AD-785 225

THE NUCLEAR-TRAINED PETTY OFFICER CONTINUATION BONUS: FIRST YEAR'S EXPERIENCE

Craig B. Foch

RAND Corporation

Prepared for:

Defense Advanced Research Projects Agency

August 1974

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER R-1519-ARPA	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER AD 785 225
4. TITLE (and Subtitle) The Nuclear-Trained Petty Officer Continuation Bonus: First Year's Experience		5. TYPE OF REPORT & PERIOD COVERED Interim
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Craig B. Foch		8. CONTRACT OR GRANT NUMBER(s) DAHC15-73-C-0181
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 Defense Advanced Research Projects Agency Department of Defense Arlington, Va. 22209		12. REPORT DATE August 1974
		13. NUMBER OF PAGES ~~100~~ 97
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)

Experience
Qualifications
Recruiting
Bonuses
Naval Personnel
Naval Training

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

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The response of the Navy's Nuclear-Trained Enlisted Force to a special continuation bonus, enacted by Congress in 1972 to forestall an expected shortage of supervisors. The Nuclear-Trained Petty Officer Continuation Bonus, payable to reenlistees with six to ten years' completed service, accumulates to more than $12,000 over the reenlistment term. The direct effect of this unique reenlistment incentive is analyzed here with data from the first four full quarters of bonus experience. Findings indicate that (1) the overall reenlistment rate for NTPOs with six to nine years' service has more than doubled between pre-bonus and bonus periods; (2) the reenlistment rate at six years shows the smallest improvement; (3) the NTPO-CB has been responsible for 862 additional man-years; (4) from FY1974 to FY1978, the bonus is projected to result in 900 additional reenlistments; and (5) total additional costs per additional man decline steadily over the projection period. 100 pp. (ETG)

ARPA ORDER NO.: 189-1
3D20 Human Resources

R-1519-ARPA
August 1974

The Nuclear-Trained Petty Officer Continuation Bonus: First Year's Experience

Craig B. Foch

A Report prepared for

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Rand
SANTA MONICA, CA. 90406

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Published by The Rand Corporation

PREFACE

This report was prepared as part of Rand's Department of Defense Training and Manpower Management Program, sponsored by the Human Resources Research Office of the Defense Advanced Research Projects Agency (ARPA). With manpower issues assuming an even greater importance in defense planning and budgeting, it is the purpose of this research program to develop broad strategies and specific solutions for dealing with present and future military manpower problems. This includes the development of methodologies for examining broad classes of manpower problems, as well as specific problem-oriented research. In addition to providing analysis of current and future manpower issues, it is hoped that this research program will contribute to a better general understanding of the manpower problems confronting the Department of Defense. It is within this frame of reference and with the cooperation of the Compensation Directorate, Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs), that this study was undertaken.

The report investigates the response of the Navy's Nuclear-Trained Enlisted Force (NTF) to a special continuation bonus, enacted by Congress in 1972 and first available in October of that year. This bonus, formally known as the Nuclear-Trained Petty Officer Continuation Bonus (NTPO-CB), is designed to augment the stock of supervisory-grade manpower and is payable to reenlistees with more than six but less than ten years of completed service. It amounts to approximately $12,000, paid in equal annual installments over the reenlistment term (usually four years).

One obvious measure of response to the bonus, the reenlistment rate, is explored in detail; of particular interest are large observed differences in the behavior of petty officers with six and with seven to nine years of service, respectively. This report is also concerned with other measures of response, such as the additional manpower attributable to the NTPO-CB, the costs of the bonus program, and the bonus cost per additional man-year generated. Since the NTPO-CB was instituted

to forestall an expected shortage of nuclear-trained supervisors, the most pertinent measures of response involve the implications of the bonus for the future. To this end an NTF simulation model has been developed and is used here to project manpower stocks and costs to the end of FY1978, under both bonus and no-bonus scenarios.

Part One, "Problem and Findings," is a nontechnical summary of the history of the NTF, current manpower management practices, the methodology employed to assess the effect of the continuation bonus, results, and major findings. Part Two, "Analysis and Data," is a detailed description of the methodology and results, covering not only those topics summarized in Part One, but also several comparably important but technical issues.

Because all of the results reported here are based on evidence from the first four full quarters of existence of the NTPO-CB (Jan. 1, 1973 to Dec. 31, 1973), they should be viewed as tentative and preliminary; they will require verification over time as experience with the bonus accumulates.

SUMMARY

Declining first-term reenlistment rates and expected large increases in the demand for experienced personnel came together in 1972 to render Nuclear-Trained Enlisted Force (NTF) retention an "immediate action required" problem area. The Navy appealed to Congress, and the Congress responded by authorizing a new pay category--the Nuclear-Trained Petty Officer Continuation Bonus (NTPO-CB). The effect of this unique reenlistment incentive on present and future NTF manpower levels is seen to have three elements: a direct effect on the reenlistment behavior of those eligible for the bonus; an anticipatory effect on the extension activity of men still in their first term; and a career effect on those past the term for which the NTPO-CB was paid.

The analysis reported here employs data from the first four full quarters of bonus experience and is therefore limited to its direct effect. Three sets of measures are presented, with the following analytical objectives: (1) Changes in year-specific and overall reenlistment rates, pre-bonus to bonus periods, are highly visible and useful summary statistics. (2) Additional man-years of obligated service and additional dollar commitments attributable to the NTPO-CB to date find their utility in the perspective of manpower planning and budgeting. (3) Projections of total NTF manpower levels and costs to FY1978, by directly addressing the motivation of the NTPO-CB, provide the best tests of its ultimate value.

The major findings are:

1. The overall reenlistment rate for NTPOs with six to nine years of service has more than doubled, from 15.1 percent to 34.7 percent, between pre-bonus and bonus periods and is expected to rise even higher in future years.
2. The reenlistment rate at six years shows the smallest improvement, and even this is probably transitory. The bonus *is* expected, however, to cause a future decline in the number of NTPOs becoming eligible for reenlistment at six years.

3. During its first four full quarters of existence, the NTPO-CB has been responsible for 862 additional man-years, at an average cost of $6413 (per additional man-year).
4. Over the period FY1974 to FY1978 as a whole, the bonus is conservatively projected to result in roughly 900 additional reenlistments, with the experienced cadre (those with six or more years of service) increasing from 2883 in FY1972 to 4466 in FY1978.
5. Total additional costs per additional man in the NTF decline steadily over the projection period, to $16,970 in FY1978; the bonus cost per additional man shows a similar decline, dropping to $4550 by FY1978.

ACKNOWLEDGMENTS

The dispatch with which this analysis was accomplished is due in large part to the competence and cooperation of the Compensation Directorate, Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs), which provided the reenlistment data on which the analysis is based. Special notes of thanks are due its director, Capt. James B. Campbell, USN, and Comdr. Dee Fitch, USN, for aid in interpretation and documentation of the basic data.

Programming assistance was provided by Alfred B. MacInnes of the Rand Computation Center. The reviews of William P. Butz, William H. Albright, and Susan Marquis were thoughtful, painstaking, and much appreciated. The draft manuscript was cheerfully and expertly typed by G. M. O'Brien.

Finally, the author acknowledges a large debt of gratitude to Richard V. L. Cooper and Gary R. Nelson for their unflagging support, guidance, and assistance throughout the course of the study.

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ABBREVIATIONS

ADBD: Active Duty Base Date

ARPA: Defense Advanced Research Projects Agency

CB: Continuation Bonus

DOF: Date of File

EAOS: End of Active Obligated Service

FY: Fiscal Year

NEC: Navy Enlisted Classification

NPS: Nuclear Power School

NPTU: Nuclear Power Training Unit

NTF: Nuclear-Trained Enlisted Force

NTPO: Nuclear-Trained Petty Officer

PP: Proficiency Pay

RMC: Regular Military Compensation

VRB: Variable Reenlistment Bonus

YOC: Remaining Years of Commitment

YOS: Completed Years of Service

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VARIABLE DEFINITIONS*

$c_{i,j}$ = direct costs of an NTPO with i years of service and j years of remaining commitment

cb_i = year-specific total individual bonus award

$d_{i,j}$ = proportion of NTPOs with i years of service having j years of remaining commitment

$m^y_{i,j}$ = number of NTPOs in year y with i years of service and j years of remaining commitment

n_i = year-specific eligibles-group participation rate

r = overall reenlistment rate

r_i = year-specific reenlistment rate

r_w = weighted-overall reenlistment rate

s_i = year-specific survival rate

C = direct cost profile matrix

CB = total bonus dollars obligated

M^y = manpower stock profile matrix in year y

MY = man-years of obligated service

N_i = number of reenlistment-eligible NTPOs with i years of service

R_i = number of reenlisting NTPOs with i years of service

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*If a variable refers to either pre-bonus or bonus periods, the latter case is distinguished by a prime (′).

PART ONE

PROBLEM AND FINDINGS

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I. INTRODUCTION

Beginning in October 1972, members of the Navy's Nuclear-Trained Enlisted Force (NTF) coming to the end of their initial commitment of service have been greeted by an incentive to reenlist unavailable elsewhere in the military: a Nuclear-Trained Petty Officer Continuation Bonus (NTPO-CB), equal to six months' basic pay for each year of additional obligated service. Considered as a group, the NTF has responded enthusiastically. The overall reenlistment rate during the first four full quarters of bonus experience is more than double that observed immediately before the bonus (34.7 percent versus 15.1 percent). Submerged in these aggregate measures, however, lie significant differences among the several year-groups constituting the reenlistment-eligible pool. The retention rate for six-year eligibles has historically been far below that for men with seven or more years, and the NTPO-CB has only served to widen that gap.

But although retention rates are useful summary statistics, they are not *directly* relevant to manpower planning and management. In this case, retention improvement is better presented in terms of actual additional manpower and costs attributable to the NTPO-CB. With regard to reported bonus experience, this requires estimating the number of bonus-induced reenlistments, translating these into their man-year equivalents, and calculating total NTPO-CB dollars obligated during the reported period.

The ultimate test of the value of the NTPO-CB, however, lies in its implications for *future* NTF manpower levels and costs, addressed here by an NTF simulation model. Projections to the end of FY1978 under bonus and no-bonus scenarios indicate that the NTPO-CB will have a large cumulative effect. Estimated bonus and no-bonus end-point experienced (six or more years of service) cadres differ by approximately 900 men.

Because reported bonus experience is limited, it must be recognized that the actual (or long-run) effect of the NTPO-CB may be substantially smaller or larger than that reported here. These two possibilities do not, however, have equal probabilities of occurrence. The analysis

presented below identifies effects of the bonus that extend beyond the reenlistment-eligible group. These secondary bonus effects are not yet observable; but they are expected in the years ahead to exert an additional positive influence on NTF manpower levels in general and retention rates in particular.

The number of individuals directly affected by the institution of the NTPO-CB measures in the hundreds; the entire NTF consists of approximately 10,000 men. Though small, viewed in the context of a 2.2-million-man armed force, it is not unimportant. The men of the NTF constitute the first line of responsibility for maintenance, operation, and supervision of the propulsion systems of the Navy's nuclear submarine and surface fleet. These ships are among the most expensive weapon systems in existence; and they are a principal element in the U.S. strategic defense triad.

The importance attached to this responsibility is reflected in the NTF entrance process. Rigorous selection standards limit the pool from which new manpower may be drawn; once selected, the prospective NTPO must undergo nearly two years of academic and experiential* training. Thus, response to increasing personnel requirements is both expensive and time-consuming. This situation holds even more strongly with respect to *supervisory-grade* NTPOs. These men must have several years' experience in nuclear power, in addition to having been fully trained. In consequence, the only source of nuclear-trained supervisors is first-term personnel.

Retention of experienced NTPOs, although always important, has not always had its current crisis proportions; nor is the NTPO-CB the first incentive to extended service employed in the NTF. Thus, a more thorough treatment of the analysis used and results obtained here, summarized in Sec. IV, is best preceded by considering the historical background of the present situation (Sec. II) and a description of the NTF career from enlistment to reenlistment (Sec. III).

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*That is, in a land-based prototype. For a fuller discussion of the NTF entrance process, see Sec. III.

II. HISTORICAL BACKGROUND

The reactors of the Navy's first nuclear-powered ships were manned by career petty officers--volunteers from elsewhere in the fleet. Presumably drawn by the prospect of rapid advancement, the novelty of nuclear power, and the challenge of a difficult assignment, they came throughout the 1950s and early 1960s in numbers sufficient to staff the steadily growing, but still small nuclear fleet.

With the rapid buildup of the fleet in FY1964 (see Fig. 1), the flow of volunteer careerists was no longer adequate, and it was decided that further NTF growth would be by direct input (from the recruit pool).

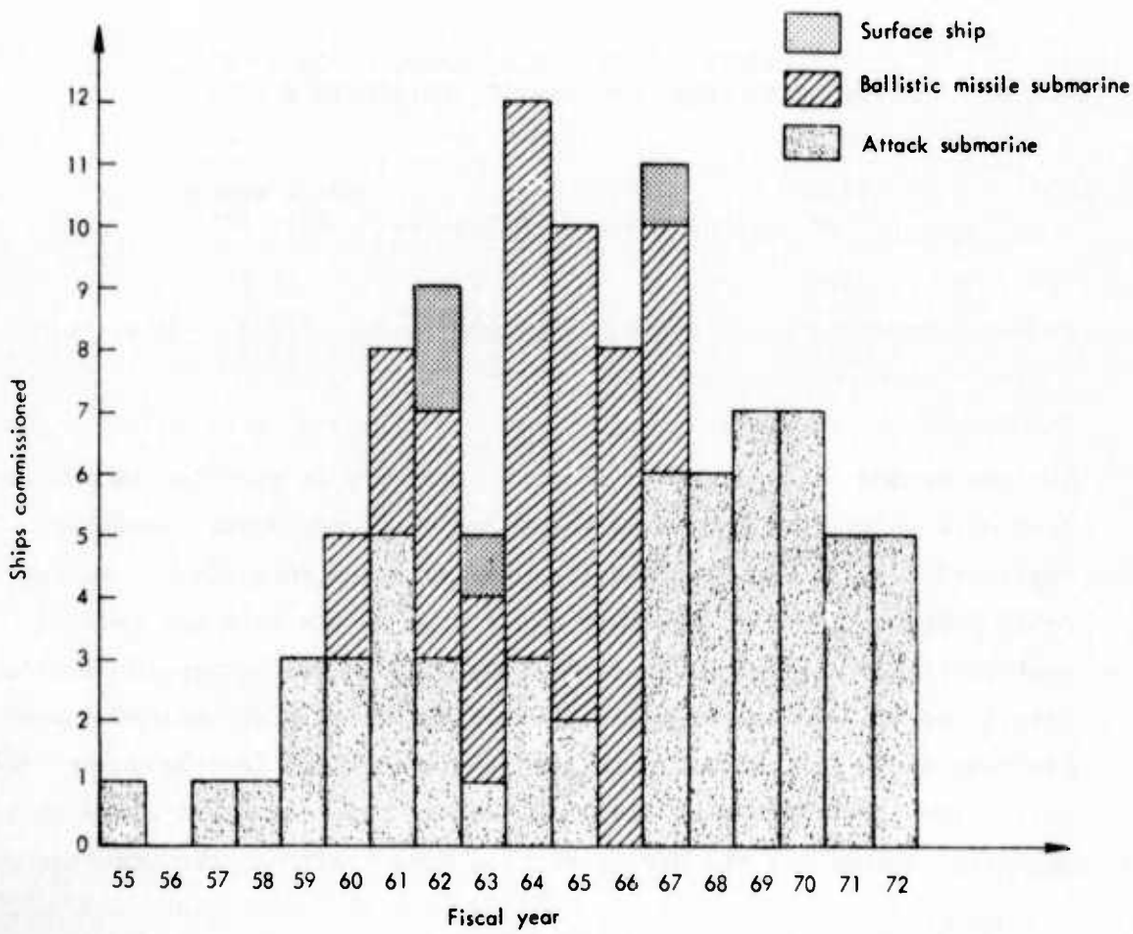

Fig. 1 — Growth of the nuclear fleet, by year of commission, FY1955 to FY1972

This shift in input policy was mirrored with a six-year lag in the nature of the NTPO reenlistment decision. Although specific data on the NTF before FY1970 are not available, it is reasonable to assume that the careerists then constituting the reenlistment-eligible group evidenced continuation rates similar to those of careerists elsewhere in the service. During the period FY1965 to FY1969, for example, reenlistment rates of Navy "career" regulars averaged over 83 percent.* Beginning with the first year for which data are available, however, the reenlistment-eligible group contained large numbers of men coming to the end of their *initial* commitments to military service. As Table 1 illustrates, the resulting reenlistment rates reflect decisions to embark upon a Navy career, rather than to continue one already launched.

Table 1

REENLISTMENTS AND ELIGIBLES AMONG NTPOs WITH SIX TO NINE YEARS OF SERVICE, FY1970 TO FY1972

Fiscal Year	Reenlistments	Eligibles	Reenlistment Rate (%)
1970	172	922	18.7
1971	189	1170	16.1
1972	167	1239	13.5

But the exodus of experienced manpower was only in part the lagged effect of a shift from careerist volunteer to direct input. Another explanation is the lure of civilian employment alternatives. In the early years of the NTF, the Navy was virtually the sole employer of nuclear-reactor operators, and the NTPO deciding to return to civilian life found his service-acquired nuclear skills all but useless. Now the Navy is in competition with private-enterprise electric power companies and other owners of civilian nuclear reactors. And although the principal concern of the NTF is running *Navy* reactors, the transfer of

**Selected Manpower Statistics*, Department of Defense, OASD (Comptroller), Directorate for Information Operations, April 15, 1973, p. 57.

skilled manpower from the NTF to civilian nuclear power can nevertheless be regarded as a worthwhile government subsidy, benefiting a promising but embryonic industry.* But if the transfer is so large as to interfere with the NTF's main function, the cost of the subsidy outweighs any possible benefits to society as a whole.

Whatever their relative importance, these two factors produced NTF reenlistment rates that were not merely low, but as is evident from Table 1 they were on a downward trend. The low (perhaps even negative) rates of growth of the experienced cadre implied by these reenlistment rates would probably have been a cause for concern, even without a projected increase in manning requirements. Scheduled arrivals of the Trident class of submarines beginning in the late 1970s, however, served to put manning requirements on an upward trend and rendered NTF retention an "immediate action required" problem area.

Since all available incentives to extended service were already in use in the NTF (see Sec. III), the action taken was to request Congressional authority for a new category of pay--the Nuclear-Trained Petty Officer Continuation Bonus (NTPO-CB). Congress concurred, and the NTPO-CB became available Oct. 27, 1972. Its details are presented in the next section's discussion of the NTF career experience, enlistment to reenlistment.

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*Since the land-based prototype nuclear propulsion systems on which NTPOs are experientially trained are jointly supported by the Navy and the Atomic Energy Commission, the argument is not without foundation.

III. THE NTF CAREER

The NTPOs whose careers are being observed here enlisted as Seamen (pay grade E3) for four years, after having met certain physical and mental screening criteria,* and signed an agreement to extend that enlistment by two years if they continued in the nuclear program. On completion of basic recruit training, they were assigned to one of the Navy's class "A" schools for four to nine months of training in one of four ratings: (1) machinist's mate (MM); (2) electrician's mate (EM); (3) interior communications technician (IC); (4) electronics technician (ET). Graduates in the upper two-thirds of the classes were automatically promoted to Petty Officer Third Class (pay grade E4) and scheduled for entrance in Nuclear Power School (NPS).†

This school gives twenty-four weeks of college-level instruction in the theory and operation of nuclear propulsion systems. Those who successfully completed this rigorous academic training were assigned to one of three Nuclear Power Training Units (NPTU), where their skills were both tested and extended by actual operation of a land-based reactor prototype.

For those destined for surface NTF billets, the NPTU was the final hurdle. Successful completion conferred a "nuclear-qualified" Navy Enlisted Classification (NEC). Prospective submariners, on the other hand, had to undergo four to six weeks of further training at the Navy's Submarine School before receiving their "submarine-trained, nuclear-qualified" NEC.

Through this process, the Navy transforms raw recruits into fledgling NTPOs in approximately two years; the ensuing four to seven years are marked by a concerted effort to effect the further transformation from fledgling to experienced, career-motivated operator/supervisor.

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*The requirements read: U.S. citizen able to meet security clearance requirements; minimum general classification and arithmetic test score of 115; less than 25 years of age; high school graduate; no record of civil or military offenses.

†Those who fail to make the "A" school "cut" may transfer to another technical field or request that their two-year extensions be cancelled.

The NTPO-CB is the newest and most substantial element in that effort; but it by no means stands alone.

The first incentive is the offer of proficiency pay (PP): $1200 per year for E5s; $1800 per year for E6s with more than six years of service. To be eligible, the NTPO must become "career-designated" by agreeing to extend his initial commitment from six to seven or more years. Although the option of career designation and proficiency pay eligibility is offered continuously, the total reward collected for the extension of commitment declines with each year of delay. For instance, if the NTPO executes the extension in his third year, he could collect as much as $6400 (undiscounted) between then and the end of his seventh year; if the option is exercised at the last possible moment (the end of the sixth year), the total could be as little as $1200.

The second incentive, the Regular and Variable Reenlistment Bonus package (VRB), is somewhat less straightforward then the first. The minimum six-year NTF commitment consists of a four-year enlistment plus an automatic two-year extension. For VRB purposes, the two-year extension is defined as a reenlistment, and therefore *all* NTPOs begin collecting this bonus ($2195 per year for an E5, 1973 rates of pay) in their fifth year. To receive the full VRB award of four such payments, however, the NTPO must, of course, serve eight years. Thus, although the VRB was originally intended as a reenlistment incentive, its manner of application in the NTF makes it half-incentive to extended service (payments in years seven and eight) and half-incentive to enlist in the NTF in the first place.

The third element in the incentive structure, and the focus of this report, is the Continuation Bonus (CB). It is offered from the end of the sixth year to the beginning of the tenth in exchange for a reenlistment of from two to four years. Payments are made annually, for the duration of the reenlistment contract, in the amount of six months' basic pay, as of date of reenlistment. Thus, at the extremes, an E6 with six years of service will receive $3109 per year (at 1973 rates of pay), while an E7 with nine years of service gets $3762 per year. The enabling legislation prohibits payments beyond the twelfth year, however, so while the reenlistee with nine years of service receives the highest

possible *annual* amount, he is also limited to a maximum of three such payments. The largest *total* award goes to the eight-year man reenlisting for four years.

The combined effects of these three incentive programs--PP, VRB, and CB--are illustrated by Table 2's comparison of annual income streams of individuals who (1) decline all incentives to extension of first-term service and reenlist at six years; or (2) extend the initial term by two years and reenlist at eight. The first group receives proficiency pay beginning in the seventh year, two VRB installments, and a $3109 annual CB award. The second group receives proficiency pay beginning in the third year, four VRB installments, and a $3227 annual CB award.

The undiscounted sums of income of members of these two groups from the third year on are $129,592 and $139,254, respectively--a difference of $9662. Discounting everything back to the third year at 10 percent yields totals of $84,147 and $90,140, respectively--a difference of $5993.

Table 2

ALTERNATIVE NTPO INCOME STREAMS

(Dollars)

Career Path	Years of Completed Service and Pay Grade											
	1	2	3	4	5	6	7	8	9	10	11	12
	E3	E4	E5	E5	E5	E6	E6	E6	E6	E6	E6	E6
1. Six-Year Reenlistment Eligibility												
RMC[a]	6,390	6,803	7,650	7,894	8,128	9,014	9,252	9,252	9,489	9,489	9,731	9,731
Sea pay			192	192	192	240	240	240	240	240	240	240
Submarine pay			840	840	960	960	1,020	1,020	1,080	1,080	1,140	1,140
VRB					2,195	2,195						
Proficiency pay							1,800	1,800	1,800	1,800	1,800	1,800
CB							3,109	3,109	3,109	3,109		
Total	6,390	6,803	8,682	8,926	11,475	12,409	15,421	15,421	15,718	15,718	12,911	12,911
2. Eight-Year Reenlistment Eligibility												
RMC[a]	6,390	6,803	7,650	7,894	8,128	9,014	9,252	9,252	9,489	9,489	9,731	9,731
Sea pay			192	192	192	240	240	240	240	240	240	240
Submarine pay			840	840	960	960	1,020	1,020	1,080	1,080	1,140	1,140
Proficiency pay			1,200	1,200	1,200	1,200	1,800	1,800	1,800	1,800	1,800	1,800
VRB					2,195	2,195	2,195	2,195				
CB									3,227	3,227	3,227	3,227
Total	6,390	6,803	9,882	10,126	12,675	13,609	14,507	14,507	15,836	15,836	16,138	16,138
Eight-year/six-year (ratio)	1.00	1.00	1.14	1.13	1.10	1.10	0.94	0.94	1.01	1.01	1.25	1.25

[a]RMC = Regular Military Compensation: basic pay, basic allowance for quarters, basic allowance for subsistence, and tax advantage (married, two dependents).

IV. OVERVIEW

The preceding sections have dealt in a general way with the NTF, the NTPO-CB, and the analysis being reported here. The sections that follow are devoted to a detailed presentation of methodology and results. This intermediate section provides an overview summary of the study as a whole: (1) description of the problem; (2) presentation of the analysis brought to bear upon it and summaries of the results obtained; and (3) discussion of major findings.

A. THE PROBLEM

Stated in its broadest terms, what is at issue is the effect of the NTPO-CB on present and future NTF manpower levels. Increases in NTF manpower as a result of the bonus can occur in three distinct ways. First, men with six to nine years of service may reenlist at a higher rate. This increase in personnel serving second terms of enlistment is referred to as the "direct effect." Second, in anticipation of the bonus, more personnel in years of service three through five will agree to extensions to qualify for proficiency pay. The additional manpower gained through extensions is called the "anticipatory effect." Third, men who accept the bonus will become eligible to reenlist again in four years. Since these personnel will already have 10 to 12 years of service, a high proportion may choose to remain in the Navy until retirement. The increase in manpower past the point for which the bonus is paid is called the "career effect."

The direct effect, though most important, requires the least description. The group eligible for bonus--NTPOs with six to nine years of service, coming to the end of their initial term of service--are being offered over $12,000 to reenlist, and their response may be measured by observed increases in retention rates or in terms of bonus-induced additional man-years accruing to the NTF.*

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*It should be noted, however, that currently observable overall retention rates understate long-run expectations, since the anticipatory effect of the bonus has not yet begun to affect the eligible pool.

The anticipatory effect is predicated on the assumption that decisions to extend the initial commitment from the minimum six years to seven or more are in part responses to the incentives of proficiency pay and the VRB and in part indicative of career motivation.* Career motivation, in turn, is assumed to reflect consideration of the income stream accruing over the entire period of military service (annual earnings from point of career decision to retirement). The NTPO-CB, by augmenting the stream of income from military service, will render an NTF career more attractive to first-termers, and in consequence more of them will extend their commitment. This expected increase in the proportion extending will result in additional first-term manpower and indirectly boost overall reenlistment rates. The latter result may be traced to the near-zero reenlistment rate of nonextendees; a decline in their relative representation in the eligible pool unambiguously increases the overall rate.

The career effect concerns what happens after the individual receives his final NTPO-CB installment. At the expiration of his second enlistment contract, an individual will have served from ten to twelve years. Past experience with career reenlistments indicates that the prospect of retirement benefits all but guarantees continuation from the twelfth year to the retirement point at twenty years, and there seems no reason why bonus-induced reenlistees should prove to be exceptions. Thus, the four-year reenlistment term for which the NTPO-CB is paid may be only one-third of the actual increment attributable to the bonus.

B. ANALYSIS AND RESULTS

The effect of the NTPO-CB can be measured in a variety of ways, depending on the purpose of the analysis. First, there are obvious measures--changes in reenlistment rates or number of reenlistments. If one wanted to compare the NTPO-CB with other reenlistment incentives, such as the VRB or the nuclear-trained officers' bonus,† one would calculate

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*The assumption is supported by the evidence that reenlistment rates of extendees have historically been at least ten times those of nonextendees.

†For an example of cross-sectional analysis of incentive effectiveness, see John Enns, *The Effect of the Variable Reenlistment Bonus on Reenlistment Rates: Empirical Results for FY1971*, The Rand Corporation, R-1502-ARPA (forthcoming).

proportional changes in reenlistment rates or bonus costs per man-year. In the perspective of budgeting and manpower planning, what matter most are total bonus costs and total additional man-years attributable to the bonus.

Because the NTPO-CB was created expressly to forestall an expected shortage of supervisory personnel, perhaps the best measure of its effect lies in its implications for actual *future NTF experience profiles*. That is, the crucial question may be, how many experienced men will there be in the NTF, year by year, from now to the late 1970s?

The analytical framework employed here reflects this plurality of contexts with a three-pronged approach. Specifically, it measures the effect of the bonus on:

1. Observed reenlistment rates.
2. *Aggregate* man-year and bonus-cost equivalents of observed reenlistment response.
3. *Annual* NTF manpower stocks and costs, FY1973 to FY1978.

Pursuit of each of these objectives, it should be noted, is constrained by limited evidence. Only the direct effect is currently observable, and even that is an underestimate of expected long-run reenlistment rates, given the absence of an anticipatory effect on current eligibles.

With regard to the first of these measures, observed reenlistment rates, it is assumed that the NTPO-CB represents the only changing influence on reenlistment decisions and therefore that observed *changes in reenlistment rates* may be directly attributed to the presence of the NTPO-CB. Specifically, year-group and total reenlistment rates are calculated for the final five calendar quarters before the inauguration of the bonus (first quarter, FY1972, to first quarter, FY1973) and compared with the analogous rates for the first four full quarters of bonus experience (third quarter, FY1973, to second quarter, FY1974).* (See Table 3.)

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*Because the NTPO-CB first appeared in the *middle* of the second quarter, FY1973, data from that period cannot be classified as either pre-bonus or bonus and so are excluded from the analysis.

Table 3

NTF REENLISTMENT RATES, BY COMPLETED YEARS OF SERVICE (YOS) AND COMPONENT, PRE-BONUS AND BONUS PERIODS

(Percent)

	(1)	(2)	(3)=(2)-(1)
YOS/Component	Pre-Bonus 7/1/71-9/30/72	Bonus 1/1/73-12/31/73	Change
6	2.5	9.2	+6.7
7	22.5	50.0	+27.5
8	32.6	58.7	+26.1
9	40.4	67.1	+26.7
Total	15.1	34.7	+19.6
Total submarine	16.4	37.9	+21.5
Total surface	10.7	23.6	+12.9

The second objective can be termed a benefit-cost analysis of the observed bonus response. The benefits of the NTPO-CB are defined as the man-year equivalents of bonus-period, bonus-induced reenlistments. Bonus-induced reenlistments are in turn defined as the actual number observed, less the number that would have been observed had pre-bonus reenlistment rates prevailed.* Thus, the benefits are the *additional man-years* of obligated service attributable to the NTPO-CB. (See Table 4, col. 1.)

The corresponding additional costs are *total bonus obligations*, calculated by multiplying the full NTPO-CB individual award† by the

*Symbolically, if r and r′ are pre-bonus and bonus reenlistment rates, and N′ is bonus-period eligibles, then bonus-induced reenlistments, R_b, may be written

$$R_b = (r' - r)N' .$$

†That is, the simple sum of annual bonus payments made during the bonus reenlistment term. The customary practice of discounting payments to be made in the future is avoided here and elsewhere in this report for two reasons: (1) Methodological consistency would require discounting bonus-induced man-years of obligated service--which makes

total number of bonus-period reenlistments. (See Table 4, col. 2.) The cost/benefit ratio is then the average additional cost per additional man-year. (See Table 4, col. 3.) This measure represents the bonus cost of bonus-induced man-years. If the average cost of *additional* reenlistee man-years is close to the average cost for *all* reenlistee man-years (the actual annual NTPO-CB award), it may be concluded that a high proportion of those accepting the bonus would otherwise have left the Navy.

Table 4

BONUS COST PER BONUS-INDUCED MAN-YEAR, TOTAL NTF BY COMPLETED YEARS OF SERVICE (YOS) AND COMPONENT, 1/1/73-12/31/73

	(1)	(2)	(3)=(2)÷(1)
YOS/Component	Induced Man-Years	Total Bonus Cost ($1000)	Bonus Cost per Bonus-Induced Man-Year ($)
6	162.9	696	4273
7	270.6	1588	5868
8	311.4	2259	7254
9	117.1	984	8403
Total	861.9	5527	6413
Total submarine	733.0	4701	6413
Total surface	137.5	827	6015

The third element in the analysis is the most ambitious, addressing the cumulative effect of the bonus on total NTF manpower levels and costs between now and the end of FY1978. Specifically, a simulation model is applied to the actual stock of manpower as of June 30, 1973, to predict FY1974 eligibles, reenlistments, and first-term extensions, which are in turn used to generate a description of the stock as of June 30, 1974. A second iteration of the model ages the

little sense; and (2) payment in annual installments instead of a lump sum is determined administratively. It is common for the services to offer the second option on a "funds available" basis. See, for example, John Enns, op. cit.

force to June 30, 1975, and so on. Projections are made in both *bonus and no-bonus scenarios*: The bonus scenario employs reenlistment rates observed during the bonus period (calendar 1973); the no-bonus scenario uses rates observed before institution of the bonus. Table 5 presents the expected number of reenlistments under both bonus and no-bonus scenarios for the period FY1974 through FY1978; Table 6 shows the expected number of men serving in the nuclear Navy under both scenarios. As the differences between the figures demonstrate, the NTPO-CB is projected to have a cumulative incremental effect on future NTF manning levels.

The effect of the NTPO-CB on manpower costs is portrayed in two different ways in Table 7. There are, on the one hand, estimates of annual bonus outlays (col. 4), reflecting both changing numbers of bonus reenlistments (see Table 5, col. 1) and increasing bonus *coverage*. In the first year of the bonus (FY1973), all of its recipients were in the first year of their reenlistment term. By FY1974, bonus recipients will include men in their first or second years; by FY1975, first, second, or third; and by FY1976, the bonus will have reached its maximum coverage. Beyond FY1976, increases in bonus outlays will be due solely to increasing numbers of bonus reenlistments.

The second way in which the effect of the bonus is addressed is by a pair of projections of total manpower costs, paralleling the bonus and no-bonus projections of manpower (cols. 1, 2, and 3). Because these cost projections reflect all pays and allowances, the difference between the bonus and no-bonus numbers is much larger than bonus outlays, and the rate of growth of the difference does not slacken.*

Table 7 also presents the year-by-year differences between the bonus and no-bonus projections of total manpower (col. 5). These are combined with the two cost measures to produce total additional cost per additional man (col. 6) and bonus cost per additional man (col. 7).

C. MAJOR FINDINGS

The first year's evidence on the special continuation bonus for

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*That is, men no longer receiving the NTPO-CB make no further contribution to *bonus outlays*, but do continue to contribute to total manpower costs.

Table 5

PROJECTED REENLISTMENTS AND ELIGIBLES, NTPOs WITH SIX TO NINE YEARS OF COMPLETED SERVICE, BONUS AND NO-BONUS SCENARIOS, FY1974 TO FY1978

	(1)	(2)	(3)
FY	Bonus Reenlist-ments	No-Bonus Reenlist-ments	Eligibles
1974	320	154	1206
1975	257	125	968
1976	293	134	1252
1977	388	179	1642
1978	460	215	1776
Total	1718	807	6844

Table 6

NTF MANPOWER, BY SELECTED COMPLETED YEARS OF SERVICE (YOS)-AGGREGATES, BONUS AND NO-BONUS SCENARIOS, FY1972 TO FY1978

	(1)	(2)	(3)	(4)
	YOS			
FY	2-5	6-12 Bonus/No-Bonus	13+ Bonus/No-Bonus	Total Bonus/No-Bonus
1972	5333	2132	751	8216
1973	6864	1930/1849	794	9588/9507
1974	7830	2008/1768	845	10683/10443
1975	8845	2181/1828	886	11912/11559
1976	9355	2510/2026	948	12813/12329
1977	9355	2964/2320	1052/1041	13371/12716
1978	9355	3237/2438	1229/1182	13821/12975

Table 7

NTF DIRECT MANPOWER COSTS, BONUS AND NO-BONUS SCENARIOS, FY1974 TO FY1978

	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(3)÷(5)	(7)=(4)÷(5)
	Total Cost ($ × 10^6)			Bonus Cost ($ × 10^6)	Additional Men[a]	Total Additional Cost per Additional Man ($)	Bonus Cost per Additional Man ($)
FY	Bonus	No-Bonus	Difference				
1974	121.78	116.96	4.82	1.98	240	20,080	8,260
1975	138.34	131.38	6.96	2.65	353	19,720	7,510
1976	151.04	141.88	9.16	3.19	484	18,930	6,600
1977	159.08	147.55	11.53	3.44	655	17,600	5,260
1978	165.57	151.21	14.36	3.85	846	16,970	4,550

[a]Additional men = (total stock, bonus scenario) - (total stock, no-bonus scenario).

nuclear-trained petty officers gives solid support to the judgment that it has had a strong positive effect on reenlistments among those eligible for it. In particular, the results presented in the preceding subsection warrant the following conclusions:

1. The overall reenlistment rate for NTPOs with six to nine years of service has more than doubled, from 15.1 percent to 34.7 percent between pre-bonus and bonus periods, and is expected to rise even higher in future years.
2. The reenlistment rate at six years shows the smallest improvement, and even this is probably transitory. The bonus is expected, however, to cause a future decline in the number of NTPOs becoming reenlistment-eligible at six years.
3. During its first four full quarters of existence, the NTPO-CB has been responsible for 862 additional man-years, at an average cost of $6413 (per additional man-year).
4. Over the period FY1974 to FY1978 as a whole, the bonus is conservatively projected to result in roughly 900 additional reenlistments, with the experienced cadre (those with six or more years of service) increasing from 2883 in FY1972 to 4466 in FY1978.

5. Total additional costs per additional man in the NTF decline steadily over the projection period, to $16,970 in FY1978; the bonus cost per additional man shows similar decline, dropping to $4550 by FY1978.

1. *The Overall Reenlistment Rate.* Perhaps the most striking of the results obtained is the observed increase in the overall NTF reenlistment rate, from 15.1 percent in the period immediately preceding the arrival of the NTPO-CB to 34.7 percent in its wake. Further, the observed improvement is pervasive, spanning submarine and surface components and all YOS-groups.

2. *The Reenlistment Rate at Six Years.* Though pervasive, the improvement in retention has not been uniform: Over 90 percent of bonus-period NTPOs becoming eligible to reenlist at six years chose not to do so. This is not surprising, since it has already been noted (Sec. III) that reenlistment eligibility at six years imples forfeiture of up to $5400 in proficiency pay and at least $4390 in VRB awards--amounts comparable in size with the total NTPO-CB award. The reasonable inference to draw from the data, in fact, is that the long-run equilibrium reenlistment rate at six years is near zero; the NTPO-CB cannot be expected to affect the *behavior* of individuals who follow this path, but rather the *number* who do so. That is, individuals who have elected not to extend, thereby forfeiting substantial cash benefits, are unlikely to accept the additional commitment resulting from the acceptance of the CB.

3. *Bonus-Induced Man-Years and Costs.* When the observed response is presented in terms of bonus-induced additional man-years (Table 4), however, a slightly different picture emerges. The small improvement in the six-year reenlistment rate is magnified by the sheer volume of men involved. Because the six-year group constitutes over 40 percent of the total eligibles, even slight improvement in the reenlistment rate may be significant in terms of man-years. At the other end of the spectrum are the nine-year eligibles, whose contributions to additional man-years are limited by their number (roughly 10 percent of the total) and by their high pre-bonus reenlistment rate. Thus, while 67.2 percent of

them reenlisted during the reported bonus period, previous experience indicates that 41.4 percent would have done so even without the NTPO-CB.

Such differences in *relative* response show up especially clearly in the estimates of bonus cost per induced additional man-year. The six-year figure is the lowest of the lot because almost all reenlistments are induced reenlistments. Conversely, the average cost at nine years is high because a large part of this group is receiving rent (payment for doing what they would have done anyway).

4. *Nuclear-Trained Manpower, FY1974 to FY1978.* Another dimension is added in Table 5, where bonus and no-bonus reenlistments are projected to FY1978. The bonus reenlistments are inherently conservative, since they do not reflect the expected, but as-yet-unmeasurable anticipatory effect of the NTPO-CB on first-term extension activity. Six-year eligibles, for instance, constitute equal fractions of total eligibles in the bonus and no-bonus scenarios. What the numbers in Table 5 nevertheless illustrate is the cumulative effect of the bonus over the five-year projection period: roughly 900 additional reenlistments.

The full-scale projections of NTF manpower, from which the estimates in Table 5 were extracted, are presented in summary form in Table 6, which also includes actual data for FY1972 for comparative purposes. The accumulating bonus-induced additional reenlistments are again apparent in two sets of estimates of numbers of men with six to twelve years of service, but they now acquire added significance. With the bonus, this group is projected to grow from 2132 in FY1972 to 3237 in FY1978, an increase of 51.8 percent; without the bonus, the projected end-point is only 2438, an increase of 14.4 percent.

5. *Declining Per-Man Costs, FY1974 to FY1978.* To understand the decline in total and bonus costs per additional man, it is necessary to look again at the estimates of bonus cost per bonus-induced man-year in Table 4. Note that the cost per man-year rises steadily from YOS six to nine ($4273 to $8403) and therefore that the average cost ($6413) is very sensitive to the composition of bonus-induced reenlistments. If, for example, there was an increase in the number of eligibles at six and seven years, everything else constant, there would be more bonus-induced reenlistments at six and seven years (which cost less than the average), and the average bonus cost per induced man-year would decline.

This is, in fact, what is occurring in the projections. It is clear from Table 6, col. 1, that "first-term" ($2 \leq YOS \leq 5$) manpower is growing rapidly, and the first of these to become reenlistment-eligible are those who do so at six and seven years. Thus, the average cost of additional men declines over the projection period in part because (relatively) inexpensive reenlistments are constituting a larger fraction of total reenlistments.

Another factor in the decline is the aforementioned "career effect." Beginning about FY1976, the bonus projection of manpower includes men who were induced to reenlist by the NTPO-CB and who are assumed to reenlist again when the bonus term expires.* Thus, they still count as additional men in the force, but make no further contributions to the cost of the NTPO-CB program.

This influence on per-man costs is fairly small during the projection period--there are only 124 post-bonus additional men by FY1978--but its long-run implication is enormous. If it is assumed that the average bonus recipient serves an additional eight years beyond the term for which the bonus is paid,† the bonus cost per additional man in the force will eventually decline to roughly one-third its projected FY1978 level.

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*They are attracted by retirement benefits. See subsection A above.

†Since the final bonus payment can occur as early as the tenth year, but no later than the twelfth, the assumption is not unreasonable.

PART TWO

ANALYSIS AND DATA

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V. INTRODUCTION TO PART TWO

Part One of this report has addressed the retention problems of the nuclear-trained Navy and has presented evidence of the first year's experience with the special continuation bonus for nuclear-trained petty officers. Part Two is devoted to the details of the analysis underlying the evidence presented in Part One, covering not only those topics summarized earlier, but also several comparably important but technical issues. It is intended as both documentation of the reported research and as a user's guide to a set of analytical techniques with possibly wide applicability.

Section VI contains a thorough treatment of the methodology used to estimate the effect of the bonus. That effect is measured in two fundamentally different ways: (1) through its effect on reenlistment rates, and (2) through its effect on supervisory manpower available to the Navy in the later years of this decade. Section VII presents the results as well as the underlying data from the analysis of the NTPO-CB. Finally, Sec. VIII briefly outlines some issues that need to be considered in future work on retention problems in the nuclear Navy.

VI. METHODOLOGY

This section describes in some detail the assumptions, definitions, and estimation techniques employed to assess the effect of the NTPO-CB. As noted in Part Or. , the analysis has three components, respectively addressing: (1) observed reenlistment rates; (2) aggregate man-year and bonus-cost equivalents of observed reenlistment response; and (3) annual NTF manpower stocks and costs, FY1973 to FY1978. The first two, though differing in perspective, share a common focus on *observed* response and are therefore discussed together in subsection A. The third analytical objective is associated with an NTF *simulation* model, described in subsection B.

A. MEASURES OF OBSERVED RESPONSE

Individual decisions to enlist in the NTF in the first place, to extend one's initial period of commitment once there, and to reenlist at the end of that period are all choices among alternative occupations. The factors influencing such choices are, of course, legion, but they may be usefully categorized as alternative wage streams and alternative bundles of nonpecuniary aspects (rigor of duties, location of employment, etc.). The several members of a group can be expected to react differently to a given set of stimuli, generating correspondingly different occupational choices. One man, for instance, might find the demanding NTF performance standards challenging, a positive aspect of the job; while another might find the standards onerous and require offsetting compensation in some other respect (a wage rate higher than would satisfy the first man).

These individual decision processes are not in themselves observable; only the process outcomes are revealed in subsequent behavior. Thus NTPOs sort themselves into two groups: (1) those who find the NTF wage stream and bundle of nonpecuniary aspects barely, somewhat, or extremely superior to all available alternatives; and (2) those who find in varying degree some non-NTF position superior. The first group is made up of those who accept proficiency pay and the VRB in return for

extensions of initial commitment and/or those who reenlist when eligible. The second group maintains the original commitment at six years and/or leaves the NTF when eligible for reenlistment.

The incremental effect of the NTPO-CB is on those members of the second group who regard some non-NTF position as either barely or only somewhat superior. The rise in income associated with the NTPO-CB tips the scale, so to speak, and those closest to the balance point of indifference are newly moved to regard the NTF as superior. Furthermore, if the individual decision process is not utterly myopic, this incremental effect of the NTPO-CB will not be limited to those currently eligible to receive it. That is, if both current and anticipated future income streams influence job choices, it may be expected that the prospect of receiving the bonus some years hence will push from indifference to acceptance some of those currently facing early reenlistment/extension options.

This secondary effect of the bonus on length of initial commitment, referred to earlier as the *anticipatory* effect, has immediate importance in that the Navy will thereby acquire additional NTPO man-years. In the context of long-run forecasting, moreover, its role is crucial. As will be seen below, historically there has been a large gap between the subsequent reenlistment rates of those who execute early extensions and those who do not, and the arrival of the NTPO-CB made the gap still larger (see Table 12, Sec. VII). If long-run predictions of *overall* reenlistment rates are to be accurate, it is insufficient to measure and extrapolate the reenlistment rates of such NTF subgroups. It is also necessary to predict the future relative sizes of the subgroups.

This reference to qualitative differences in the natures of expected long-run and observed short-run response to the NTPO-CB also serves as a propitious context in which to discuss the problem of identifying the cause. It has been noted that occupational choices are subject to a variety of influences. If a change occurs in just one of those influences, followed by an observed change in the behavior of an affected group, it is reasonable to infer that the former is the cause of the latter. The offer of the NTPO-CB to a randomly selected sample of reenlistment-eligible NTPOs, for example, would provide an ideal test

of its effectiveness, since all *other* influences would be the same for the bonus and no-bonus groups. Where the change affects all alike, as does the NTPO-CB, there is no naturally occurring control group, and it becomes possible that observed changes in behavior are in significant measure the result of factors other than the bonus. Explicit treatment of this possibility is beyond the scope of this report. Rather, it is simply assumed that if other factors are at work, their combined short-run influence is small, relative to that of the NTPO-CB. Comparisons of behavior immediately before and after inauguration of the bonus, therefore, are assumed to be at least close approximations of its true incremental effect.

Over the long run, of course, gradual changes in non-bonus influences can accumulate unnoticed to large totals, and the "other things equal" assumption must give way to the sophistication of multiple regression analysis. That is, individual decisions must be related as explicitly as possible to all observable stimuli and the question of causation must be answered by reference to the estimated values of coefficients.*

What remains to be considered is the specific description of the analytical measures employed. For notational convenience and clarity, where a variable can refer to either a pre-bonus or a bonus time period, in the latter case it is identified by a prime (′), and definitions, relationships, etc. are presented once but understood to apply to both periods.

Let N_i be the number of reenlistment-eligible NTPOs with i years of service, and let R_i be the number who choose to reenlist in each group ($6 \leq i \leq 9$). *A year-specific reenlistment rate*, r_i, may then be defined as

$$r_i = \frac{R_i}{N_i} . \tag{1}$$

The *overall reenlistment rate*, r, may similarly be defined as

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*Explicit NTPO decision modeling is discussed in greater detail in Sec. VII.

$$r = \frac{\sum R_i}{\sum N_i} . \tag{2}$$

Under the "other things equal" assumption, the changes in these rates, pre-bonus to bonus periods, provide direct measures of the incremental effect of the bonus. The set of *year-specific responses* may be represented by:*

$$\Delta r_i = r_i' - r_i . \tag{3}$$

The *overall response* is

$$\Delta r = r' - r . \tag{4}$$

But overall reenlistment rates, and thus changes in overall rates, reflect not only the behavior of the several year-groups, but their relative sizes as well. This may be illustrated by defining a year-specific eligibles group *participation rate*, n_i, as

$$n_i = \frac{N_i}{\sum N_i} , \tag{5}$$

and introducing it into the definition of the overall reenlistment rate:†

$$r = \frac{\sum R_i}{\sum N_i} = \sum r_i n_i . \tag{6}$$

---

*Primes (′) denote bonus-period values.

†That is,

$$r = \frac{\sum R_i}{\sum N_i} = \frac{R_6}{\sum N_i} + \frac{R_7}{\sum N_i} + \frac{R_8}{\sum N_i} + \frac{R_9}{\sum N_i}$$

$$= \frac{R_6}{N_6} \cdot \frac{N_6}{\sum N_i} + \frac{R_7}{N_7} \cdot \frac{N_7}{\sum N_i} + \frac{R_8}{N_8} \cdot \frac{N_8}{\sum N_i} + \frac{R_9}{N_9} \cdot \frac{N_9}{\sum N_i}$$

$$= r_6 n_6 + r_7 n_7 + r_8 n_8 + r_9 n_9 = \sum r_i n_i .$$

In the long run, changes in these eligibles-group participation rates will reflect the effect of the bonus on early reenlistment/extension behavior (the sum $n_7 + n_8 + n_9$ will grow; n_6 will decline). Participation rates observed immediately before and after the arrival of the bonus, on the other hand, all have origins in a pre-bonus environment; from this fact, two implications can be drawn: First, overall reenlistment rates currently observed *understate* the long-run effect of the bonus, since the expected changes in participation rates constitute a positive influence independent of increases in year-specific reenlistment rates. Second, if pre-bonus- and bonus-period participation rates do differ, the bonus cannot be the responsible agent, and ascription of the whole of the change in the overall reenlistment rate to the bonus is incorrect. To avoid this possibility, define the bonus-period *weighted-overall reenlistment* rate, r'_w, as

$$r'_w = \sum r'_i n_i \ , \tag{7}$$

and the *weighted overall response*, Δr_w, as

$$\Delta r_w = r'_w - r = \sum (r'_i - r_i) n_i \ . \tag{8}$$

Thus, the weighted rate is that which would have been observed in the bonus period had participation rates remained at pre-bonus-period levels. Further, the weighted response describes only current, bonus-induced changes in reenlistment behavior.

The analytical value of reenlistment rates is in large part due to their independence from scale. Here, for instance, they allow comparison of the response of reenlistment-eligible year-groups of differing sizes. By the same token, however, reenlistment rates do not measure the response to the bonus in a way amenable to benefit/cost analysis. The appropriate interpretation of statements concerning the bonus cost per percentage point rise in overall reenlistment rate, for instance, is not readily apparent.

No such ambiguity surrounds the measurement of bonus response in terms of additional man-years accruing to the Navy. If it is assumed

that all contracts for which bonuses are paid are of maximum allowable duration, then each reenlistment at years six, seven, and eight converts to four man-years, and each at year nine converts to three man-years.* *Bonus-induced reenlistments* in each year-group ($\Delta R_i'$) may be defined as the actually observed number less what reenlistments would have been had pre-bonus year-specific rates prevailed:

$$\Delta R_i' = (r_i' - r_i)N_i' \ . \tag{9}$$

And total *bonus-induced reenlistment man-years* ($\Delta MY'$) may be written

$$\Delta MY' = 4\Delta R_6 + 4\Delta R_7 + 4\Delta R_8 + 3\Delta R_9 \ . \tag{10}$$

While the return on the NTPO-CB is limited to incremental reenlistments, present and future bonus costs are incurred on *all* reenlistments. To gain comparability with man-year estimates, these present and future bonus costs are here aggregated† to a year-specific bonus (cb_i). The total obligation associated with the bonus-induced additional man-years (CB) is therefore

$$CB = \sum cb_i R_i' \ . \tag{11}$$

Total obligations may be thought to depend on reenlistment rate levels; bonus-induced man-years reflect rate changes. The ratio of the two, $CB/\Delta MY'$, is the average additional cost of additional man-years and depends on both rate levels and changes. This may be illustrated by suppressing the year-group subscript and writing average cost as

$$\frac{CB}{\Delta MY} = \frac{cb \cdot R'}{4(r' - r)N'} = \frac{cb \cdot r' \cdot N'}{4(r' - r)N'} = \left[\frac{cb}{4}\right]\left[\frac{r'}{r' - r}\right] . \tag{12}$$

---

*The distinction is due to the regulation that no NTPO-CB payments may be made beyond the twelfth year.

†Without discounting future costs.

In this approximately correct formulation, the first bracketed term is the bonus cost per reenlistee man-year, determined not by behavior but by pay tables. The second term inflates this cost figure to the level of bonus cost per induced man-year. It is a measure of proportional change in the reenlistment rate--small absolute changes at high levels implying much inflation of cost, large changes at low levels meaning little inflation.

B. THE NTF SIMULATION MODEL

It has been said before, but bears repeating, that the NTPO-CB was a response to an expected shortfall of experienced nuclear-trained personnel in the late 1970s and that therefore the best test of the value of the bonus rests in its implications for future NTF manpower stocks and costs. Specifically, what will be the total of NTPO-CB dollar awards in FY1974, FY1975, and so on? How many men will there be in each NTF year-group in each of those years? And how many would there have been had the NTPO-CB never appeared?

The approach here is to answer these questions in two distinct stages. The first stage is represented by an NTF simulation model, described in some detail below. This consists of a set of definitions, assumptions, and notational conventions by which one may first organize and manipulate the data to simulate the NTF growth process and subsequently interpret the results of that simulation.

The second stage is the development of alternative sets of data to feed into the model: original manpower stocks, pay scales, reenlistment rates, etc. Two such sets, or scenarios, representing likely NTF futures with and without the NTPO-CB, are described in summary form at the end of this subsection and in detail in App. B.

For manpower planning purposes, an individual NTPO is uniquely described (at any particular moment) by his accumulated years of service (YOS) and remaining years of current commitment (YOC). Similarly, the NTF as a whole is uniquely described by a point-in-time *distribution* of NTPOs by YOS, by YOC. Row-indexed by YOS, column-indexed by YOC, and augmented by row and column totals, this distribution is defined as a manpower stock profile matrix, $\underline{\underline{M}}$:

$$\underline{\underline{M}} = \begin{bmatrix} m_{2,1} & \cdots & m_{2,6} & m_{2,T} \\ \vdots & & \vdots & \vdots \\ m_{13+,1} & \cdots & m_{13+,6} & m_{13+,T} \\ m_{T,1} & \cdots & m_{T,6} & m_{T,T} \end{bmatrix} . \tag{13}$$

Some of the cells in $\underline{\underline{M}}$ will, of course, be empty. It has been noted, for example, that men just entering active service (YOS = 2) have remaining commitments of at least four years (YOC $\geq$ 4). It must therefore be true that for $j < 4$, $m_{2,j} = 0$. The elements in the last column of $\underline{\underline{M}}$ are row totals; the column as a whole provides a distribution of the NTF by YOS. Similarly, the last row is made up of column totals and provides a projection of the total number of men reaching End of Active Obligated Service (EAOS) in each of the ensuing six years. Rounding out the matrix in the last row and column ($m_{T,T}$) is the total number of men in the NTF.

The personnel actions that cause this matrix to change from one year to the next fall into three categories: (1) reenlistments/extensions during years three to six; (2) reenlistments and losses at EAOS during years seven to ten; and (3) losses before EAOS.*

To begin with the simplest, pre-EAOS losses are assumed to occur randomly within a YOS-group and therefore affect only its total size and not its distribution by YOC. It is further assumed that each YOS-group will in the future lose the same *fraction* of its total as did predecessor cohorts occupying that YOS-group in the past. Symbolically, YOS-group i in year y, $m^{y}_{i,T}$ in number, becomes YOS-group i + 1 in year y + 1, numbering $m^{y+1}_{i+1,T}$. The two group sizes are related by a YOS-specific survival rate, s_i, distilled from past experience:†

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*Losses before EAOS are due to misconduct and disability discharges, deaths, etc.

†For $2 \leq i \leq 5$, the survival rate is applied to total YOS-group size as in Eq. (14). For $i \geq 6$, the assumption of no effect on YOC-distributions remains in force, but total YOS-group sizes are arrived at by summing over all YOC cells. See below.

$$m^{y+1}_{i+1,T} = s_i m^y_{i,T} \ . \tag{14}$$

Reenlistments/extensions during years three to six leave the sizes of YOS-groups unchanged, but alter their distribution by YOC. Past experience is again taken as a guide to the future, in that YOS-groups are assumed to duplicate the behavior of predecessor cohorts.* Specifically, historical observations of YOS-group distributions by YOC are normalized by dividing each cell in the distribution by the total size of the YOS-group, generating a set of distribution parameters $d_{i,j}$:

$$d_{i,j} = \frac{m^o_{i,j}}{m^o_{i,T}} \ ; \qquad i = 2, \ldots, 5; \ j = 1, \ldots, 6 \ . \tag{15}$$

These parameters are then applied to estimated future YOS-group sizes to produce estimated future distributions by YOC:

$$m^{y+1}_{i+1,j} = d_{i+1,j} m^{y+1}_{i+1,T} = d_{i+1,j} s_i m^y_{i,T} \ . \tag{16}$$

Unlike either pre-EAOS losses or early reenlistments/extensions, reenlistments during service years seven to ten affect both YOS-group sizes and distributions by YOC because (1) only one cell in each YOS-group distribution (YOC = 1) faces the reenlistment option; and (2) the affected individual either leaves the NTF, thereby reducing the YOS-group size, or alters the YOC-distribution by reenlisting. Running the risk of further explaining what is already clear, the story is presented in graphical form in Fig. 2.

Here the individual is imagined to *occupy* a series of cells in the profile matrix $\underline{\underline{M}}$. He enters at the top with two years of service and four remaining years of commitment ($\boxed{2,4}$) and accepts none of the early reenlistment extension options. The simple passage of time moves him

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*The assumption is reasonable for the no-bonus projection, but imparts a conservative bias to the bonus projection. See the discussion of scenarios below and App. B.

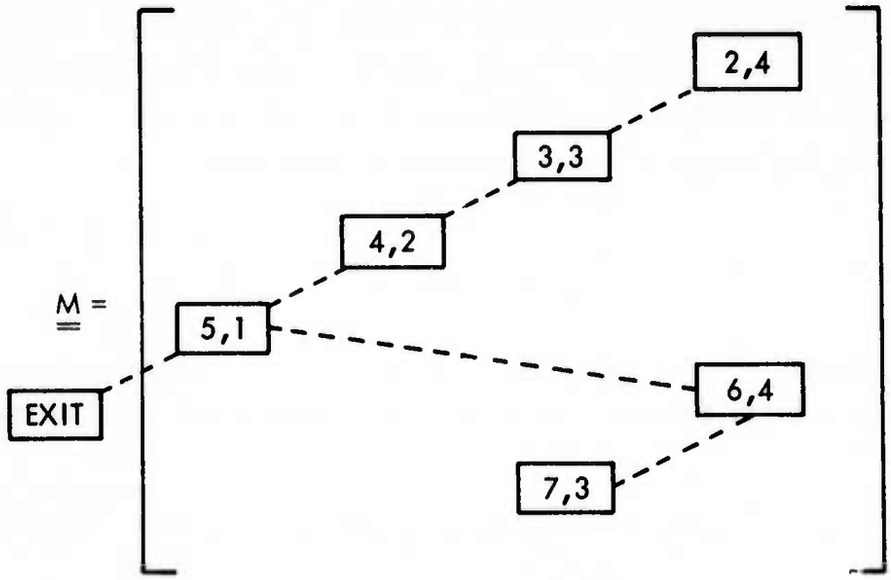

Fig. 2 — Illustrative path through matrix

along a southwest diagonal until he reaches the left-hand edge at $\boxed{5,1}$. Further resistance to incentives to extended service means further southwesterly motion, out of the matrix, out of the NTF. Reenlistment at this point, on the other hand, leapfrogs the individual to the far end of the distribution ($\boxed{6,4}$), from which point he resumes his former direction of travel.

Of the total occupying these boundary cells, the proportion expected to move back to the interior is given by the YOS-specific reenlistment rate, r_i, defined in subsection A above. That is, starting from $m^y_{i,1}$, $s_i m^y_{i,1}$ survive to divide into a reenlisting group, $r_i s_i m^y_{i,1}$, and an exiting group, $(1 - r_i)s_i m^y_{i,1}$. The reenlisting group is the next year's group* $m^{y+1}_{i+1,4}$:

$$m^{y+1}_{i+1,4} = r_i s_i m^y_{i,1} \ . \tag{17}$$

---

*Relationship (17) is correct (albeit by assumption) for i = 6, 7, 8. For i = 9, however, it should be

$$m^{y+1}_{10,3} = r_9 s_9 m^y_{9,1} \ ,$$

since bonus-induced reenlistments at nine years are of three years' duration. See subsection A above.

For cells in the range $6 \leq YOS \leq 9$, but not on the boundary (i.e., $YOC \neq 1$), the passage of a year implies only pre-EAOS losses. YOS-group i in year y becomes YOS-group i + 1 in year y + 1, declines in number, and erases a year of remaining commitment:

$$m^{y+1}_{i+1,j-1} = s_i m^y_{i,j} , \qquad j \neq 1 . \tag{18}$$

The change in *total* YOS-group size from year y to year y + 1 thus reflects both failures to reenlist when eligible and pre-EAOS losses:

$$m^{y+1}_{i,T} = \sum_{j=1}^{6} m^{y+1}_{i,j} = r_i s_i m^y_{i,1} + \sum_{j=2}^{6} s_i m^y_{i,j} . \tag{19}$$

Two aspects of the profile matrix aging process remain to be discussed: (1) inputs of newly trained men, and (2) NTPOs with ten and more years of service. The former are simply assumed constant:

$$m^{y+1}_{2,T} = m^y_{2,T} . \tag{20}$$

The latter are divided into four groups* (YOS = 10, 11, 12, 13+) and suffer annual losses at the rate $(1 - s_i)$:

$$m^{y+1}_{i+1,T} = s_i m^y_{i,T} , \qquad i = 10, 11, 12, 13+ . \tag{21}$$

The rate for the first three groups reflects pre-EAOS losses only; that for the last group covers retirement losses as well. All surviving reenlistment-eligibles in these groups are assumed to sign on for four more years:

$$m^{y+1}_{i+1,4} = s_i m^y_{i,1} , \qquad i = 10, 11, 12, 13+ . \tag{22}$$

---

*The reason for the division will become clear during the discussion of direct manpower *cost* estimation below.

Putting all these pieces together, the aging process may be outlined as follows:

1. Start with actual-data profile matrix $\underline{\underline{M}}^y$;
2. Insert constant new input in $\underline{\underline{M}}^{y+1}$, $m^{y+1}_{2,T} = m^y_{2,T}$;
3. YOS-groups 2, 3, 4 in $\underline{\underline{M}}^y$ become YOS-groups 3, 4, 5 in $\underline{\underline{M}}^{y+1}$, suffering involuntary losses at rate $(1 - s_i)$:

$$m^{y+1}_{i+1,T} = s_i m^y_{i,T} , \qquad i = 2, 3, 4 ;$$

4. Distribute new YOS-groups 2, 3, 4, 5 (from steps 2 and 3) among the YOCs according to the normalized distribution parameters $d_{i,j}$:

$$m^{y+1}_{i,j} = d_{i,j} m^{y+1}_{i,T} , \qquad i = 2, 3, 4, 5 ;$$

5. For YOS = 5, 6, 7, 8 and YOC = 1 in $\underline{\underline{M}}^y$, multiply by survival rate (s_i) and reenlistment rate (r_i); insert products in $\underline{\underline{M}}^{y+1}$ as YOS = 6, 7, 8, 9, YOC = 4:

$$m^{y+1}_{i+1,4} = s_i r_i m^y_{i,1} , \qquad i = 5, 6, 7, 8 ;$$

6. For YOS = 9, 10, 11, 12 and YOC = 1, multiply by survival rate (s_i) and insert products in $\underline{\underline{M}}^{y+1}$ as YOS = 10, 11, 12, 13+, YOC = 4:

$$m^{y+1}_{i+1,4} = s_i m^y_{i,1} , \qquad i = 9, 10, 11, 12 ;$$

7. For YOS = 6, ..., 12 and YOC $\neq$ 1, multiply by survival rate (s_i), add one to YOS, subtract one from YOC, and insert in $\underline{\underline{M}}^{y+1}$:

$$m^{y+1}_{i+1,j-1} = s_i m^y_{i,j} , \qquad i = 6, \ldots, 12, \; j \neq 1 ;$$

8. For YOS = 13+ and YOC = 1, multiply by survival rate and insert in $\underline{\underline{M}}^{y+1}$ as YOS = 13+, YOC = 4:

$$m^{y+1}_{13+,4} = s_{13} m^{y}_{13+,1} \; ;$$

9. For YOS = 13+ and YOC $\neq$ 1, multiply by survival rate, subtract one from YOC, and insert in $\underline{\underline{M}}^{y+1}$:

$$m^{y+1}_{13+,j-1} = s_{13} m^{y}_{13+,j} \; , \qquad j \neq 1 \; ;$$

10. Generate new YOS-group sizes, YOS = 6, ..., 13+ by summing over all YOCs:

$$m^{y+1}_{i,T} = \sum_{j} m^{y+1}_{i,j} \; , \qquad i = 6, \ldots, 13+ \; ;$$

11. $\underline{\underline{M}}^{y+1}$ is now complete. For $\underline{\underline{M}}^{y+2}$, return to step (1) and substitute $\underline{\underline{M}}^{y+1}$ for $\underline{\underline{M}}^{y}$.

The manpower stock profile matrices thus generated are not only useful in their own right, but they also enable the estimation of annual *direct manpower costs*.* That is, it can be inferred from an individual's YOS and YOC in what pay grade he is *and* what incentive pays he is receiving.† If these YOS-specific, YOC-specific, per-man direct costs are designated by $c_{i,j}$, then $c_{ij} m^{y}_{i,j}$ is the annual direct cost of the typical cell in $\underline{\underline{M}}^{y}$. The set of all $c_{i,j} m^{y}_{i,j}$, arrayed like $\underline{\underline{M}}^{y}$ and augmented by row totals,‡ is defined as a direct cost profile matrix, $\underline{\underline{C}}$:

$$\underline{\underline{C}} = \left[c_{i,j} m_{i,j} \;\vdots\; \sum_{j} c_{i,j} m_{i,j} \right] . \tag{23}$$

---

*Direct manpower costs are defined here to include only wages, bonuses, and monetary equivalents of income-in-kind paid during active service; training and retirement costs, for example, are excluded.

†For instance, YOS = 2, YOC = 4 implies an annual income of $8682; YOS = 2, YOC = 6 implies $9882. See Table 2, Sec. III, and Tables B-4 and B-5, App. B.

‡*Column* totals of direct costs have no significance and are therefore omitted.

This, then, is the NTF simulation model. Its data input requirements are: (1) an existing stock profile matrix $\underline{\underline{M}}$; (2) YOS-specific annual survival rates s_i, $i = 2, \ldots, 13+$; (3) normalized YOC-distribution parameters $d_{i,j}$ for $i = 2, \ldots, 5$; (4) YOS-specific reenlistment rates r_i for $i = 6, \ldots, 9$; and (5) direct cost coefficients $c_{i,j}$. The NTPO-CB will not affect (1) or (2); bonus and no-bonus futures differ only with regard to the $d_{i,j}$, the r_i,* and the $c_{i,j}$. Because experience with the bonus is so limited, however, there is as yet no basis for prediction of bonus-era patterns of early reenlistments and extensions. It may reasonably be expected that the bonus *will* cause a larger proportion of NTPOs to extend their initial commitment beyond six years, but it is impossible now to know *how much* larger that proportion will be. Therefore, the bonus and no-bonus scenarios employed here share a common set of $d_{i,j}$'s derived from pre-bonus experience, and differ only with respect to reenlistment rates and direct cost coefficients for YOS-groups six through nine.†

The specific contents of the bonus and no-bonus scenarios, and the procedures used to derive them from the basic data, are presented in App. B.

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*The effect of the NTPO-CB on the r_i is its direct effect, and that on the $d_{i,j}$ is the anticipatory effect.

†Bonus and no-bonus direct cost coefficients do not differ simply by the amount of the NTPO-CB, since acceptance of this new incentive precludes simultaneous receipt of the VRB.

VII. RESULTS

This section's detailed presentation of results serves two purposes. First, the findings and summaries of evidence appearing in Sec. IV, "Overview," are lent additional credibility; and second, attention is turned to several important but technical points omitted from that earlier discussion in the interest of simplification.

The distinction between measures of observed response and projections into the future, employed in the preceding section's description of methodology, is employed again here.

A. MEASURES OF OBSERVED RESPONSE

The Navy identifies members of the NTF by a set of "nuclear-qualified" Navy Enlisted Classification codes (NECs)* and regularly reports reenlistments and eligibles for these NECs, by year of service, in a document called the E218A.† The first reports in the series, covering the period July 1, 1969 to Dec. 31, 1971, were semiannual; subsequent reports have been issued quarterly.

Because the NTPO-CB became available in late October 1972, the E218A for the second quarter of FY1973 (Oct. 1, 1972 to Dec. 31, 1972) contains both pre-bonus and bonus reenlistments and is therefore classified here as transitional. That leaves one full year of reported bonus experience, Jan. 1, 1973 to Dec. 31, 1973, to constitute the bonus period. The pre-bonus period is five quarters long: July 1, 1971 to Sept. 30, 1972.‡

The actual number of reenlistments and eligibles observed during these three periods, reported in Table 8, demonstrates that the pre-bonus

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*Specifically, the submarine component consists of NECs 3351 to 3366; the surface component, NEC 3381 to 3396.

†The E218A also reports reenlistments and eligibles for nonnuclear, submarine-qualified NECs having six-year initial obligations: e.g., Submarine Sonar Technician, NEC 0409.

‡The difference in length of pre-bonus and bonus periods is the result of the aforementioned change in the E218A reporting period. A four-quarter pre-bonus period would have required data for the second quarter of FY1972--but there was a single E218A for the entire first half of that year.

and bonus periods are comparable in terms of volume of experience (number of eligibles) and that the submarine component is dominant, comprising over 75 percent of the total.

Table 8

REENLISTMENTS (R) AND ELIGIBLES (N), BY COMPONENT, BY COMPLETED YEARS OF SERVICE, BY PERIOD

Component	Years of Service	Pre-Bonus		Transition		Bonus	
		R	N	R	N	R	N
Submarine	6	15	518	1	57	51	446
	7	54	253	17	64	105	203
	8	62	180	37	63	147	249
	9	40	89	19	26	81	115
	Total	171	1040	74	210	384	1013
Surface	6	3	196	0	33	5	165
	7	19	71	4	17	18	43
	8	11	44	9	19	28	49
	9	2	15	3	3	17	31
	Total	35	326	16	72	68	288
NTF	6	18	714	1	90	56	611
	7	73	324	21	81	123	246
	8	73	224	46	82	175	298
	9	42	104	22	29	98	146
	Total	206	1366	90	282	452	1301

The first-stage refinement of these basic data appears in Table 9. Without exception, year-specific and total reenlistment rates are seen to rise between pre-bonus and bonus periods. Furthermore, for years seven and eight and total, the increase from pre-bonus to transition to bonus periods is continuous.* This lends support to the contention that the observed improvement in retention is due to the NTPO-CB. That is, if the comparison were simply of two multiquarter periods, an observed increase in reenlistment rates could well be due to factors

*The somewhat anomalous pattern of six-year and nine-year rates, on the other hand, is readily traceable to the paucity of transition-period data--see Table 8.

Table 9

REENLISTMENT RATES (r) AND ELIGIBLES-GROUP PARTICIPATION RATES (n), BY COMPONENT, BY COMPLETED YEARS OF SERVICE, BY PERIOD

(Percent)

Component	Years of Service	Pre-Bonus		Transition		Bonus	
		r	n	r	n	r	n
Submarine	6	0.029	0.498	0.018	0.271	0.114	0.440
	7	0.213	0.243	0.266	0.305	0.517	0.200
	8	0.344	0.173	0.587	0.300	0.590	0.246
	9	0.449	0.086	0.731	0.124	0.704	0.114
	Total	0.164	1.000	0.352	1.000	0.379	1.000
Surface	6	0.015	0.601	0.000	0.458	0.030	0.573
	7	0.268	0.218	0.235	0.236	0.419	0.149
	8	0.250	0.135	0.474	0.264	0.571	0.170
	9	0.133	0.046	1.000	0.042	0.548	0.108
	Total	0.107	1.000	0.222	1.000	0.236	1.000
NTF	6	0.025	0.523	0.011	0.319	0.092	0.470
	7	0.225	0.237	0.259	0.287	0.500	0.189
	8	0.326	0.164	0.561	0.291	0.587	0.229
	9	0.404	0.076	0.759	0.103	0.671	0.112
	Total	0.151	1.000	0.319	1.000	0.347	1.000

unrelated to the bonus. The presence of an intermediate quarter with intermediate reenlistment rates, however, means that such extraneous factors were exactly coincident with the arrival of the NTPO-CB--an unlikely event.

Attribution of the *whole* of the observed change in total reenlistment rates to the bonus, however, is rendered suspect by examination of Table 9's eligibles-group participation rates. Note, for example, that the six-year contingent in the submarine component constituted 49.8 percent of total eligibles in the pre-bonus period, 27.1 percent during transition, and 44.0 percent in the bonus period. These changes in eligibles-group composition, combined with the large gap between six-year reenlistment rates and rates at seven, eight, and nine years,

represent a positive influence on the total rate independent of the NTPO-CB.*

This non-bonus influence is eliminated by the employment of weighted reenlistment rates, which hold participation rates constant at pre-bonus-period levels. Table 10 shows, for instance, that although the observed total NTF reenlistment rate rose from 15.1 percent in the pre-bonus period to 31.9 percent in the transition period, a change of 16.8 percentage points, only about one-third of the rise is attributable to the bonus. That is, if eligibles-group participation rates had equaled pre-bonus levels, the transition-period observed reenlistment rate would not have been 31.9 percent, but 21.7 percent, an increase of only 6.6 percentage points over the pre-bonus rate.

Table 10

BONUS RESPONSE: ACTUAL (r, r') AND WEIGHTED (r'_w) REENLISTMENT RATE LEVELS AND CHANGES (Δ), PRE-BONUS TO TRANSITION PERIODS, BY COMPONENT

(Percent)

Component	r	r'	Δr	r'_w	$\Delta r'_w$
Submarine	0.164	0.352	+0.188	0.238	+0.074
Surface	0.107	0.222	+0.115	0.161	+0.054
NTF	0.151	0.319	+0.168	0.217	+0.066

This eligibles-group composition influence is again observed in Table 11's comparison of pre-bonus and bonus periods. Here, however, the adjustment wrought by the weighted rate is far smaller--on the order of 2.5 percentage points--implying that the influence is more or less random and might disappear entirely with larger samples.

Another possible influence on observed bonus-period reenlistment rates is what might be called "EAOS-jumping." Reenlistments normally occur at the End of Active Obligated Service (EAOS), but *can* occur

*Pre-bonus- and bonus-period participation rates were all forged in a pre-bonus environment. See Sec. IV, A.

Table 11

BONUS RESPONSE: ACTUAL (r, r') AND WEIGHTED (r'_w) REENLISTMENT RATE LEVELS AND CHANGES (Δ), PRE-BONUS TO BONUS PERIODS, BY COMPONENT

(Percent)

Component	r	r'	Δr	r'_w	$\Delta r'_w$
Submarine	0.164	0.379	+0.215	0.345	+0.181
Surface	0.107	0.236	+0.129	0.212	+0.105
NTF	0.151	0.347	+0.196	0.314	+0.163

before that time as well. And if, for example, those men scheduled to reach EAOS several years hence had doubts about the future of the NTPO-CB program, it would make sense for them to cancel current commitments, reenlist, and get the bonus while it was available. Since such actions would add one each to reported reenlistments and eligibles, they would inflate bonus-period rates above long-run expectations.

To check for the presence of this influence, individual service records were used to generate a second set of pre-bonus- and bonus-period reenlistment data--restricted to a sample of NTPOs whose EAOS had been stable during the year before reenlistment. Due to differences in definitions of variables and periods (discussed in App. A), these data are not directly comparable with the E218A. The observed improvement in retention, however, is nevertheless impressive: pre-bonus period, 8.2 percent; bonus period, 27.5 percent.

In summary, the reenlistment rate measure of response unequivocally implies that the NTPO-CB is an effective incentive to extended service. Total NTF, submarine, surface, and year-specific rates are all seen to rise, pre-bonus to bonus periods; weighting the rates, to correct for changes in eligibles-group participation rates, does not substantially reduce the observed response; in most cases, the improvement is continuous, pre-bonus to transition to bonus periods; and the E218A results are corroborated by observations on reenlistment rates derived from files of individual service records.

Table 12 portrays the response to the bonus in somewhat different terms. Pre-bonus-period rates are applied to bonus-period eligibles to estimate the number of reenlistments that would have occurred in the absence of the NTPO-CB. These estimates, titled "No-Bonus Reenlistments" in Table 12, are subtracted from actually observed bonus-period reenlistments to produce the number of bonus-induced reenlistments. The

Table 12

BONUS-INDUCED REENLISTMENTS AND MAN-YEARS, BY COMPONENT, BY COMPLETED YEARS OF SERVICE

Component	Years of Service	Total Reenlistments	No-Bonus Reenlistments[a]	Induced Reenlistments	Reenlistment Term (Years)	Induced Man-Years (ΔMY)
Submarine	6	51	12.9	38.1	4	152.4
	7	105	43.2	61.8	4	247.2
	8	147	85.7	61.3	4	245.2
	9	81	51.6	29.4	3	88.2
	Total	384	193.4	190.6	N.A.	733.0
Surface	6	5	2.5	2.5	4	10.0
	7	18	11.5	6.5	4	26.0
	8	28	12.3	15.7	4	62.8
	9	17	4.1	12.9	3	38.7
	Total	68	30.4	37.6	N.A.	137.5
NTF	6	56	15.3	40.7	4	162.9
	7	123	55.4	67.6	4	270.6
	8	175	97.2	77.8	4	311.4
	9	98	59.0	39.0	3	117.1
	Total	452	226.9	225.1	N.A.	861.9

[a]No-bonus reenlistments are the number that would have been observed had pre-bonus-period rates prevailed.

product of the latter and their respective durations are presented as bonus-induced man-years (ΔMY). These differ from rate measures of response in that they reflect not only *relative* improvement in retention, but also *numbers* of men involved, with the result that the pattern of bonus-response is fairly even across year-groups. Consider, on the one

hand, the six-year group, which showed the smallest absolute change in reenlistment rates, pre-bonus to bonus periods (0.092 - 0.029 = 0.063). But because the six-year pre-bonus rate was so low, the vast majority of reenlistments observed during the bonus period are classified as bonus-induced. This large relative response is further magnified by the sheer volume of six-year bonus-period eligibles: 611, 47.0 percent of the total. The nine-year group, on the other hand, showed the largest absolute change in reenlistment rates, pre-bonus to bonus periods (0.671 - 0.404 = 0.267). But because this is a relatively small proportional increase, and because nine-year eligibles are few in number (146, 11.2 percent of the total),* the contribution of the nine-year group to total NTF additional man-years is actually smaller than that of the six-year group.

The cost of the bonus during its first four full quarters of existence is the subject of Table 13, and again it is interesting to note the relative contributions of the several year-groups. Years seven and eight were dominant, together accounting for almost 70 percent of the total cost. This is natural, since these two year-groups accounted for two-thirds of all reenlistments (298 of 452) and since they also have the highest bonus cost per reenlistee. Also noteworthy is that, in contradistinction to the case of induced man-years, the nine-year cost figure is larger than that at six years. The explanation is simple--bonus-period reenlistments at nine years outnumbered those at six years--but the implication, as will be seen below, is very interesting.

The estimates of bonus-induced man-years and total bonus costs come together in Table 14 to produce bonus costs per bonus-induced man-year--the average unit cost of the retention improvement attributable to the NTPO-CB. The difference between these figures and the actual annual bonus award (which ranges from $3109 to $3346, approximately) is a measure of the amount being paid out in rent, or compensation for doing what would have been done anyway. The average unit cost for the NTF as a whole ($6413), for instance, is consistent with the observed doubling of the overall NTF reenlistment rate. Roughly half of those who reenlisted

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*And because nine-year reenlistments are only three years in duration.

Table 13

BONUS COSTS, PER REENLISTEE AND TOTAL, BY COMPONENT, BY COMPLETED YEARS OF SERVICE

Component	Years of Service	Total Reenlist-ments	Reenlistee Bonus Cost ($)[a]	Total Bonus Cost ($1000)
Submarine	6	51	12,434	634
	7	105	12,910	1,356
	8	147	12,910	1,898
	9	81	10,039	813
	Total	384	N.A.	4,701
Surface	6	5	12,434	62
	7	18	12,910	232
	8	28	12,910	361
	9	17	10,039	171
	Total	68	N.A.	827
NTF	6	56	12,434	696
	7	123	12,910	1,588
	8	175	12,910	2,259
	9	98	10,039	984
	Total	452	N.A.	5,527

[a]Undiscounted sum of current payments and future obligations.

Table 14

BONUS COST PER BONUS-INDUCED MAN-YEAR, TOTAL NTF BY COMPLETED YEARS OF SERVICE (YOS) AND BY COMPONENT

YOS/Group	Induced Man-Years	Total Bonus Cost ($1000)	Bonus Cost per Bonus-Induced Man-Year ($)
6	162.9	696	4273
7	270.6	1588	5868
8	311.4	2259	7254
9	117.1	984	8403
Total	861.9	5527	6413
Total submarine	733.0	4701	6413
Total surface	137.5	827	6015

during the bonus period would have done so even without the NTPO-CB, so the bonus cost per *induced* man-year is roughly twice the bonus cost per *reenlistee* man-year.

Note, too, the large variance across year-groups. Little rent is being paid six-year bonus recipients, since very few of them would have reenlisted in the absence of the NTPO-CB. The higher pre-bonus continuation rates of men with more than six years of service imply correspondingly larger rents. In the extreme, fully 60 percent of bonus-period reenlistments among nine-year eligibles could reasonably have been expected without the NTPO-CB, pushing the bonus cost per induced man-year to almost twice that of six-year men.

B. NTF MANPOWER AND COSTS, FY1974 TO FY1978

Beginning with the actual stock as of June 30, 1973 (derived from files of individual service records), end-of-year NTF manpower stocks were projected for FY1974 through FY1978 under the assumption that the NTPO-CB program continues. The detailed results of the projections are presented in parts a of Tables B-6 through B-11 in App. B. These are paralleled by a set of NTF direct manpower cost* projections (based on 1973 rates of pay and regulations governing promotion, bonus awards, etc.), appearing in parts a of Tables B-12 through B-17.

Projections of NTF manpower under the assumption that the NTPO-CB never came into being begin with an adjustment to the June 30, 1973, stock--to reflect the existence of the bonus during the latter half of FY1973--and continue to June 30, 1978. These constitute parts b of Tables B-6 through B-11 in App. B. No-bonus projections of direct manpower costs, FY1974 through FY1978, appear in parts b of Tables B-12 through B-17.

The projection methodology has already been discussed (in Sec. V, B); detailed descriptions of the bonus and no-bonus projection scenarios and the techniques employed to derive those scenarios appear in App. B. Two observations of a general sort, however, must precede discussion of the

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*Direct manpower cost is defined here as the sum of regular and special pays, allowances, and bonuses. It does not include training, medical, or retirement costs.

projections themselves. First, the bonus scenario incorporates the aforementioned "career effect" of the NTPO-CB: All those projected to reenlist under the influence of the bonus are assumed to reenlist again when they complete their respective bonus terms of service. Second, bonus and no-bonus scenarios alike project a common pattern of early ($2 \leq YOS \leq 5$) extensions. In view of the expected "anticipatory effect" of the NTPO-CB on early extensions, the bonus projections of manpower and costs can be viewed as essentially conservative. That is, it is expected that proportionally fewer NTPOs will become reenlistment-eligible at six years; rather, they will extend to seven or more years to receive proficiency pay and the VRB and then reenlist at rates comparable with those historically evidenced by men with seven or more years. Such behavior would yield larger numbers of reenlistments than projected here, but the limited volume of currently available evidence does not allow estimation of the size of this bias.

Thus, Table 15's projections of reenlistment eligibles do not differ from one scenario to the other. Further, these common projections show an *increasing* fraction of total eligibles falling in the six-year group. The reason is that inputs of newly trained NTPOs were growing rapidly before FY1973 and are projected to remain high (see Table 16). The first members of these larger cohorts to reach reenlistment-eligibility are, of course, those who maintain the initial commitment at six years.

The no-bonus and bonus projections, therefore, compare with one another much as did the measures of observed response, pre-bonus and bonus periods: The presence of the NTPO-CB roughly doubles the total number of reenlistments per year. Over the five-year projection period as a whole, this doubling accumulates to approximately 900 extra, bonus-induced reenlistments (see Table 15f).

The effect of these additional reenlistments on NTF manpower stocks can be seen in Table 16. In its first six months of operation (the latter half of FY1973), the NTPO-CB contributes 81 additional men, concentrated in years six through nine. By FY1974 these men are in the second year of their respective bonus term of enlistment, occupying YOS-groups seven through ten, and are joined by the second wave of bonus-induced reenlistees in years six through nine. As a result, the

Table 15

PROJECTED NTF REENLISTMENTS AND ELIGIBLES, BY COMPLETED YEARS OF SERVICE (YOS), FY1974 TO FY1978

a. FY1974

YOS	Reenlistments		Eligibles
	No-Bonus	Bonus	
6	17	63	756
7	39	87	175
8	58	104	177
9	40	66	98
Total	154	320	1206

b. FY1975

YOS	Reenlistments		Eligibles
	No-Bonus	Bonus	
6	14	52	617
7	28	63	125
8	35	62	106
9	48	80	120
Total	125	257	968

c. FY1976

YOS	Reenlistments		Eligibles
	No-Bonus	Bonus	
6	20	72	858
7	41	92	183
8	52	94	159
9	21	35	52
Total	134	293	1252

d. FY1977

YOS	Reenlistments		Eligibles
	No-Bonus	Bonus	
6	26	94	1119
7	57	127	255
8	50	91	155
9	46	76	113
Total	179	388	1642

e. FY1978

YOS	Reenlistments		Eligibles
	No-Bonus	Bonus	
6	26	94	1119
7	74	165	331
8	70	127	216
9	45	74	110
Total	215	460	1776

f. FY1974-FY1978

YOS	Reenlistments		Eligibles
	No-Bonus	Bonus	
6	103	375	4469
7	239	534	1069
8	265	478	813
9	200	331	493
Total	807	1718	6844

Table 16

NTF MANPOWER, BY COMPLETED YEARS OF SERVICE (YOS), FY1972 TO FY1978

	FY1972	FY1973		FY1974		FY1975		FY1976		FY1977		FY1978	
YOS	Actual	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus
2	1,621	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453	2,453
3	1,350	1,825	1,825	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379
4	1,418	1,286	1,286	1,789	1,789	2,331	2,331	2,331	2,331	2,331	2,331	2,331	2,331
5	944	1,300	1,300	1,209	1,209	1,682	1,682	2,192	2,192	2,192	2,192	2,192	2,192
6	720	405	420	484	530	534	572	743	795	968	1,036	968	1,036
7	596	476	503	245	307	358	436	359	446	501	620	653	808
8	289	373	398	309	379	149	232	214	327	219	338	304	468
9	173	214	228	285	334	213	309	105	196	130	263	136	274
10	121	153	153	195	208	259	304	194	281	95	179	119	239
11	111	115	115	142	142	181	194	241	283	180	262	89	166
12	122	113	113	108	108	134	134	170	182	227	266	169	246
13+	751	794	794	845	845	886	886	948	948	1,041	1,052	1,182	1,229
Total	8,216	9,507	9,588	10,443	10,683	11,559	11,912	12,329	12,813	12,716	13,371	12,975	13,821

difference between bonus and no-bonus projections jumps to 240 additional men. The third wave of bonus-induced reenlistments, in FY1975, brings the number of additional men to 353.

Those who reenlisted with nine years of service in FY1973 will complete their twelfth year in FY1976 and will cease receiving bonus payments. Thus it is in FY1976 that the career effect first shows up, with twelve additional men in YOS-group twelve. This, plus another round of reenlistments, raises the difference between bonus and no-bonus projections of manpower to 484. In FY1977 and FY1978, the career effect is much stronger, including those who reenlisted with six, seven, or eight years of service four years before, or with nine years of service three years before. The difference in total stocks continues to grow, reaching 655 in FY1977 and 846 in the final year of the projection period.

Of particular interest, in light of the expected shortfall of supervisorial manpower, is a comparison of bonus and no-bonus projections with regard to the rate of growth of the *experienced cadre* (YOS = 6+). This group numbered 2883 in FY1972 and, without the NTPO-CB, is projected to grow to 3620 by FY1978, an average annual rate of growth of 3.9 percent. With the bonus, the experienced cadre grows at the rate of 7.6 percent per year, totaling 4466 men in FY1978.

The no-bonus and bonus projections of manpower costs, summarized in Table 17, show a pattern of increasing divergence similar to that of the manpower projections. The bonus projection of total costs is larger by $1.82 million in FY1973, $4.82 in FY1974, $6.96 in FY1975, $9.16 in FY1976, $11.53 in FY1977, and $14.36 in FY1978. These estimates, it should be noted, differ from costs of the NTPO-CB program in a number of ways. First, they reflect the full annual cost of each bonus-induced reenlistee--not just the bonus cost. Second, they include the cost of post-bonus NTPOs. The services of these men are assumed available to the Navy without further recourse to reenlistment incentives, but those services are not free. Third, comparison of bonus and no-bonus projections of costs involves what might be called a "VRB-offset," since an NTPO is not allowed to collect simultaneously both VRB and CB payments. Consider, for example, six-year reenlistees. In the no-bonus scenario they, of course, do not collect the NTPO-CB, but they do receive two more

Table 17

NTF DIRECT MANPOWER COSTS, BY COMPLETED YEARS OF SERVICE (YOS), FY1973 TO FY1978

($ million)

	FY1973		FY1974		FY1975		FY1976		FY1977		FY1978	
YOS	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus	No-Bonus	Bonus
2	22.00	22.00	21.92	21.92	21.92	21.92	21.92	21.92	2.192	21.92	21.92	21.92
3	17.11	17.11	22.22	22.22	22.22	22.22	22.22	22.22	22.22	22.22	22.22	22.22
4	15.31	15.31	21.32	21.32	27.78	27.78	27.78	27.78	27.78	27.78	27.78	27.78
5	17.02	17.02	16.00	16.00	22.26	22.26	29.00	29.00	29.00	29.00	29.00	29.00
6	5.88	6.13	7.02	7.75	7.75	8.35	10.78	11.60	14.04	15.12	14.04	15.12
7	6.91	7.40	3.55	4.58	5.19	6.44	5.21	6.61	7.27	9.19	9.47	11.97
8	4.70	5.38	3.90	5.40	1.88	3.49	2.70	4.78	2.76	4.96	3.83	6.87
9	2.70	3.10	3.59	4.77	2.69	4.73	1.32	3.11	1.64	4.17	1.71	4.35
10	1.98	1.98	2.52	2.90	3.34	4.44	2.50	4.39	1.23	2.80	1.54	3.72
11	1.48	1.48	1.83	1.83	2.34	2.70	3.11	4.13	2.32	3.87	1.15	2.40
12	1.50	1.50	1.43	1.43	1.78	1.78	2.26	2.42	3.01	3.53	2.24	3.26
13+	10.96	10.96	11.66	11.66	12.23	12.23	13.08	13.08	14.36	14.52	16.31	16.96
Total	107.55	109.37	116.96	121.78	131.38	138.34	141.88	151.04	147.55	159.08	151.21	165.57

VRB installments; in the bonus scenario, they collect the NTPO-CB but forego the VRB. Thus, the additional cost during the first two years of the bonus term of enlistment (for six-year reenlistees) is the NTPO-CB award *less* the VRB award.* Similarly, there is a VRB-offset for the first year of the bonus term of reenlistees at seven years.

The most pertinent observation to make concerning Table 17, however, is that the cost of experienced manpower--bonus or no-bonus--constitutes a rather small fraction of total costs. Rather, the costliest personnel are "first-termers"--men with two to five years of service. In the no-bonus projection, their share of total costs ranges from 66.4 percent in FY1973 to 66.7 percent in FY1978. The addition of the NTPO-CB changes these shares only slightly: 65.3 percent in FY1973, 61.0 percent in FY1978.

The costliness of first-termers is also apparent with regard to the *growth* in total costs. Of the $58.02 million projected increase, no-bonus FY1973 to bonus FY1978, first-term pay accounts for $29.48 million or 50.8 percent; the growth in numbers and rates of pay of all other year-groups together account for the rest: $28.54 million, 49.2 percent of projected growth in total costs.

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*For an E6 with six years of service, the NTPO-CB annual award would be $3109; the VRB, $2195. Thus, in this case, the additional cost during each of the first two years of the bonus term is only $914.

VIII. PLANS FOR FURTHER RESEARCH

The results presented in this report are preliminary in two senses. First, because the NTPO-CB has been in existence for such a short time, experience is necessarily limited. As time passes, additional data will become available, increasing the degree of precision. Second, each of the analytical approaches employed here is at an initial stage of development and would profit greatly by further work.

It has already been noted that long-range forecasting of reenlistment behavior is incompatible with the assumption employed here that influences other than the military wage remain unchanged. High on the agenda of further research, therefore, is more *explicit* modeling of the reenlistment and extension decision processes.

From the point of view of NTF management, the determinants of these processes may be broadly characterized as either exogenous or discretionary. In the exogenous group are such factors as the extent and attractiveness of competing civilian alternatives* and societal attitudes toward military service in general.

Among the group of factors over which the Navy has some control, the NTF income stream is the most obvious, but it does not stand alone. It has already been remarked that individuals can be expected to have differing attitudes concerning nonpecuniary aspects of alternative occupations; if such attitudinal differences can be (in part) related to objectively measurable personal characteristics, the NTF entry screening process could be used to increase the probability of career decisions.

Consider, for example, dependency status. One of the most striking differences between the NTF and its civilian competition is the degree of isolation. The civilian employee goes to work in the morning and returns home that evening. This is also true of Polaris/Poseidon submarine crewmen--for 90 days at a time. Then comes the NTPO's rotation to sea

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*It is widely felt that the Navy's chief competition is the civilian nuclear power industry. Further research will seek not only to estimate the number and financial rewards of such positions, but also to determine what fraction of men leaving the NTF actually take such jobs.

duty: He goes to work in the morning and returns home two months later.* Other things being equal, this aspect of isolation might be expected to have different effects on married and single men.†

The mechanism by which such personal characteristics, military wages, societal attitudes, etc. affect NTF manpower stocks and flows is undoubtedly complex. Symbolically, however, it may be represented quite simply. Consider a vector $\underline{\underline{D}}$, consisting of the YOS-group, YOC-distribution parameters d_{ij} (defined in Sec. VI, B above) and a vector $\underline{\underline{R}}$, containing year-specific reenlistment rates r_i (defined in Sec. VI, A). Explicit modeling of the extension and reenlistment processes may then be defined as the econometric estimation of

$$\underline{\underline{D}} = f(W_m, P, C)$$

and

$$\underline{\underline{R}} = g(W_m, P, C) \text{ ,}^{\ddagger}$$

where W_m is the NTF income stream,

P is a vector of personal characteristics,

C is a vector describing civilian employment alternatives.

Choices regarding the precise nature of the independent variables (e.g., *which* personal characteristics) and assumed functional forms of relationships are best based on the criterion of explanatory power, that is, how well the estimated model predicts actual behavior.

The second promising path for further work concerns the NTF simulation procedure. The one used here is manually operated and therefore

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*According to current plans, crews of Trident-class submarines will spend 70 days at sea, followed by 120 days in home port. *Navy Times*, February 20, 1974, p. 34.

†Married men may object strongly to separation from their families; single men may regard their periodic absences as serious deterrents to *formation* of families. The relative effect cannot be determined a priori, but statistically.

‡These equations are meant to be purely illustrative. Before they could be estimated, they would have to be statistically identified.

limited in flexibility by the stamina of the analyst. A computer, on the other hand, is tireless; and development of a software NTF simulation package would allow investigation of its sensitivity to varying assumptions and/or the plotting of *alternative* NTF futures under differing management strategies.

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Appendix A

A DERIVED REENLISTMENT DATA SET

One of the assumptions made in this report is that the reenlistment decision is taken at EAOS, that is, the eligible pool contains only men coming to the end of standing commitments. However, the fact is that an NTPO may be allowed to cancel an existing extension agreement and reenlist pre-EAOS.

Under a stable set of incentive stimuli, such pre-EAOS activity is probably limited to near insignificance. But when the incentive system is substantially altered, as with the arrival of the NTPO-CB, pre-EAOS reenlistments might bulk large in the short run. On the one hand, such pre-EAOS activity might reflect individual decisions concerning long-run optimality: Had the NTPO-CB existed at the beginning of the current extension, such an extension would never have been made. Or the extension cancellation may be caused by uncertainty about the future: Reenlist and get the CB now, for the program may have disappeared by the time EAOS rolls around.

The E218A does not allow determination of the extent of such pre-EAOS activity, since total eligibles are defined as reenlistments plus eligible losses. Commitment cancellation therefore artificially inflates E218A reenlistment rates by adding one each to the numerator and denominator.*

In an effort to check for such bias in observed reenlistment rates, attention was focused on a group of NTPOs having EAOS during the second half of FY1973 (the first two full quarters of CB availability), recorded as of June 30, 1972--well before the CB appeared. Their subsequent actions were inferred from observed changes in EAOS as of June 30, 1973, or from their appearance on the FY1973 loss file. YOS at the time of reenlistment was defined as 1973 minus fiscal year of active duty base date.

A pre-bonus period control group was similarly constructed. It consists of those having EAOS in the second half of FY1972, recorded

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*That is, the only pre-EAOS activity *allowed* is reenlistment.

as of June 30, 1971; and their subsequent behavior was inferred from the FY1972 master active and loss files.

The results appear in Table A-1. Reenlistments are defined as changes in EAOS of three years or more, and eligibles are reenlistments plus losses. The figures are not directly comparable with those based on the E218A, but it is noteworthy that, here as there, the overall reenlistment rate has increased dramatically, pre-bonus to bonus periods.

Table A-1

REENLISTMENTS (R), ELIGIBLES (N), AND RATES (r, %), PRE-BONUS AND BONUS PERIODS, BY COMPLETED YEARS OF SERVICE (YOS), RESTRICTED SAMPLE[a]

	Pre-Bonus			Bonus			
YOS	R	N	r	R′	N′	r′	Δr
6	2	282	0.007	4	206	0.019	+0.012
7	16	95	0.168	34	99	0.343	+0.175
8	17	92	0.185	72	139	0.518	+0 333
9	5	20	0.250	19	25	0.760	+0.510
Total	40	489	0.082	129	469	0.275	+0.193

[a]See the text for variable definitions and a description of sample restriction.

Appendix B

SIMULATION AND COST-IMPUTATION PARAMETERS

The technical details of the NTF simulation process used in this report fall into four categories:

1. Presimulation adjustments of actual data.
2. Estimation of YOS-group survival rates.
3. Estimation of YOC-distribution parameters for YOS-groups two through five.
4. Adjustment of E218A-based reenlistment rates for YOS-groups six through nine.

These are discussed in turn below, followed by a brief description of the direct cost imputation process. Except as noted, the discussion applies to both bonus and no-bonus scenarios.

PRESIMULATION ADJUSTMENTS OF ACTUAL DATA

The individual service records on which the simulation rests do not record directly either completed years of service (YOS) or remaining years of commitment (YOC). YOS was defined as fiscal year of file update minus fiscal year of active duty base date (ADBD). Thus, for example, the NTF contained 1286 men with ADBD in FY1969 as of June 30, 1973, which translates to YOS = 4 (1973 - 1969) in Table B-6a. The YOC number is similarly defined as fiscal year of recorded end of active obligated service (EAOS) minus fiscal year of file update. To continue the example, 87 of the above-mentioned 1286 men had recorded EAOS in FY1976 as of June 30, 1973, which translates to YOC = 3 in Table B-6a.

This YOC definition led to two sorts of contradictions between the data base and the analytical model. The easier to rectify were observations of NTPOs in YOS-groups two, three, and four with total commitment (i.e., EAOS - ABDB) of less than six years. It was assumed in such cases that the automatic (and mandatory) two-year extension had not yet been recorded; these cells were added to the minimum-service cells in each

YOS-group YOC-distribution. The other sort of contradiction observed were YOCs exceeding those specified by the model as maximum. For example, the model limits YOS-group three to a maximum YOC of six; the data show that some members of this group have YOC of seven or more. But since such a commitment would carry an individual beyond the ten-year ceiling on NTPO-CB eligibility (YOS + YOC = 3 + 7 = 10), it seems reasonable to assume the commitment would eventually be reduced to a total of (at most) nine years.* There seemed to be little point in modeling such commitments and then also having to model the subsequent commitment cancellation; rather, these observations were simply added to the maximum-allowable YOC-cell in each YOS-group distribution. In neither case, it should be noted, did such aberrations number more than a few percent of the total in the YOS-group.

YOS-GROUP SURVIVAL RATES

The data on which the simulation's survival rates were based are presented in Table B-1. Starting at the bottom, the survival rates for YOS-groups ten and more are meant to reflect *all* losses; year-end group sizes and subsequent-year losses therefore include all YOCs. Moving upward in the table, the rates for YOS-groups six through nine are meant to reflect only pre-EAOS losses;† year-group sizes and losses are in consequence limited to those NTPOs for whom YOC ≥ 2. YOS-groups two through four by regulation suffer only pre-EAOS losses; therefore, the numbers in Table B-1 for these years include all YOCs.

YOS-group five's special nature requires separate discussion. The model assumes, for the sake of convenience, that inputs of new NTPOs take place only on the first day of each fiscal year. Thus, those petty officers listed as belonging to YOS-group five at year's end are assumed to have *exactly* five years of completed service, and *none* of them are assumed to become reenlistment-eligible during the ensuing year. The model's survival rate for year five, therefore, is meant to reflect

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*Assuming, of course, that the NTPO involved puts some positive subjective value on extra income. For an explanation of commitment reduction, see App. A.

†Because losses *at* EAOS are reflected in reenlistment rates.

Table B-1

COMPLETED YEARS OF SERVICE (YOS)-GROUP SIZES, SUBSEQUENT-YEAR LOSSES, AND SURVIVAL RATES (%)

YOS	Size 6/30/71	Losses FY1972	Survival Rate	Size 6/30/72	Losses FY1973	Survival Rate	Survival Rate (avg.)
2	988	40	0.960	1621	21	0.987	0.97
3	1553	48	0.969	1350	16	0.988	0.98
4	1063	74	0.930	1418	80	0.944	0.94
5	774	49	0.937	406	22	0.946	0.94
6	635	60	0.906	442	15	0.966	0.94
7	261	32	0.877	308	22	0.929	0.90
8	162	22	0.864	173	5	0.971	0.92
9	140	21	0.850	125	4	0.968	0.91
10	136	17	0.875	121	1	0.992	0.93
11	150	17	0.887	111	1	0.991	0.94
12	143	16	0.888	122	1	0.992	0.94
13+	786	70	0.911	751	37	0.951	0.93

only pre-EAOS losses--like those for years two through four. Of course, new inputs occur throughout the year, and some of those listed in the data as belonging to YOS-group five will nevertheless reach EAOS in the ensuing year. Thus, although the model treats this group like groups two through four, Table B-1 treats it like groups six through nine (see above).

One final comment is in order, on the survival rate for YOS-group thirteen plus. If the NTF were in steady-state equilibrium, each year's stock of manpower looking just like that of the year before, the rate used here (93 percent) would imply retirement at about twenty-seven years of service.* In fact, the NTF is sufficiently young that significant

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*Let n = the size of YOS-group 13+, x = yearly input, and 0.93 = survival rate. In steady-state equilibrium, n is constant from one year to the next. Thus,

$$0.93n + x = n$$

or

$$n = 14.3x \ .$$

If everyone retires at the same YOS, each YOS-group within the group 13+ is the same size as the yearly input. This implies, in turn, that there must be at least 14 different YOS-groups within the group 13+, and that YOS at retirement is at least 27 (13 + 14 = 27).

retirement losses need not be expected during the five-year projection period used here.

YOC-DISTRIBUTION PARAMETERS

Reenlistments and extensions during the initial period of commitment are implicitly represented in the simulation model by differences in the distributions by YOC of YOS-groups two through five. Further, the model assumes future members of these groups duplicate the behavior of previous members, so that the *fractions* of the total number winding up in each YOC-category do not change from observation to projection periods.

Four different files of individual service records--updates as of June 30, 1971, June 30, 1972, Dec. 31, 1972, and June 30, 1973--were processed as described in Part One above to produce four different sets of distributions of YOS-groups two through five by YOC. Each YOC-cell was then divided by the total number in the corresponding YOS-group to generate the normalized distribution parameters of Table B-2. The values used in the simulation are simple arithmetic averages of these parameters; but the uneven spacing of file updates used puts extra weight on most recent experience.

REENLISTMENT RATES, YEARS SIX THROUGH NINE

As noted in App. A, the E218A defines eligibles as reenlistments plus eligible losses, whereas the best estimate of eligibles that can be derived from individual service record data is total number reaching EAOS. If a significant fraction of this number is declared ineligible to reenlist, use of E218A-based reenlistment rates will *overstate* the number of reenlistments to be expected.

The extent of such possible bias was investigated by using the simulation model to predict reenlistment eligibles by YOS for FY1972 and FY1973; and these predictions were then compared with totals recorded in the E218A for the same years. The results of this effort are given in Table B-3; and while it is clear that the two sets of numbers show a good deal of variance, note that for years seven, eight, and nine the variance is not systematic. That is, the prediction is

Table B-2

COMPLETED YEARS OF SERVICE (YOS)-GROUP NORMALIZED DISTRIBUTIONS BY REMAINING YEARS OF COMMITMENT (YOC), SELECTED DATES

(Percent)

YOS	DOF[a]	YOC 1	2	3	4	5	6
2	1	---	---	---	0.825	0.029	0.145
	2	---	---	---	0.745	0.029	0.226
	3	---	---	---	0.837	0.012	0.152
	4	---	---	---	0.750	0.027	0.222
	Avg.	---	---	---	0.789	0.024	0.187
3	1	---	---	0.715	0.072	0.138	0.074
	2	---	---	0.674	0.055	0.153	0.117
	3	---	---	0.626	0.051	0.233	0.090
	4	---	---	0.600	0.062	0.238	0.100
	Avg.	---	---	0.654	0.060	0.191	0.095
4	1	---	0.597	0.223	0.107	0.074	---
	2	---	0.643	0.090	0.153	0.114	---
	3	---	0.646	0.063	0.158	0.133	---
	4	---	0.633	0.067	0.167	0.134	---
	Avg.	---	0.630	0.111	0.146	0.113	---
5	1	0.438	0.243	0.171	0.144	---	---
	2	0.524	0.236	0.139	0.100	---	---
	3	0.616	0.099	0.160	0.125	---	---
	4	0.593	0.107	0.169	0.131	---	---
	Avg.	0.543	0.171	0.161	0.125	---	---

[a]Date of File = 1, June 30, 1971; 2, June 30, 1972; 3, Dec. 31, 1972; 4, June 30, 1973; Avg., arithmetic average.

Table B-3

PREDICTED AND ACTUAL REENLISTMENT ELIGIBLES, FY1972 TO FY1973, BY COMPLETED YEARS OF SERVICE (YOS)

YOS	FY1972 Predicted	FY1972 Actual	FY1973 Predicted	FY1973 Actual
6	660	597	506	466
7	241	225	261	274
8	211	142	259	310
9	81	65	107	146
Total	1193	1029	1133	1196

too high one year, too low the other. The inference drawn from this evidence was that use of unadjusted E218A-based reenlistment rates as predictors for these YOS-groups would not result in serious bias of the results.

The prediction for YOS-group six, however, is too high in both years. A purely speculative explanation is that reenlistment-ineligibility, to the extent that it occurs, might be expected to be concentrated in the group least favorably disposed to service in the NTF.* In any event, E218A-based reenlistment rate for YOS-group six was adjusted downward by the factor 0.913 to reflect the observed difference between predicted and actual eligibles.†

Bonus-scenario reenlistment rates are those observed during the first four full quarters of experience with the NTPO-CB; the no-bonus scenario employs rates observed during the final five quarters before the arrival of the NTPO-CB. (See Table 9, Sec. VII above.)

DIRECT COST IMPUTATION

The manpower stock projections were converted to direct cost estimates by multiplying the number in each YOS-, YOC-cell by an estimate of annual income of men in that position, derived from 1973 pay tables and rules governing the awarding of special pays and reenlistment bonuses. The typical NTPO is assumed to be married with two dependents and to be promoted in the pattern of Table 2, Sec. III, above.

The no-bonus projection cost estimates are presented in Table B-4. The first entry in the first four rows is smaller than the rest because men in these slots have not extended beyond the minimum six years and are therefore not eligible for proficiency pay. Beginning with YOS six, all members of a particular year-group receive the same compensation. The income figure in the final row (YOS thirteen plus) is a rough approximation, corresponding to YOS sixteen.

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*Other things being equal, the negative disposition of YOS-group six may reasonably be inferred from its unswerving resistance to incentives to extended service.

†That is,

$$0.913 = \frac{1}{2}\left(\frac{597}{660} + \frac{466}{506}\right).$$

Table B-4

ESTIMATED NTPO ANNUAL INCOME, ALL SOURCES, BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), NO-BONUS SCENARIO

(Dollars)

	YOC					
YOS	1	2	3	4	5	6
2	---	---	---	8,682	9,882	9,882
3	---	---	8,926	10,126	10,126	10,126
4	---	11,475	12,675	12,675	12,675	---
5	12,409	14,209	14,209	14,209	---	---
6	14,507	14,507	14,507	14,507	---	---
7	14,507	14,507	14,507	14,507	---	---
8	12,609	12,609	12,609	12,609	---	---
9	12,609	12,609	12,609	12,609	---	---
10	12,911	12,911	12,911	12,911	---	---
11	12,911	12,911	12,911	12,911	---	---
12	13,271	13,271	13,271	13,271	---	---
13+	13,799	13,799	13,799	13,799	---	---

The arrival of the NTPO-CB progressively alters this cost matrix, as shown by Table B-5, parts a-d. Those cells having identical income estimates, bonus and no-bonus scenarios, are suppressed in the interest of clarity. Thus, in FY1973 (part a) the NTPO-CB affects only those who have just reenlisted: (YOS, YOC) = (6,4), (7,4), (8,4), or (9,3). In FY1974 (part b) these men will be receiving their second NTPO-CB installment in cells (7,3), (8,3), (9,3), and (10,2). Coverage extends to the third year of the bonus term (8,2), (9,2), (10,2), and (11,1) in FY1975 (part c) and becomes complete in FY1976 (part d).

Detailed results of the NTF manpower projections are presented in Tables B-6 to B-11. Parts a of those tables pertain to the bonus scenario; parts b to the no-bonus scenario.

Detailed results of the NTF manpower cost projections appear in Tables B-12 to B-17, also divided into parts a (bonus scenario) and b (no-bonus scenario).

Table B-5

ESTIMATED NTPO ANNUAL INCOME, ALL SOURCES, BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), BONUS SCENARIO[a]

(Dollars)

YOS	YOC 1	2	3	4	5	6
a. FY1973						
6	---	---	---	15,421	---	---
7	---	---	---	15,539	---	---
8	---	---	---	15,836	---	---
9	---	---	15,896	---	---	---
b. FY1974						
6	---	---	---	15,421	---	---
7	---	---	15,421	15,539	---	---
8	---	---	15,836	15,836	---	---
9	---	---	15,896	---	---	---
10	---	16,198	---	---	---	---
c. FY1975						
6	---	---	---	15,421	---	---
7	---	---	15,421	15,539	---	---
8	---	15,718	15,836	15,836	---	---
9	---	15,836	15,896	---	---	---
10	---	16,198	---	---	---	---
11	16,198	---	---	---	---	---
d. FY1976 to FY1978						
6	---	---	---	15,421	---	---
7	---	---	15,421	15,539	---	---
8	---	15,718	15,836	15,836	---	---
9	15,718	15,836	15,896	---	---	---
10	16,138	16,198	---	---	---	---
11	16,198	---	---	---	---	---

[a]For the sake of clarity, those cells having *identical* income estimates, bonus and no-bonus scenarios, are suppressed. See Table B-4.

Table B-6a

ACTUAL NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1973, BONUS SCENARIO

	YOC						
YOS	1	2	3	4	5	6	Total
2	0	0	0	1866	69	518	2453
3	0	0	1142	105	407	171	1825
4	0	827	87	205	167	---	1286
5	804	141	200	155	---	---	1300
6	186	125	67	42	---	---	420
7	197	144	65	97	---	---	503
8	107	74	104	113	---	---	398
9	61	77	70	20	---	---	228
10	53	56	23	21	---	---	153
11	39	48	14	14	---	---	115
12	37	44	18	14	---	---	113
13+	286	275	126	107	---	---	794
Total	1770	1811	1916	2759	643	689	9588

Table B-6b

ESTIMATED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1973, NO-BONUS SCENARIO

	YOC						
YOS	1	2	3	4	5	6	Total
2	0	0	0	1866	69	518	2453
3	0	0	1142	105	407	171	1825
4	0	827	87	205	167	---	1286
5	804	141	200	155	---	---	1300
6	186	125	67	27	---	---	405
7	197	144	65	70	---	---	476
8	107	74	104	88	---	---	373
9	61	77	56	20	---	---	214
10	53	56	23	21	---	---	153
11	39	48	14	14	---	---	115
12	37	44	18	14	---	---	113
13+	286	275	126	107	---	---	794
Total	1770	1811	1902	2692	643	689	9507

Table B-7a

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1974, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,127	199	261	202	---	1,789
5	656	207	195	151	---	---	1,209
6	133	188	146	63	---	---	530
7	118	63	39	87	---	---	307
8	130	58	87	104	---	---	379
9	68	96	170	---	---	---	334
10	70	64	18	56	---	---	208
11	52	21	20	49	---	---	142
12	45	13	13	37	---	---	108
13+	297	134	113	301	---	---	845
Total	1,569	1,971	2,556	3,187	715	685	10,683

Table B-7b

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1974, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,127	199	261	202	---	1,789
5	656	207	195	151	---	---	1,209
6	133	188	146	17	---	---	484
7	118	63	25	39	---	---	245
8	130	58	63	58	---	---	309
9	68	96	121	---	---	---	285
10	70	51	18	56	---	---	195
11	52	21	20	49	---	---	142
12	45	13	13	37	---	---	108
13+	297	134	113	301	---	---	845
Total	1,569	1,958	2,469	3,047	715	685	10,443

Table B-8a

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1975, BONUS SCENARIO

	YOC						
YOS	1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	913	288	271	210	---	---	1,682
6	195	183	142	52	---	---	572
7	177	137	59	63	---	---	436
8	57	35	78	62	---	---	232
9	53	80	176	---	---	---	309
10	87	155	---	62	---	---	304
11	60	17	52	65	---	---	194
12	20	19	46	49	---	---	134
13+	137	117	314	318	---	---	886
Total	1,699	2,500	2,953	3,299	776	685	11,912

Table B-8b

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1975, NO-BONUS SCENARIO

	YOC						
YOS	1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	913	288	271	210	---	---	1,682
6	195	183	142	14	---	---	534
7	177	137	16	28	---	---	358
8	57	22	35	35	---	---	149
9	53	58	102	---	---	---	213
10	37	110	---	62	---	---	259
11	47	17	52	65	---	---	181
12	20	19	46	49	---	---	134
13+	137	117	314	318	---	---	886
Total	1,686	2,420	2,793	3,199	776	685	11,559

Table B-9a

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1976, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	1,190	375	353	274	---	---	2,192
6	271	255	197	72	---	---	795
7	172	133	49	92	---	---	446
8	123	53	57	94	---	---	327
9	32	72	92	---	---	---	196
10	73	160	---	48	---	---	281
11	144	---	58	81	---	---	283
12	16	49	61	56	---	---	182
13+	126	335	341	146	---	---	948
Total	2,147	2,901	3,023	3,281	776	685	12,813

Table B-9b

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1976, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	1,190	375	353	274	---	---	2,192
6	271	255	197	20	---	---	743
7	172	133	13	41	---	---	359
8	123	14	25	52	---	---	214
9	20	32	53	---	---	---	105
10	53	93	---	48	---	---	194
11	102	---	58	81	---	---	241
12	16	49	61	44	---	---	170
13+	126	335	341	146	---	---	948
Total	2,073	2,755	2,916	3,124	776	685	12,329

Table B-10a

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1977, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	1,190	375	353	274	---	---	2,192
6	352	332	258	94	---	---	1,036
7	240	185	68	127	---	---	620
8	120	44	83	91	---	---	338
9	49	52	162	---	---	---	263
10	66	84	---	29	---	---	179
11	149	---	45	68	---	---	262
12	---	55	76	135	---	---	266
13+	358	374	188	132	---	---	1,052
Total	2,524	2,970	3,048	3,368	776	685	13,371

Table B-10b

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1977, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	1,190	375	353	274	---	---	2,192
6	352	332	258	26	---	---	968
7	240	185	19	57	---	---	501
8	120	12	37	50	---	---	219
9	13	23	94	---	---	---	130
10	29	48	---	18	---	---	95
11	86	---	45	49	---	---	180
12	---	55	76	96	---	---	227
13+	358	374	177	132	---	---	1,041
Total	2,388	2,873	2,874	3,120	776	685	12,716

Table B-11a

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1978, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	1,190	375	353	274	---	---	2,192
6	352	332	258	94	---	---	1,036
7	312	243	88	165	---	---	808
8	166	61	114	127	---	---	468
9	40	76	158	---	---	---	274
10	47	147	---	45	---	---	239
11	78	---	2[illegible]	61	---	---	166
12	---	42	64	140	---	---	246
13+	400	246	250	333	---	---	1,229
Total	2,585	2,991	3,127	3,657	776	685	13,821

Table B-11b

PROJECTED NTF MANPOWER BY COMPLETED YEARS OF SERVICE (YOS), BY REMAINING YEARS OF COMMITMENT (YOC), AS OF JUNE 30, 1978, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	0	0	0	1,935	59	459	2,453
3	0	0	1,556	143	454	226	2,379
4	0	1,469	259	340	263	---	2,331
5	1,190	375	353	274	---	---	2,192
6	352	332	258	26	---	---	968
7	312	243	24	74	---	---	653
8	166	17	51	70	---	---	304
9	11	34	91	---	---	---	136
10	21	86	---	12	---	---	119
11	45	---	17	27	---	---	89
12	---	42	46	81	---	---	169
13+	400	236	213	333	---	---	1,182
Total	2,497	2,834	2,868	3,315	776	685	12,975

Table B-12a

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1973, BONUS SCENARIO

	YOC						
YOS	1	2	3	4	5	6	Total
2	---	---	---	16.20	0.68	5.12	22.00
3	---	---	10.19	1.06	4.12	1.73	17.11
4	---	9.49	1.10	2.60	2.12	---	15.31
5	9.98	2.00	2.84	2.20	---	---	17.02
6	2.70	1.81	0.97	0.65	---	---	6.13
7	2.86	2.09	0.94	1.51	---	---	7.40
8	1.35	0.93	1.31	1.79	---	---	5.38
9	0.77	0.97	1.11	0.25	---	---	3.10
10	0.68	0.72	0.30	0.27	---	---	1.98
11	0.50	0.62	0.18	0.18	---	---	1.48
12	0.49	0.58	0.24	0.19	---	---	1.50
13+	3.95	3.79	1.74	1.48	---	---	10.96
Total							109.37

Table B-12b

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1973, NO-BONUS SCENARIO

	YOC						
YOS	1	2	3	4	5	6	Total
2	---	---	---	16.20	0.68	5.12	22.00
3	---	---	10.19	1.06	4.12	1.73	17.11
4	---	9.49	1.10	2.60	2.12	---	15.31
5	9.98	2.00	2.84	2.20	---	---	17.02
6	2.70	1.81	0.97	0.39	---	---	5.88
7	2.86	2.09	0.94	1.02	---	---	6.91
8	1.35	0.93	1.31	1.11	---	---	4.70
9	0.77	0.97	0.71	0.25	---	---	2.70
10	0.68	0.72	0.30	0.27	---	---	1.98
11	0.50	0.62	0.18	0.18	---	---	1.48
12	0.49	0.58	0.24	0.19	---	---	1.50
13+	3.95	3.79	1.74	1.48	---	---	10.96
Total							107.55

Table B-13a

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1974, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	16.80	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	12.93	2.52	3.31	2.56	---	21.32
5	8.14	2.94	2.77	2.15	---	---	16.00
6	1.93	2.73	2.12	0.97	---	---	7.75
7	1.71	0.91	0.60	1.35	---	---	4.58
8	1.64	0.73	1.38	1.65	---	---	5.40
9	0.86	1.21	2.70	---	---	---	4.77
10	0.90	1.04	0.23	0.72	---	---	2.90
11	0.67	0.27	0.26	0.63	---	---	1.83
12	0.60	0.17	0.17	0.49	---	---	1.43
13+	4.10	1.85	1.56	4.15	---	---	11.66
Total							121.78

Table B-13b

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1974, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	16.80	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	12.93	2.52	3.31	2.56	---	21.32
5	8.14	2.94	2.77	2.15	---	---	16.00
6	1.93	2.73	2.12	0.25	---	---	7.02
7	1.71	0.91	0.36	0.57	---	---	3.55
8	1.64	0.73	0.79	0.73	---	---	3.90
9	0.86	1.21	1.53	---	---	---	3.59
10	0.90	0.66	0.23	0.72	---	---	2.52
11	0.67	0.27	0.26	0.63	---	---	1.83
12	0.60	0.17	0.17	0.49	---	---	1.43
13+	4.10	1.85	1.56	4.15	---	---	11.66
Total							116.96

Table B-14a

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1975, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	11.33	4.09	3.85	2.98	---	---	22.26
6	2.83	2.65	2.06	0.80	---	---	8.35
7	2.57	1.99	0.91	0.98	---	---	6.44
8	0.72	0.55	1.24	0.98	---	---	3.49
9	0.67	1.27	2.80	---	---	---	4.73
10	1.12	2.51	---	0.80	---	---	4.44
11	0.97	0.22	0.67	0.84	---	---	2.70
12	0.27	0.25	0.61	0.65	---	---	1.78
13+	1.89	1.61	4.33	4.39	---	---	12.23
Total							138.34

Table B-14b

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1975, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	11.33	4.09	3.85	2.98	---	---	22.26
6	2.83	2.65	2.06	0.20	---	---	7.75
7	2.57	1.99	0.23	0.41	---	---	5.19
8	0.72	0.28	0.44	0.44	---	---	1.88
9	0.67	0.73	1.29	---	---	---	2.69
10	1.12	1.42	---	0.80	---	---	3.34
11	0.61	0.22	0.67	0.84	---	---	2.34
12	0.27	0.25	0.61	0.65	---	---	1.78
13+	1.89	1.61	4.33	4.39	---	---	12.23
Total							131.38

Table B-15a

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1976, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	14.77	5.33	5.02	3.89	---	---	29.00
6	3.93	3.70	2.86	1.11	---	---	11.60
7	2.50	1.93	0.76	1.43	---	---	6.61
8	1.55	0.83	0.90	1.49	---	---	4.78
9	0.50	1.14	1.46	---	---	---	3.11
10	1.18	2.59	---	0.62	---	---	4.39
11	2.33	---	0.75	1.05	---	---	4.13
12	0.21	0.65	0.81	0.74	---	---	2.42
13+	1.74	4.62	4.71	2.01	---	---	13.08
Total							151.04

Table B-15b

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1976, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	14.77	5.33	5.02	3.89	---	---	29.00
6	3.93	3.70	2.86	0.29	---	---	10.78
7	2.50	1.93	0.19	0.59	---	---	5.21
8	1.55	0.18	0.32	0.66	---	---	2.70
9	0.25	0.40	0.67	---	---	---	1.32
10	0.68	1.20	---	0.62	---	---	2.50
11	1.32	---	0.75	1.05	---	---	3.11
12	0.21	0.65	0.81	0.58	---	---	2.26
13+	1.74	4.62	4.71	2.01	---	---	13.08
Total							141.88

Table B-16a

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1977, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	14.77	5.33	5.02	3.89	---	---	29.00
6	5.11	4.82	3.74	1.45	---	---	15.12
7	3.48	2.68	1.05	1.97	---	---	9.19
8	1.51	0.69	1.31	1.44	---	---	4.96
9	0.77	0.82	2.58	---	---	---	4.17
10	1.07	1.36	---	0.37	---	---	2.80
11	2.41	---	0.58	0.88	---	---	3.87
12	---	0.73	1.01	1.79	---	---	3.53
13+	4.94	5.16	2.59	1.82	---	---	14.52
Total							159.08

Table B-16b

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1977, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	14.77	5.33	5.02	3.89	---	---	29.00
6	5.11	4.82	3.74	0.38	---	---	14.04
7	3.48	2.68	0.28	0.83	---	---	7.27
8	1.51	0.15	0.47	0.63	---	---	2.76
9	0.16	0.29	1.19	---	---	---	1.64
10	0.37	0.62	---	0.23	---	---	1.23
11	1.11	---	0.58	0.63	---	---	2.32
12	---	0.73	1.01	1.27	---	---	3.01
13+	4.94	5.16	2.44	1.82	---	---	14.36
Total							147.55

Table B-17a

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1978, BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	14.77	5.33	5.02	3.89	---	---	29.00
6	5.11	4.82	3.74	1.45	---	---	15.12
7	4.53	3.53	1.36	2.56	---	---	11.97
8	2.09	0.96	1.81	2.01	---	---	6.87
9	0.63	1.20	2.51	---	---	---	4.35
10	0.76	2.38	---	0.58	---	---	3.72
11	1.26	---	0.35	0.79	---	---	2.40
12	---	0.56	0.85	1.86	---	---	3.26
13+	5.52	3.39	3.45	4.60	---	---	16.96
Total							165.57

Table B-17b

ESTIMATED NTF DIRECT MANPOWER COSTS ($ × 10^6), FY1978, NO-BONUS SCENARIO

YOS	YOC 1	2	3	4	5	6	Total
2	---	---	---	19.12	0.58	4.54	21.92
3	---	---	13.89	1.45	4.60	2.29	22.22
4	---	16.86	3.28	4.31	3.33	---	27.78
5	14.77	5.33	5.02	3.89	---	---	29.00
6	5.11	4.82	3.72	0.38	---	---	14.04
7	4.53	3.53	0.35	1.07	---	---	9.47
8	2.09	0.21	0.64	0.88	---	---	3.83
9	0.14	0.43	1.15	---	---	---	1.71
10	0.27	1.11	---	0.15	---	---	1.54
11	0.58	---	0.22	0.35	---	---	1.15
12	---	0.56	0.61	1.07	---	---	2.24
13+	5.52	3.26	2.94	4.60	---	---	16.31
Total							151.21

Appendix C

BASIC DATA SERIES

The E218A data on reenlistments and eligibles were aggregated to NTF component totals before aggregation to pre-bonus, transition, and bonus periods. The results of this intermediate aggregation are presented in Tables C-1 and C-2.

Table C-1

NTF REENLISTMENTS AND ELIGIBLES BY COMPLETED YEARS OF SERVICE (YOS) AND COMPONENT

Time Period[a]	YOS 6	YOS 7	YOS 8	YOS 9	Total
a. Submarine					
1H72	8/274	21/120	25/62	12/29	66/485
3Q72	1/71	7/28	12/32	6/12	26/143
4Q72	3/80	7/29	5/40	9/21	24/170
1Q73	3/93	19/76	20/46	13/27	55/242
2Q73	1/57	17/64	37/63	19/26	74/210
3Q73	4/79	24/42	52/79	33/39	113/239
4Q73	1/87	15/36	43/56	17/31	76/210
1H74	46/280	66/125	52/114	31/45	195/564
b. Surface					
1H72	2/95	11/30	5/14	1/5	19/144
3Q72	0/39	3/13	2/10	0/2	5/64
4Q72	0/18	4/7	1/3	0/2	5/30
1Q73	1/44	1/21	3/17	1/6	6/88
2Q73	0/33	4/17	9/19	3/3	16/72
3Q73	1/28	4/13	13/20	5/8	23/69
4Q73	3/45	1/5	9/10	5/6	18/66
1H74	1/92	13/25	6/19	7/17	27/153
c. Submarine Plus Surface					
1H72	10/369	32/150	30/76	13/34	85/629
3Q72	1/110	10/41	14/42	6/14	31/207
4Q72	3/98	11/36	6/43	9/23	29/200
1Q73	4/137	20/97	23/63	14/33	61/330
2Q73	1/90	21/81	46/82	22/29	90/282
3Q73	5/107	28/55	65/99	38/47	136/308
4Q73	4/132	16/41	52/66	22/37	94/276
1H74	47/372	79/150	58/133	38/62	222/717

[a]H = half; Q = quarter; all years fiscal. For example, 4Q72 = 4th quarter of FY1972 = April 1, 1972 to June 30, 1972.

Table C-2

NTF REENLISTMENT RATES BY COMPLETED YEARS OF SERVICE (YOS) AND COMPONENT

Time Period[a]	YOS 6	YOS 7	YOS 8	YOS 9	Total
a. Submarine					
1H72	0.0292	0.1750	0.4032	0.4138	0.1361
3Q72	0.0141	0.2500	0.3750	0.5000	0.1818
4Q72	0.0375	0.2414	0.1250	0.4286	0.1412
1Q73	0.0323	0.2500	0.4348	0.4815	0.2273
2Q73	0.0175	0.2656	0.5873	0.7308	0.3524
3Q73	0.0506	0.5714	0.6582	0.8462	0.4728
4Q73	0.0115	0.4167	0.7679	0.5484	0.3619
1H74	0.1[illegible]43	0.5280	0.4561	0.6889	0.3457
b. Surface					
1H72	0.0211	0.3667	0.3571	0.2000	0.1319
3Q72	0.0000	0.2308	0.2000	0.0000	0.0781
4Q72	0.0000	0.5714	0.3333	0.0000	0.1667
1Q73	0.0227	0.0476	0.1765	0.1667	0.0682
2Q73	0.0000	0.2353	0.4737	1.0000	0.2222
3Q73	0.0357	0.3077	0.6500	0.5750	0.3333
4Q73	0.0667	0.2000	0.9000	0.8333	0.2727
1H74	0.0109	0.5200	0.3158	0.4118	0.1765
c. Submarine Plus Surface					
1H72	0.0271	0.2133	0.3947	0.3824	0.1251
3Q72	0.0091	0.2439	0.3333	0.4286	0.1498
4Q72	0.0306	0.3056	0.1395	0.3913	0.1450
1Q73	0.0292	0.2062	0.3651	0.4242	0.1848
2Q73	0.0111	0.2593	0.5610	0.7586	0.3191
3Q73	0.0467	0.5091	0.6566	0.8085	0.4416
4Q73	0.0303	0.3902	0.7879	0.5946	0.3406
1H74	0.1263	0.5267	0.4361	0.6129	0.3096

[a]H = half; Q = quarter; all years fiscal. For example, 4Q72 = 4th quarter of FY1972 = April 1, 1972 to June 30, 1972.