

A First Look at Sealift Options for the 1990s in Light of the Experience in Operation Desert Shield



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A handwritten signature in black ink, appearing to read "J. Nakhleh".

Jamil Nakhleh
Director
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Operation Desert Shield has put U.S. transportation capabilities to the test; the lessons learned provide a starting point for gauging their appropriateness for the post-cold-war period. This research memorandum is a first assessment of the case of sealift. It describes sealift resources available to the U.S., summarizes their performance during the first five months of Desert Shield, and examines several options for improving U.S. sealift potential in the 1990s.

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PREFACE

This paper is the result of research and analysis by members of CNA's Logistics Research Program. The principal researchers were John F. Addams, Michael A. Atamian, John D. Keenan, John J. Nelson, Ronald H. Nickel, Ronald F. Rost, George N. Walne, and Desmond P. Wilson. The final draft was written by David A. Perin and Ronald F. Rost.

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CONTENTS

	Page
Illustrations	ix
Introduction	1
Sealift Programs and Resources	2
Sealift Performance in Desert Shield	4
APF	6
Fast Sealift	6
RRF	7
Charters	7
Desert Shield as a Model for Defense Planning	9
The Potential of Current Sealift Resources	12
RRF Readiness	12
Availability of Commercial Charters	13
Sealift Potential vs. Requirements	14
Sealift Options for the 1990s	17
Responsiveness vs. Readiness Status	17
Prepositioning	19
Reduced Operating Status	19
Inactive Status	19
Commercial Service	19
Design Considerations for New Sealift	20
Illustrative Sealift Options	21
Paying for a Sealift Program	26
Concluding Discussion	28

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ILLUSTRATIONS

	Page
1 Dry Cargo Deliveries During Phase I of Desert Shield	5
2 Dry Cargo Deliveries in Phase I by Ship Type	5
3 First and Last Arrivals for Major Ground Units and the Corps Support Command	6
4 Combat Aircraft in Theater at C+30	15
5 First Arrival Times in the Persian Gulf vs. Peacetime Readiness Status for Sealift	18
6 Closure Times and Costs for Sealift Operations	24
7 Costs and Delivery Times for First Division and Support	24
8 Costs and Delivery Times for Second Division and Support	25
9 Costs and Delivery Times for 10 Million Square Feet	25

INTRODUCTION

Since World War II, the U.S. has embraced a coalition strategy built on the concept of forward defense and implemented through a combination of forward-deployed forces, prepositioned equipment, and capabilities for rapid reinforcement from the United States. Both airlift and sealift are critical to this strategy—airlift to move people and selected high-priority cargo, and sealift to transport the large quantities of unit equipment, ammunition, and other supplies. Both were the recipients of significant investments during the 1980s to improve U.S. ability to respond to the threat of a global war.

Although the threat has changed considerably in the past two years, the need for a rapid overseas deployment of U.S. forces apparently has not. Operation Desert Shield has put U.S. transportation capabilities to the test; the lessons learned provide a starting point for gauging their appropriateness for the post-cold-war period. This paper is a first assessment of the case of sealift. It describes sealift resources available to the U.S., summarizes their performance during the first five months of Desert Shield, and then examines several options for improving U.S. sealift potential in the 1990s.

SEALIFT PROGRAMS AND RESOURCES

During the 1980s, the Navy invested \$7 billion in sealift programs, including the following:

- *Afloat Prepositioning Force (APF)*. The APF consists of 13 maritime prepositioning ships (MPSs) carrying combat equipment and supplies for the Marine Corps and 12 other prepositioning (PREPO) ships—4 tankers, 7 ships carrying ammunition and other supplies for the Army and Air Force, and one ship carrying a Naval field hospital. Most of the PREPO ships are prepositioned at Diego Garcia in the Indian Ocean. They are fully manned in peacetime and are operated under charter to the Military Sealift Command (MSC). The MPSs are organized into three squadrons that carry the unit equipment and 30 days of supply for three Marine Expeditionary Brigades. The ships are also fully manned in peacetime and operated under charter to MSC. The MPS squadrons are based on Diego Garcia, Guam, and the U.S. east coast.
- *Fast Sealift Ships (FSSs)*. The fast sealift ships comprise eight SL-7 container ships that the Navy purchased from Sea Land Corporation and converted them to a mixed roll-on/roll-off (RO/RO) and container configuration for rapid movement of military equipment and supplies. They are maintained in a reduced operating status (ROS) with partial crews to be ready to sail within four days. The eight FSSs can move the unit equipment of an Army division overseas at a sustained speed of 30 knots, half again the speed of most conventional sealift.
- *Ready Reserve Force (RRF)*. The RRF is a fleet of militarily useful ships that were purchased by the Navy in the 1980s as they became surplus on the commercial market. The RRF consists of 96 ships—17 RO/ROs, 51 break-bulk cargo ships, 7 barge carriers, 11 tankers, 8 crane ships, and 2 troop ships. In peacetime, RRF ships are laid up in an inactive status under the control of the Maritime Administration (MARAD). (Maintaining a ship in an inactive status costs only about one-fourth the \$6 million per year cost of maintaining a ship in ROS.) Before they are turned over to MSC for operation, RRF ships must be towed to a nearby shipyard for mechanical preparations. They are crewed from the pool of available U.S. mariners. About two-thirds of the RRF ships were planned for activation in 5 days, the remainder in 10 to 20 days.

- *Flat Racks and Sea Sheds.* Container ships, which constitute the bulk of the U.S.-flag dry-cargo fleet, are well-suited to carrying ammunition and other containerized supplies, but not unit equipment. To exploit the capability of container ships in an emergency, the Navy has developed special devices, known as flat racks and sea sheds, that convert container ships to carry unit equipment. Twenty-five sets of equipment were procured in the 1980s. This equipment was not employed in Desert Shield because sufficient sealift was available from more timely and economical sources.

In addition to the above sealift resources under direct U.S. government control, MSC can charter ships from the U.S. and foreign-flag commercial fleets and draw on ships in the Sealift Readiness Program (SRP). (U.S.-flag shipping companies that receive operating subsidies must commit half of their ships to the SRP, which can be activated at the request of the Secretary of Defense.) In addition, in a state of emergency, the President can also requisition U.S.-flag ships. The SRP and requisitioning were not employed to support Desert Shield because more suitable ships were available for charter and because those actions would have disrupted the commercial activities of U.S. shipping companies, leading perhaps to permanent loss of business on some routes.

Sealift is only one part of the entire process of moving the Army "from fort to foxhole." The Military Traffic Management Command (MTMC), an Army command, is responsible for land transportation within the United States as well as the selection of ports and the actual loading of ships. MSC arranges for ships, assigns them to ports in response to requests from MTMC, and controls ships enroute. Unloading ships and moving their cargo to forward field locations is the responsibility of the theater commander. The entire process is designed to operate according to an operational plan and associated detailed Time-Phased Force Deployment Data (TPFDD) developed by the Joint Operational Planning System. Desert Shield was the first large-scale test of the entire process.

SEALIFT PERFORMANCE IN DESERT SHIELD

In response to the Iraqi invasion of Kuwait on 2 August, the President ordered the largest U.S. military deployment since the Vietnam War. The deployment has occurred in two phases. Phase I began on August 7 (C-day)¹ and lasted into November. The end date for Phase I is somewhat arbitrary, as the final few items associated with the initial deployment did not arrive until late November. For purposes of this discussion, the Phase I sealift is considered to have been completed on 15 November C+100. During this period the U.S. deployed about 1,000 combat aircraft, 60 Navy ships, and 240,000 U.S. military personnel, including a Marine Expeditionary Force, and about 4-1/3 Army divisions plus their associated headquarters, nondivisional equipment, and support equipment and supplies. Phase II, which apparently was decided on 7 November and announced on 8 November, continues through 15 January 1991. It will roughly double U.S. forces in theater.

Overall, sealift and airlift have gotten the job done in Desert Shield, moving as much equipment and supplies as were transported in comparable periods in Korea or Vietnam despite longer distances and fewer forces initially or scene. Summary statistics for the Phase I sealift are shown in figures 1 and 2. Sealift has accounted for about 85 percent of the dry cargo moved in Desert Shield, delivering nearly a million tons in Phase I, including over 10 million square feet of unit equipment.² A slightly larger amount will be delivered in Phase II. As figure 2 indicates, close to three-fourths of the cargo sealifted in Phase I moved on ships provided by the sealift programs of the 1980s. Without those initiatives there would have been no afloat prepositioning, no fast sealift ships, and no Ready Reserve Force. The operation was not flawless; there were glitches and problems. Yet the sealift and airlift combined to support the sequencing of force arrivals depicted in figure 3. The contributions and problems for each component of sealift are summarized below.

1. C-day stands for commitment day, the day that initial deployment orders are given and the date from which all later actions are measured. For example, 20 August is denoted C+13.

2. Sealift capacity can be measured in weight (short ton = 2,000 pounds), volume (measurement ton = 40 cubic feet), or area (square feet of usable deck spaces) depending on the type of cargo. For unit equipment—tanks, trucks, artillery, and so on—the “square” is usually the constraining factor, whereas weight or cube is usually the constraint for supplies.

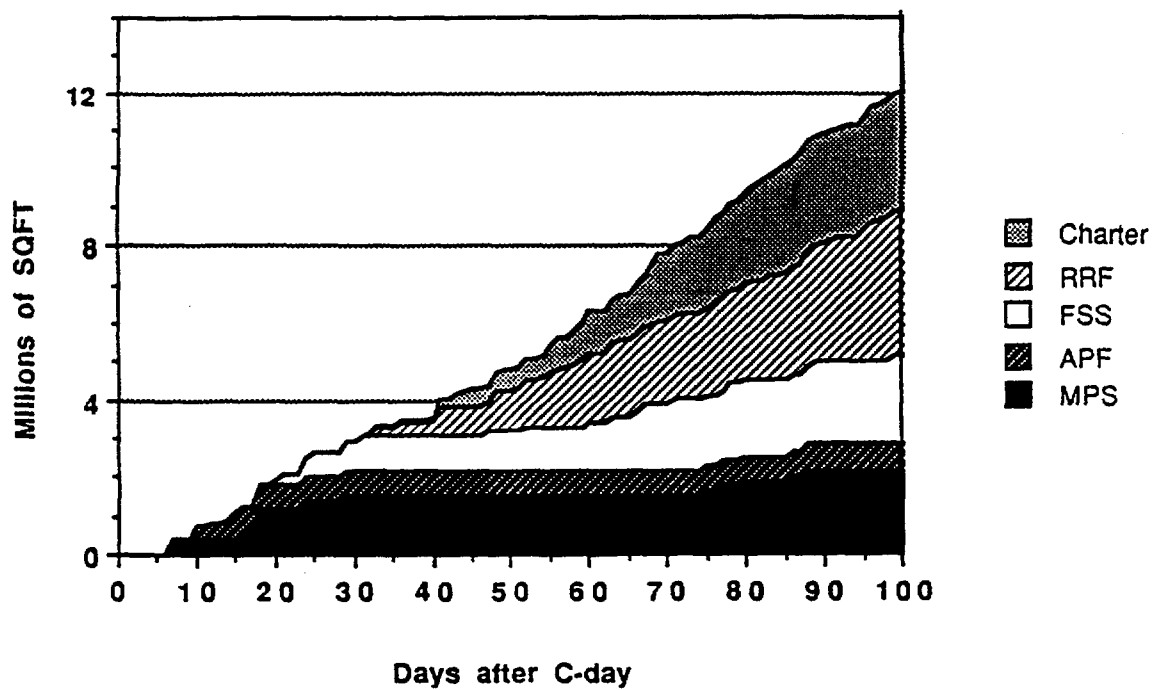


Figure 1. Dry cargo deliveries during Phase I of Desert Shield

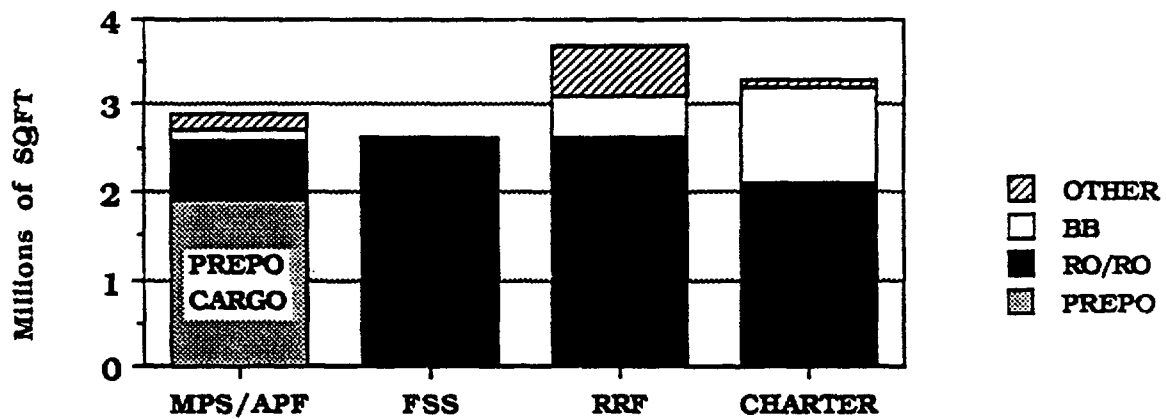


Figure 2. Dry cargo deliveries in Phase I by ship type

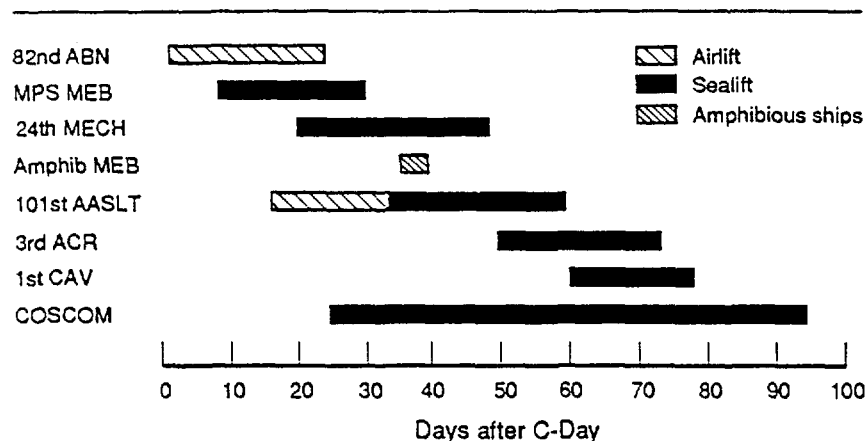


Figure 3. First and last arrivals for major ground units and the corps support command

APF

Afloat prepositioning proved itself in Desert Shield. MPS Squadron 3 from Diego Garcia arrived at C+8, PREPO ships began arriving in theater at C+10, and MPS Squadron 2 from Guam at C+18. The APF brought critical ordnance and other supplies for the Air Force and early arriving Army units. The MPSs enabled the Marines to fill a crucial niche in the sequencing of forces, along with the 82nd Airborne and the lead helicopter units of the 101st Air Assault Division (which arrived via airlift). These forces established an initial U.S. ground presence and helped "hold the fort" until additional Marine and heavier Army divisions arrived. Two MPSs were delayed one and two weeks, respectively, because they were involved in regular maintenance for their prepositioned equipment. (The value of this maintenance was confirmed in Desert Shield; of hundreds of tanks, artillery pieces, trucks, and other vehicles, only one tank required other than minor maintenance such as new batteries and fluid checks.)

FAST SEALIFT

Fast sealift also worked well in Desert Shield, with the notable and well-publicized exception of the *Antares*, which broke down and had to be towed to Rota, Spain, for repairs. The other seven FSSs performed well, delivering the majority of the 24th Mechanized Infantry Division including more than 200 M1 tanks, between C+20 and C+31—over three weeks ahead of the next major arrival of tanks. The

high speed of the FSSs also enabled them to make multiple trips, so that their total deliveries during Phase I were considerable (see figure 2).

RRF

The potential for problems was greater for the RRF because the ships are maintained in an inactive status in peacetime. (In fact, activation exercises had indicated that maintenance funds have been inadequate and that activation goals probably would not be met.)¹ Of the 44 RRF ships activated in Phase I, 20 were more than five days later than their planned activation times. The delays were due primarily to mechanical problems, which carried over into the operation and contributed to reduced transit speeds. The overall average delay of RRF arrivals in the Persian Gulf in Phase I was about two weeks. Altogether, the RRF provided 17 RO/ROs, 3 barge carriers, and 24 breakbulk ships, delivering over 3-1/2 million square feet of unit equipment during Phase I. (The RO/ROs are particularly efficient at delivering tanks and other vehicles. Only a handful remain in the U.S.-flag commercial fleet.)

CHARTERS

Commercial charters played a key role in Desert Shield, delivering about a fourth of the total dry cargo in Phase I and almost half in Phase II. In Phase I, MSC used 62 chartered ships, including 6 RO/ROs already under long-term charter and 19 other RO/ROs. Of these charters, U.S.-flag ships and one ship under effective U.S. control (i.e., owned by U.S. citizens or corporations and sailed under flags of convenience) accounted for one-third of the cargo delivered by charters. By 9 January, the number of charters used had risen to 172, of which U.S.-flag ships numbered 28 and accounted for one-third of the total chartered cargo capacity. The chartered ships came complete with crews and in good operating condition. The main limitation was the time required to discharge their civilian cargo before proceeding to the port of embarkation. The net effect was an overall charter delivery rate to the Gulf in Phase I comparable to that of the RRF.

A variety of planning glitches complicated sealift execution in the first few weeks. One difficulty was the lack of a current detailed plan of units and equipment—the so-called Time-Phased Force Deployment data, or TPFDD, mentioned earlier. The operation plan for a Persian Gulf contingency was under

1. CNA Research Memorandum 88-234, *An Assessment of Activation Testing for the Ready Reserve Force*, by Daniel Mach and Edward Cavin, Unclassified, February 1989.

revision, and a new TPFDD was not fully developed on August 7. Last-minute decisions to substitute active units for reserve units and to send some support units earlier than planned also disrupted orderly sealift planning. For example, estimates of total sealift requirements doubled from mid August to late September,¹ forcing MSC to operate in an ad hoc and reactive manner and exacerbating the problems caused by the ship breakdowns noted earlier. In general, staffs were able to work around and minimize the resulting problems, but the net effect did add to the delay of some units.

Overall, the deployment of heavy Army forces in Phase I took about three weeks longer to complete than would have been the case if everything had worked perfectly. A number of detailed lessons have been learned that will improve efficiency next time; however, a search for absolute efficiency is almost certainly misguided. Desert Shield illustrates, once again, that in war it is risky to assume that everything will go according to some plan. Judged by this standard, the transportation system came close to its potential in its first real test. The main issue now is whether the potential itself is adequate for the post-cold-war world. Before turning to that discussion, it is necessary to examine the appropriateness of Desert Shield as a model for future sealift planning in order to understand some of the important caveats in basing an analysis on the current crisis.

1. A similar growth in cargo requirements has occurred in Phase II, from 8 million square feet in mid-November to over 14 million square feet by the end of December.

DESERT SHIELD AS A MODEL FOR DEFENSE PLANNING

There is no doubt that Desert Shield will be an important model for gauging future U.S. defense policies and programs, particularly for sealift and airlift. Given the prevailing assumption that global war is more or less inconceivable, one or more major regional contingencies is the most stressful case for U.S. defense planning. Desert Shield illustrates several key factors that are likely to be common to future regional conflicts involving U.S. forces:

- The U.S. must be prepared to project ground and air power at great distances to a region where few forces are on scene prior to the crisis.
- The crisis may arise with little warning except in retrospect. Rapid deployment of initial naval, air, and at least some ground forces may be crucial to prevent a fait accompli.
- The crisis may continue for an extended period, requiring the U.S. to sustain forces on scene for many months while simultaneously meeting essential military requirements in other theaters—all without fully mobilizing.
- There will be strong incentives for a multilateral response. The political requirements of a coalition defense are likely to be a factor in the nature and timing of military operations.
- The "threat" will be less numerous and capable than the Warsaw Pact, but still significant. The opponent is likely to have considerable modern hardware, possess weapons of mass destruction, and enjoy a homefield advantage. Unless the Soviet Union is involved as an opponent, however, there will not be a serious interdiction threat to sealift outside the immediate crisis area.

On the other hand, Desert Shield is an incomplete model for defense planning in at least two ways. First, some of its important features would not be replicated in other regional wars. For example, fuel supplies are not a problem in the Persian Gulf. In most other regions, fuel would be a major concern, and tankers would be needed to transport it. The facilities available in the Persian Gulf—particularly airfields and ports—would also not be available in many other parts of the world. For example, Al Jubayl and Ad Dammam, the two main ports of debarkation in the Gulf, are modern facilities with considerable excess capacity and an excellent

infrastructure of pier space, warehouses, uncovered storage space, and utilities. As a result, there were no major bottlenecks in the offload and subsequent marry-up of equipment with units, and the U.S. was not required to offload any cargo over the beach. Defense planners cannot count on being so lucky next time, as indicated by the port statistics in table 1.

Table 1. Selected port capabilities

Country	Large ports with channel depth > 37 ft	Pier space		Uncovered storage (M sq ft)
		Stern offload ^a	Alongside ^b	
Israel	Eilat	Unk	Unk	0.4
	Haifa	15+	6	6.4
Thailand	Laem Chabang	15+	3	Unk
Philippines	Manila	15+	3	2.9
South Korea	Pusan	15+	8	4.4
	Inchon	15+	5	1.3
	Pohang	15+	5	2.6
Saudi Arabia	Dammam	15+	12	31.7
	Al Jubayl	15+	14	11.1

a. For RO/ROs that have a stern discharge ramp.

b. For breakbulk ships, the eight FSSs, and other RO/ROs lacking a stern discharge ramp.

The statistics in table 1 indicate that both pier space and assembly/storage space could be serious constraints. The Desert Shield lift required the ability to offload 10 to 12 ships simultaneously during the peak periods. Even more of a problem is the space required to break out equipment and marry it up with units. Al Jubayl and Ad Dammam are probably the two best ports in the world for this task. If the operation occurs in some other area, port capacity could easily limit the throughput of sealift, so that additional sealift would not necessarily speed up the operation.

Another potential constraint is airlift. In the early days of Desert Shield, airlift was apparently constrained by the Saudis' restricting most U.S. airlift arrivals to one airfield. The resulting "maximum-on-ground" constraints were a controlling fac-

tor until a second major airfield was made available. In this case, the constraint was political rather than physical, but sheer physical constraints are likely in many other parts of the world where airfields are more limited, particularly if there is a major increase in early-arriving sealift that requires an increase in early-arriving airlift. For example, based on USMC experience, afloat prepositioning of an armored division in the Persian Gulf might require over 500 additional C-141-equivalent airlift sorties in the first two weeks,¹ which equates to over 50 dedicated C-141s or the equivalent. Thus, the potential airlift constraints must be kept in mind when considering sealift programs.

Despite these caveats, Desert Shield is the natural benchmark for judging sealift options. The options introduced in the next section are judged according to their ability to move the cargo that was sent to the Persian Gulf during Phase I of Desert Shield. This includes a Marine Expeditionary Force (MEF) and the unit equipment and support for two armored divisions, the 101st Air Assault Division, an Armored Cavalry Regiment, and associated nondivisional units and support. In Desert Shield, the initial Army movement totalled about 10 million square feet, of which almost half comprised support and nondivisional units. The first armored division requires about 1.5 million square feet for unit equipment and an additional 0.8 million square feet for associated initial combat support and combat service support (CS/CSS). The total of 2.3 million square feet is taken as the requirement for delivering the first armored division as a sustainable fighting unit. The comparable figure for the second armored division is 3.0 million square feet because additional support is required for the total force.

1. The airlift requirement depends on the details of the prepositioned equipment. Some scarce and expensive items are not prepositioned and must be airlifted with the Marines. The airlift requirement could be reduced by prepositioning all items, but only at a significant increase in cost.

THE POTENTIAL OF CURRENT SEALIFT RESOURCES

Desert Shield illustrated that the sealift expenditures of the 1980s have provided significant sealift capabilities and that the key to achieving their full potential for rapid response lies in the readiness posture of the Ready Reserve Force. Desert Shield also showed that commercial charters can make a significant contribution in the second and subsequent months. In this case, the key to achieving their full potential lies in chartering ships early in anticipation of future cargo requirements.

RRF READINESS

The direction of needed changes in RRF readiness is clear-cut: more attention to the readiness of RO/ROs and more realistic readiness goals for other RRF ships. Because of their efficiency in loading and moving unit equipment, the 17 RO/ROs were the first RRF ships activated in Desert Shield, and they would likely be the first in a future sealift operation. Ensuring that the RO/ROs can be activated quickly should be the first priority of RRF readiness improvements. One strategy would be to maintain these ships in a reduced operating status (ROS) with partial crews, similar to the fast sealift ships, and to "outport" them at sites near Army units earmarked for early shipment. This would ensure that the RO/ROs could be activated and loaded in 7 to 9 days. Together with the eight FSSs, the RO/ROs would provide a rapid response capability to move the first armored division and initial support in the first month.¹

Based on experience with FSS ships, the annual cost for full ROS status would be at most \$6 million per ship, or \$4.5 million more than the current average yearly maintenance cost per RRF ship. It is likely, however, that some type of modified ROS status could achieve acceptable readiness at lower cost. One idea involves "nesting" several RO/ROs that would be maintained by full-time personnel who would also provide the crew for the first ship in wartime. Reasonable confidence of a 5-day reactivation should be achievable for an incremental cost of about \$3 million per ship, or about \$50 million for the 17 RO/ROs above current annual RRF expenditures.² The remaining RRF ships are not needed as quickly as the RO/ROs. Desert Shield timelines could be met by maintaining them in a 10- to 15-day RRF status,

1. Only 9 or 10 RO/ROs would be needed to meet the initial 2.3-million-square-foot requirement identified in the previous section. Other RO/ROs could be maintained in slightly lower readiness.

2. If new dedicated sealift ships are procured, some of the current RRF RO/ROs would not be needed as quickly, so their readiness status and funding could be adjusted accordingly.

which is also a more reasonable planning figure for activating nonoperational ships and should be achievable within current maintenance budgets.

Based on the timelines in Desert Shield, the proposed change in RRF readiness—i.e., a 5-day reduced operating status for RRF RO/ROs and a 10- to 15-day inactive status for most other RRF ships—would reduce the closure of the entire Phase I deployment by about three weeks, from about 100 to 80 days.¹ This capability becomes the baseline for gauging the adequacy of current sealift resources for the future: i.e., the ability to move a MEF via MPS; to move the 82nd Airborne and an aviation task force from the 101st Air Assault Division via airlift; and to move 3-1/3 other Army divisions and associated headquarters, nondivisional and support units, and supplies via sealift to the Persian Gulf in 80 days. The 82nd Airborne, the aviation task force, the MEF, and one armored division would be available in the first month.

AVAILABILITY OF COMMERCIAL CHARTERS

As noted earlier, commercial charters accounted for over a fourth of the sealift deliveries in Phase I of Desert Shield. This contribution does not represent their full potential, however. MSC did not turn aggressively to charters until the second week of the crisis, when the growth in cargo requirements and the delays in RRF activations clarified the need for charters. Based on this experience, in Phase II ships were chartered prior to identification of cargo requirements, enabling MSC to stay ahead of the problem as cargo requirements grew from November to December.

In a replay of Desert Shield, MSC would tap the charter market immediately. Based on the experience in Desert Shield, charters would begin to arrive at loading ports in about 10 days, or about a week earlier than in Desert Shield. In addition to faster arrivals, charters might also be available in somewhat greater numbers, particularly from foreign sources. In short, charters clearly have the potential to deliver more cargo in the second and third months than was the case in Desert Shield. It appears that earlier chartering could reduce the potential delivery time for 10 million square feet of cargo by about 5 days, from 80 to 75 days—although a precise estimate of numbers and times cannot be deduced from the Desert Shield data.

1. This estimate assumes that RRF RO/ROs are activated on C-day, that Army equipment is available at ports when ships arrive, that there are no port constraints in theater, and that ships chartered from commercial trade are available on the same schedule as in Desert Shield.

A possible consequence of greater availability of foreign charters would be retirement of some older RRF breakbulk ships, on the assumption that charters would make up any shortfall. But this strategy entails an obvious risk that foreign charters might not be available as freely as in Desert Shield. An Arab-Israeli conflict, for example, would probably not produce the same widespread coalition that has opposed Iraq. In the long run, money usually talks, but the *early* availability of foreign charters is less reliable. In addition, cargo requirements in the second and third months might be greater than they were in Desert Shield. The RRF provides valuable insurance against both contingencies.

Thus, scrapping RRF ships is not sensible unless the roughly \$1.5 million per ship annual savings in RRF maintenance could be better spent on other sealift programs. The savings would not go far in paying for new sealift ships. For example, to pay for a single new RO/RO over five years would require the retirement of 27 RRF ships representing about 1.5 million square feet of capacity or seven times that of the RO/RO. This cost tradeoff might be more attractive if used RO/ROs became available at a good price. The appropriate strategy is probably to selectively scrap a few older breakbulk ships and invest the funds in used RO/ROs that may come available on the commercial market.

SEALIFT POTENTIAL vs. REQUIREMENTS

The adequacy of current sealift for the future depends on the cargo delivery requirement, since the amount and rate of cargo to be delivered drive the amount and type of sealift required. At this point, there are many opinions but no "blessed" cargo delivery requirement. Nonetheless, the experience in Desert Shield provides some basis for discussion. It shows that unit equipment is the most critical factor, since commercial container ships have proven adequate to deliver sustaining supplies. In Desert Shield, the buildup in unit equipment has occurred in two phases, corresponding to an initial mission to defend Saudi Arabia and a subsequent shift to an offensive option.

It seems likely in future contingencies that the country will respond immediately to an attack but will not support U.S. initiation of hostilities until diplomatic alternatives are thoroughly explored, which argues that the five-month buildup for Desert Storm is probably a reasonable estimate of the time available prior to hostilities. Current sealift capabilities can meet this timeline, given a reasonable availability of foreign charters. Thus, the key to sealift requirements is the situation that existed in Phase I of Desert Shield—an imminent threat of attack in the first weeks of the crisis. Assuming improvements in readiness of RRF RO/ROs,

current airlift and sealift assets could deliver the 82nd Airborne, an aviation task force of the 101st Air Assault Division, a MEF, and one armored division plus essential nondivisional units and support to the Gulf in a month, followed by another 2-1/3 divisions in the next six weeks and the remaining support in the next two weeks. (More aggressive use of charters might reduce the timelines for the follow-on divisions and support by perhaps another 5 days.)

Although the first month's forces would have been outnumbered by an Iraqi invasion force, several factors would have served as equalizers. In such a scenario, the opponent is forced to take the offensive, which stretches supply lines and exposes armored forces to U.S. airpower and potentially naval gunfire. In Desert Shield, the Phase I buildup of U.S. airpower was largely complete by C+30. It consisted of about 700 fixed-wing fighter and attack aircraft and over 200 attack helicopters, as shown in figure 4. Navy forces also contributed over 100 Tomahawk land-attack missiles and the firepower of the battleship *Wisconsin's* 16-inch guns, which were within range of the main coastal invasion route. This firepower, together with Saudi forces, the 82nd Airborne, the MEF, and the 24th Mechanized, was a formidable obstacle to any Iraqi hope for quick victory.

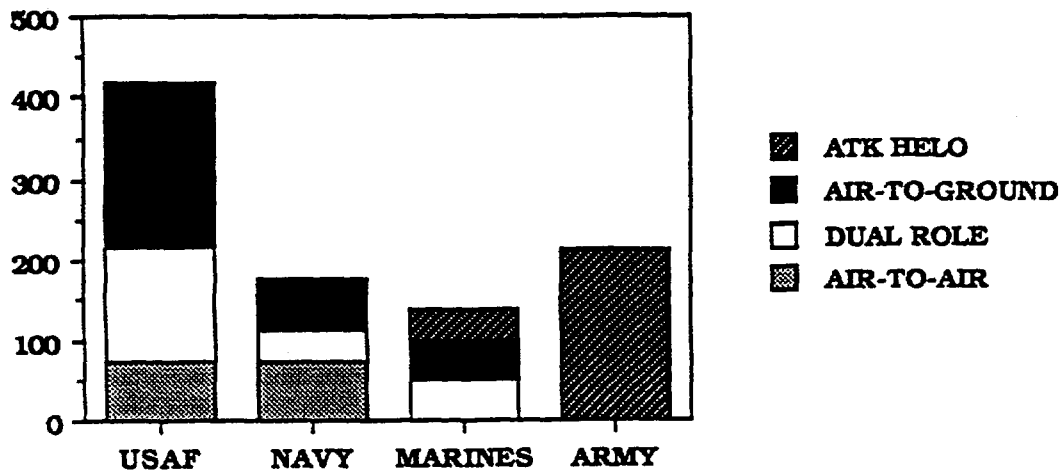


Figure 4. Combat aircraft in theater at C+30

Specifying time-phased force requirements ultimately depends on military judgment and a detailed assessment of several potential combat scenarios, which are beyond the scope of this paper. Nonetheless, two simple but important points seem clear. First, the most critical requirement is providing initial combat power

to forestall a rapid defeat and to hold the fort until reinforcements arrive. Second, the U.S. already possesses a considerable capability in the form of air, naval, and rapidly deployable ground combat power that is not dependent on traditional sealift.

SEALIFT OPTIONS FOR THE 1990s

Developing sealift plans and programs for the 1990s involves wrestling with many uncertainties. These include the locations of future conflicts, the capabilities of future adversaries, and the time-phased deliveries of military forces deemed necessary to accomplish U.S. objectives. Still, the foregoing discussion suggests that several rough benchmarks would be relevant to a wide variety of future contingencies. For example, it will be important to know how quickly an Army heavy division can be made available to augment combat units delivered by airlift and by prepositioning ships. In more demanding scenarios, arrival times of a second division and of the full force committed to Phase I of Desert Shield would also be of interest.

In what follows, these three benchmarks will be used to assess the potential performance of alternative sealift programs for the 1990s. As Desert Shield is nearly a worst-case scenario from a time-distance point of view, transit times to the Persian Gulf will be used in illustrative calculations of force closure rates. Similarly, it will be assumed that the availability of commercial charters at U.S. seaports of embarkation will follow the same timelines evinced during Phase I of Desert Shield. Unit equipment is assumed to arrive at SPOEs at a rate compatible with the simultaneous loading of ten ships.

The discussion will begin with an overview of sealift readiness posture and a brief treatment of important considerations in the design of sealift ships. This introductory material will be followed by descriptions and analytical comparisons of illustrative options for meeting various hypothetical delivery requirements. The discussion will conclude with a few words about paying for a future sealift program.

RESPONSIVENESS vs. READINESS STATUS

The timeline for cargo delivery drives the required readiness status of sealift. As figure 5 indicates, only prepositioning ships can meet a requirement for sealift deliveries in the first one to two weeks. Delivery requirements of three to four weeks can be met by dedicated ships in the U.S. in a reduced operational status similar to that maintained for the FSSs. Beyond four weeks, ships in an inactive status and ships from commercial service can become major contributors.

C-day
 + 1
 + 2
 + 3
 + 4
 + 5
 + 6
 + 7 - Prepositioning ships at Diego Garcia (20 knots)
 + 8
 + 9
 +10
 +11
 +12
 +13
 +14
 +15 - Prepositioning ships in the Western Pacific (20 knots)
 +16
 +17
 +18
 +19
 +20 - Fast sealift ship (32 knots) in ROS-4 (available in 4 days)
 +21
 +22
 +23
 +24 - Conventional sealift in ROS-4 (24 knots)
 +25
 +26
 +27 - Commercial build/charter (24 knots), first ship
 +28
 +29
 +30
 +31 - Inactive RO/RO (20 knots) in RRF-10 (available in 10 days)
 +32
 +33
 +34 - Inactive breakbulk ship in RRF-10 (20 knots)
 +35
 +36
 +37
 +38
 +39
 +40
 +41
 +42
 +43
 +44 - Commercial build/charter (24 knots), last ship
 +45

Figure 5. First arrival times in the Persian Gulf vs. peacetime readiness status for sealift

Prepositioning

The success of prepositioning in Desert Shield has led to suggestions that the concept be extended to the Army so that an armored division could close in the first two weeks. The main disadvantage is the potential \$5 billion to \$6 billion price tag over 10 years—about \$2.7 billion to build 12 new RO/ROs and one container ship to carry the unit equipment and supplies for the division and essential supporting units, a similar amount to operate and maintain the ships and their equipment over 10 years, plus the cost of purchasing equipment for prepositioning.¹

Reduced Operating Status

Delivery of forces from the U.S. in the first month requires ships at loading ports in 5 to 10 days, which implies dedicated ships laid up in the U.S. in some type of reduced operating status with at least partial crews. In theory, ships in an inactive status could be reactivated in time to meet this requirement, but the experience in Desert Shield casts serious doubt on planning for activation in less than 10 days.

Inactive Status

RRF ships in an inactive status can be reactivated reliably in 10 to 15 days, based on the experience in Desert Shield. These ships could begin delivering cargo at the beginning of the second month but could not make a reliable contribution to the initial rapid response in the first month.

Commercial Service

The response time of ships in commercial service reflects the time to return to port, discharge their cargo, convert to a military configuration if necessary, and sail to a port of embarkation. In Desert Shield, the first charter arrived in the Persian Gulf at C+41 (not counting ships under long-term charter to MSC). That figure might have been reduced by a week had chartering begun immediately on C-day. Among the large pool of world shipping, a few ships are likely to be in a favorable position that would allow them to arrive early, but there would be considerable

1. Surplus equipment will become available as Army divisions withdraw from Europe. Assuming the equipment is not consumed in a war with Iraq, it could be made available for afloat prepositioning. However, the surplus is likely to be older equipment (e.g., M1 vice M1A1 tanks), whereas it would be desirable to have the best equipment for the leading heavy forces. Thus, some purchase of equipment would probably be needed. Based on USMC experience, the cost could be up to \$1 billion.

variability in arrival times for a specific group of ships. For example, a RO/RO plying the Japan-to-west-coast auto delivery route might arrive at U.S. southeast or Gulf coast ports as early as C+10, assuming a favorable location, immediate availability for charter, and no time lost for conversion to a military configuration. On average, however, the figure would be 17 to 18 days, and it could take as long as 25 days. The resulting arrival times in the Persian Gulf would stretch from C+32 to C+49—which illustrates that commercial charters could contribute to cargo delivery in the second month, similar to inactive RRF ships, but they could not make a significant or reliable contribution to the initial rapid response during the first month.

DESIGN CONSIDERATIONS FOR NEW SEALIFT

The two major considerations in the design of new sealift ships are the cargo configuration and the sustained speed. The experience in Desert Shield indicates that the most pressing dry-cargo requirement is for unit equipment and that RO/ROs are the efficient way to move the bulk of it. Thus, a new-design dedicated sealift ship should be a large RO/RO, perhaps with some container capacity or other special features appropriate to the specific concept of operations.

A ship designed for commercial operation in peacetime would require additional design features. It must be militarily useful and still respond to the commercial market—for example, moving Toyotas as well as tanks and containers as well as vehicles. Design of a RO/RO for rapid civil-military convertibility is apparently not difficult or expensive. Efficient convertibility between container and RO/RO configurations is more challenging. Because of their greater responsiveness, dedicated sealift ships are the focus of the analysis in the next section, but a commercial option is considered for illustrative purposes.

Speed is also a key design factor. Most new-construction merchant vessels have diesel propulsion, which can achieve speeds up to the mid 20s. Speeds in the mid 30s are possible with other propulsion systems and existing hull designs. The most likely design for a near-term fast sealift ship is a modified version of the current FSS hull form with gas turbine rather than steam propulsion. Such a ship might have a maximum speed of 35 knots, leading to a sustained speed of advance of about 32 knots. (Sustained speeds up to 35 knots are considered possible by some observers, but would entail much greater risk.) Such a ship would be roughly 40 percent more expensive to build than a comparable diesel-powered ship. On the other hand, such a ship would speed up the first delivery to the Persian Gulf by 4 days and the second by 12 days. Both speed regimes will be considered in the analysis that follows.

ILLUSTRATIVE SEALIFT OPTIONS

This section examines the cost and effectiveness of several sealift options for the 1990s. Effectiveness is assessed according to the arrival timelines in the Persian Gulf for the ground forces deployed by sealift during Phase I of Desert Shield—a MEF, 3-1/3 Army divisions, plus associated combat support and combat service support (CS/CSS). Based on Desert Shield, the initial Army movement totals about 10 million square feet. Particular attention is paid to the arrival of the first heavy division and its slice of CS/CSS, which is assumed to be 2.3 million square feet as discussed earlier. The analysis also tracks the arrival of the second division and associated support, which is assumed to be 3 million square feet.

The options are summarized in table 2; table 3 tabulates their cost and effectiveness. The baseline for comparison is current sealift ships with improved readiness of RRF RO/ROs and charter availability as experienced in Desert Shield. Also shown is an illustration of how more aggressive chartering might contribute to earlier closure of the second division and of the whole force. Additional charters would not speed up the closure of the first division because they would not arrive at SPOEs quickly enough. The assumption for this illustration is that during Phase I, ships were chartered at the more aggressive rate of Phase II. Specifically, about an additional one million square feet of lift is assumed to be available to carry Phase I cargo.

Options are grouped according to the amount of additional sealift capacity:

- Six new RO/ROs would provide the capability to move the first armored division and support on new RO/ROs and the existing FSSs, leaving existing RRF RO/ROs and breakbulk ships to move the second division and support.
- Twelve new RO/ROs would provide dedicated RO/ROs for the first two divisions and support. The new RO/ROs could move the first heavy division and support, with the FSSs and RRF RO/ROs moving the second division and support.
- Thirty-six new RO/ROs, together with the FSS and the RRF RO/ROs, would provide a one-time lift for the entire Phase I deployment on government-controlled RO/ROs.
- The commercial example includes 20 ships and is based on an option examined by the Office of the Secretary of Defense. This option is primarily illustrative. It would not affect the arrival of the first division but would have some effect on the arrival of the second and succeeding divisions.

Table 2. Representative sealift options

Options	New sealift	RRF	Rationale/Comment
Baseline: Ready RRF	None	Improve readiness of RO/ROs. Maintain ~10 RO/ROs in ROS for immediate availability.	Provides rapid lift for a heavy division and critical support (2.3 million sq ft) on FSSs and RO/ROs.
6-ship options	Acquire six new RO/ROs. Maintain in ROS in U.S. or preposition in Indian O.	Improve readiness of RO/ROs. Tailor readiness status to availability of 2nd heavy division.	Provides capability to lift first heavy division with FSSs and modern RO/ROs.
– Diesel-6	24-kt diesel	–	Less costly, lower risk.
– Fast-6	35-kt gas turbine	–	Reduces closure time lines.
– PREPO-6	20-24 kt diesel	–	Most responsive, most expensive.
12-ship options	Acquire 12 new RO/ROs. Maintain in ROS in U.S. or preposition in Indian Ocean and West Pacific.	Tailor RO/RO and FSS readiness to availability of 2nd heavy division.	Improves reliability of lift for first heavy division. Provides capability for second rapid response division.
– Diesel-12	24-kt diesel	–	Less costly, lower risk.
– Fast-12	35-kt gas turbine	–	Reduces closure time lines.
– PREPO-12	20-24 kt diesel	–	Most responsive, most expensive.
36-ship option	Acquire 36 new RO/ROs to provide one-time lift for entire corps.	Maintain RO/ROs in a 10-day reactivation status. Selectively scrap breakbulks.	Provides capability for entire Phase I deployment in a single lift on government-controlled ships.
Commercial option (illustrative)	Acquire ships for no-cost charter to U.S. operators – 8 containerships – 8 BB/containerships – 4 RO/ROs	Improve readiness of RO/ROs. Maintain ~10 RO/ROs in ROS for immediate availability.	Reduces reliance on foreign charters for Phase I and Phase II lift. Bolsters U.S. maritime industry.

Table 3. Cost and effectiveness of sealift options

Options	10-yr cost (\$ billions)	Arrival of ground forces by sealift ^a (days after C-day)			
		MEF	Division 1	Division 2	10 m sq ft
Baseline: Ready RRF	0.5	7-17	23-33	33-50	80
With early chartering ^b	0.5	7-17	23-33	33-48	75
Six-ship options					
Diesel-6	2.2	7-17	23-28	33-48	70
Fast-6	2.9	7-17	21-25	33-48	70
PREPO-6	3.3	7-17	9-25	33-44	65
12-ship options					
Diesel-12	3.7	7-17	23-28	28-42	65
Fast-12	4.8	7-17	21-25	28-42	60
PREPO-12	5.9	7-17	7-10	23-38	60
36-ship option					
Diesel	10.0	7-17	23-28	28-33	40
Commercial option (illustrative)					
	3.8	7-17	23-33	33-46	75

a. Arrival times assume improvements in RRF readiness and availability of commercial charters on the same schedule as in Phase I of Desert Shield, with exception noted in footnote b below.

b. Assumes chartering of ships at a faster rate than occurred during Phase I of Desert Shield. Specifically, 14 additional charters, carrying a total of about a million square feet of cargo, would begin arriving in the Persian Gulf around C+45.

Within the 6-ship and 12-ship categories, there are three options reflecting differing degrees of responsiveness: prepositioning in theater, fast sealift based in the U.S., and conventional sealift based in the U.S. The PREPO-12 option provides capacity for a full division and initial support; it could be based entirely in the Indian Ocean or half in the Indian Ocean and half in the western Pacific. PREPO-6 accommodates a heavy brigade or an armored cavalry regiment, which is assumed to be based in the Indian Ocean.

Table 3 shows the 10-year cost (undiscounted 1991 dollars) for each option, which includes procurement and 10 years of operations and support for new ships as well as readiness improvements to RRF RO/ROs. Also shown are the closure times for the first and second divisions and associated support, and for the total Phase I deployment. Figure 6 provides a visual representation of the data. The basic story behind these results can be summarized by the old adage that time is money. In general, the more cargo that is delivered early, the more expensive the option. The general tradeoff between responsiveness and cost is summarized in figures 7 through 9.

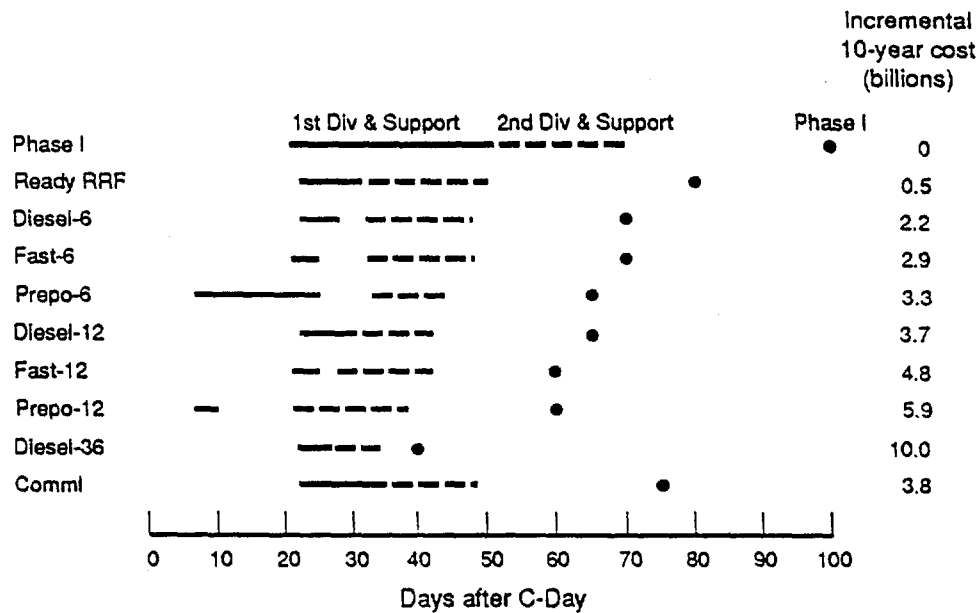


Figure 6. Closure times and costs for sealift operations

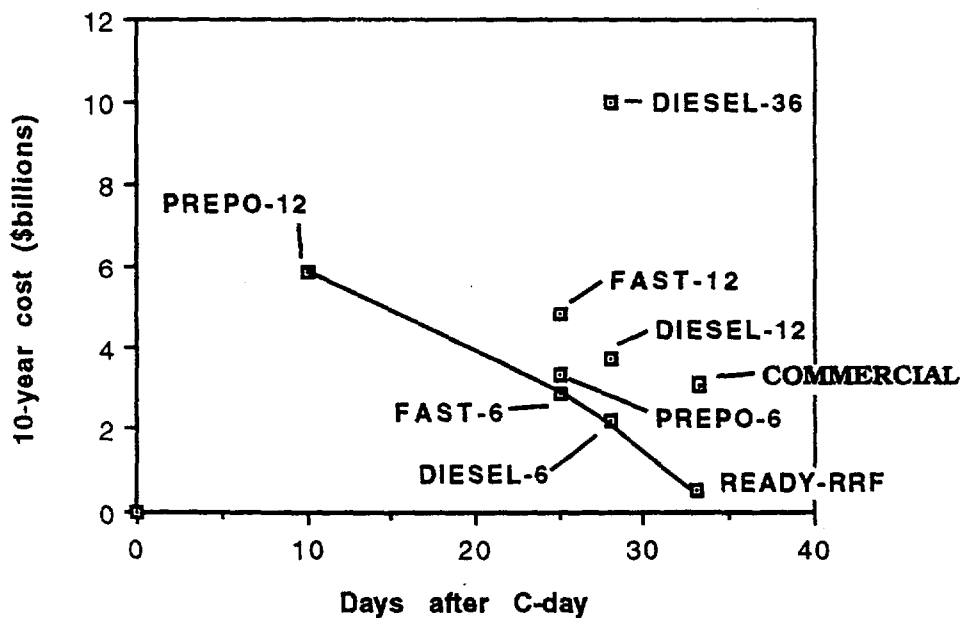


Figure 7. Costs and delivery times for first division and support

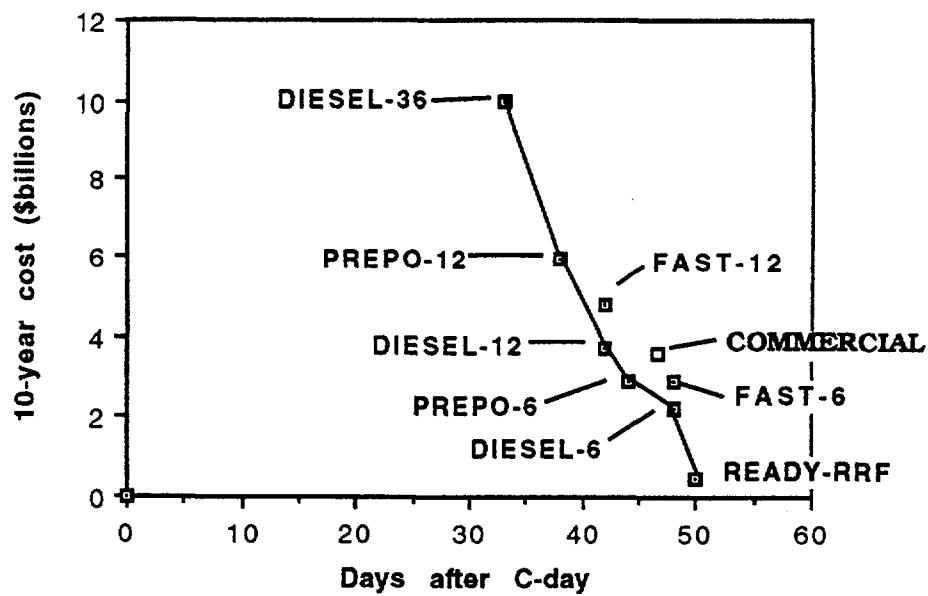


Figure 8. Costs and delivery times for second division and support

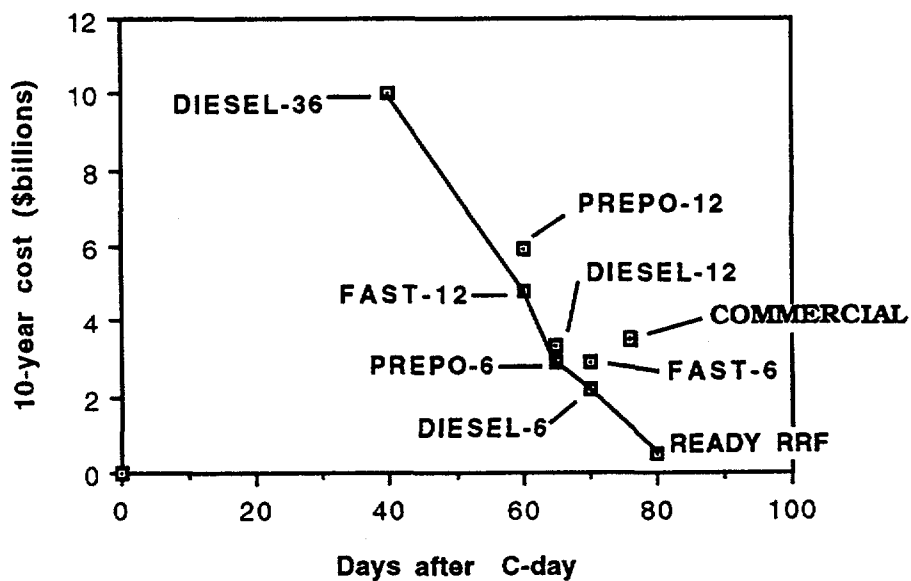


Figure 9. Costs and delivery times for 10 million square feet

The only clear-cut loser by these measures is the commercial option, which does not contribute to the immediate response and whose contribution in the second and third months is not crucial so long as foreign charters are available on the scale experienced in Desert Shield. The tradeoff between fast sealift and conventional sealift is more complicated. Fast sealift ships can make initial deliveries faster than conventional sealift, and in a long campaign they can make more trips and so be more productive. Although fast sealift based on existing hull forms can achieve sustained speeds more than half again those of most ships in the RRF or commercial trade, the speed advantage over a new diesel-powered ship is only about a third. When times for loading and unloading cargo, transit of the Suez Canal, and other factors are considered, the productivity advantage of fast sealift in a long campaign is 20 percent, whereas the cost penalty is 25 percent, not counting the higher fuel costs for a high-speed transit. The one clear advantage of fast sealift is its roughly 4-day advantage in the initial delivery.

PAYING FOR A SEALIFT PROGRAM

A major sealift program would involve a variety of considerations in addition to the delivery timelines tabulated in the previous section. Paying the bill would be at the top of the list. A variety of schemes have been advanced for "innovative" financing of sealift programs. For example, Saudi Arabia and other Gulf states might be pressured to pay all or part of new afloat prepositioning forces to be stationed in the Gulf. Such financial contributions would undoubtedly come with political strings attached, so that the prepositioning ships would not be readily available for contingencies other than the defense of the Gulf states. But that task will likely remain a high priority for the foreseeable future. Regardless of the outcome in the Gulf, the Saudis will likely be interested in some level of U.S. presence backed by a capability for rapid response. For political reasons they may prefer prepositioning afloat to troops or prepositioning ashore.

In addition to any foreign contribution, the budget stream for a new sealift program would be affected by decisions to lease or buy, by the availability of militarily useful ships for sale on the commercial market, and by the pace of new sealift building programs. The bottom line, however, is that any sealift initiative beyond the \$1.2 billion already appropriated by Congress would likely come at the expense of other defense programs—at a time when the decline in defense budgets is already forcing cancellation of major programs. In short, sealift will have to compete with warships, tanks, aircraft, bombs, bullets, and personnel—and with other deployment enhancements, including strategic airlift.

For example, a C-17 airlifter can provide about 150,000 ton miles per day of cargo delivery for a marginal procurement cost of about \$150 million for aircraft purchased in the mid 1990s. A new RO/RO could provide over 15 times that cargo delivery rate for 1.5 times the cost, a factor of ten improvement in cost per ton mile. This simple comparison masks a number of complexities and does not capture the complementary nature of sealift and airlift. Nonetheless, in a major deployment like Desert Shield, there are almost certain to be some tradeoffs at the margin between airlift and sealift. The budget outlook in DOD mandates that the tradeoffs be examined carefully to arrive at a balanced and cost-effective strategic transportation force.

CONCLUDING DISCUSSION

Ultimately, sealift decisions will depend on the basic U.S. defense strategy for the post-cold-war world, on military judgments about how many and how quickly forces are needed for a major regional contingency, and by the budget. Undoubtedly the outcome of the current crisis will shape views about the size and timing of a massive deployment of U.S. ground combat forces for a regional contingency. The policy that emerges will be translated into military requirements, which will be forced to compete with other requirements in a shrinking DOD budget.

Calls for major increases in deployment capabilities have already been sounded. For example, in testimony before the Senate Armed Services Committee, retired Army Lt. General William Odom called for the capability to move a heavy Army corps anywhere in the world in 20 days and to reinforce with a second heavy corps in another month. Meeting this requirement would require 30 to 40 new fast sealift and prepositioning ships at a procurement cost alone of up to \$10 billion. Another demanding requirement is being considered in the Congressionally-directed Mobility Requirements Study. One scenario involves a requirement to move eight armored brigades and two air assault brigades to southwest Asia within six weeks, which is estimated to require over 16 million square feet of government-controlled sealift capacity. The Navy estimates that this requirement would call for 25 additional large RO/ROs.

Taking these requirements at face value could result in sealift programs and budgets in the 1990s about double those of the major sealift expansion during the 1980s. Given the rapid decline in the overall defense budget, such a program would amount to a major reorientation of U.S. military strategy toward heavy ground combat forces—which presumably would reflect an assumption that the current Iraqi crisis is the model for future defense planning and that the U.S. must be able to crush such a threat in the first few months, on the ground, with little or no help from others.

There is a logical argument that current sealift assets are, in fact, adequate. They moved significant forces to the Persian Gulf in a month, by which time it was clear that Iraq was not going to attack Saudi Arabia. Since Iraq's conventional military power will not return to its 1990 levels for some time and there is no other comparable threat in the Gulf, what was adequate for Desert Shield should be adequate for the future. Moreover, based on the lessons learned in Desert Shield, the Phase I movement would likely proceed several weeks more quickly next time. In addition,

in any contingency that threatens the world's energy supplies, a coalition response can be expected—including some combat forces but certainly a fair amount of shipping. Based on U.S. experience in Korea, Vietnam, and now Desert Shield, foreign charters are a reliable source of shipping beyond the first month. Therefore, at most, only modest additional sealift may be desirable to compensate for the aging of existing sealift assets and to improve readiness for early deployment in the critical early weeks. If Congress approved, the existing \$1.2 billion appropriation for sealift could be used to increase RRF readiness, especially for the 17 RO/RO ships, or to maintain them in ROS status, and to add RO/ROs to the RRF fleet as they came available in the commercial market.

In the end, the sealift question is ultimately caught up in the larger question about U.S. defense strategy for the post-cold-war world that must balance the needs to (1) maintain a strategic deterrent, (2) hedge against resurgence of a Soviet threat, (3) prepare for a major regional contingency, and (4) respond to the spectrum of threats and crises in areas other than southwest Asia. Thus, sealift competes with other defense needs as DOD tries to construct a well-balanced defense force. The conclusion will depend a lot on basic policy assumptions.

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