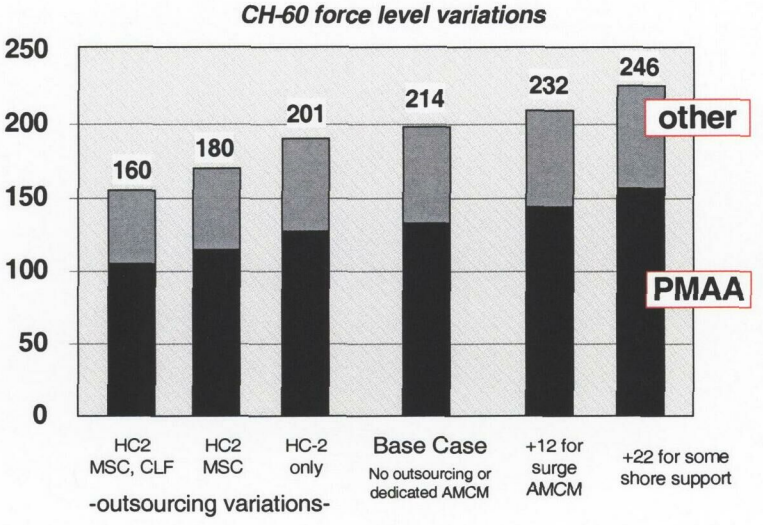
4. Janet R. Magwood. *Navy Logistics Helicopter Options Study:* Final Report, Unclassified, August 1998 (CNA Research Memorandum 98-96).

Figure 16. Increases to the base case

CH-60 Force-Level Excursions (2)

	PMAA	*Total a/c*
Base case	**135**	**214**
Surge AMCM (supporting forces in addition to BG)	**+12**	**+18**
Shore station (replace half vice none)	**+22**	**+32**

Figure 17. Comparison of base case and excursions



The three lowest variations are the force-level excursions reflecting various degrees of outsourcing of logistics tasks. The most extreme reflects a 25-percent reduction from the base case.

There are a range of opinions on the pros and cons of outsourcing. For example, some people have said that the fleet commanders would not stand for civilianizing fleet support that serves the Fleet CINCs and numbered fleet commanders, whereas others have argued that these are noncombat tasks and should be the first to be outsourced. One consideration is that civilian helicopters placed on CLF and MSC ships would not have the CH-60's flexibility to contribute to other battlegroup missions when needed. We have not conducted an independent assessment of these advantages and disadvantages.

The two bars on the right show the effect of adding CH-60s for surge AMCM and for half the shore support. The latter produces about a 15-percent increase in force levels.

Armed CH-60S option

All CH-60Ss will have some capability to assist in the SUW mission, but most will be limited: they will have the ability to ID contacts by visual means only, and will have no capability to engage targets. Unlike the SH-60R which will be equipped with FLIR and the Hellfire missile, which provides an enhanced ability to detect and classify surface targets and to target and attack surface threats, only those CH-60s configured for the CSAR/NSW mission will offer this capability. Currently, this is only about 25 percent of the CH-60Ss slated to be built.

Configuring additional CH-60s with the FLIR/Hellfire system will provide a significant enhancement in the ability to identify and engage surface threats, and ease some of the burden on the SH-60R in conducting SUW in a multi-threat environment. The approximate cost for the FLIR/Hellfire modification to configure the CH-60S with an armed SUW capability is approximately $2.5M per aircraft.[5]

5. Naval Air Systems Command, PMA-299, February 2000.

The MTW requirement for CH-60Ss

As stated in the earlier background and approach section, this study bases aircraft requirements on needs to sustain peacetime rotational and forward-based forces. The rationale for this approach is the Navy's focus on forward overseas presence, e.g., the Global Naval Forces Presence Policy (GNFPP). In this section we provide a check of the adequacy of the peacetime-based PMAA to satisfy estimated MTW requirements.

Table 19 presents the MTW calculation. We begin by assuming that we require helicopters for 85 percent of the ships. For 12 CV(N), 12 LHA/D, 8 AOE(CLF), and 13 TAFS/TAE (MSC), this yields 116 aircraft. Further, we assume that the requirement for HC-4 logistics support in the Mediterranean will remain, as well as those HC-5 helos in the western Pacific that are not servicing CVBGs and ARGs (about half the squadron). As shown in the table, this yields a PMAA requirement for MTW of 132 aircraft, comparable to our base case PMAA of 135.

Table 19. CH-60 requirements for MTW

Assumption: configure 85% of hulls

6 per CV(N)	x 10 =	60
2 per ARG	x 10 =	20
2 per CLF	x 7 =	14
2 per MSC	x 11 =	22
		116
	+	9 HC-4
	+	7 HC-5 (50% of sqd)
		132 A/C

Base case PMAA = 135 A/C

∴ Numbers needed to support deployers appear adequate for MTWs

Observations and conclusions on CH-60 requirements

- CH-60 force levels are driven largely by logistics and SAR throughout the fleet. This includes both the afloat support

offered the battlegroup and ARG, and the shore-based and Fleet Commander/CINC requirements.

- "Organic" AMCM creates significant additional requirements for the CH-60. The flexibility of the CH-60 to fulfill this role and the appropriate AMCM assigned/supporting mix are important unresolved factors in determining total CH-60 numbers.
- Outsourcing of the logistics mission is currently being tested for MSC ships supporting LANT. It remains to be resolved whether this is deemed successful from a cost-effectiveness standpoint and, if so, whether civilian helos can replace additional CH-60 logistics tasking on CLF ships and shore bases. A significant factor in the CLF issue may be the loss of the CH-60s multi-mission flexibility within the battlegroup when they are replaced by commercial helicopters.
- CH-60s, if armed, can contribute to other tasks—particularly SUW in coordination with the SH-60R and fixed-wing assets. There is an opportunity for synergism in SH-60 and CH-60 operations and for taking advantage of total CH-60 assets in the battlegroup.

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Appendix A: Additional analysis of SUW and ASW requirements

The discussion of SH-60R requirements in the main text is largely empirical. It is based on taking the battlespace dominance missions of the platforms being replaced by the SH-60R, the SH-60B, SH-60F, and S-3B, and estimating the number of SH-60R required to provide an equivalent capability. In this appendix we take a more analytical, zero-based approach. We look at the battlespace dominance capability required by a battlegroup and then determine the number of SH-60Rs (and other battlegroup assets) needed to achieve that capability.

This additional analysis is presented as an annotated briefing.

Slide 1.

Battlegroup Helicopters for Battlespace Dominance Missions

Additional analysis of SUW and ASW requirements

27 January 2000

This material supplements the December 1999 CNA report on helicopter force requirements. It provides additional calculations of ASW and SUW requirements in specific tactical settings in response to questions from COMSECONDFLEET.

Slide 2.

Approach

- **Assess number of helos (H-60R/S) needed to carry out ASW/SUW tasks without help from other forces**
  - **Tasks that might be assumed by other forces discussed later in the brief**
- **Examine ASW and SUW separately**

We look at the number of helicopters required to accomplish battlespace dominance tasking by a single battlegroup facing a simultaneous surface and submarine threat.

The calculations focus on tasks that helicopters might be assigned. The possibility that other forces might do some of these tasks is addressed at the end of this appendix. ASW and SUW are first addressed separately. At the end of the appendix we discuss how these requirements would be combined.

There are some important caveats for this work. Demand for SH-60R sorties is quite sensitive to environmental conditions and precise details of the scenario. As will be shown, reactive sorties (for contact investigation and identification) are a driving factor, but their rates are unknown and highly variable. In view of these uncertainties, only rough, simplified estimates are being made.

Slide 3.

Assumptions

Sortie rates from N88 planning factors:

- **1.5 to 2.0 sorties per day 3.5-hour**
- **~9 sorties to maintain 1 station**

For sortie rates we used the Wartime Utilization Planning Factors published by N88[1] for the SH-60B/F. These rates represent the average over the aircraft in the battlegroup. Individual aircraft could fly more or less than these averages, but the Navy buys people and spares to achieve these rates. The surge rate, which can only be maintained for a few days, is two 3.5 hr sorties per day. The sustained rate, which can be kept up for weeks, is 1.5 sorties per day. We have not seen planning factors for the 60R/S, but we assume they will be similar.

We also assume that about 9 sorties are required to keep one helicopter on station for 24 hours. This number could vary from 8 to 12 depending on the transit time to and from station, the helicopter's loadout (affecting endurance), and the complexity of the onstation turnover. Combining this with the sortie rates, we see that 4.5 to 6 aircraft are required to keep one on station for 24 hours.

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1. Chief of Naval Operations, Naval Aircraft Wartime Utilization Planning Data (U), letter ser N880G11/3S65901, Secret, 14 Sep 93

Slide 4.

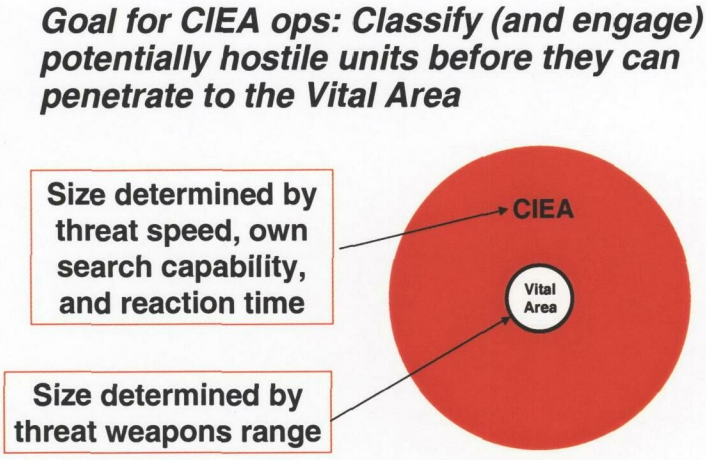
Force Defense Zones

- **Surveillance Area**
  - **Area under systematic observation to detect any object, event of possible military concern**
- **Classification, Identification, and Engagement Area (CIEA)**
  - **Area in which (1) all objects detected must be classified, identified, monitored and (2) the ability maintained to escort, cover, or engage contacts**
- **Vital Area**
  - **Designated area around MEUs to be defended by the force (determined by threat weapon range)**

The Navy-wide standing OPGEN mandates a layered concept of force defense, with three layers as defined here. The size and shape of the layers varies, depending on the threat weapons range and the force's capability to detect and engage the threat.

Our analysis focuses on helicopter requirements for the CIEA and Vital Area, the traditional employment area for rotary-wing aircraft. In general, helicopters will not have the speed or endurance to contribute to operations in the surveillance area.

Slide 5.



The size of the Vital Area is determined by the threat weapons range. It represents a keepout area around the mission essential units (MEUs).

The size of the CIEA is determined by the threat's speed and own force's search capability and reaction time. The CIEA should be sized so that any hostile unit entering the CIEA can be detected, classified, and engaged, if necessary, before it can penetrate the Vital Area.

Slide 6.

Surface Threat

- **Most numerous threat is from FPBs, armed with light weapons**
- **Most lethal threat is from PTGs with antiship missiles (ASCMs)**
  - **SS-N-2, CSSC-3, C801, C802, Exocet, SS-N-22: 25-65 nm max range**

We first look at the surface threat and then turn to the ASW problem.

Slide 7.

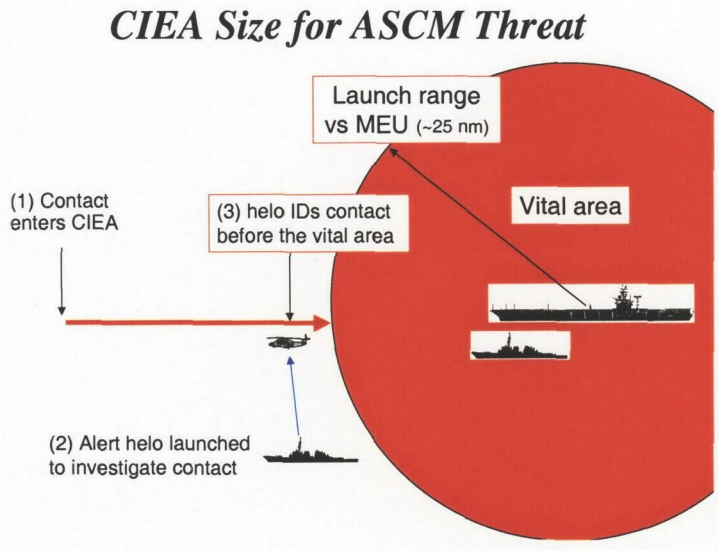
Vital Area for SUW

- **5-10 nm for FPBs**
- **20-30 nm for PTGs and larger units (assuming no OTH-T capability)**
- **Max weapons range (up to 65 nm) when third party targeting of ASCMs is believed possible**

A key factor in SUW operations is whether the enemy surface threat has an effective over-the-horizon capability that would enable missile-equipped ships to achieve the full technical range of their missiles—more than 50 n.mi. in some cases.

Given the historical difficulties in OTH-T plus the limited real-time surveillance and C2 capabilities of likely regional opponents, we focus on the case without OTH-T capability. However, the implications of an effective OTH-T capability are also addressed.

Slide 8.



This graphic illustrates the concept for sizing the CIEA against the ASCM threat. The goal is to size the CIEA so that an unidentified contact entering the CIEA could be identified and, if necessary, attacked prior to penetrating to within weapons range.

In some cases, identification will be possible at considerable range via imaging radars, such as the ISAR planned for the SH-60R and the P-3. In other cases, close-range visual/FLIR surveillance may be required—in many instances by an alert helo responding from the closest available surface combatant. Our sizing of the CIEA for SUW is based on this situation.

The next slide will give specific numbers.

Slide 9.

CIEA Size for ASCM Threat

Effective threat weapon range (nm)

	Threat Speed	25	30	50	65
Alert 30	35kt	42	55	79	98
	40	45	58	83	102
Alert 60	35	60	72	97	115
	40	65	78	103	122

If launch of alert-30 helo is ordered as 35-kt threat crosses 55 nm, helo intercepts at 30 nm

This table shows how the CIEA size is determined for the ASCM threat. It shows that for a 30-n.mi. effective missile range, the CIEA radius should be about 60 nm for alert 30 helicopters, and about 80 n.mi. for alert 60 helicopters. The helicopter speed is assumed to be 150 knots.

Slide 10.

CIEA Size for FPB Threat

- **10-nm weapons range**
- **55-kt closing speed**
- **5-min C2 delay**

Helo Alert Posture	CIEA Range (nm)
Airborne	18
Alert-15	32
Alert-30	46
Alert-60	73

This table gives the CIEA size for the high-speed FPB threat.

Comparing this with the preceding slide shows that the ASCM threat is slightly more stressing. That is, sizing the CIEA to handle the ASCM threat will provide adequate coverage against the FPB threat.

Slide 11.

LAMPS III WASP Tactic (NWP 3-20.7)

- **WASP: Wide Area Surveillance Picture**
- **60B highboy (5-6Kft) can *maintain* surface picture out to 100 nm**
  - **3 helos for 150-nm surveillance area**
- **For SH-60B (no ISAR), other assets are needed for contact ID**
- **SH-60R with ISAR should classify most large contacts at long range**

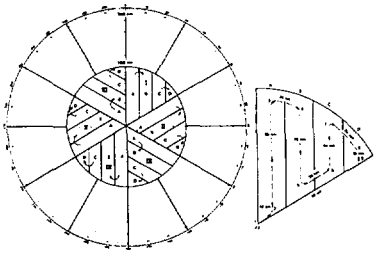
This slide summarizes a tactic the fleet has used for the last few years to maintain the surface picture with LAMPS Mk III aircraft. A single aircraft is able to maintain the picture out to about 100 n.mi.[2]

2. NWP 3-20.7, *Afloat OTHT and Surveillance (formerly NWP 64-1)*(U), Secret, Feb 96.

Slide 12.

Initializing the Picture

- **ID all ctcs within 100 nm of ZZ**
- **Use tactic S-1 of NWP 3-20.1**
- **Requires six 3-hr helo sorties**
- **Repeat whenever picture is lost**



- Each a/c flies 450 n.mi.
- 22 n.mi. track spacing

This slide describes a tactic that is used to initialize the surface picture.[3] It provides for the visual identification of every contact within a 100-n.mi. radius circle. The tactic was designed for single-cycle tactical aircraft flying at about 300 knots. Each aircraft flies a 450-n.mi.-long path, which brings it within visual range of each point in its sector.

This tactic could also be flown by six helicopters, each flying at 150 knots for three hours.

3. NWP 3-20.1, *Antisurface Warfare Commander's Manual (formerly NWP 10-1-22) (U)*, Secret, Nov 86.

Slide 13.

Maintaining the picture with SH-60R

- **Maintain 100 nm surveillance area**
  - **Provides adequate reaction time vs. 30 nm threat**
  - **Allows space for CVN flight ops**
- **1 WASP highboy maintains picture**
  - **ISAR classifies most new contacts**
- **Additional sorties required to ID remaining new contacts: *How many?***

We believe that against the 25- to 30-n.mi. ASCM threat and the 10-n.mi. FPB threat, it's desirable to maintain about a 100-n.mi. surface surveillance area/CIEA. An area of this size provides adequate reaction time, as shown by the earlier sizing calculations, and allows maneuvering space for carrier flight ops.

As discussed, a single 60R highboy will maintain this picture. Its ISAR will be able to classify most new contacts occurring after the picture is initialized, but additional sorties will be required to identify those new contacts which ISAR cannot. On the next slide we estimate how many.

Slide 14.

Contact Flux

For contact density of 250 per 100,000 sq.n.mi.
(typical larger contacts (>1,000 tons) in the Med and other high traffic areas)

- **80 contacts inside 100 n.mi. circle**
- **8 hours to cross surveillance area**
  (16-kt avg transit speed, 130-n.mi. avg path)
- **235 new contacts per day, 10 per hour**

How many will ISAR ID?

- **Depends on aspect, sea state, etc.**
- **Even if ISAR IDs 90%, would still have one contact per hour requiring VID/FLIR**

Here we try to estimate how many new contacts will need to be identified. A contact density of 250 per 100,000 sq.n.mi. is typical of the Mediterranean and other littoral areas of interest (although the density in the SW approaches to the English Channel, SWAPPs, is about 800 per 100,000 sq.n.mi.) This density refers to large (>1,000 tons) contacts, typical of merchants and warships. We don't have any data on the density of small contacts, such as fishing boats (FPB sized). However, small contacts could be threats and could add significantly to surveillance and identification requirements.

A density of 250 per 100,000 sq.n.mi. means about 80 contacts inside a 100-n.mi. circle. All these contacts are assumed to be merchants transiting through the area. The average path length across a 100-n.mi. radius circle is about 130 n.mi. For an average transit speed of 16 knots, each contact remains in the area for about 8 hours and about 235 new contacts enter the 100-n.mi. CIEA each day, or about 10 new contacts per hour.

ISAR's effectiveness at contact ID will depend on a number of factors, including target aspect and sea state. But even if ISAR IDs 90 percent, we would still have an average of one contact per hour requiring

visual or FLIR identification. Some of these contacts could be identified by tactical aircraft which just happened to be in the area, and others by SH-60Rs already out on ASW missions; however, some surface contact identification would require dedicated helicopter sorties. We assume that at least ten helicopter sorties per day would be required to visually identify new surface contacts; however, the exact number could be much higher or lower. These sorties could be flown by the CH-60, provided that it is armed and equipped with FLIR and the datalink.

Slide 15.

How many H-60s for SUW?

- **1 60R highboy continuous**
- **Additional R/S contact ID sorties (assumed 10 per day)**
- **6 R/S* sorties to initialize picture (assumed once per day)**

*Assumes S is armed and equipped with FLIR & link

	Sorties	
	R	**R/S***
Initialize picture		**6**
Maintain highboy	**9**	
Contact ID		**10**
Total sorties	**9**	**10-16**
Total aircraft	**4.5-6**	**5-11**

Could be done by P-3 with ISAR, or partially by E-2--if available

Fewer helos if tactical pict not lost

The preceding discussion leads us to this accounting of the number of H-60s needed for SUW. The nine sorties needed to maintain the WASP aircraft must be Rs, because only the R has a radar. The contact ID (and engage, if necessary) sorties can be flown by either R or S aircraft, provided that the S is armed and equipped with FLIR and link.

Slide 16.

ASW

- **Conduct area sanitization prior to the arrival of battlegroup**
- **Conduct steady-state surveillance and contact prosecution once the battlegroup is in MODLOC**

We will look at two types of ASW operations: area sanitization prior to the arrival of the battlegroup or ARG, and steady-state operations defending the battlegroup in MODLOC.

Slide 17.

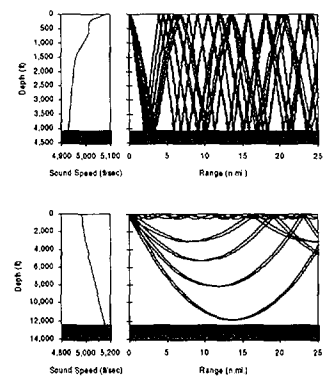
ASW Precursor Clearance

- **2,500, 5,000, 10,000-sq.n.mi. areas**
- **Search with SH-60Rs using ALFS**
  - **Requires multiple searches (2.3 times for 90% confidence)**
- **Range depends on acoustic conditions**
  - **2 n.mi. for bad (e.g., GOO)**
  - **5 n.mi. for average**
  - **10^{+} n.mi. good (e.g., Med in winter)**

For precursor operations, we look at a range of area sizes, from 50 by 50, to 100 by 100, and a range of acoustic conditions. By the random search formula for estimating search effectiveness, searching the area with 90-percent confidence requires a coverage factor of 2.3. This means that to have a 90-percent probability of detection in a 5,000-sq.n.mi. area, we must apply 2.3 x 5,000 = 11,500 sq.n.mi. of search effort.

Slide 18.

Range of Acoustic Conditions



Poor
- Gulf of Oman, Summer
- Strongly downward refracting
- Multiple bottom interactions
- Very short detection ranges

Good
- Mediterranean, Winter
- Duct + convergence zone
- Opportunities for long-range detection

Environmental conditions are crucial—and highly variable—for active and passive acoustic detection of submarines. This slide illustrates the extremes of acoustic conditions. The charts show the sound velocity profile and an acoustic ray trace, which show the types of acoustic propagation paths available.

Slide 19.

Estimating ALFS Search Rate

- **Search rate = π • ROD^2 • dip rate**
- **Dip time = time in dip + transit time between dips**
- **Time in dip = transition to/from hover + lower/raise sonar + active search + passive search**

	ROD (n.mi.)		
	2	**5**	**10**
Transit: 3xROD (n.mi.)	6	15	30
Transit spd (kt)	95	115	124
Transit time (min)	3.8	7.8	14.5
To/from hover (sec)	30	30	30
Lower to 200 ft (sec)	11	11	11
Active search (sec)	40	100	200
Passive search (sec)	180	180	180
Raise from 200 ft (sec)	8	8	8
Dip time (min)	4.5	5.5	7.2
Dips/hr	7.2	4.5	2.8
Srch Rate (sq.n.mi./hr)	**91**	**355**	**872**

This chart shows how we estimate area search rate for the ALFS dipping sonar. To maximize the area searched (and minimize overlap), we assume the dip points are spaced by three times the sonar range.

The helicopter flight characteristics are based on the 60F.[4] Active search time is based on a four-ping search at each of two sonar depths.

4. Transit time includes the time required for the aircraft to accelerate and decelerate from 0 to max speed. Thus, the average transit speed increases with the distance traveled. Sonar raise/lower times are based on the AQS-13F.

Slide 20.

SH60R Sorties Required

ALFS range of the day (n.mi.)		Area Size (sq.n.mi) 2,500	5,000	10,000
	2	23	52	127
(Depends on environment)	5	*6*	*13*	33
	10	*2*	*5*	*13*

- 3.5-hour sorties
- 3xROD between dips

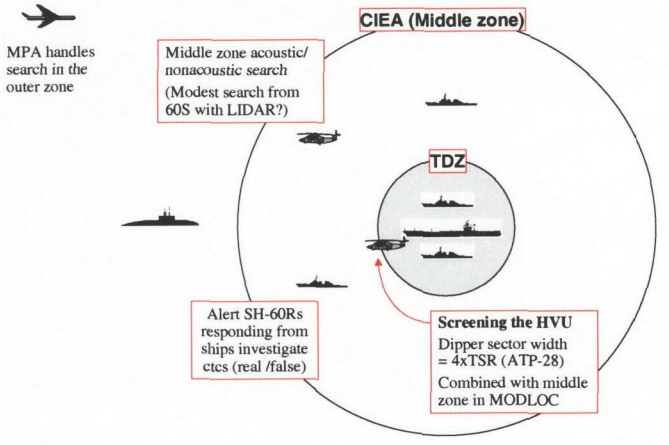
Using the search rates from the preceding slide, this table shows the number of sorties required to achieve a coverage factor of 2.3 (90-percent probability of detection). [5]

Because this search is conducted prior to the battlegroup's entry into an area, it seems likely that at most two surface combatants with two 60Rs embarked on each would be sent ahead for this operation. The numbers in *red italics* show those cases where a force of at most four 60Rs could accomplish the search in one or two days.

5. A 3.5-hour sortie is assumed. Each sortie is penalized for transit time from the host platform to the search location, which is a function of the area size. Transit distances are 25, 35, and 50- n.mi. ($\frac{1}{2}\sqrt{\text{Area Size}}$), respectively for the three search area sizes, giving productive search times of 2.8, 2.4, and 2.0 hours per sortie (135-knot transit speed).

Slide 21.

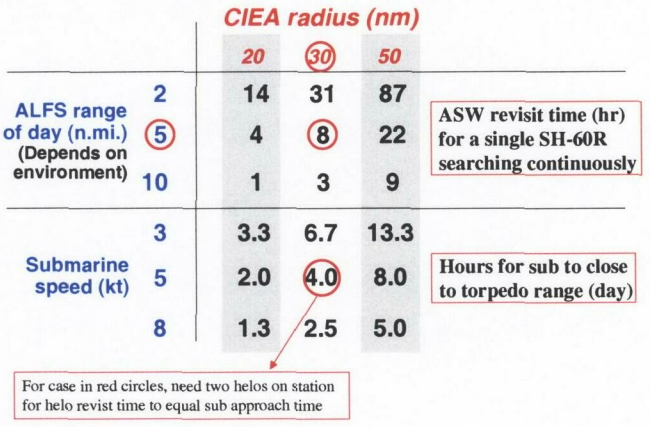
Protecting the middle and vital zones



Considerations for sizing the ASW middle zone are the same as for the surface threat: we must be able to detect and engage a submarine threat in the middle zone before it can reach the Vital Area.

Slide 22.

Timing of middle zone area search with ALFS



The top half of the chart shows how rapidly a single 60R can search an area of a given size with ALFS. For example, when the detection range is 5 n.mi., ALFS will cover a 30-n.mi. radius circle in eight hours. Or, if the search is continued indefinitely, ALFS will revisit each point within the circle every eight hours.

The bottom half of the chart shows how long it takes a submarine to cross a middle zone of a given size to reach torpedo firing range (taken to be 10 n.mi.). A 5-knot submarine (typical of a conventional submarine) crosses the outer 20 miles of a 30-n.mi. circle in 4 hours.

To cover the middle zone effectively, we would want the revisit time to be no more than the transit time. Thus for the example given, we would require at least two helicopters searching continuously to achieve the required revisit rate.

Slide 23.

Middle zone helos required

Number of **helos searching continuously** to achieve required revisit rate versus 5 kt SS

ALFS range of the day (n.mi.)	*CIEA radius (n.mi.)*		
	20	*30*	*50*
2	**7**	**8**	**11**
5	**2**	**2**	**3**
10	**1**	**1**	**1**

This slide shows the middle zone helo requirements for other situations.

As in the case of precursor search, the answer depends strongly on the acoustic conditions. For poor conditions, the number of helos required—seven or more on station, which would require more than 30 helos in the force—is not practical. In these cases the tactical commander must rely more on close-in screening or some other approach. For better conditions, two helicopters on stations should be adequate.

Slide 24.

How many helos for ASW?

	R *Sorties per day*	
Screening	9	Assumes that screening helo does middle zone search
Middle zone search	9	
Contact ID (~10 per day)	10?	largely false contacts
Total sorties	28 = 14 aircraft	

Here we total up the helicopter requirements for ASW. We assume two continuously on station for middle zone search. One of these two also provides the close-in screening of the carrier. We assume an additional ten sorties per day for false contact resolution (about ten false contacts per day, with each requiring one sortie for resolution).

All of these aircraft must be SH-60Rs because all of these sorties require its ASW capabilities.

As noted in our earlier report, the false contact rate is difficult to predict. The prevalence of false contacts has been demonstrated time and again in exercises and actual operations. Although historically in exercises 80 percent of battlegroup ASW contacts are false contacts, the number seems to be more related to the perception of a threat than to actual threat levels. Environmental conditions also appear to play a role. We do not have a firm estimate for the false contact rate, but believe that the above number is reasonable and is *not* a worst case.

Slide 25.

H60R/S for BSD (helo only)

	Sorties	
	R	*R/S*
SUW	**9**	**16**
ASW	**28**	**0**
Total sorties	**37**	**16**
Total aircraft	**18**	**8**

This slide totals up the battlespace dominance requirements for 60R/S aircraft under the assumption that no other assets help out with the problem in the CIEA.

The helo-only solution requires 18 Rs plus eight additional aircraft, which can be either SH-60Rs or CH-60Ss.

Slide 26.

Sharing the load

		Sorties per day R	Sorties per day R/S	Alternate platform
SUW	**Maintain highboy**	9		P-3/E-2, when available
SUW	**Contact ID** for non-ISAR contacts		10?	Tacair (unlikely due to strike demands), UAV?
SUW	**Initialize picture**		6	Tacair (likely if needed)
ASW	**Screening**	9		DD/CG likely insufficient for full screen, urgent atk.
ASW	**Middle zone**	9		P-3, when available
ASW	**Prosecute ctcs**	10?		P-3 (unlikely; need to keep aircraft high for surveillance)

This slide shows how other assets might help out with battlespace dominance tasks.

It seems quite likely that a P-3 or E-2 would be available most of the time to maintain the surface picture (although the E-2 would not have ISAR's contact ID capability, increasing the demand for contact ID sorties). If the surface picture needs to be initialized no more than once a day, Tacair would probably be available to do the job. Tacair would probably not be available for the steady-state surface contact ID sorties, although in the future UAVs might do some of this.

There is less availability of other assets for ASW. When acoustic conditions are very good, surface combatants may be able to handle the screening duties. The P-3 could be used for middle zone search, but it is probably better employed in the outer zone. The P-3 could also be used for false contact resolution, but it is probably better left at high altitude for surveillance.

Slide 27.

H60R/S for BSD (when the whole team plays)

	Sorties per day				
	R		R/S		
SUW	~~9~~	0	~~16~~	10	E-2/P-3 maintain picture; Tacair initializes
ASW	28				P-3 outer zone; 60R middle zone
Total sorties	~~37~~	28	~~16~~	10	
Total aircraft	~~18~~	14	~~8~~	5	

The previous two slides have given the requirements for helicopters when no other assets are taken into account, and a listing of the contribution that could be made by other units. This slide presents our best guess of which BSD tasks would be performed by other units and which, for planning purposes, would be left for battlegroup helicopters. The E-2 and/or P-3 would most likely be available to maintain the surface picture (reducing 60R sorties for SUW by 9). The P-3 would also provide outer zone ASW. TACAIR would probably be available to initialize the surface picture, provided that such tasking is needed no more than once a day (reducing R/S sorties for SUW by 6). Helicopters would still be needed to identify surface contacts entering the area.

This leaves a requirement for two SH-60Rs on station for ASW surveillance in the CIEA and screening of the carrier plus additional sorties for ASW and SUW contact identification and prosecution. As noted in the text, the number of contact ID sorties is driven by false contact rates, shipping densities, and ISAR identification capabilities—all of which are variable and somewhat uncertain. We believe that a planning factor of 10 per day for each is likely in some cases, and is a reasonable requirement. Thus, for situations in which a battlegroup

faces a combined ASW and SUW threat, this equates to a requirement for 14 SH-60Rs and 5 additional helos that can be either SH-60Rs or CH-60Ss (provided that the 60S is armed and equipped with FLIR and data link). Under certain circumstances one SH-60R might be able to do both ASW and SUW ID tasks on a single sortie, but the required coincidence of timing and geography cannot be counted on. If a third of the reaction sorties could do both, the requirement would be reduced to 14 Rs plus 2 to 3 R/Ss.

Slide 28.

Findings

Number of H60s for ASW/SUW depends on:

- **Environmental and geographical factors**
  - » **ASW false contact rate**
  - » **Shipping density, ISAR classification rate**
- **Availability of other assets for ASW/SUW**
  - » **P-3, E-2, UAV**

Typical helo posture is one airborne in CIEA plus another for close-in screening/PG plus additional sorties for contact identification

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Appendix B: Calculating SH-60R force requirements

The Method

This appendix describes our method for calculating SH-60R force requirements. This work draws heavily on methodology developed by CNA in 1995 to support the Helicopter Master Plan.[1] As described in the main text, we first determine the number of helicopters required for peacetime forward-deployed operations, and then apply standard planning factors to calculate the infrastructure needed to support the deployed units.

CNA's method is task based rather than organization based. We assume that on any given day a particular aircraft is assigned to one of a number of mutually exclusive tasks. Summing over all the tasks gives the required force size. Another approach would be an organization-based method: The 60R force will be organized as x squadrons of y aircraft each. If the organization is designed to manage the resources efficiently, the two approaches will produce about the same results. If there are sound organizational reasons why efficiencies assumed in the task-based scheme cannot be achieved, then discrepancies will arise between the two methods.

The tasks we have chosen are the following:

- **Forward deployments.** Long (six-month) deployments with either a CVBG or the Mid-East Force (MEF).

1. John V. Hall. *Method and Data for Calculating LAMPS Mk III Helicopter Requirements*, Unclassified, Mar 1995 (CNA Annotated Briefing 95-21).

- **Other deployments.** Long deployments that require less than a fully combat ready capability. These include counternarcotics operations, UNITAS, and CARAT deployments.
- **Miscellaneous operational tasking.** Operations of less than 56 days that are not considered deployments under PERSTEMPO rules. These include some counternarcotics operations and some multinational exercises.
- **Forward homeported.** These are the helicopters based in the Western Pacific that deploy with the forward deployed naval forces (FDNF) units that are homeported in the Western Pacific.
- **Final workups.** These are units making final preparations for deployment. For forward deployers, helicopters mate up with their host platforms six months prior to the deployment. As a result, workups are the same length as the deployment and hence the same number workup as are deployed. For other deployments the workup period may be less than the deployment, requiring fewer units in workups.
- **Squadron training of nondeployed crews.**
- **Naval Reserve training.**

Counting the aircraft in the above categories gives the number of Primary Mission Aircraft Authorized (PMAA). To get PAA, total primary aircraft authorized, we add the following to PMAA:[2]

- Fleet Readiness Squadron (FRS)
- RDT&E aircraft
- Miscellaneous support aircraft.

The total aircraft requirement is PAA plus an allowance for the aircraft in the maintenance pipeline. We also estimate the effects of peacetime attrition.

2. Chief of Naval Operations, *Management of the Naval Aircraft Inventory*, OPNAV Instruction 5442.8, Unclassified, 18 April 1995.

The calculation

This section provides the details for the calculations of the numbers of aircraft assigned to each of the tasks described above. A key underlying assumption of these calculations is that current deployment patterns remain the same in 2010.

Forward deployments

There are three categories of forward deployments: battlegroup, Pacific Fleet MEF deployers (PacMEF), and Atlantic Fleet MEF deployers (LantMEF). Under current deployment patterns, the Pacific Fleet deploys 2.0 battlegroups per year, and the Atlantic Fleet deploys 2.4 per year. Since the deployments are six months long, portal-to-portal, 2.2 battlegroups are deployed on any given day. There are 3.0 PacMEF deployments per year, and 2.4 LantMEF deployments per year. Table 20 summarizes the current 60B/F forward deployment statistics.

Table 20. Current forward deployments

Category	Deployments per year[a]	Average number deployed per day	Surface combatants per group	LAMPS rails per group (today)	Rails/group (2010)
PacBG	2.0	1.0	5	7	8
LantBG	2.4	1.2	5	7	8
BG Avg	4.4	2.2	5	7	8
PacMEF	3.0	1.5	3	3	4
LantMEF	2.4	1.2	2	2	2

a. Based on Atlantic Fleet schedule from November 1998 to December 2001 and Pacific Fleet schedule from November 1998 to December 2004.

The typical battlegroup today consists of an aircraft carrier and five surface combatants. One of the combatants is a DDG-51 flight I/II with no helicopter hangar. Another is a single-RAST DD-963.The remaining three ships are dual-helo capable. By 2010, all the single-RAST DD-963s are scheduled to retire. They will be replaced by DDG-51 flight IIIs, which are dual-helo capable. If battlegroup size remains constant, the average number of helo rails will increase from seven today to eight in 2010.

For our baseline 2010 case, we consider filling all the helo rails on battlegroup combatants and placing six 60Rs on the CVN, for a total of fourteen 60Rs per battlegroup. Table 21 shows the resulting number of forward deployed 60Rs.

Table 21. Number of forward deployed 60Rs

Category	Average deployed per day	60B/F per group today	Average 60B/F deployed per day (today)	60R per group (2010)	Average 60R deployed per day (2010)
BG Avg	2.2	10	22	14	30.8
PacMEF	1.5	3	4.5	4	6
LantMEF	1.2	2	2.4	2	2.4
Total forward			28.9		39.2

Other deployments

Table 22 lists other, non-forward deployments that naval surface combatants with embarked helos make on a regular basis. For these deployments we would recommend deploying a single helicopter on dual-helicopter-capable ships. This is generally consistent with current practices.

Table 22. Current non-forward deployments

Type of deployment[a]	Fleet	Surface combatants per deployment	LAMPS rails per deployment	Deployments per year	Deployment length (months)	Deployments per day
CARAT	Pacific	2.0	2.4	1.2	5	0.5
Standing Naval Force, Atlantic (SNFL)	Atlantic	1.0	1.6	2.7	4	1.0
UNITAS	Atlantic	2.0	3.8	1.2	5	0.5
JIATF East	Pacific	1.0	1.7	2.4	6	1.1
JIATF West	Pacific	1.0	2.0	1.8	3	0.5
Atlantic counterdrug	Atlantic	2.0	4.0	2.0	6	1.0

a. Based on Atlantic Fleet schedule from November 1998 to December 2001 and Pacific Fleet schedule from November 1998 to December 2004.

Table 23 summarizes the number of 60Rs needed to support non-forward deployments.

Table 23. Number of 60Rs on non-forward deployments

Type of deployment	60B/R per deployment	Deployments per day	Average 60R deployed per day
CARAT	2	0.5	1.0
Standing Naval Force, Atlantic (SNFL)	1	1.0	1.0
UNITAS	2	0.5	1.0
JIATF East	1	1.1	1.1
JIATF West	1	0.5	0.5
Atlantic counterdrug	2	1.0	2.0
Teamwork/ RIMPAC	1	0.4	0.4
Total deployed per day			7.0

Miscellaneous operational tasking

In the 1995 study,[3] CNA estimated that an average of about ten LAMPS per day were engaged in miscellaneous operational tasks. However, we have moved some of the tasks counted in that study into the non-forward-deployment category and the final workup category[4]. To avoid double counting, we estimate that about five helicopters per day will be engaged in nondeployed operational tasking, such as counterdrug operations of less than 56 days and short multinational exercises.

3. Gregory N. Suess, et al. *Future Navy Helicopter Requirements: A Summary*, FOUO, Dec 1995 (CNA Annotated Briefing 95-108).

4. The earlier study assumed a four-month final workup. We have lengthened the final workup to six months to better reflect reality. As a result, some of the tasking that the earlier study considered as interdeployment tasking now occurs during the final workup period.

Forward homeported

The FDNF group of combatants based in the Western Pacific consists of an aircraft carrier and nine ships. Today, these nine ships have 13 helo rails among them. If the single-rail ship is replaced by a dual-rail ship when it retires, and the rest of the group composition remains constant, there would be 14 helo rails in 2010. These units maintain a high operational tempo, forming both a carrier battlegroup and surface action groups that deploy in the Western Pacific. To fill all the helo rails and place six 60Rs on the carrier (base case), twenty 60Rs must be homeported in the Western Pacific.

Final workups

For forward deployers, the final workup is the same length as the deployment (six months); hence, there are the same number of units working up as are deployed.

For non-forward deployers, the workup length may be different from the deployment length. We have not obtained any data in this area, so we will assume that the number working up is the same as the number deployed. The effect of any change in this assumption would be quite small.

Squadron training of nondeployed crews

Determining the number of aircraft required for squadron training is the most complicated part of this method. We first estimate the number of pilots required to support the various operational commitments described above. We then determine the rotation base of pilots needed to fulfill the operational commitments while respecting the CNO PERSTEMPO requirement of 50 percent time at home. This gives us the total number of pilots. Of the total pool of pilots, those who are not currently engaged in operational tasking are in need of squadron training.

Current training practices require each crew (two pilots) to fly 15 hours per month. Each squadron aircraft is flown about 55 hour per month for training.[5] The number of aircraft required for squadron training is then given by

$$\frac{\text{crews requiring training} \times \text{flight hours per crew}}{\text{flight hours per aircraft}}.$$

The calculation for our base case proceeds as follows: The number of pilots involved in operational tasking is derived in table 24. The deployed helo numbers in table 24 are taken from tables 21 and 23. Each single-aircraft detachment has four pilots; each dual-aircraft detachment has six pilots. The carrier-based squadron has three pilots for each helo plus a CO and XO, who are also pilots. Thus the number of carrier-based pilots is $3n+2$, where n is the number of carrier-based 60Rs. Including the five helos with 20 pilots engaged in miscellaneous operational tasking, gives 201 deployed pilots in table 24. The table also shows 150 pilots working up. These pilots are away from home 75 percent of the workup period. Thus, there are, on average, 201+(.75)(150)=314 pilots away from home. To meet the CNO PERSTEMPO requirement, the sea-duty rotation base must be twice this size, or 628 sea-duty pilots.

Table 24. Calculation of pilots not at home

Operational tasking	60R per group	Pilots per group	Deploy-ments per day	Deployed pilots	Pilots working up	Fraction of time at home during workups	Pilots not at home
Forward BG	14	44	2.2	96.8	96.8	0.25	169.4
PacMEF	4	8	1.5	18.0	18.0	0.25	31.5
LantMEF	2	6	1.2	7.2	7.2	0.25	12.6
Other deployers	7			28	28.0	0.25	49
FDNF	20	62	0.5	31			31
Misc tasking	5			20			20
Total				201	150		314

5. Changing either of these numbers directly affects total aircraft requirements.

So, the number of pilots that require training is the number that are not on operational tasking and not in workups, 628-(201+150)=277. In the current organizational structure, the ten 60B squadrons each have a CO and XO who do not go to sea but require training. For the moment, we assume that this structure will be retained after the transition to the 60R, giving another 20 pilots who require training. Thus, 297 pilots or 149 crews require training each month. Using the planning factors shown above, we get 149x15/55=41 aircraft for squadron training.

Naval Reserve training

Currently ten SH-60B/Fs are assigned to Naval Reserve squadrons. We assume that these will transition to 60Rs in the future.

Fleet Readiness Squadron

We use the standard planning factor of 25 percent of PMAA to obtain FRS aircraft requirements.

RDT&E aircraft

Six SH-60B/Fs are assigned as RDT&E aircraft. We assume that the number will be the same for the 60R.

Miscellaneous support aircraft

Currently seven SH-60B/Fs are assigned as support aircraft to the Operational Test and Evaluation Force and the Naval Strike Warfare Center. We assume that this level of support will be maintained by the 60R in the future.

Maintenance pipeline

The Navy currently estimates pipeline requirements as 12 percent of operational aircraft (PAA).

Attrition

We use the standard Navy planning factor of 1.1 percent of the force per year. We assume a nominal life of the force of 15 years.

Summary

Table 25 summarizes the calculations described above for the base case of 14 SH-60Rs per forward-deployed battlegroup. Figure 18 shows how force-level requirements change as a function of the number of 60Rs per forward battlegroup. The data supporting the figure are summarized in table 26.

Table 25. Summary of base case calculations[a]

Category	Number of 60Rs
Forward deployed	40
Other deployments	7
Working up	47
FDNF	20
Miscellaneous tasking	5
Squadron training	41
Naval Reserve	10
PMAA	**170**
FRS	43
R&D	6
Misc support	7
PAA	**226**
Pipeline	28
Total force required	**254**
Attrition	42
Total plus attrition allowance	**296**

a. Fourteen SH-60R per forward-deployed battlegroup.

Figure 18. SH-60R force requirements

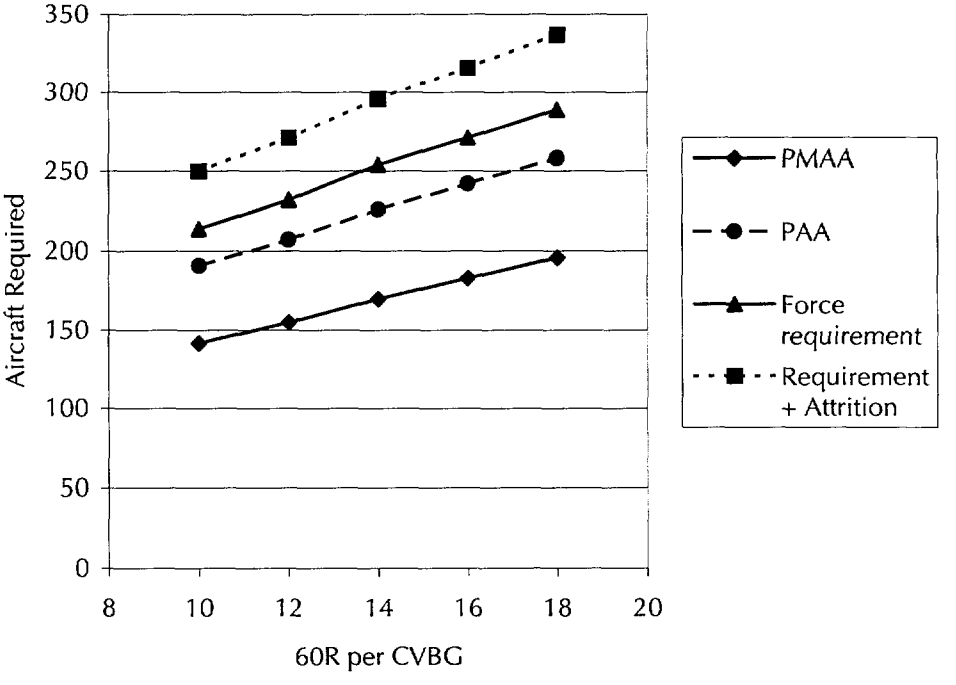

Table 26. 60R requirements as a function of number per battlegroup

	Number of 60R per forward-deployed battlegroup				
	10	12	14	16	18
Forward deployed	31	35	40	44	48
Other deployments	7	7	7	7	7
Working up	38	42	47	51	55
FDNF	16	18	20	22	24
Miscellaneous Tasking	5	5	5	5	5
Squadron training	35	38	41	44	47
Naval Reserve	10	10	10	10	10
PMAA	**142**	**155**	**170**	**183**	**196**
FRS	36	39	43	46	49
R&D	6	6	6	6	6
Misc support	7	7	7	7	7
PAA	**191**	**207**	**226**	**242**	**258**
Pipeline	23	25	28	29	31
Total aircraft required	**214**	**232**	**254**	**271**	**289**
Attrition	36	39	42	45	48
Total + attrition	**250**	**271**	**296**	**316**	**337**

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List of figures

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