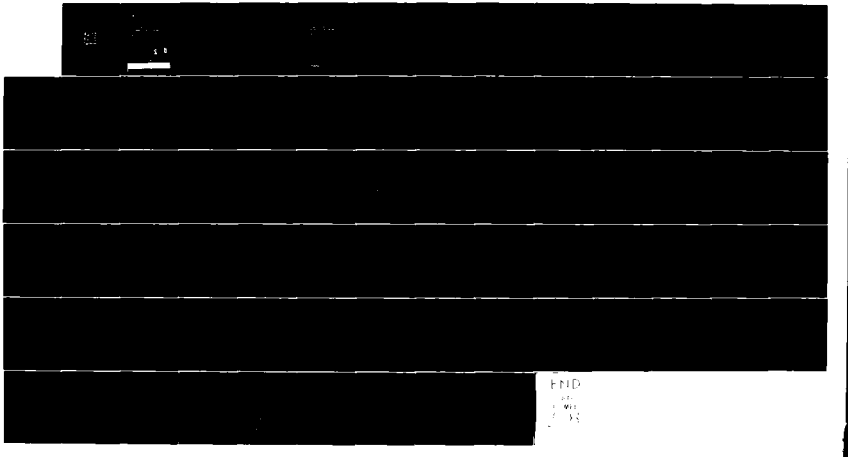
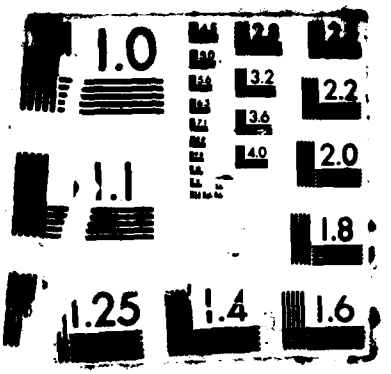
AD-A181 615 COSI ANALYSIS OF RESERVE FORCE CHANGE: NON RECURRING COSTS AND SECONDARY COSI EFFECIS(U) RAND CORP SANTA MONICA CA J F SCHANK ET AL. MAY 87 RAND/R-3492-RA 1/1

UNCLASSIFIED MDA903-85-C-0030 F/G 5/1 NL



END


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
3.2
3.6
4.0

Cost Analysis of Reserve Force Change

Non-Recurring Costs and Secondary Cost Effects

John F. Schank, Susan J. Bodilly
A. Allen Barbour

RAND

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: R-3492-RA	2. GOVT ACCESSION NO.: AD-A181615
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): Cost Analysis of Reserve Force Change: Non-Recurring Costs and Seceondary Cost Effects	5. TYPE OF REPORT & PERIOD COVERED: Interim
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): J. Schank, S. Bodilly, A. Barbour	8. CONTRACT OR GRANT NUMBER(s): MDA903-85-C-0030
9. PERFORMING ORGANIZATION NAME AND ADDRESS: The RAND Corporation, 1700 Main Street, Santa Monica, CA 90406	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: Assistant Secretary of Defense (Reserve Affairs), Washington, DC 20301	12. REPORT DATE: May 1987
	13. NUMBER OF PAGES: 64
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office):	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

No Restrictions

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Military Reserves
Air Force Personnel
Navy
Military Forces (United States)
Military Force Levels
Military Budgets
Cost Analysis
Costs

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

see reverse side

DD FORM 1 JAN 73 1473

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

This report describes a methodology for estimating the non-recurring costs of Reserve component changes in the U.S. Air Force and U.S. Navy and draws inferences about the factors that affect non-recurring unit costs. The report also addresses other cost effects associated with unit charges, including changes in annual recurring costs and indirect or force-wide costs. Construction, support equipment, and aircrew training costs account for the majority of the non-recurring costs in the various case studies. The findings suggest that non-recurring costs can be reduced if (1) the basing location has existing facilities; (2) prior-service aircrew personnel with experience in the new weapon system can be recruited; and (3) the Reserve unit is located on an Active base that has excess capacity and can share in various logistic-support assets.) (See also

Keywords: military reserves, Air Force personnel, military force levels.

R-3492-RA

Cost Analysis of Reserve Force Change

Non-Recurring Costs and Secondary Cost Effects

John F. Schank, Susan J. Bodilly
A. Allen Barbour

May 1987

Prepared for the
Office of the Assistant Secretary of Defense/
Reserve Affairs

RAND

PREFACE

This report describes a methodology for estimating the non-recurring costs of instituting changes in the Reserve Force structure. It presents several case study analyses of the non-recurring costs of Reserve component changes in the U.S. Air Force and U.S. Navy and draws inferences about the factors that affect non-recurring unit costs. The report also addresses other cost effects associated with unit changes, including changes in annual recurring cost and indirect or force-wide costs.

This research was sponsored by the Office of the Assistant Secretary of Defense (Reserve Affairs) under RAND's National Defense Research Institute, a Federally Funded Research and Development Center supported by the Office of the Secretary of Defense. It was conducted by the "Reserve Unit Costs—Case Studies" project, part of RAND's Defense Manpower Research Center.

The analysis presented here augments and complements other RAND analyses of Reserve Force costs. These previous cost studies include:

Barbour, A. A., *The Air Reserve Forces in the Total Force: Vol. II, Cost Analysis and Methodology*, R-1977/2-AF, September 1977

Barbour, A. A., *Cost Implications of Transferring Strategic Airlift C-141s to the Air Reserve Forces*, N-2252-AF, February 1985

Schank, J., S. Bodilly, and R. Pei, *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, R-3210-RA, March 1986

Those offices and individuals concerned with the non-recurring costs of unit changes and with force restructuring or force mix issues should find this study of interest.

SUMMARY

Numerous studies and analyses have addressed the cost issues of Reserve component units. The majority of these studies have compared the annual recurring costs of similar Active and Reserve Force units, without fully considering the other costs incurred when changes are made in the existing force structure. Steady-state, annual recurring costs are appropriate for a static force; however, the dynamics associated with changing the baseline force usually result in other significant primary and secondary costs. To completely understand the economic consequences of policy decisions affecting the force structure and composition, all significant cost effects must be addressed.

Non-recurring and annual recurring costs can be identified and measured for the specific units directly involved in a force structure change. However, such changes may bring about subsequent decisions affecting other units in the force structure, resulting in additional non-recurring and annual recurring costs. A total cost analysis of Reserve Force structure changes must include not only the primary non-recurring and annual recurring cost effects associated with the specific unit undergoing a change, but also any secondary, or force-wide, cost effects on other units in the total force. One of the initial and necessary steps in the analysis of the costs resulting from force structure changes is defining the boundary or scope of the policy decision. In this regard, we describe the potential for secondary cost effects and the types of changes that may lead to force-wide costs.

This report examines various costs associated with instituting unit changes in the Reserve components. To provide a perspective on the total cost analysis of force structure changes, we briefly discuss the annual recurring cost effects and the potential for secondary costs. We then concentrate on primary non-recurring costs and describe a cost methodology and data sources for estimating the primary non-recurring cost impacts of unit changes. We show, via case studies, the resulting costs of some recent changes implemented in the Air Force and Navy Reserve components and quantify, where possible, the effect of unit and mission characteristics on the magnitude of the non-recurring costs associated with unit changes.

CASE STUDIES OF NON-RECURRING COSTS

To use limited time and resources well, we confined the case study analysis of non-recurring costs to a few recent Air Force and Navy changes, and excluded Army cases. We preferred to examine a variety of unit cases that clearly illustrated the range of cost effects, rather than treat all services equally. The Air Force and Navy Reserve components offered the best examples of unit changes that covered the full spectrum of change and cost implications. The Army changes were less enlightening. The existence of numerous large Army bases meant that few construction costs were associated with unit changes. In addition, the many changes taking place in the Army and the size and complexity of the Army make cost identification less clear than in the other services.

Our case studies include the commission of new frigates in the Naval Surface Reserve components and the modernization of unit equipment in the Naval Air Reserve Force (A-7E and F-14) and in the Air Reserve Forces (C-5A, C-141, and F-16). Altogether, the non-recurring costs of 15 unit changes in the Navy and Air Force were estimated in the case study analyses.

ASSUMPTIONS AND DATA SOURCES

We adopted a number of assumptions for our analysis of the primary non-recurring costs associated with Reserve Force structure changes:

- All appropriate costs are included, regardless of the component's budget in which they are reflected.
- Sunk costs are excluded.
- Cost effects on force-wide overhead and administrative functions are excluded.
- All costs are in FY1985 dollars.

The data used in our analysis of primary non-recurring costs represent the most recently available actual or budget costs. They were received or derived from numerous sources including the cost and planning organizations of the Reserve and National Guard components of the Air Force and Navy, budget and planning documents, and previous analyses of Reserve personnel costs.

PRIMARY NON-RECURRING COSTS

The primary non-recurring cost results show a high degree of variability across the various cases. The costs ranged from slightly over one million dollars for the modernization of an A-7 unit at Cecil Naval Air Station to over 125 million dollars for modernizing an existing Air National Guard unit with C-5A aircraft. These costs include construction of facilities, procurement of support equipment, spare parts, and training munitions, and the acquisition and training of unit personnel. *Overall, the case study results suggest that the non-recurring costs associated with Reserve unit changes are highly dependent on the specific type of change and the characteristics surrounding the change. As such, general cost estimating relationships are difficult to develop for the non-recurring costs of force structure changes.*

Facility, equipment, and personnel strengths and skills are all driven by the specific requirements of the weapon system and unit mission. These requirements may be offset by existing unit resources or by other resources in the force. *Changes to existing units or changes that result in the availability of equipment from the Active Force will result in lower non-recurring costs than changes that involve the creation of a new Reserve unit or the absence of available Active inventories.*

Construction, support equipment, and aircrew training costs account for the majority of the non-recurring costs in the various case studies. Personnel acquisition and training costs (other than aircrew) are typically minor, even when additional recruiting efforts and enlistment bonuses are required. Non-recurring costs can be reduced if:

- The basing location has existing facilities.
- Prior service aircrew personnel with experience in the new weapon system can be recruited.
- The Reserve unit is located on an Active base that has excess capacity and can share in various logistic support assets. However, political, operational, or demographic constraints may override cost-effective basing options by forcing specific basing decisions.

OTHER COST EFFECTS OF FORCE STRUCTURE CHANGES

Annual Recurring Costs

Annual recurring unit cost models have been developed in numerous other studies. We did not repeat past work in this study, but reviewed the implications of unit change for annual recurring costs.[1]

Annual recurring unit costs are driven by the numbers and types of unit personnel and equipment, the peacetime equipment activity rate, and the logistics support costs of the weapon system. Changing an existing unit will affect all or some of these factors, resulting in changes in the annual personnel and operating budgets. Adding or deleting a unit from the force structure will result in a corresponding increase or decrease in annual recurring budgets. To estimate the annual cost effects of a unit change involves the formulation of appropriate factors to reflect the differences between the unit before and after the change.

Annual recurring unit costs are typically larger, especially for aviation and ship units, than the non-recurring costs identified in the case studies. If the Reserve component unit change results in a decrease in annual recurring budgets, the non-recurring investment may be recovered in a few years.

Force-Wide Costs

In addition to the non-recurring and annual recurring costs associated directly with the unit undergoing the change, changes to the force structure may result in secondary or force-wide costs. Changes to existing units, especially those changes that involve modernization of unit equipment, often ripple through the force structure. If the unit equipment that is being replaced retains some useful life, it is used either to modernize other units in the force that operate with even more obsolete equipment or to augment the similar equipment of another unit. For example, the introduction of the C-5As into the Air Force Reserve resulted in subsequent changes to at least three other Reserve units.

Force-wide costs may also arise when the unit change alters the normal operational requirements of other units in the force. If the change involves the transfer of resources from the Active to the Reserve Force with the total force inventory of the weapon system held constant, the new Reserve component unit must be capable of assuming the mission

[1]See Refs. 4 and 5 for a full description of annual recurring cost analysis.

requirements of the Active unit it replaces. If the Reserve component unit can not accomplish the complete mission, other Active or Reserve Force units may have to increase their operational requirements, with increased costs. If, however, the unit change involves an increase in the total inventory of the weapon system, the capability of the new Reserve component unit may help to reduce the operational requirements of the other units in the force.

These force-wide cost effects require careful examination and an understanding of the total force impact of the change. Force-wide cost models can facilitate the analysis of force changes by addressing the interactions of force units that are difficult to quantify with the conventional individual unit cost models.

FUTURE COST RESEARCH

The analysis documented in this report and numerous other studies conducted in recent years have addressed various issues of Active and Reserve Force costs. The various results of these analyses should be integrated in order to summarize and to formalize the preferred approaches to understanding the economic considerations of policy decisions involving the Active and Reserve Forces. One specific product of this future cost research should be a simple, easy to use, force-wide cost model designed to estimate the economic implications of force structure decisions.

ACKNOWLEDGMENTS

J. Anthony English, Director of Analysis, Office of the Assistant Secretary of Defense (Reserve Affairs), supported, encouraged, and guided this research effort. Individuals in the comptroller, personnel, manpower, training, logistics, and operations offices in the Active, Reserve, and Guard branches of the Air Force and Navy provided the needed background information. These individuals, too numerous to name, gave their time freely to provide insights and helpful advice on methodology.

James Hosek, Glenn Gotz, and David Grissmer provided thoughtful direction. Frank Camm and Gary Mills reviewed the draft report and offered many useful suggestions to improve and clarify the presentation. Finally, Luetta Pope devoted many hours to the transcript of the document and general research support.

CONTENTS

TABLES

I. INTRODUCTION

For the past several years, both the Congress and the Administration have displayed increased interest in the role of the Reserve and National Guard components in the total force concept. This interest, spurred by the need for budget constraints and the perception that the Reserve components[1] are a cost-effective complement to the Active forces, has resulted in numerous changes to the Reserve Force structure. These changes have led to the Reserve components growing both in number of units and in manpower authorizations, and receiving modern, front-line weapon systems.

Numerous recent studies and analyses [1–3] have addressed the cost issues of Reserve Force units. RAND has contributed to the analysis of Reserve costs by developing a methodology and data base to compare the annual recurring costs of similar Active and Reserve component units [4, 5] and by estimating the annual costs of a proposed equipment transfer in the Air Force [6]. These analyses, and many similar exercises performed by other organizations, have estimated the annual operating and support costs of individual units, treating only lightly, if at all, the net costs resulting from making specific changes to the existing force structure. Although the annual cost comparisons of Active and Reserve Force units are certainly important, the dynamic costs of a changing force must also be considered.

Unit changes in the Reserve components result in costs directly attributable to the specific unit undergoing the change and potentially affect the costs of other Active and Reserve units in the total force structure. The former, primary unit costs, include both one-time, non-recurring costs and changes to annual recurring unit operating and support costs. The latter, secondary or force-wide cost effects, may result from the existing force balance being perturbed because of a unit change. For example, the allocation of missions, the flow of personnel through the system and the peacetime activity levels of other units in the force may be altered.

The objectives of the research presented in this document are threefold:

[1]Throughout this report, the term Reserve component or Reserve Force represents both Reserve and National Guard units.

1. To describe the types of costs resulting from instituting changes in the Reserve Force structure including non-recurring, annual recurring, and force-wide costs.
2. To quantify, where possible, the effect of unit and mission characteristics on the magnitude of the non-recurring costs associated with Reserve Force changes.
3. To present the non-recurring budget cost estimates of some recent unit changes in the Reserve components (case study results).

Our analysis concentrates on the non-recurring cost effects of unit changes including expenditures for facilities, support equipment, spare parts, and personnel acquisition and training. Because annual unit operating and support cost models are well documented in previous studies, we treat only lightly the annual recurring cost effects of unit changes. Force-wide cost effects are more difficult to measure. Our analysis does not focus on these costs, but attempts to identify the circumstances and characteristics of changes that result in system-wide cost effects.[2]

The study was limited by time and funds; thus, we confined the analysis to recent Air Force and Navy changes, and excluded the Army. We chose to examine several dramatic cases that clearly illustrate the range of changes and non-recurring cost effects, rather than cover all the services equally. Air Force and Navy Reserve component cases were found that covered a variety of changes and clearly illustrated the cost effects of change. Army changes were less clear. The existence of numerous large Army bases means few construction costs are associated with unit changes. In addition, the many changes taking place in the Army and the size and complexity of the Army make cost identification less clear than in the other services.

The case study analyses include the activation of new frigate units in the Naval Reserve and the modernization of aircraft in the Naval and Air Reserve components. Overall, the primary non-recurring costs for 15 unit changes in the Navy and Air Force were measured during the study.

The case study results suggest that the primary non-recurring costs associated with Reserve component unit changes are highly variable

[2]Another RAND research effort, jointly sponsored by the Office of the Joint Chiefs of Staff (OJCS), Office of the Assistant Secretary of Defense (OASD)/FM&P, and Office of the Secretary of Defense (OSD)/PA&E, is developing a handbook for estimating the costs of changes in the mix of Active and Reserve Force units. The focus of that research is on how to identify the resource changes that must be included in a cost analysis. It will draw heavily on our analysis and on the analysis of operating and support costs in Ref. 4.

and greatly dependent on the specific circumstances surrounding the change. Construction and equipment procurement costs are most difficult to estimate early in the decision process. These elements of cost are driven by the facility and support requirements resulting from a unit change, counterbalanced by what may be available in the force or at a specific base. Personnel acquisition and training costs are a function of the new personnel quantity and skill requirements. The availability of standard per capita factors results in more reliable estimates of personnel-related costs compared with the non-recurring facility and equipment costs.

The annual recurring cost effects of unit changes can be estimated using available models once the personnel strengths, activity levels, and logistics support factors, such as fuel and spare parts consumption, for the new unit are determined. The force-wide, indirect costs are more difficult to identify and require a thorough examination of the system-wide effects of force perturbations. However, we think that these indirect costs are more likely to occur in specific mission areas (e.g., military airlift) and for specific types of changes (e.g., equipment transfers) where both Active and Reserve component units are affected.

Section II describes, in general terms, how the Reserve Force structure has been changing and the types of costs resulting from unit changes. This section also discusses force-wide costs. Section III describes the procedures for estimating the non-recurring unit cost effects of changes to the Reserve component structure. Section IV presents the results of specific case studies of recent unit changes in the Reserve components. Section V draws results and conclusions from the initial analysis and case study results. Finally, an appendix provides more detail on the case study unit changes examined during the analysis.

II. RESERVE FORCE CHANGES AND RESULTING COSTS

The Reserve components in all the services are currently receiving modern, front-line weapon systems, assuming new missions, and growing in terms of numbers of units and personnel authorizations. Such changes to the force composition and structure result in various direct and indirect costs.

This section provides a general overview of the changes being implemented in the Reserve components of the Air Force and Navy and a general description of the types of cost that can result from force changes. The research emphasis of this report is the non-recurring costs associated with changes to the Reserve Force structure and the remainder of the report addresses that topic. However, force structure changes may result in annual recurring and force-wide cost effects. This section briefly describes these elements of cost and references research efforts that have addressed them.

GENERAL TYPES OF RESERVE FORCE CHANGE

We separate into two main categories the various types of change being implemented in the existing force structure:

- Changes that affect the number of individual units in the Reserve components.
- Changes to existing Reserve component units.

Although the force structure can decrease through the deactivation of units, programmed and recently implemented changes in the first category have resulted in a modest growth of the Reserve components through new unit activations, primarily in the naval ship and support unit areas. At times, growth in the Reserve Force results from a corresponding Active unit deactivation, thereby keeping the number of units in the total force constant.

Changes to existing units can take many forms including:

- Equipment modernization through new weapon systems replacing older ones.

- Equipment augmentation with major end items, such as aircraft, being added to existing unit levels.
- Addition of a new peacetime or wartime mission requirement.

Certain changes can be categorized in more than one way; for example, the introduction of C-5As into the Air Reserve results in both a new wartime mission (strategic airlift) and in the modernization of an existing tactical aircraft squadron (the C-5 case is included in the case study analyses of Sec. IV).

The majority of recent and proposed changes to Reserve component units have been in the first two categories—equipment modernization and augmentation. Some of the new weapon systems received by the Reserve components are from Active inventories, such as the F-14s in the Navy and the C-5As in the Air Force. Other Reserve unit modifications represent the receipt of new, production weapon systems, such as the A-10, F-15, and F-16 in the Air Reserve.

When a Reserve component unit undergoes an equipment modernization, the equipment being replaced often retains some useful operational life. Usually such equipment is not phased out of the inventory, but is used to modernize other units operating with more obsolete equipment or to augment the equipment authorizations of other units that possess the same weapon system. The Air Force Reserve components, for example, are using the C-130 aircraft that are being replaced by C-5As and the F-4 aircraft available through F-15/F-16 modernizations to augment the equipment levels of other C-130 and F-4 units in the Reserve components. This equipment augmentation allows inventory levels to grow while retaining the same number of units in the force.

Changes to specific units, therefore, often lead to other unit changes in the total force structure. In reality, unit changes rarely happen in isolation but rather are caused by, or cause, changes to other force structure units. The presence of such a "ripple" effect leads to questions concerning how a "change" is defined for cost analysis purposes.

COSTS INCURRED BY UNIT CHANGES

Force structure changes impose a number of different costs. These include primary non-recurring unit costs, primary annual recurring unit costs, and force-wide, or secondary, cost effects. Both the primary non-recurring and annual recurring costs are direct costs that can typically be measured and associated with a specific unit in transition. Secondary costs impact units other than the one specifically earmarked for change.

The unit undergoing the change will initially incur non-recurring, or one-time costs. These non-recurring costs may be for the construction of new facilities, the procurement of necessary equipment, or the acquisition and training of personnel. Although the costs are incurred only once, they may be spread over a number of years as a new unit grows or an existing unit changes. Non-recurring costs are typically larger for new unit activations than for existing unit changes because existing facilities, equipment, and personnel generally are not available. The primary non-recurring costs associated with unit changes are the focus of this report and are discussed in detail in the next section.

Force changes also affect annual recurring unit costs. When the change to the force structure involves the activation of a new Reserve component unit, that unit will experience annual recurring expenditures that were not previously a part of the total Reserve force budgets. New units in the force, therefore, represent a growth in annual recurring expenditures (unless offset by a unit deactivation that results in a larger annual cost savings). The annual operating and support costs for the new unit can be estimated using available cost models once the various personnel, equipment, and support factors have been developed; see Ref. 4.

Changes that affect an existing unit may result in new unit equipment, personnel, and peacetime activity levels. Such changes entail increased or decreased annual recurring costs for the unit. The annual cost effect on personnel and equipment budgets can be estimated by comparing the annual recurring unit cost before and after the change. Again, available cost models can be used, but rather than calculating the full cost of each unit configuration, the annual cost effects can be estimated by considering the difference between the personnel and equipment requirements of the old and new unit configurations.

FORCE-WIDE COST EFFECTS

Force changes may impact not only the specific unit undergoing the change, but also other units in the Active and Reserve Force structure. Before a change is implemented, the existing force is in some state of balance with the operational roles and missions allocated between Active and Reserve Force components. This force balance results in peacetime activity levels for Active and Reserve component units and in the appropriate flows of personnel through training pipelines and various organizational positions. When a specific unit change perturbs the force balance, the activity levels of other units and the personnel pipelines may also be perturbed.

Our review of several case studies showed that the analysis of secondary costs is important when following categories of Reserve Force changes are contemplated:

- An acquisition of equipment transferred from the Active Force.
- An equipment acquisition, new or transfer, by a Reserve component unit that already has equipment with a useful military capability.
- Transfer of a mission with a high peacetime level of activity.
- Transfers that cause the personnel training pipeline or rotation base to be modified to a significant degree.

The following paragraphs describe these changes and their effects in more detail.

Equipment Transfers to the Reserves from the Active Force

Although the Reserve components have directly received some new weapon systems, the more usual change consists of a transfer from the Active inventory of older equipment that has been displaced by the Active Force procurement of new equipment. Transfers also result from a reduction in the size of the Active Force. When equipment transfers occur, the full budgetary impact includes the net costs of the Active Force change as well as the Reserve budget changes.

Computing the net cost of an Active Force change is essentially the same as the methodology developed for the Reserve Force: for a modernized unit, the cost of the new equipment, support equipment, and installations is estimated as one-time start-up costs. To this is added the net annual Operating and Support (O&S) costs of the modernized unit, derived by subtracting the previous O&S costs of the unit from those of the new capability. If, on the other hand, the equipment is released to the Reserves component because of an Active Force reduction, the Active Force budget simply is reduced by the amount of the retired unit's previous annual O&S costs (assuming that the cut was anticipated and the personnel acquisition and replacement training pipeline was reduced to accommodate the smaller force size). There also may be some non-recurring costs associated with the deactivation. In either event—equipment update or force reduction—the sum of both the Active and the Reserve Force cost changes constitutes the total force budget impact attributable to the equipment transfer to the Reserve components.

Reserve Force Ripple Effect

If the aircraft received by the Reserve components are used to replace the gaining squadron's old and obsolescent aircraft, which are then phased out, then a single Reserve component unit is involved and the incremental O&S cost to the Reserves is the difference between the expenditures needed previously to operate the obsolescent aircraft and the cost of operating the newer replacement aircraft. Examples of such single unit equipment changes include the Air Reserves' exchange of F-16s and F-4Es for old F-4Cs and F-106s at several locations, and the planned introduction of C-5As at Stewart Air Force Base in place of O-2As which will be retired.

Frequently, however, an acquisition of new equipment by the Reserve components presents an opportunity to modernize or upgrade more than a single unit. This potential exists because the Reserve establishment can not fully equip all its units with modern weapon systems. As a result of this policy, many Reserve component units are equipped with outdated "transition" systems, awaiting the assignment of newer weapon systems. Other Reserve component units have modern equipment but are underequipped by Active Force standards because of the Reserve Force policy of spreading the newer weapons among more units. These Reserve Force characteristics encourage a ripple effect for a large proportion of their equipment acquisitions.

A ripple effect comes into play when the newly transferred equipment or weapon systems displace others that retain a useful military capability. These displaced systems may then be used to modernize units with still older equipment, or they may be used to augment ("robust") other units of the same type to a more efficient size (provided that the local population can support a larger unit).

In the former approach, the bumping might involve several units[1] and the total budgetary effect will be the net cost change—non-recurring and recurring—of all of the units involved, including both the Active and the Reserve Force components.

The augmentation approach is an attempt to benefit from economies of scale. For instance, the most common Primary Authorized Aircraft (PAA) strength for Reserve component C-130 squadrons is eight aircraft—one-half the quantity considered normal in Active squadrons. If newly acquired aircraft displace the C-130s of an 8-PAA squadron,

[1]This practice enhances the morale of more Reserve units than would be the case if the newly received equipment were assigned directly to the Reserve unit with the equipment to be retired. On the other hand, the additional modernizations may result in a higher non-recurring cost overall, and may multiply the immediate loss of readiness during the transition to the new systems. The latter effect is less of a problem, of course, if the old and new equipment and missions are not dramatically different.

and these C-130s then are combined with those of another 8-PAA C-130 squadron, they can be operated together at a lower cost per aircraft because of savings in overhead and other economies of scale. In this case, the Reserve component budget would not save the entire cost of the C-130s that were displaced in the initial receipt of new (or transferred) aircraft—a notion which might, erroneously, be inferred from a cost analysis limited to the single gaining unit. However, a total force analysis would indicate that these eight C-130s would be operated at almost 30 percent less cost than before [4]. A similar example is the programmed displacement of an Air Force 18-PAA A-7D squadron by F-16s. In this case, the 18 A-7Ds will be divided among three other 18-PAA A-7D squadrons, "robusting" them to the more efficient 24-PAA size.

A much more complicated ripple effect is associated with the eventual transfer of 16 C-5s to the USAFR unit at Kelly AFB. The initial transfer will set off a series of unit changes. Eight of the 16 C-130Bs presently at Kelly will be used to augment an existing 8-PAA C-130B squadron at Peterson AFB to the full 16-PAA strength. The other eight will replace six HC-130Hs at March AFB. March's HC-130Hs will then be sent to augment an air rescue unit at Portland International Airport, where they will be joined by six CH-3Es due to be displaced at Luke AFB by new F-16s.

Strictly speaking, the net annual operating cost of this restructured segment of the Reserve Force can not be attributed solely to the transferred C-5s unit that set the ripple effect into motion. After all, these additional savings and improvements in cost effectiveness could have been achieved without the transfer of newer aircraft—simply by phasing out the obsolescent aircraft and consolidating the underequipped squadrons into more efficient packages.

However, these transition units do continue to exist and it is shortsighted to ignore their availability. It makes good economic sense to recognize the potential value of the Reserves' highly skilled and experienced personnel and to use them to best advantage by providing them with equipment designed for today's air war environment. The potential indirect cost savings (or increased force cost-effectiveness opportunities) described above should be considered when deciding whether a given weapon system should be operated by the Active forces or by the Reserves.

In the case studies we chose to use a modular, bottom-up costing approach which limited the tabulation of cost effects to the Reserve component unit initially benefiting from the force changes. However, to estimate the full cost of a ripple effect force change, we must take account of the net cost changes of all of the units included in the

restructuring action. For example, Table 1 provides a breakdown of the wide-ranging USAFR C-5 ripple effect into its component parts.

Peacetime Missions that Exceed Reserve Component Capabilities

Indirect, or second-order, costs can also be incurred when Reserve units are not able to fully support a vital peacetime mission. Such peacetime missions must be accomplished regardless of the mix of

Table 1

EFFECT ON BUDGET OF THE RIPPLE EFFECT OF MOVING C-5s[a]

USAF	USAFR	System-wide
– C-5A O&S costs	– C-5A associate unit O&S costs	+ Change in marginal cost of personnel acquisition
	+ C-5B associate unit O&S costs	
+ C-5B O&S costs	+ C-5A unit O&S costs at Kelly	
+ Non-recurring costs of C-5B beddown	+ Non-recurring costs of C-5A beddown at Kelly	+ Personnel turnover cost due to change
0 No change in MAC airlift mission	+ Non-recurring costs of new C-130 beddown at Peterson and March	
	+ Net change in C/HC-130 O&S at Peterson and March	
	– C-130 annual cost savings due to economies of scale	
	+ Non-recurring costs of HC-130s beddown at Portland	
	+ Change in HC-130 annual costs at Portland	
	– HC-130 O&S savings due to economies of scale at Portland	

[a]There may also be a (negative) readiness impact during the transition period.

Reserve and Active units in the force. However, the relative mix of these units in the force can make a peacetime mission more or less costly to perform. The transfer of weapon systems and equipment from the Active inventory to the Reserve components may alter the operating tempo, and therefore costs, of both the Active and Reserve units as they try to meet the peacetime mission requirements. An interesting example of this situation occurred when the Congress proposed MAC C-141 aircraft be transferred to the Reserves without funding replacement aircraft to perform the C-141 peacetime airlift missions [6]. As a result, either the Reserves would have had to drastically increase their flying hours to undertake a proportional share of the airlift mission or else the remaining Active fleet would have had to continue to perform the mission, using fewer aircraft and fewer assignment crews. Either way, the expected savings from the transfer could not be fully realized and the proposal was reconsidered.

Personnel Pipelines

Besides affecting the performance of peacetime missions, force restructuring also can affect the accomplishment of personnel training goals. For instance, besides their peacetime mission responsibilities, the pool of active duty aircrew officers also is a source of seasoned, rated officers for flying instructor requirements and for the overhead staff positions that require flying experience. The flying hour program provides for the maturing of rated officers for these training and overhead staff positions. If the number of aircraft in the Active Force is reduced appreciably, then, as we found in the above C-141 and C-130 examples, the Active Force will have to fly more hours per aircraft, or the Reserve component aircraft will somehow have to be used for this purpose.[2] Either way, an increased operating tempo and resultant operating costs should reflect this maturing requirement.

Other personnel pipelines may be affected by restructuring as well. For instance, the cost of individual acquisition and training for reservist replacement is predicated on assumptions about the number of prior service personnel who will transition from the Active Force. If restructuring reduces the flow of this pipeline of previously trained personnel into the Reserves, then the acquisition and training costs of non-prior service recruits will increase.

---

[2]Perhaps by earmarking, but not actually releasing, some proportion of the aircraft to the gaining Reserve units.

TOTAL FORCE COST APPROACH

Cost analyses typically support policy decisions. The policy decision (or decision maker) must adequately define the scope of the change for the purpose of the cost analysis (or cost analyst). This definition should include the factors that are held constant, the factors that vary, and how much of the "ripple" should be costed. If more than one unit is involved in the change, two cost analysis approaches are possible. One approach involves separately costing each unit change and then summing the individual costs to arrive at the total resulting costs. The second approach would consider the total effect across all units involved and then estimate the costs of this overall force perturbation.

Both approaches should lead to the same result. The important issues are that the change being costed is clearly defined and that all appropriate costs are considered.

When a significant force restructuring results from a specific change, a more comprehensive total force cost analysis approach is needed to reveal the total (net) budgetary impact of all of the force changes that are related, directly or indirectly, to the primary change. The extent to which the associated force-wide changes should be included in the cost estimate depends upon the focus of the decision.

III. NON-RECURRING COSTS RESULTING FROM UNIT CHANGES

This section describes the analysis of the non-recurring costs associated with units undergoing change in the Reserve Force structure. It presents the guidelines and assumptions used in our analysis, defines the various elements of non-recurring cost, and describes the current methods and data sources used by the Reserve components to estimate these elements of cost.

Defining the scope of the cost analysis is very important; the "change" that is costed must be clearly delineated. We have made a number of assumptions in this regard. These assumptions should be examined and modified as necessary to conform to the particular decision objectives of the cost analysis of specific unit changes.

GUIDELINES AND ASSUMPTIONS

The following are the general guidelines and assumptions adopted for our analysis of non-recurring cost:

- All appropriate costs are included, regardless of the component's budget in which they are reflected. Although our analysis deals with changes to Reserve Force units, we include in the cost estimates any applicable costs contained in Active Force budgets.
- Sunk costs are excluded. We do not include any costs that have been incurred in the past because of prior decisions or force changes. Sunk costs may include the cost of weapon systems, support equipment, and personnel already in the force, the initial acquisition and training cost of prior service personnel recruited by the Reserve components to satisfy the personnel requirements of force changes, and the cost of existing facilities even if these facilities were constructed in the past in anticipation of future force changes.
- We limit the scope of the analysis to the specific unit undergoing the change. Although the effect of changes may ripple through the force and have other, system-wide effects, we choose to examine each unit change individually. If necessary, the relevant costs of individual unit changes can be added

together to estimate the total cost associated with a force change.

- The cost effects on force-wide overhead are excluded. Changes to the force structure, especially those changes that involve a growth in the force, may result in changes to overhead functions. For example, new units will result in increased training requirements and, therefore, increased training overhead. We could not identify any change in overhead costs in our case study analyses. Such costs may exist for changes involving major restructuring of the force or large numbers of units.
- All costs are in FY1985 dollars. Case study costs and factors used in the development of the methodology which were in other year dollars were converted to the FY1985 base using published Department of Defense inflation indices.

NON-RECURRING COST ELEMENTS

The non-recurring costs associated with force changes can be separated into five categories:

1. Construction of unit facilities
2. Procurement of unit equipment, including test and support equipment, initial training munitions, and initial spare parts
3. Personnel acquisition
4. Personnel training
5. Other

The "other" cost category includes any costs not accounted for in the previous four categories, for example, the cost of transporting personnel and equipment. We could not separately identify any significant "other" costs in our case studies. Because the "other" cost category provided very little in our analyses we do not treat it separately in the following cost element discussions and case study results.

Each of the elements of non-recurring cost is discussed below, and includes a description of the current cost estimating methods and general data sources used by the services.

Construction

Construction cost includes the expenditures necessary to build or alter the facilities used by the unit in performing its mission and functions. These include hangars, runways, docks, maintenance buildings, administration buildings, and personnel support facilities such as

dining halls, commissaries, and barracks. We could not directly identify any construction costs associated with personnel support functions in our cost studies, primarily because Reserve Force personnel have little demand for such facilities. They are at the unit basing location only a small fraction of the time. (In the Naval Reserves, the full-time Training and Administration of Reserve personnel and the active USN personnel do require personnel support facilities.) Of course, if personnel support facilities need to be built or expanded because of a unit change, then the cost should be included in the analysis.

The magnitude of the construction cost due to a unit change is a function of the facility requirements of the "new" unit and the facilities that are available on the base. Therefore, adding a new unit to the force usually results in higher construction costs than if an existing unit is changed in some way, such as by equipment modernization.[1] When there is a choice of where to base a new unit or where to institute a unit change, the services will survey available facilities on existing bases in an attempt to minimize the amount of new construction required. However, political and other constraints may dominate unit location decisions.

Service Approach. Each service and component estimates construction costs in similar ways. First, they develop a facility requirements list describing the facilities needed to support the weapon system's operations. It is based on the size and complexity of the specific weapon system, the maintenance and other logistics support policies, and personnel needs. Then, site surveys are performed to determine if the required facilities are available as excess on any existing base. The comparison between what is required and what is available results in the numbers and sizes of facilities that must be constructed or modified for several site options. The costs of the required construction are then estimated using service and Department of Defense cost guides [9] and the actual costs of similar facilities constructed in the recent past. Factors are applied to adjust the cost estimates based on the geographical area of the country and any unique features of the facilities. Costs, political concerns, and the availability of Reserve Force personnel in a geographic region are compared for several sites and a choice is made.

Each Air Force base annually submits a Form 920, "Utilization of Facilities," which identifies the units and numbers of personnel on the base, their facility requirements, the facilities that exist on the base, and any shortfall or excess facilities. These forms provide Reserve

[1] An exception is when a transfer-in-place occurs, with a new Reserve component unit replacing an existing Active unit.

Force planners with information on the facility status of various bases. Requirements are specified in Air Force Manual 86-2 [7] and are supplemented with facility requirement information from the Active Force for aircraft that are transiting from the Active to the Reserves. Air Force Regulation 86-1 [8] describes the procedures for programming construction projects.[2]

Once construction requirements are identified for a given base, a site review is performed to further refine estimated construction cost. Cost estimates are based on historic information of similar construction projects modified with labor and material indices for the geographical region. Department of Defense construction cost review guides [9] and cost factors provide additional information to help in the estimation of construction costs. The cost of Air Reserve Force construction is reflected in the Reserve or National Guard budgets.

For aviation units, a totally enclosed hangar for maintenance activities, attached component repair shop, and a fuel system maintenance dock with specified environmental properties are the minimum requirements. Suitable runways and parking areas, squadron operations rooms, and munitions facilities may also be required.

The Naval Reserve construction requirements are identified and programmed in much the same way as the Air Reserve Force requirements. The main difference is that the Navy Reserve Surface Force typically relies upon Active Force planners or geographically located field activities of the Naval Facilities Command to provide requirements and cost estimates.

The Navy relies on the historic cost of similar construction projects and on the DoD cost guides and area indices. They also use an on-line data base of previous construction projects to help in the cost estimation process.

Cost Issues. Non-recurring construction costs often involve "piggybacking" and advance planning associated with construction activities. Facilities deteriorate over time, requiring minor construction and renovation. These minor construction projects are typically grouped together in service budgets under a single category and are difficult to fund. When a major construction project is programmed and funded, some of the minor construction due to normal deterioration may be included or "piggybacked."

Anticipation of future changes may also be included in construction plans. For example, F-4 facilities have been built with F-16 requirements taken into account. In our analysis, we attempt to eliminate

[2]See also Ref. 17 together with "Real Property Inventory" documents for an estimating approach where such base studies have not been undertaken.

piggybacked costs and assume that prior construction expenditures represent a sunk cost and should not be included.

The facility construction associated with force changes is based on unit and weapon system requirements and the existing facilities at the base. The construction costs of force changes are unique to each specific change. For this reason, a parametric estimating relationship for construction costs would be difficult, if not impossible, to develop, suggesting that the construction cost portion of a non-recurring cost model would probably be based on gross estimates and inputs of known cost requirements.

Equipment Procurement

This category includes the cost of all ancillary equipment required for the unit to perform its mission. It includes ground support equipment (typically termed "yellow gear"), maintenance support and test equipment, training equipment, initial spare parts, and the initial unit munition requirements. The procurement cost of the major weapon system (aircraft or ship) may also be included depending on the policy decision supported by the cost analysis.

As previously mentioned, we do not include the cost of equipment already in the total force inventory. For example, if existing aircraft and equipment are transferred from an Active to a Reserve Force unit, the procurement cost is considered sunk, having been incurred in previous budgets. If prior decisions have resulted in the procurement of new equipment, and the decision objectives being supported by the cost analysis are concerned only with which component should receive the new equipment, the weapon system procurement cost should be excluded from the cost analysis.

Support equipment requirements are specified by the weapon system Table of Allowances in the Air Force or the Individual Material Readiness List (IMRL) in the Navy. These requirement documents specify the numbers and types of support equipment needed for a ship or for various numbers of unit aircraft. Matching the requirements with available equipment results in the requirement for support equipment procurement. Historic unit costs of the equipment, in combination with the requirements, results in the total cost of support equipment. In both the Air Force and Navy, the cost of support equipment for Reserve Force units is often contained in Active budgets, especially if the new aircraft or ship is from production rather than existing inventory.

The dispersed peacetime basing of Reserve and National Guard aviation units may require more items of support equipment than the

consolidated peacetime basing of Active units. For example, if one piece of test equipment is required for every 36 aircraft, two pieces will be needed for an Active wing of 72 aircraft on a single base, but three pieces will be required for Reserve component units with 24 aircraft on each of three bases.

Collocation of units may result in the sharing of certain items of support equipment. Such sharing occurs more frequently in Air Force Reserve aircraft units, which are often collocated with Active units, than for Air National Guard units, which are usually based on commercial airfields. Wartime mobilization requirements may reduce the potential for sharing equipment because of individual squadron deployment requirements.

For force decisions involving the transfer of aircraft or ships from the Active to Reserve components, excess support equipment may be available. If the weapon system is being phased out of the Active inventory or if the number of units of the weapon system is being reduced in the total force, the existing equipment that supports the Active unit may also be transited to the Reserve unit, thereby reducing the requirement for support equipment procurement.

Similar to the estimation of construction costs, support equipment costs associated with force changes are unique to particular changes and basing locations. The gross requirement levels are dictated by the specific weapon system and basing options. The net requirements are influenced by the availability of existing equipment in the force inventory and the degree of sharing that is possible. For this reason, it is difficult to develop general relationships for estimating the support equipment costs associated with force changes.

Personnel Acquisition

This category includes the cost of personnel recruiting, basic training, and initial skill training. Costs include recruiting expenses, pay and allowances of trainers and trainees, and the variable cost of training materials, equipment, and supplies.

The non-recurring costs associated with personnel acquisition can be estimated as the product of the number of personnel that must be recruited and trained and the per capita acquisition cost. Since initial skill training costs will vary by skill requirements, there should be separate per capita cost factors for different skill requirements, at least for aggregate skill levels such as aircrew, maintenance, and administration. Prior service gains and location unique factors should be included in the personnel requirements and average cost factor calculations.

(Service and case specific cost factors and turnover rates are found in the appendix.)

The personnel strength and skill requirements for a unit are dictated by unit manning documents. If the force change involves the modification of an existing unit, personnel acquisition requirements equal the difference between the strengths of the old and new configurations. If the change involves the creation of a new unit, the unit strength requirements represent the upper bound on the number of people to be acquired. Because prior service personnel have been trained as part of the Active Force, they result in only minor recruiting costs to the Reserve components. Non-prior service personnel, however, incur full acquisition and initial training costs. Thus, the personnel acquisition requirement must be modified to reflect the percentage who are likely to be prior service. We call this a prior service factor. It is developed by taking average prior service gains divided by average total gains (minus reenlistment). The prior service factor is applied to the personnel acquisition requirement to calculate the number of non-prior service personnel that the Reserves must acquire and train.

The timing of the force change, especially for changes involving the creation of a new unit, also affects personnel acquisition costs. If the new unit must be brought up to full strength in a short period of time, additional recruiting resources or enlistment bonuses may be required to meet the recruitment goals. If the unit can be phased into the force on a gradual basis, personnel acquisition and training can be spread over the period of transition.

Location specific demographics may also affect recruiting costs. If the geographic area surrounding the basing location can not readily supply the necessary personnel gains, additional recruiting resources or enlistment bonuses may be required. Any site specific personnel acquisition costs should be included.

Personnel Training

This category comprises the training or retraining of personnel to meet the specific skill requirements of the unit. It includes the specialty training beyond initial skill training provided to new members of the Reserve Force unit, and the retraining or cross-training of existing unit members or prior service accessions in the skill requirements of the new unit equipment. Included are the costs for pay and allowances of the trainer and trainees, travel, and the variable portion of training equipment, supplies, and support.

Personnel training costs can be estimated as the product of the number of people requiring training and the average cost of the

training summed over the various skill requirements. For new unit activations, the majority of the unit personnel will require skill training. For modifications to existing units, usually only maintenance personnel and equipment operators will require retraining on the new equipment; the personnel support, administrative, and clerical skills for the new, modified unit are usually the same as the skills required for the old unit functions.

If the force change involves the modification of an existing unit, the degree of similarity between the old and new configurations can greatly affect training costs. For example, if a fighter unit is being modernized by introducing a newer fighter aircraft, the existing skill requirements may change very little. If, however, a fighter unit is transiting to a transport unit, the existing personnel skills may have little applicability, thereby necessitating subetantial retraining.

Average cost factors for the unit training requirements can be difficult to develop, especially for non-aircrew personnel, for several reasons. First, the Reserve components have only limited information on total training costs since they include only trainee pay, allowances, and travel in their budgetary estimates. The costs associated with schools are reflected in Active budgets. Second, numerous courses may be required. The number varies on a case-by-case basis and is difficult to predict. Finally, a large portion of the new skill training may be accomplished with on-the-job training (OJT) or with field training detachments (FTDs), where the schools will send the appropriate instructors to the unit basing location to conduct school training on-site. This type of training costs less than formal school courses, but the services do not track these costs.

The services typically track aircrew training costs closely. Thus, suitable aircrew training cost factors may be available from the Reserve component cost organizations or from the Active training schools. For example, Air Force aircrew training costs are contained in Ref. 10.

The training cost factors for maintenance skills are not closely tracked, but can be estimated using an average course length and an average cost per day. Although the course lengths and costs will vary over the various skill requirements, the factors developed from the simple average technique usually supply fairly good approximations.

The services attempt to send all the full-time equipment operators and maintenance personnel to formal school courses or FTD. These full-time personnel then provide OJT for the part-time reservists. An exception is the Active USN personnel that stay with a ship when it transfers to the Naval Surface Reserve Force. These personnel become part of the Reserve ship crew and, since they are already trained, do not incur retraining costs.

Some skill areas will require more than one course. For example, maintenance personnel may need a quality assurance or corrosion control course in addition to specific maintenance course requirements. For large changes such as the conversion of the C-5 in the Air Reserve components, it may be impossible to provide all the school training requirements. For such large changes, OJT and FTDs are heavily relied upon.

As an initial estimating relationship for personnel training costs associated with unit changes, the following steps can be used:

1. For new unit activations, assume that all personnel (less prior service gains or active duty personnel ordered into the unit) will require training. For existing unit modifications, assume that only equipment operators and maintenance personnel will require retraining.
2. For equipment operators, use the appropriate cost factors from Active references (e.g., Ref. 10) or cost information from the training schools. Prior service aircrew members may require retraining on a specific weapon system, but should not require initial specialty training (e.g., undergraduate pilot training—UPT). If cost factors are available for other skill requirements, use them to estimate training costs; if they are not available, use the approximations suggested in (3) below.
3. For maintenance personnel, assume all full-time unit members will receive a full school course (this assumption may overstate costs since partial courses may be sufficient) and the part-time unit members will receive FTD or an abbreviated school course. Use average days per school course to estimate total training day requirements for full-time personnel and average days per abbreviated school course for part-time unit personnel. Use average costs per school training day to estimate training costs.

The relationship suggested above approximates training costs. The relationship will underestimate the true cost impact for unit changes that involve large numbers of new personnel or large differences between the old and new unit configuration.

Many factors affect this element of cost, including the degree of similarity between the old and new weapon system, prior service/non-prior service mix of unit personnel, the time schedule for accomplishing the unit change, and the specific number and duration of the various required courses. Further analysis in this area should result in better

methods for estimating the personnel training requirements associated with unit changes.

Air Reserve Force units undergoing change are often assigned additional drill days to enable personnel to accomplish the additional work load involved in the transition. These days, usually found under Special Training, Unit Conversions in the Budget Justifications, are allotted to part-time reservists. Units undergoing change usually receive additional drill days for up to a two-year period to complete the transition. These additional drill days must be accounted for in non-recurring costs for the transition period. The costs for these days are estimated by multiplying average manpower costs per Active duty drill day times the number of reservists in the unit who do not have full-time civilian unit duties.

Naval Air Reserve units usually transition to a new aircraft within a one-year period. The unit as a whole does not receive additional training days. However, Selected Reserve aircrew members may receive additional drill days during the transition period to familiarize themselves with the new aircraft. (Care must be taken not to double count any such additional drill days with the training costs mentioned previously.)

The Naval Surface Reserve Force begins the transition process at least a year before they receive a new ship. The objective of this pre-transition period is to recruit and train the Selected Reserve members of the unit and to identify and assign the appropriate full-time personnel. The Reserve unit will be trained and in place when the ship actually transitions from the Active fleet. The cost of this initial preparation period before receipt of the ship should be included in the non-recurring costs under personnel training costs.

The next section presents the results of the actual case studies examined during the research and draws some general conclusions from these results.

IV. CASE STUDY RESULTS

A number of specific Reserve component unit changes were analyzed in an attempt to understand the magnitude of the associated non-recurring costs and the factors that affect the resulting costs. These case studies include the modernization of existing squadrons in the Air Reserve Force components either with new production aircraft (F-16) or with aircraft transferred from the Active inventory (C-5, C-141), the activation of new surface units in the Naval Reserve (FF1052, FFG7), and the modernization of existing Naval Air Reserve squadrons with aircraft transferred from the Active Force (F-14, A-7E). For each of these cases, the costs of different basing locations were examined. In total, non-recurring costs were analyzed for 15 case study units.

The costs for each of the case studies represent program budget estimates; they are not the actual costs incurred by the unit transition. Actual costs are very difficult to track, especially in the personnel-related areas. The majority of personnel acquisition and training is monitored at the unit level. The actual personnel-related costs associated with changes are rarely reported to the Reserve component cost groups and are often "lost" from the system. The construction and equipment costs are controlled by force-level organizations and, therefore, are more accurately estimated and tracked.

The construction and equipment costs were received from the appropriate Reserve component budget and programming groups. The personnel-related costs are based on information from the programming groups plus average per capita factors used by the services or developed in previous cost analyses. The non-recurring costs associated with the various case studies are separately described in more detail in the following charts and are summarized in Table 2. Details on each of the case studies are contained in the appendix.

NAVAL SURFACE RESERVE FORCES: FRIGATE TRANSFERS

Background. The Active Navy is moving 26 FF1052 and FFG7 class frigates to the Naval Reserve Force. These ships represent new unit activations in the Reserves. The ships will be based at a number of locations on the Atlantic and Pacific coasts. The case study examines the introduction of four FF1052s at San Francisco and two at New York and the basing of six FFG7s at Long Beach and two ships at Puget Sound.

Description:	Long Beach is a large Active base with excess facilities. San Francisco, New York, and Puget Sound need extensive renovation or expansion.
Construction:	Pier projects are required at San Francisco, New York, and Puget Sound. Ship Intermediate Maintenance Activity (SIMA) construction is required at all locations.
SIMA equipment:	Required at all locations.
Personnel acquisition:	Each FF1052 has 87 full-time Training and Administration of Reserve (TAR) and 139 part-time Selected Reserve (SelRes) crew members. Each FFG7 has 45 TAR and 76 SelRes crew members. An additional 100 full-time SIMA personnel are required for each ship.
Personnel training:	All TAR and SelRes crew members require training courses.

		Total Non-Recurring Costs ($M)
FF1052:	San Francisco (4 ships)	58.0
	New York (2 ships)	36.2
FFG7:	Long Beach (6 ships)	30.4
	Puget Sound (2 ships)	74.4

NAVAL AIR RESERVE FORCES: F-4 TO F-14 UNIT MODERNIZATION

Background. Two F-4S squadrons (12 aircraft each) at Dallas Naval Air Station (NAS) are being modernized with F-14 aircraft from existing Active inventory. These Active aircraft are available from pipeline and peacetime attrition replacement excesses. Active F-14 units are not affected. The case study addresses the option of activating two new Reserve F-14 units at Oceana NAS compared with modernizing the current F-4 squadrons at Dallas.

	Dallas NAS	*Oceana NAS*
Description:	Reserve base with no current F-14 squadrons.	Active basing location for all F-14 squadrons in the Atlantic Fleet.
Construction:	New F-14 unit requires an addition to the Intermediate Maintenance Facility.	Two new squadrons on the base require hangar and ramp space.
Equipment and spare procurement:	New F-14 peculiar support equipment and spare parts are required.	Availability of existing F-14 repair capability and spare parts reduces requirement for new buys. Some prepositioned support equipment and spare parts are required.
Personnel acquisition:	Each F-14 unit must acquire 24 new TAR personnel.	Each new F-14 unit requires 263 total unit personnel of which 125 are TAR. Added demand on already strained recruiting supply requires additional recruiting resources.
Personnel training:	Two units require 282 enlisted maintenance personnel to take 477 courses (including Aviation Training Series courses, compressed courses, and split course); the full-time aircrew members receive a 6-month course; part-time aircrew members require a condensed course that includes 10 flight hours.	

	Total Non-Recurring Costs ($M)
Dallas NAS	36.0
Oceana NAS	34.2

NAVAL AIR RESERVE FORCES: A-7B TO A-7E MODERNIZATION

Background. The introduction of new F/A-18 aircraft into the Active inventory results in the transfer of A-7E aircraft to the Reserve components. These aircraft will be used to modernize existing A-7B squadrons. The case study compares the costs of modernizing existing units at Atlanta (VA205), New Orleans (VA204), and Cecil (VA203) Naval Air Stations.

	Atlanta/New Orleans NAS	*Cecil NAS*
Description:	Reserve bases with no current A-7E squadrons.	Active basing location for all A-7E squadrons in Atlantic Fleet.
Construction:	Engine shop required at New Orleans.	Adequate facilities.
Equipment and spare procurement:	New A-7E peculiar support equipment and spare parts are required.	Availability of existing Active A-7E repair capability and spare parts reduces requirement for new buys. Some prepositioned support equipment is required.
Personnel acquisition:	A-7E manning equal to A-7B strength. Each A-7E unit requires 23 additional TAR personnel (and, therefore, 23 fewer SelRes personnel).	
Personnel training:	Each squadron requires retraining of 198 maintenance personnel; aircrews require very minimal recertification effort because of Active service experience.	

	Total Non-Recurring Costs ($M)
Atlanta NAS	10.4
New Orleans NAS	10.5
Cecil NAS	1.3

AIR RESERVE FORCES: C-5A TRANSFER

Background. As new C-5Bs enter the USAF, the older C-5As will be transferred to existing units in the Reserve components. The AFR units receiving the C-5As will transfer their older aircraft to other Reserve units. Among the units selected to receive the C-5As are an existing C-130 USAFR unit at Kelly AFB and an O-2 Air National Guard (ANG) unit at Stewart Airfield. The case studies of these two units shows the wide variance possible in construction costs due to unit siting.

	AFR, Kelly AFB	*ANG, Stewart Airfield*[a]
Description:	The existing C-130 unit at a large Active base began receiving 16 C-5A in 1985.	An existing O-2 unit at a new field began receiving 8 C-5As in 1985.
Construction:	New hangar, apron, maintenance facilities needed.	Full C-5 facility construction required.
Equipment:	No transfer or sharing of support equipment.	No transfer or sharing of support equipment.
Personnel acquisition:	Aircrew is prior service. Total acquisition equals 1110 enlisted.	Aircrew is prior service. Total acquisition equals 36 officers and 652 enlisted.
Personnel[b] training:	Aircrew of 128 pilots and 288 enlisted require retraining. 740 full-time maintenance personnel must be trained.	Aircrew of 64 pilots and 144 enlisted require retraining. 377 full-time maintenance personnel must be trained.

	Total Non-Recurring Costs ($M)
Kelly AFB	106.8
Stewart Airfield	127.3

[a]The Air Force has recently increased the number of C-5s at Stewart from 8 to 12. The personnel figures are based on the original 8-aircraft unit.

[b]The Air Force has recently reduced the crew ratio for AFR C-5s from 4 to 2. The aircrew figures are based on the original 4.0 crew ratio.

AIR RESERVE FORCES: C-141 TRANSFER

Background. The USAF will be drawing down their C-141 assets from several different units and transferring them to existing Reserve units. The aircraft that the C-141 are replacing will modernize other units. Two of the units receiving the C-141s are an AFR unit at Andrews and a ANG unit at Jackson, Mississippi.

	AFR, Andrews AFB	*ANG, Jackson Airfield*
Description:	An existing C-130 unit at Andrews will receive 8 C-141s beginning in 1986. Andrews is a large base with collocated Active airlift units.	An existing C-130 unit at Jackson will receive 8 C-141s beginning in 1986. Jackson is a small ANG field.
Construction:	Because of existing facilities at Andrews, only hangar modifications are required.	The new aircraft require a new hangar and new fuel storage facilities.
Equipment:	No transfer or sharing of support equipment.	No transfer or sharing of support equipment.
Personnel acquisition:	Aircrew is prior service. Total acquisition equals 15 officers and 273 enlisted.	Aircrew is prior service. Total acquisition equals 2 officers and 175 enlisted.
Personnel training:	Aircrew of 64 pilots and 112 enlisted require retraining; 165 full-time maintenance personnel require training.	Aircrew of 64 pilots and 122 enlisted require retraining. 155 full-time maintenance personnel require training.

	Total Non-Recurring Costs ($M)
Andrews AFB	28.1
Jackson Airfield	39.8

AIR RESERVE FORCES: F-16 MODERNIZATION

Background. New F-16CDs coming off the production line will be placed directly into the Reserves. These aircraft will go to existing units who will send their current aircraft to other locations. There will be no increase in the number of flying units in the Reserve. An AFR unit at Luke AFB and an ANG unit at Kelly will receive the new F-16s. These two cases show the cost effects of weapon systems procurement and offer an example of the costs associated with special recruiting efforts.

	AFR, Luke AFB	*ANG, Kelly AFB*
Description:	An existing unit will send its CH/HH-3s to an existing unit in Portland and receive 24 F-16s beginning in 1987. Luke is an Active fighter training base.	An existing F-4 unit will begin receiving 24 new F-16s in 1987. Kelly is a large Active base.
Construction:	The existing base will need new maintenance and operations facilities. Current hangars and aprons are adequate.	The ANG fighter unit at Kelly AFB provides all the needed facilities except a simulator facility.
Equipment:	There is no sharing or transfer of equipment from Active inventory.	There is no sharing or transfer of equipment from Active inventory.
Personnel acquisition:	Aircrew is prior service. Total acquisition equals 46 officers and 695 enlisted.	Aircrew is prior service. Total acquisition equals 192 enlisted.
Personnel training:	Aircrew of 46 pilots require retraining. 194 full-time personnel must be trained. In addition, 5 recruiters with an advertising budget of $50,000/yr are needed for 4 years.	Aircrew of 30 pilots require retraining. 170 full-time maintenance personnel must be trained.

	Total Non-Recurring Costs ($M)
Luke AFB	95.1
Kelly AFB	58.6

CASE STUDY COST IMPLICATIONS

The non-recurring costs displayed in Table 2 show a high degree of variability across the cases examined. When the unit change is minor in nature—the A-7 modernization in the Naval Reserve, for example—non-recurring costs are minimal. When the unit change is more substantial, involving either a new unit, such as the Naval Reserve frigates, or a major modernization, such as the Air Reserve C-5s, the resulting non-recurring costs can be much larger. Overall, the case study results suggest that the non-recurring costs associated with Reserve component unit changes are greatly dependent on the specific type of change and the characteristics surrounding the change.

Table 2

NON-RECURRING COSTS FOR CASE STUDY UNITS
(Millions of FY1985 dollars)

		Non-Recurring Costs				
	Case Study	Construction	Support Equipment Procurement	Personnel Acquisition	Personnel Training	Total
Naval Reserve						
FF1052:	San Francisco (4 ships)	41.1	6.9	6.4	3.6	58.0
	New York (2 ships)	31.2	(a)	3.2	1.8	36.2
FFG7:	Long Beach (6 ships)	11.2	(a)	6.2	13.0	30.4
	Puget Sound (2 ships)	68.0	(a)	2.1	4.3	74.4
A-7E:	Cecil (12 PAA)	0	0.7	0.0	0.6	1.3
	Atlanta (12 PAA)	0	9.8	0.0	0.6	10.4
	New Orleans (12 PAA)	1.4	8.5	0.0	0.6	10.5
F-14:	Oceana (24 PAA)	19.0	9.5	2.7	3.0	34.2
	Dallas (24 PAA)	3.2	29.8	0.0	3.0	36.0
Air Reserve						
F-16:	Luke (24 PAA)	16.0	18.0	4.2	56.9	95.1
	Kelly (24 PAA)	2.1	18.0	0.8	37.7	58.6
C-5:	Kelly (16 PAA)	55.5	18.2	3.1	30.0	106.8
	Stewart (8 PAA)[b]	91.8	17.3	2.7	15.5	127.3
C-141:	Andrews (8 PAA)	6.9	12.0	0.8	8.4	28.1
	Jackson (8 PAA)	18.3	12.0	0.7	8.8	39.8

[a]Not available.
[b]Recently increased to 12 aircraft; cost data are based on original 8-aircraft allocation.

Construction, support equipment, and aircrew training costs represent the majority of the non-recurring costs in the various case studies. Personnel acquisition and training (other than aircrew) costs are typically minor, even when additional recruiting efforts and enlistment bonuses are required. Non-recurring costs can therefore be reduced if basing locations offer available facilities and equipment and if prior service aircrew personnel with experience in the new weapon system can be acquired.

The cost advantages of various basing locations are apparent in the case study results. If the Reserve Force unit change can be implemented at a large Active base, non-recurring costs can be reduced. Changes at smaller National Guard or Reserve bases are typically more expensive because of lack of existing facilities, support equipment, and maintenance support activities. This effect is seen at Long Beach versus San Francisco, New York, or Puget Sound (Navy frigate case), Kelly versus Stewart (Air Force C-5 case), and Andrews versus Jackson (Air Force C-141 case). Political, demographic, or operational constraints may dictate specific basing locations, but, if the options are available, collocation on Active bases may result in lower non-recurring costs than siting Reserve component units independently on smaller Reserve or commercial airfields.

The advantage of an Active base is negated, however, when the Active base does not have excess capacity or when the change involves an existing unit on a Reserve component base. This effect is seen in the comparison of the costs of the Navy Reserve F-14 modernization at Dallas versus Oceana. The Active base at Oceana provides the advantage of existing intermediate-level maintenance capability but does not have available hangars and other facilities. Dallas, on the other hand, has facilities available from the existing F-4 unit but requires substantial F-14 support equipment and spare parts.

When a change involves a transfer from the Active to the Reserve components or a decision between placing a new unit or weapon system in the Active versus the Reserve, the total life-cycle cost must be considered. Although the initial, non-recurring costs of implementing a change in the Reserve components may appear large by itself, it may be small compared with the cost of operating and supporting the unit over a number of years. For example, the non-recurring costs associated with the C-5 change are over 100 million dollars. However, the annual operating and support costs for an Active C-5A unit are close to 150 million dollars [10]. If the Reserves realize a lower annual cost than the Active Force (previous studies [4] suggest that in certain cases an Air Reserve Force unit can save up to 30 percent of the annual cost

of a similar Active unit), the initial non-recurring cost may be recouped in a few years.

Our case studies have considered only Air and Naval Reserve Force combat units. Changes to other types of units, services, or components may result in different types and magnitudes of costs and different factors and characteristics that affect the resulting non-recurring costs. For example, changes to Army Reserve Force units may result in much lower costs because of the substantially different environment and characteristics of Army units as compared with Air Force and Navy units. Army units are labor intensive (the Army is often said to "equip the man"), whereas Air Force and Navy units are capital intensive ("man the equipment"). Army equipment typically requires few facilities, often being positioned in large, outdoor motor pools. Also, there are usually very modest support equipment requirements for Army equipment, although this is changing as the Army acquires new, "high-tech" systems such as the M-1 tank, Patriot missile, and Blackhawk and Apache helicopters. Finally, Army skill requirements are often less than the Air Force and Navy requirements because of fewer avionics systems. Even aircrew training costs for Army helicopters are significantly less than aircrew training costs for the fighters and transport aircraft of the Navy and Air Force.

The magnitude of the non-recurring costs and the inferences drawn from the case study analyses should not be generalized across all services, components, and types of units. Each change must be evaluated independently to reliably measure the associated costs.

In summary, the case study results suggest that the non-recurring costs associated with Reserve component unit changes are unique to each change and not easily predictable on a general basis. There are ways in which the non-recurring costs can be reduced, such as by collocation with other, similarly equipped units, but each change and basing location must be thoroughly examined to understand the constraints and costs involved.

V. CONCLUSIONS

The first step in estimating the costs associated with implementing a change to the Reserve Force structure is to define the boundaries or scope of the decision being addressed. At one level, there are costs directly associated with the specific unit undergoing the change. These primary unit costs include the initial non-recurring expenditures for new facilities and support equipment and for the acquisition, training, or retraining of unit personnel. Primary unit cost effects also include the change in annual operating and support costs resulting from the creation of the new unit or changes to an existing unit.

The total cost effects of a change to the Reserve Force structure often go beyond the direct costs associated with the specific unit undergoing the change. Secondary, or force-wide, costs result either from unit changes rippling through the Reserve Force structure or from changes to the operational requirements of other units in the total force structure.[1]

The costs resulting from changes to Reserve Force units are highly variable and depend greatly on the circumstances surrounding the change. The remainder of this section summarizes the factors that affect the costs due to force changes.

CONTEXT OF CHANGES

The costs resulting from changes to the Reserve Force structure are dependent not only on the type of change but also on the context of the change in terms of the total force structure. We can categorize the types of change into those decisions that affect the number of Reserve component units and those that affect an existing Reserve component unit. These changes to the Reserve components can be implemented without changing the structure of the Active Force or made in concert with a change to an Active unit. We, therefore, define four general categories of force change:

1. Change the number of Reserve Force units; Active Force is unchanged.

[1]It should be noted that the rippling of changes through the force structure results not only in increased costs but also in increased operational capability as older, obsolete weapon systems are replaced by more modern and capable equipment.

2. Change the number of Reserve Force units; Active Force changes.
3. Change existing Reserve Force unit; Active Force is unchanged.
4. Change existing Reserve Force unit; Active Force changes.

We could further classify each of the above four categories by the type of change (equipment modernization, unit equipment augmentation, or mission enhancement) and by whether the Active change involves a unit activation or deactivation or a change to an existing Active unit.

Below we discuss the general effects on the costs associated with Reserve Force changes that fall into each of the above four categories. Because changing the number of units in the Reserve Force structure usually involves the activation of a new Reserve unit, and because the cost effects of Reserve unit deactivations are usually minimal (amounting to personnel termination costs offset by a decrease in the total annual recurring budget), we will discuss changing the number of Reserve component units only in terms of unit activations.

Activating a Reserve Force unit without changing the Active Force. Changes rarely occur in this category. Typically, an increase in the number of Reserve Force units is accomplished in conjunction with changing an Active unit or with a general overall growth in the total force (the next category to be discussed).

Non-recurring costs of changes in this category are typically large in comparison with the cost of the other categories because existing facilities and equipment are usually not available. Also, the full complement of unit personnel must be recruited and trained. By the same token, the annual recurring budget increases by the total annual operating and support cost of the new unit. Secondary costs are usually absent because the peacetime operational missions of the Active Force are not perturbed. Secondary effects may actually result in a reduced operational workload for existing units because of the increase in capability provided by the new Reserve Force unit.

Activating a Reserve Force unit in conjunction with a change to the Active Force. A current example of this category of change is the frigate program in the Naval Reserve. As the Active Navy is growing with the procurement of new ships, Active Force FF1052 and FFG7 frigates are being used to establish new units in the Surface Reserve Force.

The non-recurring costs of this category of change could again be fairly large because facilities might have to be constructed and personnel must be recruited and trained. As an example, most of the new

frigate units in the Naval Reserve required significant construction projects. Support equipment procurement costs can be reduced if the Reserve Force unit is created around a weapon system that is being phased out of the Active inventory because of modernization. The availability of the weapon system may also indicate the availability of excess support equipment from the Active inventory. Note, however, that the diseconomies of dispersed Reserve Force basing may lead to higher support equipment requirements than those of consolidated Active unit basing modes.

The non-recurring costs associated with a Reserve Force unit activation in conjunction with an Active unit deactivation can be reduced if a "transfer-in-place" is performed. Such a change would basically involve only switching unit personnel. The availability of Reserve Force personnel in the proximity of the Active basing locations is necessary for such a unit switch.

The total annual Reserve Force operating budget will increase because of the new unit activation. However, this increase may be more than offset by a decrease in the annual Active budget if an Active unit is deactivated and there is a corresponding reduction in Active personnel strength. In this case, the total annual force budget might be reduced while maintaining the total force size because of the lower annual costs associated with the Reserve Force unit.

Secondary cost effects potentially exist within this category when an Active unit is deactivated. If the new Reserve Force unit can not assume the full peacetime requirements of the Active unit it replaces, then the remaining Active units may experience an increase in operational requirements. Active personnel training patterns may also be affected by the loss of a unit resulting in increased strain on other units in the Active Force structure.

Change an existing Reserve Force unit without changing the Active Force structure. Changes that fall in this category are rare because changes to an existing Reserve Force unit are usually triggered by a change in the Active Force. The F-14 case in the Navy is an example that falls into this category. The modernization of Air Reserve Force units with F-16, A-10, or F-15 aircraft also may be considered in this category because the new aircraft are from production and not Active inventories.

Non-recurring costs for changing an existing Reserve Force unit are lower than the non-recurring costs associated with activating a new Reserve Force unit because the existing unit can provide facilities, common equipment, and personnel. The costs are higher for those changes that involve a large difference in requirements between the "old" and "new" Reserve unit. For example, converting an observation

(O-2) unit to a large transport aircraft (C-5) unit will require more new facilities, equipment, and personnel than modernizing a fighter unit with a new fighter aircraft. The F-14 case study in the Navy is an example of the low costs associated with the modernization of unit equipment with the same general type of aircraft.

Annual recurring cost effects of changes in this category follow the same general pattern as non-recurring costs. If the unit change results in minimal differences in personnel strengths, equipment operating hours, and logistics support costs, then the annual operating budget will not be significantly affected. However, changes involving gross differences in requirement levels will result in greatly increased annual unit costs.

There are usually no secondary cost effects because the Active Force structure remains unchanged.

Changing an existing Reserve Force unit in conjunction with a change in the Active Force. Most of the changes to existing Reserve Force units result from changes to Active units. Weapon modernization is a prime example. When an Active unit's equipment is replaced with a more modern weapon system, the replaced equipment is usually then used to modernize a Reserve component unit's more obsolete equipment. The A-7, C-5, and C-141 case studies are all examples of this category of change.

Non-recurring costs are usually minimal because the unit and support structure already exist. Some new construction and support equipment procurement may be required and some personnel may be recruited and trained or current personnel retrained. If support equipment is available from Active inventories, the non-recurring costs can be reduced even further.

As was the case in the previous category, equipment changes involving large differences in requirements will lead to higher non-recurring costs than changes involving only slight differences between the unit's old and new equipment. As an example, the non-recurring costs for the Air Force C-130 to C-5 modernization were significantly higher than the costs associated with the Naval Reserves' A-7B to A-7E modernization.

The annual recurring cost effects for the specific unit being changed represent the difference between the annual costs of the old and new unit. Again, changes involving large differences in unit personnel strengths, equipment operating levels, and logistics cost factors result in larger increased annual operating and support costs.

Secondary cost effects are usually minimal, if present at all, unless the change to the Active Force involves a unit deactivation. In such a case, the Reserve Force unit must be able to assume the peacetime

mission of the Active unit it replaces or the other Active units will experience increased operational requirements. The C-141 case study is an example where secondary cost effects may be present (see Ref. 6).

The preceding qualitative discussion of the costs associated with different categories of Reserve Force changes can be summarized as:

- New Reserve Force unit activations will usually result in greater costs than modifying existing Reserve Force units.
- Non-recurring costs can be reduced if support equipment is available from Active inventories.
- Costs associated with changing an existing Reserve Force unit increase as the difference in facility, support equipment, personnel, and operational requirements between the old and the new unit become larger.
- Secondary costs are most likely to occur when Active units are deactivated and the new Reserve component units can not fully assume the peacetime operational requirements of the Active unit.

ESTIMATING THE COSTS RESULTING FROM CHANGE

The ability to estimate the costs resulting from changes to the Reserve Force structure varies greatly across the cost elements. The non-recurring costs are driven by various requirements. Major weapon systems need specific types of facilities, support equipment, and personnel strengths and skill requirements. A certain portion of the requirements may be satisfied by existing unit facilities, equipment, and personnel, or may be available from existing Active inventories. The non-recurring costs, therefore, are a function of the difference between what is required and what is available. These differences can vary depending on the type of change and the specific basing location. One outcome of the case study analysis is that the costs of change are unique to each specific case and are difficult to predict.

Construction and support equipment costs are the most difficult non-recurring cost elements to estimate without detailed knowledge of requirements and availabilities at the basing location. Non-recurring personnel costs are easier to estimate because per capita acquisition and training cost factors can be developed and the number of personnel to be recruited and/or trained can be estimated from unit strength and skill requirements.

Annual recurring cost effects can be estimated using available operating and support cost models (see Refs. 1, 4, 10) and personnel and equipment factors. Cost estimates of the difference in annual

costs between an old and new unit configuration are simpler to develop than the total costs of a new unit activation because not all elements of cost need to be fully developed—only the changes, or "deltas," are of interest.

Secondary cost effects are more difficult to estimate because of the uncertainty of the effects on operational requirements and personnel flows. These indirect costs require more detailed examination on a force-wide basis and may involve subjective assumptions concerning the impact on the operational requirements of other force units. A force-wide model is almost a necessity for estimating the secondary cost effects due to change.

FUTURE COST RESEARCH

Policy decisions affecting the composition and structure of the Active and Reserve components must be supported by adequate economic and capability analyses. The analysis documented in this report and numerous other studies conducted in recent years have addressed various issues of Active and Reserve Force cost. These studies need to be tied together in order to summarize and formalize the preferred approaches to understanding the economic considerations of Active and Reserve Force units. The development of an Active and Reserve Force cost handbook, mentioned early in the document, should provide this needed integration.

A simple, easy to use, force-wide cost model would also facilitate the cost analyses supporting policy decisions. A total force model has been developed (Ref. 18), but it requires numerous inputs and a large mainframe computer. A scaled-down version of this total force cost model that runs with minimal input data on a microcomputer would provide a more useful tool for Active and Reserve cost analyses.

A personnel cost model that included Active, Reserve, National Guard, and civilian personnel costs would aid in understanding the economic implications of personnel-related decisions. Such a model should include not only the various costs of acquiring, training, retaining, and separating the various types of personnel, but also provide information on capability or productivity measures.

Appendix

CASE STUDY ANALYSES

NAVY CASE STUDIES

Data Sources

Most of the cost data for the Naval Air case studies were provided by the staff organizations of the Commander, Naval Air Reserve Forces, New Orleans. The Director, Aircraft Material (code 57), provided the construction, support equipment, and spare part costs and the Director, Flight Programs (code 51), provided information on the number of aircrew and maintenance personnel scheduled for training courses and on the class times for the various courses. The Director, Active Duty Billet Requirements and Authorizations (code 24), under the Commander, Naval Reserve components provided the numbers of full-time training and administration of Reserves (TARs) and part-time selected reservists (SelRes) in the various units.

Data for the Naval Reserve Surface Fleet case studies were provided by the Assistant Deputy for Training Systems, Naval Surface Reserve components (code 32), in New Orleans and the Surface Reserve Program Coordinator (NOP-03R) under the Deputy Chief of Naval Operations, Surface Warfare. The cost groups of the Director, Naval Reserve (NOP-09R), provided general cost data and information.

Personnel acquisition and training cost factors were updated from Refs. 4 and 11, and are shown in Tables A.1 and A.2. These factors were used for estimating the non-recurring acquisition and initial training costs of the new personnel for the frigate program. They also can be used for estimating the non-recurring acquisition and initial training costs for new personnel associated with changes to Naval Air Reserve units. The personnel skill training cost estimates for the F-14 and A-7 case studies were developed from the number of school courses and the appropriate aircrew retraining requirements (provided by Director, Flight Programs in New Orleans).

A-7E Modernization

New F/A-18s are being bought and introduced into Active Navy light attack squadrons, replacing the A-7E aircraft. As the A-7Es become available from the Active squadrons, they go to Reserve

squadrons, replacing the older model A-7Bs. The major decision affecting the Reserve forces is which units to modernize. It has been decided that the Reserve squadrons at Cecil (VA-203), Atlanta (VA-205), and New Orleans (VA-204) Naval Air Stations (NAS) will all eventually be modernized with A-7E aircraft. In the future, these squadrons may be further modernized with F/A-18 or A-6E/KA-LD to provide more fleet compatibility. The non-recurring costs associated with these squadron modernizations are displayed in Table A.3.

Table A.1

USNR AVERAGE PERSONNEL ACQUISITION COSTS
(FY1985 dollars)

Personnel Type	Acquisition	Initial Training	Total
Navy Reserve			
Officer:			
Pilot	42,190	923,100	965,290
Other crew	34,860	245,440	280,300
Non-rated aviation	39,860	30,410	70,270
Surface ship	50,500	30,410	80,910
Enlisted:			
Surface ship	10,860	8,580	19,440
Aviation	10,860	8,250	19,110

SOURCE: Reference 4, updated to FY1985 dollars using a factor of 1.086.

Table A.2

USNR NON-PRIOR SERVICE GAINS
(Estimated for FY1985)

Officer gains:	
Non-prior service	1,073
Total	5,141
Percent non-prior service	20.9
Enlisted gains:	
Non-prior service	11,000
Total	32,692
Percent non-prior service	33.6

SOURCE: Naval Reserve—Ref. 11, pp. 11, 12.

Construction

The A-7E has essentially the same airframe as the A-7B although the engine and some avionic systems are different. Because of the similarity between the two models of the same series of aircraft, most existing facilities are sufficient for the modernized squadrons. The only major construction required is for a new shop at NAS New Orleans. The commonality between the old and new squadron aircraft also helps reduce retraining requirements. Only short courses, without flight training hours, are required for the aircrew members and only the engine and some of the avionics maintenance personnel need retraining courses.

Equipment and Space Parts

Cecil Naval Air Station is an Active base and the home base for Active A-7E squadrons in the Atlantic Fleet. Cecil, therefore, has adequate intermediate-level repair facilities, test equipment, and spare parts to support the Reserve A-7E squadrons. The capabilities of Cecil plus the availability of some common test equipment and spares for the A-7B aircraft result in only a very small cost for some additional prepositioned, intermediate-level support equipment (less than one million dollars).

Atlanta and New Orleans are Reserve bases. Although some equipment and parts are available from the A-7B logistics resources, the introduction of a new series of aircraft results in the procurement of some A-7E engine intermediate-level support equipment and spare parts. The dispersed basing of the Reserve squadrons, necessary

Table A.3

A-7B TO A-7E NON-RECURRING COSTS
(Millions of FY1985 dollars)

	Cecil[a]	Atlanta	New Orleans
Construction	0.0	0.0	1.4
Support equipment	0.7	5.8	4.5
Spare parts	0.0	4.0	4.0
Personnel acquisition	0.0	0.0	0.0
Personnel training	0.6	0.6	0.6
Total	1.3	10.4	10.5

[a]One squadron of 12 aircraft at each base.

because of demographic constraints, results in diseconomies of scale for support equipment when compared with the consolidated basing of the Active squadrons.

Personnel Acquisition and Training

The Reserve squadron enlisted personnel requirements for the A-7B are 88 TARs and 169 SelRes, and for an A-7E squadron are 111 TARs and 147 SelRes. The majority of these enlisted personnel are in maintenance functions. Although the total personnel from the squadron manning documents (SQMDs) are essentially the same, there are 23 additional full-time TARs required for the A-7E squadrons. This is partly due to a higher direct maintenance man-hour per flight hour factor for the A-7E as compared with the A-7B, but also to the fact that the A-7B units were undermanned in terms of full-time personnel. Personnel in the old squadron will be carried over into the new squadron. The same number of personnel in the old and new squadron results in almost no personnel acquisition cost and no costs of transporting people from one site to another.

As mentioned, retraining requirements are minimized because of the similarities between the A-7B and A-7E and the fact that approximately 90 percent of all transitioning pilots have had extensive fleet experience in the A-7E. The number of personnel scheduled for courses include:

83 full-time maintenance personnel
115 part-time maintenance personnel
3 full-time pilots
16 part-time pilots

The pilots receive minor, on-the-job training by the Fleet Replacement Squadrons (assume no cost involved) and each maintenance person requires one training course in A-7E systems. Personnel training costs are estimated as: (83 + 115)(12)(248) = $589,248.

F-14 Modernization

The Naval Air Reserve components are scheduled to receive 49 F-14A aircraft from the existing Active inventory. These aircraft will replace the F-4S aircraft[1] in four Reserve squadrons—two squadrons at Miramar Naval Air Station (VF 301/302) and two squadrons at Dallas

[1]The Naval Reserve F-4S aircraft will transfer to Marine Reserve squadrons to replace older aircraft.

Naval Air Station (VF 201/202). Initially, Oceana and Dallas NASs were compared as possible basing locations for the Reserve squadrons, and the cost data for this case study reflects that comparison. Table A.4 displays the non-recurring costs of the F-4 to F-14 squadron modernizations at Oceana and Dallas.

Construction

Oceana NAS is an Active base and the home for all Active F-14s in the Atlantic Fleet. Since there are no Reserve F-4 squadrons at Oceana (the current Reserve F-4 squadrons are at Miramar and Dallas), the Reserve F-14s would represent additional aircraft on the base. Dallas NAS is a Reserve base and the home for two Reserve F-4 squadrons. Therefore, the introduction of the F-14s at Dallas would not increase the base load of aircraft.

The increased aircraft at Oceana result in a requirement for additional hangars, ramp spaces, and squadron organizational facilities. A significant amount of construction money is needed. Construction requirements at NAS Dallas involve an addition to the intermediate maintenance facility.

Table A.4

F-4S TO F-14A NON-RECURRING COSTS
(Millions of FY1985 dollars)

	Oceana[a]	Dallas
Construction	19.0	3.2
Support equipment	1.5	18.0
Spare parts	8.0	11.8
Personnel acquisition[b]	2.7	0.0
Personnel training	3.0	3.0
Total	34.2	36.0

[a]Two squadrons of 12 aircraft each at both bases.

[b]Includes a Permanent Change of Station cost of 0.9 million dollars for the transfer of full-time TARs to Oceana.

Equipment and Spare Parts

The additional F-14s at Oceana require higher levels of spare parts, although they also enjoy the benefits of economies of scale. As the home base for Active F-14s, Oceana has adequate intermediate-level equipment to support the Reserve F-14s. Only minor buys of prepositioned support equipment are needed. The collocation of the Reserve unit with the Active units at Oceana helps reduce the support equipment and spare part requirements.

Dallas has no F-14 aircraft on the base, so the modernization of the Reserve F-4 squadrons requires almost a complete package of initial F-14 spare parts and intermediate-level support equipment. In contrast to Oceana, the dispersed basing of Reserve squadrons does not benefit from potential economies of scale.

Personnel Acquisition and Training

The Reserve enlisted strengths for an F-4S squadron include 95 TARs and 141 SelRes; the F-14 unit strength includes 125 TARs and 138 SelRes. Most of the enlisted personnel are in maintenance functions. The Oceana unit, being new at the base, would require the acquisition of most of the SelRes personnel. Some Reservists would transfer from other Reserve units at Oceana and the full-time TARs would either be transferred from the deactivated F-4 unit at Dallas or be recruited from the Oceana area. All SelRes aircrew are prior service, resulting in no acquisition cost for the F-14 aircrew members. The existing F-4 unit at Dallas would provide the majority of the requirements for the F-14 unit, resulting in only minor personnel acquisition costs.

The acquisition cost for the enlisted personnel at Oceana equals the number of squadrons (2) times the SelRes enlisted strength per squadron (138) times the non-prior service percentage (.336) times the per capita enlisted acquisition cost. The resulting personnel acquisition cost estimate is 1.77 million dollars. Permanent Change of Station costs of 0.9 million dollars are added to this figure for the transfer of TAR personnel to Oceana from other Reserve locations.

The introduction of the F-14 means the aircrew and maintenance personnel must be retrained. Each F-14 squadron has 14 SelRes pilots and 2 TAR pilots plus 13 SelRes flight officers and 3 TAR flight officers. The TAR aircrew members receive a six- to seven-month full Category II syllabus in the F-14.[2] The SelRes aircrew members receive

[2]A prior service TAR pilot with experience in the F-14 would receive a four- to six-week refresher course.

a condensed two-week Category IV course that includes 10 flight hours. The TARs are expected to provide additional instruction to the SelRes aircrew at the completion of their longer curriculum.

In the two squadrons, 282 enlisted maintenance personnel will take a total of 477 courses. Certain individuals will receive a quality control or corrosion course in addition to their basic maintenance course. Other maintenance skills for the F-14 will require more than one course. Some of the courses are two-weeks long, whereas others are six-weeks long (primarily for the full-time TARs).

The cost of retraining the maintenance personnel is estimated as the product of the number of courses (477), the average course length (12 days), and cost per day ($248).[3] The result is 1.42 million dollars for both Dallas and Oceana. The SelRes aircrew training cost is estimated as the product of the number of SelRes aircrew (54), the average course length (12 days), the cost per day ($248) plus the cost of 10 F-14 flying hours per two-person crew (at $3,056 per flying hour [12]). This equals 0.99 million dollars. The cost for the 10 TAR aircrew personnel is calculated on the same basis except the TARs receive a full six-month course (180 days). TAR aircrew training cost is estimated at .6 million dollars. The total training cost for 2 F-14 squadrons is, therefore, 3.00 million dollars.[4]

Reserve Frigate Program

Responding to a Congressional directive, the Navy will transfer 26 FF1052 and FFG7 class frigates to the Naval Reserve components. Although a few of the frigates will replace older, FRAM-type destroyers, the frigate program represents new unit activations and, therefore, a growth in the Naval Surface Reserve fleet. The frigates have home ports in a number of locations; the introduction of FF1052s at New York and San Francisco and FFG7s at Puget Sound and Long Beach is examined in the case study analyses. Table A.5 displays the nonrecurring costs associated with these four locations.

Construction and Support Equipment

Each home port must have suitable pier space and utility provisions, in addition to SIMAs. The SIMAs provide support to all ships, Active and Reserve. Naval Reserve Force ships, however, rely heavily on

[3]Cost per day for the course is assumed equal to costs for similar Air Force courses. See Air Force case studies.

[4](477)(12)(248) + (54)(12)(248) + (27)(10)(3,056) + (10)(180)(248) + (5)(10)(3,056).

Table A.5

RESERVE FRIGATE PROGRAM NON-RECURRING COSTS
(Millions of FY1985 dollars)

Location	San Francisco	New York	Long Beach	Puget Sound
Type (number of ships)	FF1052(4)	FF1052(2)	FFG7(6)	FFG7(2)
Non-recurring costs				
Construction:				
Pier	29.2	23.3	0	53.0
SIMA	11.9	7.9	11.2	15.0
SIMA support equipment	6.9	(a)	(a)	(a)
Personnel acquisition	6.4	3.2	6.2	2.1
Personnel training	3.6	1.8	13.0	4.3
Total	58.0	36.2[b]	30.4[b]	74.4[b]

[a]Not available.
[b]Does not include cost of Ship Intermediate Maintenance Activity (SIMA) support equipment.

SIMAs to accomplish a portion of the organizational level maintenance that can not be performed by the reduced ship's complement.

Long Beach is a large Active facility and the home port to numerous ships in the Pacific Fleet. As such, pier space and utilities are available. The Long Beach SIMA does require modification and improvement. San Francisco, New York, and Puget Sound lack suitable facilities and require major construction projects. In addition to construction, the SIMAs may require new support equipment procurements. The cost of this equipment may be quite large, as the almost 7 million dollar buy for San Francisco indicates. Comparable SIMA equipment costs for Long Beach, New York, and Puget Sound were not available.[5]

Personnel Acquisition and Training

Crew compositions for the Reserve FF1052 and FFG7 ships are shown in Table A.6. In addition, approximately 100 full-time SIMA personnel are required on each ship. When the frigates transfer from Active to Naval Reserve Force status, part of the Active crew is

[5]The construction and SIMA equipment cost estimates were provided by the Surface Reserve Program Coordinator (OP-30R) under the Deputy Chief of Naval Operations, Surface Warfare.

replaced by either full-time TARs or part-time Selected Reservists. A portion of the Active crew remains with the ship and becomes part of the NRF ship crew composition. These Active personnel do not, therefore, incur any acquisition or training costs.

The acquisition and training of the SelRes portion of the crew begins two years before the ship is scheduled to transfer to the Naval Reserve Force fleet. This lead time allows the Reserve crew to prepare for the new ship so that when the ship is transferred, the Reserve components can maintain operational capability.

We assume that all TAR and non-prior service SelRes personnel must be recruited and trained. The factors provided in Tables A.1 and A.2 are used to estimate the acquisition cost of the SelRes officers and enlisted personnel. Since TARs are mostly prior service, their initial training cost has already been incurred. A recruiting cost of $3,219 per TAR is suggested by data supplied by OP-03R. (The 100 SIMA members per ship are added to the TAR figures in Table A.6.) The calculation of personnel acquisition cost per ship is:

FFG7: (100 + 95)(3,219) + (7)(.209)(80,910)
+ (69)(.336)(19,440) = 1.04 million dollars per ship

FF1052: (100 + 87)(3,219) + (8)(.209)(80,910)
+ (131)(.336)(19,440) = 1.59 million dollars per ship

The Navy Training Plans (NTP) for each class of ship (Refs. 13 and 14) provided the number of courses and the course length for the various billets in the crew. The NTP is developed for Active ships and assumes all crew members must be trained. For Naval Reserve Force

Table A.6

RESERVE FRIGATE PERSONNEL STRENGTHS

Personnel Type	FF1052	FFG7
Officer		
Active USN	9	9
TAR	0	0
SelRes	8	7
Enlisted		
Active USN	74	73
TAR	87[a]	45[a]
SelRes	131	69
Total	309	203

[a]Plus 100 SIMA members.

ships, the NTP is modified to reflect the part-time availability of the SelRes crew members.

The total courses and class days for the FFG7 are displayed in Table A.7. We assume the USN crew members have been trained and, therefore, incur no additional cost. The training cost for the Reserve crew is estimated at $248 per day. All SelRes classes and days are included and, since TARs represent 38 percent of the full-time crew, 38 percent of the full-time enlisted training days are added to the SelRes totals.[6] The cost per ship for personnel training is, therefore, estimated as:

$$\text{FFG7: } [1{,}455 + 2{,}363 + (.38)(12{,}910)](248)$$
$$= 2.16 \text{ million dollars per ship}$$

The NTP for the FF1052 (Ref. 13) did not provide separate detail for full-time and part-time crew members. The total days are 2661 for officers and 4801 for enlisted. The SelRes officer requirements are estimated using the part-time/full-time officer ratio for the FFG7 from Table A.7 since the officer mix is essentially the same on the two classes of frigates. Since 43 percent of the total officer training days for the FFG7 are for SelRes personnel, it is assumed that the SelRes officer training requirement for the FF1052 equals 1,148 days. The enlisted training days for TARs and SelRes are more difficult to estimate because of the different enlisted crew composition on the FF1052 ships versus the FFG7s. Since almost 50 percent of the total enlisted training days for the FFG7 are allocated to TAR and SelRes personnel, it is assumed that half of the 4,801 enlisted days for the FF1052 are for TARs and SelRes. The training cost per FF1052 is, therefore, estimated as:

$$(1{,}148 + 2{,}400)(248) = 0.88 \text{ million dollars}$$

Table A.7

FFG7 SCHOOL TRAINING REQUIREMENTS

	Courses	Days
Officer		
Full-time	86	1,919
Part-time	62	1,455
Enlisted		
Full-time	229	12,910
Part-time	357	2,363

SOURCE: Reference 14.

[6]No information was available on the training cost of SIMA members; therefore, the training cost estimates may be understated.

AIR FORCE CASE STUDIES

Data Sources

The following paragraphs describe the estimating techniques and data sources for the non-recurring elements of costs.

Construction. The construction costs for the case studies were provided by the relevant Reserve and Guard programming offices responsible for facilities.[7] These shops provided both the major and minor construction budgets. The budgets include lists of facilities to be built, the appropriate years, and the estimated cost for each year. When necessary, we translated these costs into FY1985 dollars using standard military construction inflation indices.[8] All facilities not directly related to the unit were deleted from the budgets.

Equipment and spare parts. Information relating to support equipment and initial buy of spare parts came from several sources. The primary source was the most recent Program Decision Package for each case. However, these documents are often unclear as to the exact nature of the decision they describe. For further clarification and guidance we relied on the program element manager and the relevant Active Air Force office.[9] The cost takes account of any sharing or transfer of equipment into the Reserves; however, due to the nature of the decision process, this figure can change over time and is very difficult to track accurately. It also includes munitions buys.

In some cases, the costs of the procurement of the original weapon system may be included in the cost. This occurs when the equipment is obtained directly from the production line. In cases where the equipment is acquired from the Active Force, the procurement cost is considered sunk. Data on weapons procurement costs are from Ref. 10, Table 2-6.

Personnel acquisition. The numbers and types of people involved in each of the changes were received from each component's personnel

---

[7]USAFR construction costs were provided by the Office of the Air Force Reserve, Programs and Resources Division, Programs Branch, 4/26/85. ANG costs were provided by the National Guard Bureau, Director of Air National Guard, Engineering and Services Division, 7/30/85.

[8]Reference 10, Chap. 5.

[9]Program Decision Packages can be obtained from the program element officer. For the USAFR: Office of the Air Force Reserve, Programs and Resources Division, Programs Branch. For the ANG: The National Guard Bureau, Director of Air National Guard, Plans and Operations Division. Additional information can be received from: USAF, DCS Logistics and Engineering, Weapons Systems Program Division (or Aircraft System Division).

organization.[10] Information included both the personnel strength of the unit prior to the change and the authorized configuration of the new unit, including any additional base support personnel. The difference between the existing unit personnel requirement and the new unit personnel requirement is used as the acquisition requirement.

This acquisition requirement must be modified to account for only those personnel who will be acquired from the non-prior service pool of recruits. For the changes being considered, all aircrew members are assumed to be prior service personnel; therefore, they must be deleted from the requirement.

The acquisition requirement minus the aircrew is adjusted by a prior service factor. This factor is developed for officer and enlisted personnel using FY1986 personnel gains from the Budget Justifications (see Table A.8). Non-prior service gains are divided by the total gains minus reenlisted personnel to arrive at a non-prior service acquisition factor.

The cost of personnel acquisition is on an average cost basis for nonflight officer and enlisted (see Table A.9). Civilians have no acquisition costs. Military acquisition costs include recruiting, basic training, and initial skill acquisition. The factor covers all pay and allowances and some variable portion of training costs. The factors used are from Ref. 10, Tables 3-1 and 3-15, and pages 115 and 116.

Table A.8

NON-PRIOR SERVICE ACQUISITION RATES
(FY1986)

	USAFR		ANG	
	Officer	Enlisted	Officer	Enlisted
NPS gains	0	3,290	90	5,140
Reenlistment	0	12,550	0	18,074
Total gains	1,020	25,270	1,785	32,053
Minus reenlisted	1,020	12,720	1,785	13,979
NPS factor	—	.259	.050	.368

SOURCES: Reference 15, pp. 9, 10; Ref. 16, pp. 9, 10.

[10]AFR personnel numbers are from Office of the Air Force Reserve, Programs and Resources Division, Resources Branch, Manpower and Organization, 8/30/85. ANG numbers are from the National Guard Bureau, Director of Air National Guard, Air National Guard Support Center, Manpower and Organization Branch.

Where necessary, additional funds for special recruiters or for local advertising have been added. This may result in minor double counting. The costs are standard yearly pay and allowances for recruiters and the budgeted advertising costs from the relevant Program Decision Package.

Aircrew personnel training. As an estimation technique, we assume all aircrew members must receive cross-training in the new aircraft (the aircrew is all prior service so they have already received basic and UPT training). The cost per student of this training is taken from Ref. 10, Table 3-15, and is specific to the aircraft (see Table A.10). It includes only the training cost on a particular aircraft. The cost of UPT and UNT are included in the factors in Table A.9.

Non-aircrew personnel training. The training cost for other personnel is more difficult to estimate. First, most personnel in Reserve Force units cross-train or qualify for a particular skill by attending field training detachments (FTD) or through on-the-job training (OJT). The USAF has no standard costs associated with this type of training. Currently, only the pay and allowances of attendees are included in the cost. No cost estimates exist for the trainers, training

Table A.9

RESERVE PERSONNEL ACQUISITION COST FACTORS
(FY1985 dollars)

	Recruiting and Basic Training[a]	Initial Skill[a]	Total Acquisition Cost
Officer[b]			
Pilot	16,513	354,700	371,213
Other aircrew	16,513	63,600	80,113
Non-aircrew	16,513	9,188	25,701
Enlisted			
Aircrew	3,200	3,832	7,032
Non-aircrew	3,200	7,767	10,967

SOURCE: Reference 10, Tables 3-1 and 3-15, Fig. 7-1, and pp. 115–116.

[a]Initial skill for aircrew includes undergraduate pilot training (UPT) and undergraduate navigator training (UNT).

[b]Officer is average of ROTC and OTS.

Table A.10

AIRCREW TRAINING COST FACTORS

	C-5	C-141	F-16
Pilot[a]	196,400	111,000	1,215,200
Navigator[a]	0	31,500	0
Enlisted aircrew	3,832	3,832	3,832

SOURCE: Reference 10, Table 3-15, Fig. 7-1.

[a]Excluding UPT or UNT.

equipment, or training materials used on field training days or for on-the-job training. The number of days necessary for training varies by course.

Second, the number of people who attend school, FTD, or OJT training varies for each case; however, both the ANG and the AFR attempt to send all full-time maintenance technicians to some sort of training. Other members of the units are less likely to need training if a unit changes. In smaller unit changes, like the C-130 to C-141, this is usually feasible. For very large unit changes, like the C-130 to the C-5, it is usually not possible.

To estimate training cost for non-flight personnel, we assume that the reserves will attempt to have all the full-time maintenance personnel receive FTD or formal schooling. All other non-flight personnel receive OJT training, which has no out-of-pocket cost. Thus, the number of nonflight personnel receiving training equals the number of full-time maintenance reservists.

The cost per student of maintenance training is estimated by using the average costs per student of formal school maintenance courses as received from the Air Force Operations and Maintenance Training Branch, AF/UPPB. Data printouts, called Average Training Costs Per Graduate, show all costs associated with formal school training on a per student week basis. The per student week basis was divided by five to obtain a per student day base. The maintenance courses were drawn from a random sample of relevant courses taught in FY1984; their cost averages $248 per student day in FY1985 dollars.

There is a drawback to this approach. It makes no distinction between FTD and formal schools. It assumes the cost of both are the same. Yet, the cost of FTD may be lower than the cost of formal school. However, at this time no data on FTD costs exist. As more data become available, this factor should be updated.

The average length in days of a course was taken from AFR 50-5 and is specific to each type of aircraft (see Table A.11). No weighting was used for the number of people attending each course because these data are not available.

The estimating equation for nonflight personnel training cost is: (number of full-time maintenance personnel) times (average cost per graduate per day) times (the average number of days per course for type of aircraft).

Special training days. In addition to individual training, the unit as a whole may be allotted extra unit training days to exercise equipment and bring the unit to mission-ready status. The average number of days used and the average cost per day for unit conversion training days can be found in the Budget Justifications (see Table A.12). Each part-time person in the unit is charged on an average basis for these days for one year.

Table A.11

DAYS FOR MAINTENANCE TRAINING COURSES

	Average Days/Course
C-5	17
C-141	14
F-16	15

SOURCE: AFR 50-5, Chap. 6.

Table A.12

UNIT CONVERSION TRAINING DAYS
(Per part-time person, FY1985 dollars)

	USAFR		ANG	
	Officer	Enlisted	Officer	Enlisted
Cost per day ($)	163	85	145	67
Number of days per year	2.6	3.0	6.8	7.0

SOURCES: Reference 15, p. 71; Ref. 16, p. 72.

C-5A Transfer

As the Active Air Force begins to acquire C-5Bs off the production line, C-5As will be transferred from the Active into USAFR and ANG units. Since the USAFR and ANG are not scheduled to grow in number of units, the C-5As will be replacing existing equipment in the Reserve Force.

In some cases, the old aircraft will not be retired, but rather will be used to augment the total number of aircraft in other units. Several existing C-130 units will grow from 8 PAA to 16 PAA. In other cases, the old aircraft may be retired or used in existing training squadrons. Thus, the C-5A switch to the Reserves represents a growth in the total number of aircraft available to the Reserves while keeping the number of units constant. The C-5s also require more maintenance manpower per aircraft than the aircraft they are replacing. Thus, manpower requirements will grow substantially because of this change.

We have chosen to study two examples of the C-5A move into the Reserves: the beddown of 16 C-5As at Kelly AFB in a USAFR unit and the beddown of 8 at Stewart Airfield[11] in a New York ANG unit.

The USAFR 433 Military Airlift Wing (MAW) at Kelly AFB will receive 16 C-5As to replace their C-130Bs. The 16 C-130s will be moved to two AFBs: Peterson and March. The first of the C-5As was scheduled to arrive in FY1985; the last should arrive by FY1989.

The ANG 105th Military Airlift Group (MAG) will receive 8 C-5As, which will replace old O-2s. The ANG 105th MAG unit had been located in White Plains, N.Y. This airfield was small and could not support large aircraft or unit expansions. The state of New York wished to take the airfield back from the National Guard and offered a large field near New Paltz as a replacement. The new field, Stewart, is big enough to enable larger aircraft beddown and unit expansion. The acquisition of this new location enabled the ANG to retire the old O-2s and replace them with C-5As. Stewart Airfield will hold the ANG units and some Marine Corps units. The C-5s began arriving in July FY1985 and will build to an 8-PAA unit by FY1988.[12]

Construction. Kelly AFB is a major airfield operated by the Logistics Command with Active, Reserve, and Guard Air Force units all collocated. In addition, it is the depot or air logistics center for the C-5s. As such, the base already had excellent facilities to support most types of units before the decision to bed down the Reserve C-5 unit. Because of these extensive facilities, including space for handling the large C-5s,

[11]The original 8 aircraft have since been increased to 12. The figures contained in this appendix are based on the original figure of 8 aircraft.

[12]The unit may expand to 12 aircraft later.

only moderate construction was necessary for the C-5A unit. The only major construction required two apron/hydrant fueling systems, a hangar, and a fuel cell shop. In addition, a jet engine maintenance facility is being built at Kelly to handle the entire C-5A engine maintenance needs of both the USAFR and ANG. Because it provides force-wide support, it has been excluded from the construction cost of the Kelly unit.

The beddown of C-5s at Stewart requires a greater amount of construction because few facilities existed at the site. Construction, which was begun in FY1985, will be accomplished in two phases and take until FY1987. Construction at the field will not include such items as mess halls or barracks, as these are not part of the National Guard base package.

Equipment and spares. The C-5A aircraft are coming from several Active units, preventing the drawdown of Active support equipment into the Reserves. In addition, both the USAFR and the ANG units are independent and require full complements of equipment. Thus, little sharing is possible. The additional costs of the jet engine maintenance facility at Kelly AFB have been deleted from the unit costs. The difference in support equipment cost between the Kelly and Stewart units is due to their differing numbers of aircraft.

Personnel acquisition. For both cases, the population pool surrounding the bases and the pool of recruits are considered to be adequate to produce the number of recruits needed without special recruiting efforts. In both cases, the policy of the Reserves is to use only prior service aircrews. Thus, there are no acquisition costs associated with the aircrew. Tables A.13 and A.14 show the old and new unit personnel strengths for Kelly and Stewart C-5A units. At Kelly, an additional 11 civilians will be added to base support and 53 full-time reservists to the military security police. For Stewart, the move from White Plains to Stewart is within a 75 mile radius within which the ANG does not have to pay for moving costs of personnel; thus there are no additional transportation costs.

Personnel training. Each aircrew member must receive cross-training on the C-5A. In addition, we assume full-time maintenance technicians will attend courses within one year.

The non-recurring costs associated with the introduction of the C-5s into the Air Reserve components are shown in Table A.15.

Table A.13

C-5As, AFR 433 MAW, KELLY AFB
(Personnel strength)

	C-130B (16 PAA)				C-5A (16 PAA)			
	Drill		Full-Time		Drill		Full-Time	
	Officer	Enlisted	Technician	Civilian	Officer	Enlisted	Technician	Civilian
Crew	72	48	23	0	128	288	42	0
Pilot	48	0	5	0	128	0	13	0
Navigator	24	0	0	0	0	0	0	0
Flight engineer	0	24	9	0	0	128	13	0
Loadmaster	0	24	9	0	0	160	16	0
Maintenance	7	349	168	5	25	1248	740	10
Other	74	287	24	18	86	496	49	29
Total	153	684	215	23	239	2024	831	39

NOTE: The aircraft figures, and resulting cost estimates, are based on the original C-5A crew ratio of 4.0. This ratio has recently been reduced to 2.0.

Table A.14

C-5, ANG 105 MAG, STEWART AIRFIELD
(Personnel strength)

	0-2A (18 PAA)				C-5A (8 PAA)			
	Drill		Full-Time		Drill		Full-Time	
	Officer	Enlisted	Technician	Civilian	Officer	Enlisted	Technician	Civilian
Crew	27	0	11	0	64	144	27	0
Pilot	27	0	4	0	64	0	7	0
Navigator	0	0	0	0	0	0	0	0
Flight engineer	0	0	3	0	0	64	10	0
Loadmaster	0	0	4	0	0	80	10	0
Maintenance	5	148	86	0	7	635	377	0
Other	43	464	118	0	77	629	230	0
Total	75	612	214	0	148	1408	634	0

NOTE: The aircraft figures, and resulting cost estimates, are based on the original C-5A crew ratio of 4.0. This ratio has recently been reduced to 2.0.

Table A.15

C-5A NON-RECURRING COSTS
(Millions of FY1986 dollars)

	Kelly AFB	Stewart Field
Construction	55.5	91.8
Equipment	16.2	17.3
Personnel acquisition	3.1	2.7
Personnel training	30.0	15.5
Total	106.8	127.3

C-141 TRANSFER

In the future, the Air Reserve components will be acquiring C-141s from the Active inventory. The first C-141s will be coming from several different units in the Active over a period of several years. Spreading the initial Active drawdown over several units precludes the transfer of support equipment or parts with the aircraft. Some of the C-130s in Reserve Force units receiving the C-141s will be transferred to other units for augmentation.

The two cases we chose to study are the C-141 move into a USAFR unit at Andrews AFB and the C-141 move into the ANG at Jackson, Mississippi.

The USAFR 459th Tactical Airlift Wing (TAW), an 8-PAA C-130E unit at Andrews AFB, will transfer its aircraft to an existing 8-PAA C-130A unit at Minneapolis/St. Paul. The 459th TAW at Andrews will receive C-141 aircraft from the Active Force. The conversion begins with two PAA in FY1986 and finishes in FY1987 with eight PAA.

The ANG 172nd Tactical Airlift Group (TAG) will be receiving eight C-141s. They will be replacing eight C-130Hs, which will be transferred to another unit.

Construction costs. Andrews is a Military Airlift Command operated base with collocated Active and Reserve units. Because Andrews AFB is large, few facilities will be required for the USAFR conversion to C-141s. The major expense will be the modification of C-130 aircraft maintenance hangar. Construction began in FY1986 and will end in FY1987.

Jackson is an ANG base. The construction at Jackson will be more extensive than at Andrews, because of Jackson's fewer facilities. The major expense will be to add an aircraft parking ramp, jet fuel storage

facilities, and a hangar. Construction began in FY1985 and will end in FY1988.

Equipment and parts. Both units operate independently; there will be very little sharing of equipment or parts. Support equipment from the Active inventory will not be transferred.

Personnel acquisition. The Reserves will use only prior service aircrews for these two units. Thus, there are no acquisition costs. Tables A.16 and A.17 show the old and new unit personnel strengths for Andrews and Jackson.

Table A.16

C-141, AFR 459 TAW, ANDREWS AFB
(Personnel strength)

	C-130E (8 PAA)				C-141 (8 PAA)			
	Drill		Full-Time		Drill		Full-Time	
	Officer	Enlisted	Technician	Civilian	Officer	Enlisted	Technician	Civilian
Crew	48	32	16	0	64	112	19	0
Pilot	32	0	3	0	64	0	7	0
Navigator	16	0	2	0	0	0	0	0
Flight engineer	0	16	8	0	0	64	6	0
Loadmaster	0	16	3	0	0	48	6	0
Maintenance	4	171	87	4	8	386	165	4
Other	66	253	19	14	77	302	51	14
Total	118	456	122	18	149	800	235	18

At Jackson Airfield, as shown in Table A.17, the difference between the old and new unit is an additional 26 officers and 223 enlisted. Of this, the aircrew accounts for an additional 28 officers and 48 enlisted.

Personnel training. All aircrew members will receive cross-training and all full-time maintenance personnel will receive training.

The non-recurring costs for the C-141 modernizations are displayed in Table A.18.

Table A.17

C-141, ANG 172 TAG, JACKSON AIRFIELD
(Personnel strength)

	C-130H (8 PAA)				C-141 (8 PAA)			
	Drill		Full-Time		Drill		Full-Time	
	Officer	Enlisted	Technician	Civilian	Officer	Enlisted	Technician	Civilian
Crew	48	32	20	0	72	80	24	0
Pilot	32	0	6	0	64	0	6	0
Navigator	16	0	2	0	8	0	2	0
Flight engineer	0	16	7	0	0	32	8	0
Loadmaster	0	16	5	0	0	48	8	0
Maintenance	4	176	115	0	6	345	155	0
Other	98	517	120	0	98	523	127	0
Total	150	725	255	0	176	948	306	0

Table A.18

C-141 NON-RECURRING COSTS
(Millions of FY1986 dollars)

	Andrews AFB	Jackson Field
Construction	6.9	18.3
Equipment	12.0	12.0
Personnel acquisition	0.8	0.7
Personnel training	8.4	8.8
Total	28.1	39.8

F-16 MODERNIZATION

Per Congressional direction, new F-16s will be introduced into the Reserve Forces. Both F-16Cs and Ds will be entering the Reserves from the production line. As these are new aircraft, no equipment transfer is possible.

We chose to study two cases: the F-16 move into an existing USAFR unit at Luke AFB and the F-16 move into an existing ANG unit at Kelly AFB.

Luke AFB is operated by the Tactical Air Command and is their main fighter training base. As such, it has extensive facilities and a large pool of personnel. It is, however, somewhat isolated. The AFR 302nd Special Operations Squadron (SOS) is located there with six CH/HH-3E helicopters. The helicopters will be sent to Portland, Oregon to create a composite rescue and recovery unit. The new Luke unit will receive 12 F-16s in FY1987 and grow to 24 by FY1988.

The ANG 149th Tactical Fighter Group (TFG) at Kelly AFB will receive 24 F-16s in FY1986, replacing 18 F-4C aircraft.

Construction costs. The construction costs at Luke are significant, although not great, because of the change to a completely different type of aircraft. Originally, the unit was scheduled to change to F-4s and construction for this change began in FY1983. This construction was easily adapted for F-16 use. The F-16 construction will end by FY1988. The F-16 construction cost shown in Table A.18 includes that begun for the F-4 change since it was necessary for the F-16. Major construction items include a maintenance facility, a squadron operations facility, and a hangar/shop.

The existing facilities at Kelly make this an excellent location for the F-16 beddown. The new unit will require almost no additional facilities. The major cost will be for a training simulator facility. Construction began in FY1985 and will end in FY1987.

Equipment and parts. The F-16 units are independent; no equipment will be transferred or shared. The cost includes the ammunitions buy. The buy of the weapons system, if included, is 12.6 million dollars per aircraft.[13]

Personnel acquisition. The policy of the Reserves is for all aircrews to be prior service members, which limits the acquisition cost to transition training. Tables A.19 and A.20 show the old and new unit personnel strengths for Luke and Kelly. Because of the remote location of Luke AFB and the newness of the aircraft to all services, additional recruiting efforts are required. The base is scheduled to receive five enlisted recruiters and one clerk to support the recruiting drive for the

[13]Reference 10, Table 2-6.

Table A.19

F-16, AFR 149 TAG, LUKE AFB
(Personnel strength)

	CH3/HH3 (6 PAA)				F-16 (24 PAA)			
	Drill		Full-Time		Drill		Full-Time	
	Officer	Enlisted	Technician	Civilian	Officer	Enlisted	Technician	Civilian
Crew	20	18	10	0	46	0	3	0
Pilot	20	0	3	0	46	0	3	0
Navigator	0	0	0	0	0	0	0	0
Flight engineer	0	18	7	0	0	0	0	0
Maintenance	2	61	30	3	10	560	194	8
Other	5	38	8	7	43	234	38	22
Total	27	117	48	10	99	794	235	30

Table A.20

F-16, ANG 149 TFG, KELLY AFB
(Personnel strength)

	F-4C (18 PAA)				F-16 (24 PAA)			
	Drill		Full-Time		Drill		Full-Time	
	Officer	Enlisted	Technician	Civilian	Officer	Enlisted	Technician	Civilian
Crew	46	0	8	0	30	0	5	0
Pilot	23	0	5	0	30	0	5	0
Weapon systems officer	23	0	3	0	0	0	0	0
Flight engineer	0	0	0	0	0	0	0	0
Maintenance	8	369	196	0	9	562	170	0
Other	73	471	126	0	71	470	129	0
Total	127	840	328	0	110	1032	304	0

AFR F-16 unit. In addition, $50,000 in advertising will be spent. These requirements will be incurred annually for four years at a cost of 1.076 million dollars.

Personnel training. All aircrew personnel will require cross-training and all full-time maintenance personnel will require training

The non-recurring costs for the introduction of the F-16s are shown in Table A.21.

Table A.21

F-16 NON-RECURRING COSTS
(Millions of FY1985 dollars)

	Luke AFB	Kelly AFB
Construction	16.0	2.1
Equipment	18.0	18.0
Personnel acquisition	4.2	0.8
Personnel training	56.9	37.7
Total	95.1	58.6

REFERENCES

1. Department of the Navy, *A Report to the Congress on the Navy's Total Force*, February 1984.
2. Kostiuk, Peter, *Cost Analysis of Selected Units in the Marine Corps Active and Reserve Components*, Center for Naval Analyses, CRC-519, January 1984.
3. Reserve Forces Policy Board, *Active/Reserve Force Mix Report*, Office of the Secretary of Defense, December 1984.
4. Schank, J., S. Bodilly, and R. Pei, *Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology*, The RAND Corporation, R-3210-RA, March 1986.
5. Schank, J., S. Bodilly, and R. Pei, *Unit Cost Analysis: Executive Briefing*, The RAND Corporation, R-3210/1-RA, March 1986.
6. Barbour, A. A., *Cost Implications of Transferring Strategic Airlift C-141s to the Air Reserve Forces*, The RAND Corporation, N-2252-AF, February 1985.
7. Department of the Air Force, *Standard Facility Requirements*, AFM 86-2, 1 March 1973.
8. Department of the Air Force, *Programming Civil Engineer Resources*, Vols. I and II, AFM 86-1, 7 May 1984.
9. Department of Defense, *Military Construction Cost Review Guide*, Office of the Deputy Assistant Secretary of Defense, Facilities, Environment and Economic Adjustment, DoD 4270.1-CG, July 1982.
10. Headquarters, United States Air Force, *USAF Cost and Planning Factors*, AFR 173-13, February 1984.
11. Department of the Navy, *Justification of Estimates for Fiscal Year 1985, Reserve Personnel*, February 1984.
12. Department of the Navy, *Justification of Estimates for Fiscal Year 1985, Operations and Maintenance, Navy Reserve*, February 1984.
13. Naval Sea Systems Command, *Training Plan for the NRF FF-1052 Class Frigate*, February 1985.
14. Chief of Naval Operations, *Navy Training Plan, Naval Reserve Force Guided Missile Frigate (FRG7 Class)*, S-30-7409E, undated.
15. Department of the Air Force, *Justification of Estimates for Fiscal Year 1986, Reserve Personnel, Air Force*, February 1985.
16. Department of the Air Force, *Justification of Estimates for Fiscal Year 1986, National Guard Personnel, Air Force*, February 1985.

17. Barbour, A. A., *Estimating the Cost of Relocating Military Bases*, The RAND Corporation, RM-5585-ISA, May 1969.
18. Barbour, A. A., and A. W. Bonner, *The Air Reserve Forces in the Total Force*, Appendix A, *Derivation of the FORCE Cost Model Data Base*, The RAND Corporation, R-1977/3-AF, September 1977.