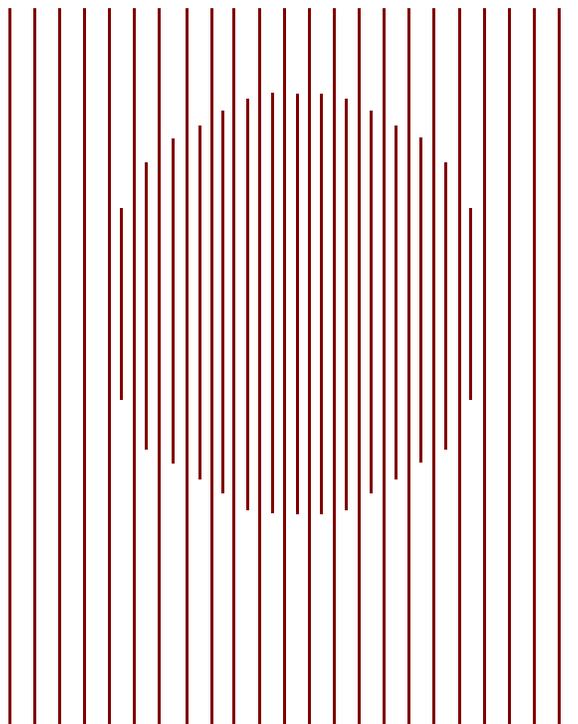


CBO PAPERS

**IMPROVING THE EFFICIENCY
OF FORWARD PRESENCE
BY AIRCRAFT CARRIERS**

August 1996



CONGRESSIONAL BUDGET OFFICE

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SECOND AND D STREETS, S.W.
WASHINGTON, D.C. 20515**

PREFACE

Aircraft carriers are the centerpiece of the U.S. Navy. The Department of Defense indicates that it needs 12 carriers in the fleet to provide forward presence in the Mediterranean, Pacific, and Indian Ocean theaters most of the time. Yet, on average, a carrier spends less than a quarter of its service life on-station in those theaters. This Congressional Budget Office (CBO) paper, prepared at the request of the House Committee on the Budget, examines several options to improve the amount of time a carrier spends in its theater. The options range from altering the ships' deployment cycle to creating an overseas home port for a carrier in the Mediterranean.

CBO was aided in its analysis by information provided by the Navy, the Department of Defense, the Center for Naval Analyses, and various independent analysts. In keeping with the Congressional Budget Office's mandate to provide objective analysis, this paper makes no recommendations.

Ivan Eland of CBO's National Security Division wrote the paper under the general supervision of Cindy Williams and R. William Thomas. Raymond J. Hall, Amy Plapp, and Jeannette Van Winkle of CBO's Budget Analysis Division estimated the costs for the options. William P. Myers, formerly with the Budget Analysis Division, estimated the costs for an earlier version of the analysis. Wayne Glass ensured that the paper was factually correct.

Christian Spoor edited the manuscript, and Judith Cromwell prepared the paper for publication.

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Director

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SUMMARY

The modern U.S. Navy has been built around the aircraft carrier. That ship, with its battle group of surface ships and submarines and its resupply vessels, has been the major tool for projecting power ashore and controlling the seas during wartime. In peacetime, the carrier battle group has been used to remind national leaders of U.S. power through its presence in areas of tension. Such presence, according to its proponents, has deterred aggression, reassured allies, and allowed a more rapid response to regional crises than if carriers had sailed from the United States.

The average aircraft carrier, however, spends less than a quarter of its life providing presence--that is, being "on-station"--in overseas theaters. The main constraint on getting more presence out of each carrier is that the Navy limits the amount of time sailors spend at sea. In an environment in which demands for overseas presence are high and financial constraints are great, the Navy may want to get more out of the forces it is paying for. The Congressional Budget Office (CBO) examined several alternatives to improve the efficiency of carrier operations. They range from altering carrier deployment cycles to establishing an overseas home port for a carrier on the Mediterranean Sea.

In the past, the Navy justified the number of carriers in its fleet by saying that a particular force level was necessary both to fight wars and to provide adequate overseas presence during peacetime. With the end of the Cold War, however, the Bottom-Up Review conducted by the Department of Defense in 1993 identified peacetime presence as the driving force behind its goal of a fleet of 12 carriers (11 active and one reserve).

Even so, the current 12-carrier force cannot provide continuous presence in all three major theaters--the western Pacific, the Mediterranean Sea, and the North Arabian Sea/Indian Ocean. That requirement was developed during the later years of the Cold War but has now been relaxed. Based on historical data on the deployment of carriers, 12 ships provide 100 percent presence in the western Pacific and 79 percent presence, or an average of nine and a half months a year, in the other two regions. (The Navy defines its carrier based at a home port in Japan as being on-station in the western Pacific theater 100 percent of the time.) The Navy requires 12 carriers to provide that level of presence because the average carrier spends only about 23 percent of its time on-station.

CARRIER DEPLOYMENT AND OPERATING CYCLES

Each carrier follows a deployment cycle, only a small part of which is spent on-station. When not on-station, the ship is in one of three other phases: in transit to or from the operating area (which, together with the time spent on-station, makes up the period of deployment); in its home port for maintenance, crew rest, and shore training; or at sea for short periods of crew training or operations when not deployed (known as the nondeployed operations tempo, or "optempo," period). Those phases constitute the deployment cycle. Both conventionally powered and nuclear-powered carriers undergo several deployment cycles within one operating cycle, which is the time between complex overhauls (periods of major maintenance).

Because nuclear-powered carriers undergoing a complex overhaul cannot readily deploy in times of crisis, the Navy plans to change the operating cycle of those ships beginning next year. The Navy's new "incremental maintenance" plan will eliminate the period of complex overhaul and spread its extensive maintenance more evenly among the deployment cycles. Those longer periods of shorter-term maintenance will lengthen the deployment cycle for nuclear-powered carriers from the notional 21 months that the Navy uses for planning to 24 months.

In the new 24-month cycle, six months will be spent on deployment, 14 months in home port (including six months of short-term maintenance), and four months for nondeployed optempo. Under the new plan, the force of 11 active carriers and one reserve carrier could provide presence 100 percent of the time in the western Pacific and 84 percent of the time in the Mediterranean and the North Arabian Sea/Indian Ocean regions.

That amount of presence is greater than has actually been achieved under the current deployment cycle because it does not assume the additional maintenance that nuclear carriers have actually required. If past maintenance trends continue under the new plan, the Navy may not achieve a presence of 84 percent in the two regions.

OPTIONS TO IMPROVE THE EFFICIENCY OF FORWARD PRESENCE BY CARRIERS

CBO examined a number of alternatives to improve the efficiency of forward presence by carriers--allowing the Navy to either increase presence with its planned carrier force or achieve the same presence while reducing the number of carriers. Most of the alternatives have been proposed in some form by Navy personnel or by studies done for the Navy or the Congress. They range from altering the deployment cycle to establishing an overseas home port on the Mediterranean Sea.

Shorten the Deployment Cycle from 24 Months to 18 Months

This alternative would shrink the length of the deployment cycle from 24 months under the incremental maintenance plan to 18 months. The 18-month cycle would include six months for deployment, three months for nondeployed optempo, and nine months in home port for maintenance (six months), crew rest, and training ashore. Cutting the deployment cycle to 18 months might seem drastic, but in the early 1980s the Navy operated with cycles of just 16 months.

Under this alternative, the Navy could achieve the baseline presence of the incremental maintenance plan (100 percent presence in the Pacific and 84 percent in the other two theaters) with only nine carriers and eight air wings instead of 12 carriers and 11 air wings. A permanent reduction to that force level would save a net \$2.1 billion a year, on average, in procurement and operation and support (O&S) costs.

Alternatively, if the Navy retained 12 carriers, shortening the deployment cycle would allow it to maintain 100 percent presence in the Pacific and 112 percent in the Mediterranean and the North Arabian Sea/Indian Ocean. That is, two carriers could be on-station in each of those two theaters some portion of the time.

Lengthen the Deployment Period from Six Months to Eight Months

Lengthening the deployment period from six months to eight months would boost the time spent on-station for every transit a carrier made to its operating area. That extra time would come at the expense of the time the crew would normally spend in its home port.

This option would allow the Navy to provide nearly its baseline presence with only eight carriers and seven air wings. Reducing the force to that level would save a net \$3.1 billion in average annual procurement and O&S costs. Alternatively, increasing the period of deployment and keeping 12 carriers in the force would allow the Navy to maintain a presence of 100 percent in the Pacific and 125 percent in the other two regions.

Shuttle Multiple Crews to Carriers On-Station

Another way the Navy could improve the efficiency of carrier deployments would be to rotate crews and air wings to carriers that were on-station. The Navy's limit on the amount of time personnel are allowed to spend at sea is the major constraint to

the efficiency of carrier operations. The current personnel tempo ("perstempo") requirement states that crews must spend 50 percent of their time in their home port. By rotating crews and air wings, one set of personnel could be deployed while others were in home port or getting ready for a deployment.

Shuttling crews in that way would allow the Navy to maintain its baseline presence with fewer than eight carriers and nine crews and air wings, saving an average of at least \$1.3 billion a year in procurement and O&S costs. Or the Navy could substantially increase presence by retaining the 12 carriers and shuttling crews and air wings to them on-station.

Transfer Two Carriers from the Pacific to the Atlantic

Basing more carriers on the Atlantic coast would bring a small gain in efficiency. The Navy deploys carriers on both U.S. coasts to the North Arabian Sea/Indian Ocean region. But the distance to that region from the Atlantic coast (using the Suez Canal) is about 3,500 nautical miles shorter than from the Pacific coast. If the Navy transferred two carriers from the West Coast to the East Coast, 11 active carriers could provide the baseline presence normally provided by 11 active carriers and one reserve carrier.

CBO estimates that eliminating the reserve carrier and the reserve air wing would save \$1 billion a year in procurement and O&S costs. However, those savings would be partially offset by a one-time cost of about \$200 million for moving the ships and creating any new facilities needed to accommodate them. Alternatively, transferring two carriers and keeping the existing carrier force would allow the Navy to keep a presence in both the Mediterranean and North Arabian Sea/Indian Ocean 87 percent of the time, rather than the 84 percent in the baseline.

Establish a Home Port on the Mediterranean Sea

If the Navy established a home port in the Mediterranean and considered the carrier deployed there as on-station 100 percent of the time--as it does with the one based in Japan--it could reduce the carrier force to eight ships and seven air wings. The one-time cost of constructing or upgrading the facilities needed at a home port (\$700 million to \$1.9 billion) is estimated to be substantially less than one year's average net savings from reducing the carrier force by four carriers and four air wings. Those savings are estimated to be \$4 billion a year.

If the Navy chose to establish another home port and keep 12 carriers, it could provide 100 percent presence in the Pacific and Mediterranean theaters and 129 percent in the North Arabian Sea/Indian Ocean.



CHAPTER I

PATTERNS OF AIRCRAFT CARRIER DEPLOYMENTS

The aircraft carrier is the centerpiece of the U.S. Navy. Deployed in a battle group with its escort of surface ships, submarines, and resupply ships, it is both a weapon that can be used in wartime and a symbol of U.S. military presence in peacetime. In the past, the Department of Defense (DoD) determined the number of aircraft carriers that it needed based on both the number required for war and the number needed to provide sufficient peacetime presence overseas. During the Reagan Administration and early in the Bush Administration, the Navy maintained that it needed 15 carriers to fill either of those roles.

During the Clinton Administration, however, DoD's Bottom-Up Review (BUR) concluded that the peacetime presence mission determined the minimum number of carriers needed. The review said up to 10 carriers would be necessary to fight two major regional conflicts that occurred nearly simultaneously (four to five ships per theater). But it called for a 12-carrier force as the minimum needed to provide adequate peacetime presence in three key theaters--the Mediterranean, the western Pacific, and the North Arabian Sea/Indian Ocean.¹ Advocates of overseas peacetime presence say carrier battle groups deter regional aggressors, reassure U.S. allies, and allow a more rapid response to regional crises than if carriers had to sail from the United States.

Even so, given the Navy's current practices in deploying aircraft carriers, the force of 12 does not provide continuous presence in the three principal theaters of concern--a goal that was enunciated in the latter stages of the Cold War.² Earlier in the Cold War, the United States deployed its carriers primarily in the Mediterranean and western Pacific. After the Cold War, the requirement for a continuous presence in three theaters was relaxed somewhat.

The Congressional Budget Office (CBO) calculates that, based on recent deployment patterns, 15 carriers would be needed to provide continuous presence in all three theaters. (See the appendix for more details about this calculation, which uses a formula derived from Navy equations.) That figure implies that the Navy would need a total of five carriers in the force (15 carriers divided by three theaters)

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1. The BUR's 12-carrier force would contain 11 active carriers and one in reserve that could also be used for training.
 2. Andrew Krepinevich, *The Bottom-Up Review: An Assessment* (Washington, D.C.: Defense Budget Project, February 1994), p. 33.

for every one it deployed to maintain such a presence. In the late 1980s, by contrast, the Navy stated that it needed three carriers in the force for every one it deployed. In the early 1980s, the Navy kept five carriers deployed out of a force of 13 at any one time--a 2.6-to-1 ratio.

According to the formula, the 12-carrier force can maintain year-round presence in one theater and provide presence 79 percent of the time (nine and a half months) in the other two theaters. Twelve carriers are required to provide that level of presence because the average aircraft carrier is "on-station" (patrolling its assigned theater) only 22.7 percent of the time. What does it do the other 77.3 percent of the time?

THE CARRIER DEPLOYMENT CYCLE

Each carrier has a deployment cycle, only part of which is spent on-station. When it is not on-station, the ship is in one of the following phases:

- o In transit to or from its operating area (that time plus the time spent on-station equals the period deployed);
- o In its home port for maintenance, and for leave and shore training for the crew; or
- o At sea for short periods of crew training or operations when not yet deployed (called nondeployed operations tempo or "optempo").

For planning purposes, the Navy has used various lengths for the deployment cycle--18, 20, 21, and 22.5 months, according to Navy officials and documents. The 21-month cycle has been used most often. In reality, however, the average duration of the deployment cycle for nuclear-powered carriers has been 24 months since the beginning of fiscal year 1986 (when the current carrier deployment policy began). The average cycle for conventionally powered carriers has been 19 months. For both types of carriers, however, the length of the cycle and the activities within it vary from one deployment to the next.

Conventionally Powered Carriers

Conventionally powered carriers have a shorter deployment cycle because they need less time for maintenance than nuclear-powered carriers do. From that perspective, they are more efficient in providing overseas presence. In other words, they can

provide the same amount of presence with fewer ships or greater presence with the same number. In a typical 19-month cycle, after a conventionally powered carrier finishes a deployment, it spends 10 months in home port for maintenance, shore leave, and crew training (see Figure 1). That cycle meets the Navy's requirement that ships spend at least 50 percent of their time in home port over a period of five years for the sake of the crew's quality of life.

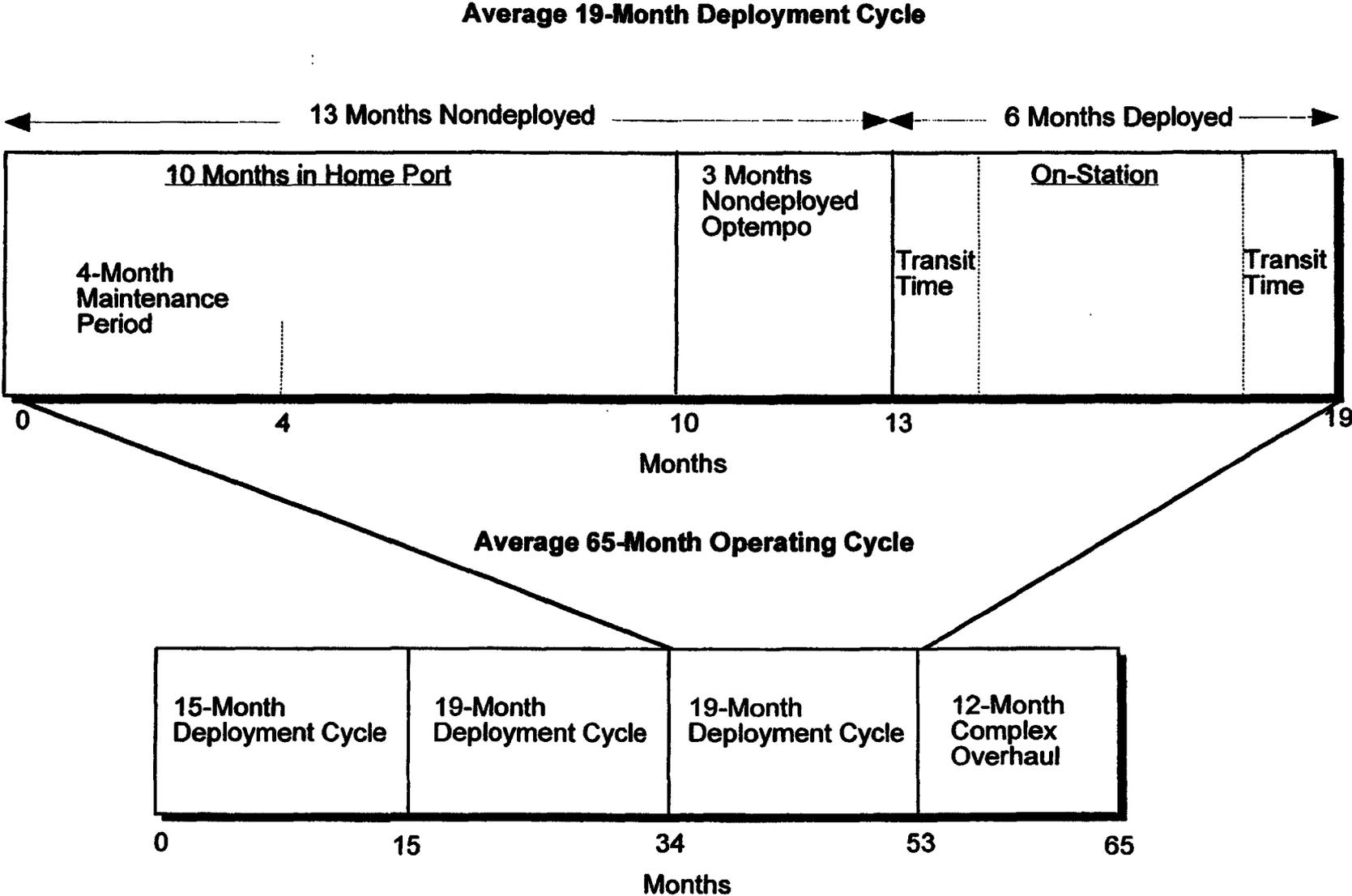
The Navy initiated that limit on the time at sea for a ship and its personnel (known as personnel tempo or "perstempo") in fiscal year 1986 because it believed that sailors were leaving the Navy at unacceptably high rates to avoid too much time at sea. The 50 percent perstempo restriction is an important constraint on the efficiency of carrier deployments. Additional Navy perstempo requirements include a minimum turnaround ratio--the ratio of nondeployed time to deployed time--of 2 to 1 and a maximum deployment period of six months.

Besides spending the 10 months in home port between six-month deployment periods, conventionally powered carriers engage in three months of activities that are counted as time at sea. That "nondeployed optempo" period consists of short, at-sea training cruises and exercises that allow the crew and air wing to hone their skills ("work up") before the next deployment. The period also includes nondeployed operations such as port visits in nearby countries, exercises with the navies of neighboring countries, or use of the ship to research, develop, and test new technology. When a crew is working up for a deployment, the work-up progresses from training individuals in their jobs to training members of a unit (such as the aircraft in the carrier's air wing) to operate together. Next, the ship trains with its air wing and later with other ships in the battle group and the forces of other services.

Once a carrier is deployed, it must spend part of its time in transit to and from its area of operations. Total transit time can consume anything from one month to more than two and a half months of the six-month deployment period, depending on the location of the home port and the area of operations. Transit to and from the North Arabian Sea or Indian Ocean, for example, requires much longer periods than transit to and from the Mediterranean.

The deployment cycle of an aircraft carrier is part of a larger operating cycle--the time between major maintenance periods. A conventionally powered carrier typically undertakes three deployment cycles before requiring a complex overhaul (see Figure 1). That overhaul generally lasts 12 months, during which the ship is taken apart and undergoes extensive maintenance and modernization. Thus, the

FIGURE 1. DEPLOYMENT AND OPERATING CYCLES FOR A CONVENTIONALLY POWERED CARRIER



complete operating cycle for a conventionally powered carrier lasts about five and a half years.³

Nuclear-Powered Carriers

Nuclear-powered carriers have different deployment and operating cycles because they require more maintenance than conventionally powered vessels do. During every deployment cycle they spend 14 months in home port, six months of which are for maintenance (rather than 10 months in home port with four months of maintenance). The complex overhaul for nuclear-powered carriers, which is conducted at the end of every fourth deployment cycle, usually requires 20 months instead of 12 months (see Figure 2). Also, Nimitz class nuclear carriers (all but one of the nuclear carriers in the force) are scheduled for a 32-month refueling complex overhaul near the middle of their service life--to undergo extensive maintenance and refuel the reactor--that conventionally powered carriers do not have. (The average 24-month deployment cycle of nuclear carriers is less efficient than the notional 21-month cycle that the Navy uses for planning. That 21-month cycle includes the same six months deployed but only 11 months in home port, of which three months are spent in maintenance.)

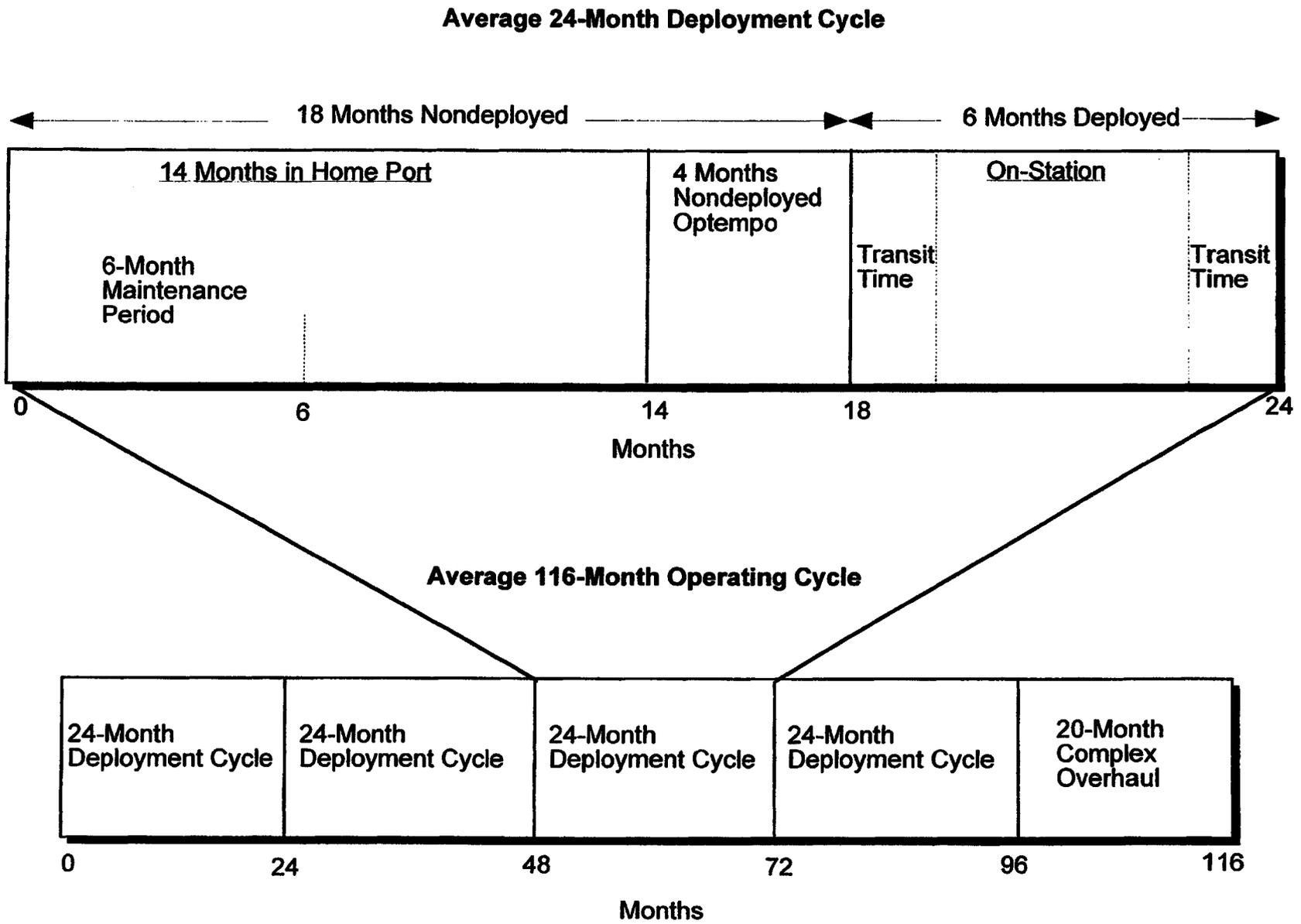
The operating cycle of nuclear-powered carriers lasts nearly 10 years rather than five and a half. On average, under current deployment cycles, a nuclear-powered carrier will spend 21 percent of its 45-year service life deployed, whereas a conventionally powered carrier will spend 28 percent of its life deployed.

According to the Navy, the lower efficiency and the higher procurement and overhaul costs of nuclear-powered carriers are offset by their increased combat power and greater endurance at maximum speed. Because such carriers do not have to burn and store large amounts of fossil fuel, they can store more ordnance and jet fuel for their aircraft and, at least in theory, go longer between replenishments.

Critics, however, contend that when the Navy actually deploys ships, it treats nuclear- and conventionally powered carriers the same. Also, they say, the Navy must replenish battle groups containing each kind of ship about equally often because most of the surface ships that escort and protect both types of carriers are

3. Although the average deployment cycle for a conventionally powered carrier is 19 months, Figure 1 shows that the first deployment cycle in the operating cycle is only 15 months. The four-month maintenance period is not needed then because the ship has just finished a complex overhaul in the previous operating cycle. For a nuclear-powered carrier, the first maintenance period (six months) is not eliminated but is spread throughout the operating cycle. Figure 2 has been simplified, however, to reflect the average 24-month deployment cycle during the operating cycle.

FIGURE 2. DEPLOYMENT AND OPERATING CYCLES FOR A NUCLEAR-POWERED CARRIER



conventionally powered.⁴ Navy officials familiar with carrier operations acknowledge that the battle groups of both nuclear-powered and conventionally powered carriers regularly keep fuel stores replenished near capacity to hedge against the need to make a sudden, lengthy response to a crisis. In addition, critics claim that nuclear-powered carriers are constrained in their operations because they are restricted from visiting certain ports and from steaming through certain bodies of water. For example, they have not always been able to transit the strategic Suez Canal.

Despite that debate, the Navy continues to build nuclear carriers--at a cost of about \$5 billion apiece in 1997 dollars. Once the carriers authorized by the Congress to date are finished--around 2003--the Navy expects to have a force of 10 nuclear-powered carriers and two conventionally powered ones, compared with a force of eight nuclear-powered and four conventionally powered carriers at the end of 1996. Thus, the nuclear carrier will soon dominate in planning both for wartime and for peacetime presence. According to its long-range plan, the Navy will request an 11th nuclear carrier in 2002, but the ship will not join the force until the end of that decade. Beyond that, the Navy is studying whether future carriers should be nuclear- or conventionally powered.

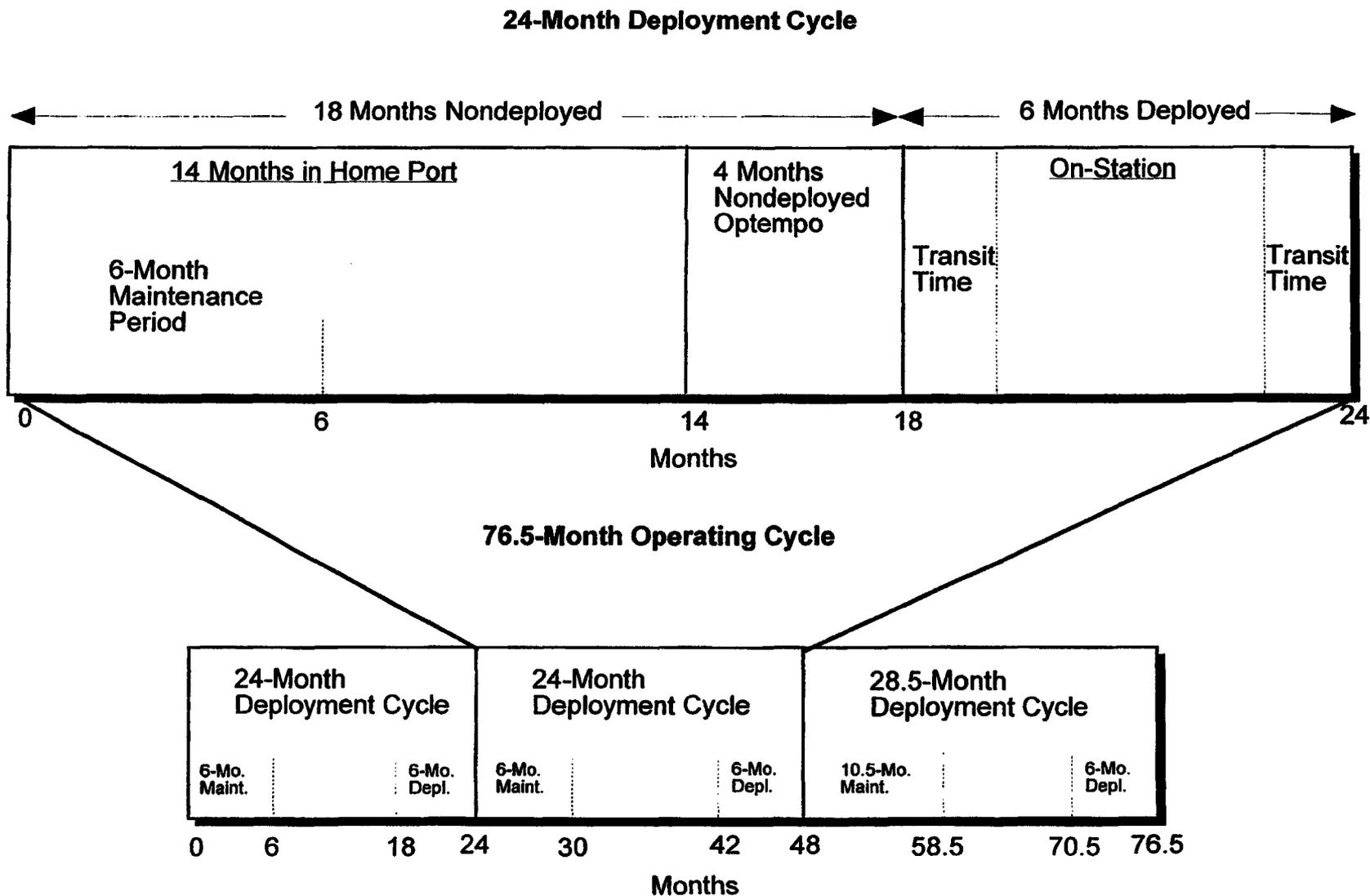
CURRENT PLANS TO CHANGE THE OPERATING CYCLE FOR NUCLEAR-POWERED CARRIERS

The Navy plans to alter the operating cycle for nuclear-powered carriers beginning next year. A nuclear-powered carrier that is in the middle of a complex overhaul cannot be deployed quickly in the event of a crisis. To allow such ships to be more available for use during crises, the Navy is eliminating the complex overhaul period and is spreading upkeep more evenly throughout the operating cycle by extending the shorter maintenance periods. Under this new "incremental maintenance" plan, the maintenance periods will be extended from three months (in the Navy's notional deployment cycle of 21 months) to six months, and a 10.5-month maintenance period in every third deployment cycle will replace the complex overhaul (see Figure 3). Also under this plan, the operating cycle will drop from 116 months to 76.5 months and include only three deployment cycles rather than four.

While undergoing these more frequent periods of less intensive maintenance, the carrier can be readied for a sudden deployment more quickly and the crew can remain in a higher state of readiness than during an extended period of overhaul. In fact, if the Navy can maintain nuclear-powered carriers according to the schedules

4. Hans Kristensen, William Arkin, and Joshua Handler, *Aircraft Carriers: The Limits of Nuclear Power*, Neptune Paper No. 7 (Washington, D.C.: Greenpeace, June 1994), pp. 3-5.

FIGURE 3. CHANGES IN DEPLOYMENT AND OPERATING CYCLES FOR NUCLEAR-POWERED CARRIERS BEGINNING IN 1997 UNDER THE INCREMENTAL MAINTENANCE PLAN



under the incremental maintenance plan, the carriers' average availability for crisis response will increase from 83.2 percent of their service life to 84.5 percent. (The historical availability for conventionally powered carriers is 82.2 percent.)

With the shorter maintenance periods being extended by three months under the new regimen, deployment cycles within the operating cycle will officially increase from a notional 21 months to the 24 months they average now (see Figure 3). Under the new deployment cycle, a carrier will be at sea 42 percent of the time, still well below the 50 percent maximum allowed.

Because CBO's analysis requires a baseline with which to compare alternatives to improve the efficiency of carrier presence, CBO used as its base case the theoretical presence that the incremental maintenance plan would achieve by 2003. For the current force of 11 active carriers and one reserve, that presence would be a carrier in the Pacific 100 percent of the time and a carrier in both the Mediterranean and the North Arabian Sea/Indian Ocean regions 84 percent of the time.

The presence projected under the Navy's plan is greater than has been achieved under the current deployment cycle (100 percent in the western Pacific and 79 percent in the other two regions) because, in practice, nuclear carriers have required an average of three months' more maintenance per deployment cycle than anticipated. If that trend continues under the new plan, the Navy may not achieve a presence of 84 percent in the two regions. The absolute amount of presence used for CBO's baseline is not critical, however, because all of the alternatives that are compared with it will have to provide similar amounts of presence. Therefore, CBO used the theoretical 84 percent even though the Navy may not be able to achieve it in practice. Using that theoretical presence, the average carrier would be on-station 23.3 percent of the time, compared with 22.7 percent historically.

