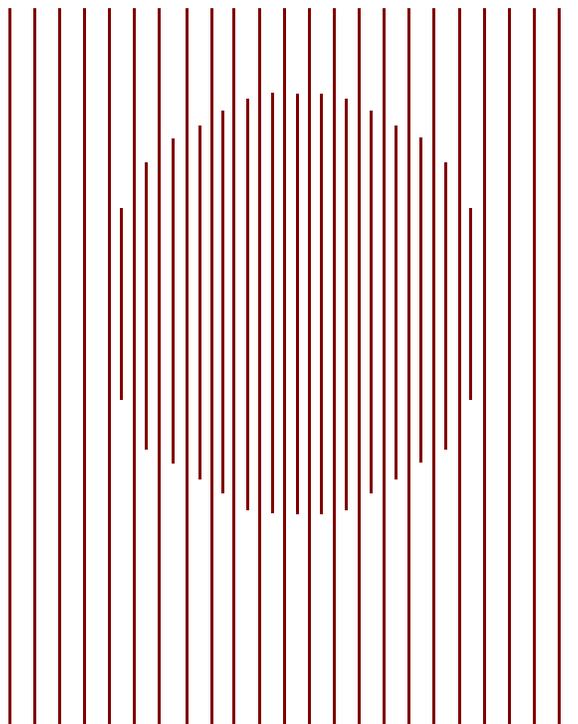


# CBO PAPERS

**BONUSES FOR NUCLEAR-TRAINED  
OFFICERS IN THE NAVY:  
CURRENT PROGRAM  
AND ALTERNATIVES**

**September 1996**



**CONGRESSIONAL BUDGET OFFICE**



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September 1996



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



## **PREFACE**

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The Navy, like the other military services, faces the difficult task of managing a drawdown of personnel and forces while looking for further areas in which to trim its budget. Likewise, in today's atmosphere of fiscal austerity, the Congress has the responsibility to review the services' programs for possible budgetary savings. One area that both might consider is the Nuclear Officer Incentive Pay (NOIP) program. This Congressional Budget Office (CBO) paper, prepared at the request of the Subcommittee on Personnel of the Senate Committee on Armed Services, examines the NOIP program and three alternative pay plans for nuclear-trained naval officers. In keeping with CBO's mandate to provide objective, impartial analysis, this paper contains no recommendations.

Marvin M. Smith of CBO's National Security Division prepared the paper under the general supervision of Cindy Williams and Neil M. Singer. The author gratefully acknowledges the assistance of Amy Plapp of CBO's Budget Analysis Division, who prepared the cost estimates, and Ivan Eland of the National Security Division. The paper also benefited from the support provided by Michael Nakada of the Navy Personnel Research and Development Center. (Outside assistance implies no responsibility for the final product, which rests solely with CBO.)

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

June E. O'Neill  
Director

September 1996



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## **SUMMARY**

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As the Navy considers its staffing requirements in an era of smaller fleets, a continuing concern is filling positions that call for officers with nuclear training. Such officers operate the Navy's nuclear-powered submarines and surface combatants and serve in a variety of other billets on shore. Although recent downsizing efforts have reduced the requirements for such officers, the Navy's total demand for nuclear-trained submarine and surface officers exceeds the number now in the service. That situation is expected to persist in coming years. The Navy projects that the shortage of nuclear-trained submarine officers will decline slightly by the end of the decade, but the shortage of nuclear-trained surface officers will worsen.

For years, the Navy has relied on bonus payments to try to encourage as many nuclear-trained officers as possible to remain in the service. The current Nuclear Officer Incentive Pay (NOIP) program provides annual cash bonuses of \$7,200 or \$10,000 to eligible nuclear submarine and surface officers who agree to remain on active duty after their minimum service requirement of four years. The NOIP program also offers a \$6,000 accession bonus to new officers who select the nuclear field.

At a time of tight budgets, however, the Congress is reviewing the cost-effectiveness of nuclear officer bonuses and other special military pay. As part of that effort, this Congressional Budget Office (CBO) paper evaluates the current NOIP program and three less expensive variations in terms of their estimated effects on the retention of nuclear officers.

### **HOW MANY NUCLEAR-TRAINED OFFICERS DOES THE NAVY NEED?**

The Navy's demand for nuclear-trained officers in the submarine and surface communities is governed by its nuclear billet requirements. Some of those requirements consist of positions that must be filled by an officer with nuclear training. Others, however, are billets that would benefit from an officer with nuclear expertise but could be filled with any submarine or surface officer, or positions that could be filled by any naval officer. Only about one-third of the total billets for nuclear submarine officers and one-fourth of those for nuclear surface officers require an officer with nuclear training. Many of the rest are high-profile positions that are thought to improve an officer's management skills or career prospects. In

the interest of fairness, the Navy believes that nuclear-trained officers, like all other officers, should be given access to a certain number of those positions.

Comparing the estimated number of nuclear-trained officers in 1997 with the total requirements for nuclear officers and with only those requirements that must be filled by a nuclear-trained officer yields striking differences. Compared with total billet requirements, the Navy expects the number of nuclear-trained officers next year to fall short by 557 submarine officers and 350 surface officers. But compared with the number of nuclear-specific billets, there will be a projected surplus of 2,008 qualified submarine officers and 584 surface officers.

### ALTERNATIVES TO THE CURRENT BONUS PROGRAM

Nuclear officer incentive pay includes two bonuses for officers who extend their service. A nuclear submarine or surface officer who remains on active duty under a three-, four-, or five-year contract receives a continuation pay (COPAY) bonus of \$10,000 per year. A nuclear officer who opts to stay without a contract receives a smaller annual incentive bonus (AIB) of \$7,200.

In considering any modifications to the NOIP program, the Congress needs to look at several factors: future job opportunities for nuclear officers in the civilian sector, having an adequate supply of officers to fill billets that require nuclear expertise, and ensuring sufficient access by nuclear officers to billets that might be considered career enhancing.

Although officers with nuclear training can still count on finding some type of employment in the civilian sector, their job prospects in related fields are not as promising as in the past. That change results in large measure from a decline in the civilian nuclear power industry and a projected drop in the number of nuclear engineering jobs. Nuclear officers might find employment outside the nuclear industry--for example, as managers in other fields--but the overall lure of the civilian labor market has lost some of its strength. For that reason, reductions in nuclear bonuses might not produce unacceptable reductions in the number of nuclear-trained officers in the Navy.

To examine the range of possible lower bonus payments, CBO analyzed three alternatives to the current program. In the first two, the Navy would pay smaller bonuses to nuclear surface officers than to submarine officers because the projected shortage of nuclear-trained officers in the surface community is not as great. In all three alternatives, the Navy would continue to pay the \$6,000 accession bonus to new officers who chose the nuclear field.

- o Alternative 1: for nuclear submarine officers, COPAY of \$7,200 per year with a four-year contract or an AIB of \$6,000 per year without a contract. For nuclear surface officers, COPAY of \$6,000 a year with a four-year contract or an AIB of \$3,200 a year with no contract.
- o Alternative 2: COPAY of \$6,000 a year for submarine officers and \$4,000 a year for surface officers with a four-year contract, but no AIB. That plan is designed to encourage officers who would otherwise renew without a contract to sign one, thus ensuring the Navy a more predictable labor force.
- o Alternative 3: no COPAY or AIB for any nuclear officer.

### Effects on Officer Retention

CBO analyzed the current NOIP program and the three alternatives using a model of nuclear officer continuation from the Navy Personnel Research and Development Center. The model examines whether officers will extend their service based on such variables as military pay (including bonuses), possible civilian pay, and a variety of nonmonetary factors and personal characteristics. CBO then compared the results of the model for each alternative with the Navy's projected number of officers under the current program.

A key finding of CBO's analysis is that the level and structure of special pay apparently does not have a large impact on the decision of nuclear officers to remain in the service. For example, under the current NOIP program, the Navy expects to fill no more than 85 percent of its total billet requirements for nuclear submarine officers next year and 72 percent of requirements for nuclear surface officers. Under Alternative 1, those levels would decline by only 1 or 2 percentage points. Even under Alternative 3 (doing away with the bonuses completely), the Navy would fill 82 percent of its total requirements for nuclear submarine officers next year and 67 percent for nuclear surface officers.

If the Navy focused only on billets requiring nuclear training, it would have a surplus of officers in all grades and both communities through the end of the decade under the current program. The same would hold true under the three alternative plans: the Navy would have twice as many nuclear officers as needed to fill the nuclear-specific billets in both communities. Moreover, all of the alternatives would permit a significant number of nuclear officers to gain experience in non-nuclear-specific, career-enhancing assignments--one of the Navy's staffing concerns.

### Cost Savings

Since all three alternative compensation plans would involve reducing COPAY and the AIB, they would yield savings to the government compared with the current program. Not surprisingly, Alternative 3, which would eliminate the bonuses, would result in the largest savings--\$40 million over the 1997-2000 period in the nuclear submarine community and \$9 million in the nuclear surface community. Alternative 1 would produce cumulative savings of \$12 million over four years and Alternative 2 of \$30 million, with similar savings ratios between the submarine and surface communities.

## **CHAPTER I**

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### **INTRODUCTION**

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As the Navy completes its personnel drawdown and contemplates future manpower issues, one persistent concern is filling critical billets at sea and on shore. Of particular concern is recruiting and retaining enough officers who are trained to operate the Navy's fleet of nuclear-powered submarines and surface combatants. Despite the Navy's recent downsizing efforts, its stated total demand for submarine and surface officers trained in the nuclear field exceeds the number now in the service, and it expects that shortage to continue for several years.

Nuclear officers undergo arduous training, and as with other naval personnel, the possibility of back-to-back sea tours presents Navy planners with a challenge in recruiting and retaining enough of them to man the nuclear fleet. The retention of nuclear-trained officers is influenced by many factors, a major one being their level of compensation.

### **CURRENT PAY FOR NUCLEAR-TRAINED OFFICERS**

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All nuclear-trained officers receive regular military compensation (RMC), which includes basic pay and tax-free allowances for food and housing. In addition, those who qualify collect sea-duty pay and nuclear officer incentive pay. Nuclear officers serving aboard submarines also receive submarine pay.

#### **Regular Military Compensation**

All nuclear-trained officers receive RMC under the same provisions applying to other officers and enlisted personnel. The major component of RMC is basic pay, which depends on an officer's years of service and pay grade. RMC also includes two types of housing allowances for personnel not living in government quarters. A basic allowance for quarters (BAQ) provides service members with a cash allowance to help them obtain civilian housing when government quarters are not available. BAQ varies by pay grade and by whether the recipient has dependents. Similarly, a variable housing allowance (VHA) is provided to service members who have to seek housing while stationed in high-cost areas.

Military personnel, including nuclear-trained officers, also receive a basic allowance for subsistence (BAS) to help defray part or all of their food costs. The

amount of the BAS payment is the same for all officers regardless of dependency status. Besides direct pay, military personnel enjoy a tax advantage because the allowances they receive in the form of BAQ, VHA, and BAS are not taxed by the federal government.

### Special Pay

Eligible nuclear-trained officers and other military personnel who are assigned to a ship or a ship-based staff receive sea-duty pay. Personnel planners regard that pay as a valuable tool for meeting their staffing goals. It recognizes the competition that exists with the civilian sector for the services of naval officers with certain skills as well as the arduous duty and personal sacrifices (such as family separations) that they must endure during long deployments at sea. Sea pay varies with pay grade and years of sea duty.

Submarine-duty incentive pay is "paid continuously to members who hold a submarine duty designator, or are in training leading to such designation, and remain in submarine service on a career basis."<sup>1</sup> Thus, nuclear-trained officers serving on submarines are included among those receiving submarine pay. The amount of that pay depends on an officer's pay grade and years of service.

Given the various types of pay available to nuclear-trained surface officers, their total compensation can vary from \$70,909 a year for a midgrade officer (a lieutenant commander with 10 years of military service) to \$102,728 for a more senior officer (a captain with 22 years of military service). The equivalent range for nuclear-trained submarine officers is from \$78,049 to \$109,868 (see Table 1).

## THE NUCLEAR OFFICER INCENTIVE PAY PROGRAM

To address the Navy's perceived shortage of nuclear-trained officers, the Congress created the Nuclear Officer Incentive Pay (NOIP) program in June 1969. Under the program, eligible nuclear submarine officers received a \$15,000 bonus payment (\$3,750 per year) if they agreed to extend their military obligation for four years. Over time, the NOIP program has undergone several changes, including a period, from June 1975 to August 1976, when it expired after the Congress missed the deadline to extend it (see Box 1 for a brief history of the program). In 1972, NOIP was broadened to include nuclear surface officers. The most dramatic changes,

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1. Department of Defense, Office of the Secretary of Defense, *Military Compensation Background Papers* (November 1991), p. 278.

TABLE 1. COMPENSATION OF NAVY NUCLEAR OFFICERS, 1996 (In dollars)

Pay	Lieutenant Commander with 10 Years of Military Service and Six Years of Sea Duty	Captain with 22 Years of Military Service and 11 Years of Sea Duty
Regular Military Compensation <sup>a</sup>	58,449	89,128
Nuclear Officer Incentive Pay (with a four-year contract)	10,000	10,000
Sea-Duty Pay	<u>2,460</u>	<u>3,600</u>
Total for Nuclear Surface Officers	70,909	102,728
Submarine-Duty Incentive Pay	<u>7,140</u>	<u>7,140</u>
Total for Nuclear Submarine Officers	78,049	109,868

SOURCE: Congressional Budget Office using data from the Department of Defense Compensation Office.

NOTE: These figures do not include retirement pay or the cost-of-living adjustment paid to service members in the continental United States.

- a. Regular military compensation is a combination of basic pay, subsistence allowance, basic allowance for quarters, and the variable housing allowance, plus the tax advantage stemming from not having either the housing or subsistence allowances taxed.

however, occurred in 1976 when the program added two other bonus payments. Besides the continuation pay (COPAY) provided to officers signing a four-year contract, NOIP added a nuclear career annual incentive bonus (AIB) of \$4,000 a year for eligible officers not on a COPAY contract. It also offered new officers who chose the nuclear field an accession bonus of \$3,000, which was paid at the end of their nuclear training.

Since 1976, the Navy, acting on authority granted by the Congress, has raised the various bonus payments and broadened the NOIP program. Most notably, the Navy now offers COPAY of \$10,000 a year to officers signing three-, four-, and five-year contracts up to an officer's 26th year of service. Eligible nuclear officers who do not sign COPAY contracts can now receive the AIB (\$7,200 a year) until they

BOX 1.  
A HISTORY OF THE NUCLEAR OFFICER  
INCENTIVE PAY PROGRAM

The amounts for the various bonuses indicated below are the maximum amounts the Navy is allowed to pay under law. The Navy sometimes pays less; for example, it now offers continuation pay (COPAY) of \$10,000.

June 1969	Program begun for submarine officers only. Eligible officers could sign up for continuation pay of \$3,750 a year for a one-time, four-year contract.
October 1972	Program expanded to include nuclear surface officers.
June 1975	Program expired.
August 1976	Program restarted and expanded: <ul style="list-style-type: none"> <li>o COPAY for a four-year contract raised to \$5,000 a year.</li> <li>o Annual incentive bonus (AIB) of \$4,000 a year created.</li> <li>o Accession bonus of \$3,000, to be paid at completion of nuclear training, created.</li> </ul>
January 1981	COPAY for a four-year contract raised to \$7,000 a year. AIB raised to \$6,000 a year. Accession bonus raised to \$6,000 (\$3,000 before training and \$3,000 after).
October 1985	COPAY expanded to cover multiple three-, four-, and five-year contracts up to 26 years of service and raised to \$9,000 a year. AIB raised to \$7,200 a year. Accession bonus modified to pay \$4,000 before training and \$2,000 after training.
December 1987	COPAY raised to \$12,000 a year.

retire or are promoted to the rank of admiral. Moreover, the Navy now pays two-thirds of the \$6,000 accession bonus before nuclear training, with the rest paid afterward.

In an era of military downsizing and budget consciousness, the NOIP program, along with other special military pay, is receiving close scrutiny by the Congress. At issue is whether the program is still needed, and if so, whether it should maintain its present bonus amounts or scale them back.

## **CHAPTER II**

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### **DOWNSIZING IN THE NUCLEAR FLEET**

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The Navy, like the other military services, has been downsizing both its personnel and force structure. The reduction in force structure is reflected in part in the Navy's plans for its nuclear fleet. Over the next eight years, the Navy expects to cut its total number of nuclear-powered ships by about half from the level at the beginning of the 1990s (see Table 2). Although the service continues to phase out its conventional aircraft carriers and replace them with nuclear carriers, all of its other nuclear vessels will be reduced in number or completely phased out over time. For example, Trident ballistic missile submarines will be cut from 34 in 1991 to 14 by 2003. The Navy's nuclear attack submarines have already been reduced from 92 in 1991 to 83 in 1995, with a further decline to 51 projected by 2003. And the Navy intends to reduce its current five nuclear cruisers to two in 2000 and phase them out by 2003. Those cuts in force structure lend credence to the notion that the Navy's need for nuclear-trained officers will diminish in coming years.

### **REQUIREMENTS FOR AND PROJECTED NUMBER OF NUCLEAR OFFICERS**

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The Navy recognizes that as the number of nuclear-powered ships decreases, so will the number of junior-officer billets (ensign through lieutenant) for nuclear-trained officers. As a result, it plans to reduce the number of new nuclear officers ("accessions") by 15 percent between 1994 and 2000 (see Table 3). Without such reductions, the number of new officers could outstrip the number of training slots available on nuclear vessels.

Despite the drawdown, however, the Navy expects a continued shortage of midlevel nuclear officers (lieutenant commander and commander) in the future. To help fill the shortage, it is focusing on keeping more midlevel officers from leaving the service. That focus on retention is reflected in the Navy's accession plans, which suggest a slight shift to relatively more graduates of the Naval Academy and the Reserve Officers Training Corps (ROTC) and fewer Officer Candidate School (OCS) graduates. The Navy contends that academy and ROTC graduates remain in the service longer than their OCS counterparts.<sup>1</sup>

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1. Despite the Navy's plans, accessions from the academy declined in 1996. The Navy had originally projected 130 nuclear officer accessions from the academy but managed to get only 86. The Navy says that result is an anomaly, but it is studying the reasons for the shortfall.

TABLE 2. NUMBER OF NUCLEAR SHIPS IN THE NAVY, SELECTED YEARS, 1991-2003

	1991	1995	2000 <sup>a</sup>	2003 <sup>a</sup>
Ballistic Missile Submarines	34	16	18	14
Nuclear-Powered Aircraft Carriers	6	7	9	10
Nuclear-Powered Attack Submarines	92	83	55	51
Nuclear-Powered Cruisers	<u>9</u>	<u>5</u>	<u>2</u>	<u>0</u>
Total	141	111	84	75

SOURCE: Congressional Budget Office using data from the U.S. Navy.

a. Congressional Budget Office projections.

The Navy continues to rely on the accession bonus to help attract new officers to the nuclear community. If it is successful in meeting its accession goals, the service appears likely to have a steady annual flow of new officers to meet its manning needs.

The Navy's demand for nuclear-trained officers is governed by its billet requirements. Those requirements differ in the specific need for nuclear expertise: some positions in the nuclear submarine and surface communities require an officer with nuclear training, but others do not. Billets in the latter category can be filled by non-nuclear-trained officers in the same community (submarine or surface) or drawn from other naval communities.

In general, the requirements for nuclear officers can be viewed as falling into three categories, each containing both sea and shore billets:

- o Positions that require a nuclear-trained officer--such as positions on the Nuclear Reactors staff, at the Nuclear Power School, as a nuclear prototype instructor, as a member of the wardroom (except supply officer) of a nuclear submarine, or as a member of the engineering department of a nuclear-powered cruiser or aircraft carrier.<sup>2</sup>

2. Those billets are assigned an Additional Qualification Designator or Nuclear Subspecialty Code in the Navy's Master Billet File.

TABLE 3. NUCLEAR OFFICER ACCESSIONS, BY SOURCE, 1994-2000

	1994	1995	1996 <sup>a</sup>	1997 <sup>a</sup>	1998 <sup>a</sup>	1999 <sup>a</sup>	2000 <sup>a</sup>
<b>Submarine Nuclear Officers</b>							
USNA	91	88	100	100	100	100	100
NROTC	111	106	135	135	135	135	135
OCS	106	85	66	70	70	70	70
Other <sup>b</sup>	<u>43</u>	<u>41</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>
Total	351	320	306	310	310	310	310
<b>Surface Nuclear Officers</b>							
USNA	28	36	30	30	30	30	30
NROTC	31	22	40	40	40	40	40
OCS	66	55	38	35	30	30	30
Other <sup>b</sup>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	129	113	108	105	100	100	100
<b>Total Nuclear Officers</b>							
USNA	119	124	130	130	130	130	130
NROTC	142	128	175	175	175	175	175
OCS	172	140	104	105	100	100	100
Other <sup>b</sup>	<u>47</u>	<u>41</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>
Total	480	433	414	415	410	410	410

SOURCE: Congressional Budget Office using data from the U.S. Navy.

NOTE: USNA = United States Naval Academy; NROTC = Navy Reserve Officers Training Corps; OCS = Officer Candidate School.

- a. Projected accessions based on requirements to fill junior-officer billets.
- b. Direct appointments and warrant officers.

- o Positions that could benefit from the knowledge and experience of a nuclear-trained officer but that could be filled by any submarine or surface officer--such as squadron operations officer of a submarine or destroyer, instructor or administrator at a submarine school, or a staff member for the Director of the Submarine Warfare Division.
- o Positions that may be filled by any naval officer--such as staff member at the Naval Post-Graduate School or the Naval War College, instructor at the Naval Academy or for Navy ROTC, or a joint duty assignment. Service in some of those billets is thought to improve an officer's prospects for promotion, so the Navy feels that the opportunity to serve in such positions should be made available to all officers, including nuclear-trained ones.

Only about one-third of the total billets for nuclear submarine officers (one-fourth for surface officers) fall into the first category of needing nuclear-trained personnel. Although the Navy would prefer that the remaining two-thirds of the billets for nuclear submarine officers (three-fourths for nuclear surface officers) be filled by officers with nuclear training, those jobs could be performed by other officers. To the extent that the positions were filled by non-nuclear-trained personnel, the Navy's expected shortfall of nuclear-trained officers could be minimized.

For both nuclear communities (submarines and surface ships), the Navy expects the demand for and supply of officers to decline over the next few years in keeping with its downsizing efforts (see Tables 4 and 5). However, the shortage of officers in the two communities will differ. The Navy projects that the shortage of nuclear-trained submarine officers will lessen from 557 in 1997 to 423 in 2000. The shortage of nuclear surface officers, by contrast, will increase slightly from 350 to 382 over that period.

Those shortages are based on the Navy's overall requirements, which include positions that could be filled by officers with no nuclear training. If the Navy had to fill only those billets that required nuclear training, it would have a surplus of nuclear officers in every pay grade in both the submarine and surface categories (see Tables 6 and 7). For those critical nuclear billets, the supply of officers is projected to exceed the requirements by a total of 2,008 submarine nuclear officers and 584 surface nuclear officers in 1997. The surpluses will decline slightly in 2000--to 1,854 and 536, respectively.

In other words, the Navy's perceived shortage of nuclear-trained officers does not affect the most critical manning needs, such as operating submarines or surface

combatants.<sup>3</sup> Instead, it involves assignments on staffs and in schools, recruiting offices, and joint commands.<sup>4</sup> By focusing specifically on billets that require nuclear training, the Navy would not only have a surplus of nuclear officers but also be able to satisfy any concerns about sea/shore rotation. The reason is that those billet requirements include the necessary shore billets to support a reasonable rotation. For example, of the 1,266 officers expected to fill nuclear-specific submarine positions in 1997, only 77 percent will actually be assigned to sea, with the rest filling shore billets that call for a nuclear-trained officer.

The Navy's projections of the future supply of officers reflect its assumptions about continuation rates--that is, the percentages of nuclear submarine and surface officers who remain in service from one year to the next. The Navy expects continuation rates to remain near their current level for both types of nuclear-trained officers. If nuclear officers became increasingly less willing to remain in the service, however, and the Navy's requirements remained unchanged, the estimated shortage of nuclear officers in both communities would of course grow.

## REASONS THAT NUCLEAR OFFICERS LEAVE THE NAVY

Many factors influence a nuclear officer's decision to leave military service, but they fall into two general categories: the quality of military life, and employment opportunities in the civilian sector.

### Quality of Life

Nuclear officers, like other officers on surface ships and submarines, serve under unique conditions that should be taken into account when evaluating their retention decisions. Those conditions include "(1) cramped living and working conditions aboard ship, (2) the unpredictability of operating schedules of Navy ships, (3) limited recreational facilities at sea, (4) in-port duties assigned to shipboard personnel to maintain ship readiness, (5) long working hours at sea, (6) long and repetitive deployments, and (7) family separations."<sup>5</sup> For some officers, those conditions are reason enough to leave the Navy. However, in spite of the hardships of shipboard

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3. Ernest Blazer, "Retention of Junior Sub Officers Dives," *Navy Times*, May 1, 1995, p. 4.

4. Ibid.

5. Department of Defense, Office of the Secretary of Defense, *Military Compensation Background Papers* (November 1991), p. 303.

TABLE 4. TOTAL DEMAND FOR AND SUPPLY OF NUCLEAR SUBMARINE OFFICERS, BY PAY GRADE, 1997 AND 2000

Pay Grade	Demand			Number of Nuclear Submarine Officers in the Service	Difference
	Sea	Shore	Total		
<b>1997</b>					
Ensign	338	428	766	556	-210
Lieutenant Junior Grade	517	52	569	556	-13
Lieutenant	398	568	966	1,308	+342
Lieutenant Commander	420	297	717	333	-384
Commander	108	349	457	317	-140
Captain	<u>39</u>	<u>317</u>	<u>356</u>	<u>204</u>	<u>-152</u>
Total	1,820	2,011	3,831	3,274	-557
<b>2000</b>					
Ensign	258	405	663	581	-82
Lieutenant Junior Grade	395	49	444	499	+55
Lieutenant	303	539	842	996	+154
Lieutenant Commander	321	281	602	306	-296
Commander	82	331	413	282	-131
Captain	<u>30</u>	<u>300</u>	<u>330</u>	<u>207</u>	<u>-123</u>
Total	1,389	1,905	3,294	2,871	-423

SOURCE: Congressional Budget Office using data from the U.S. Navy.

TABLE 5. TOTAL DEMAND FOR AND SUPPLY OF NUCLEAR SURFACE OFFICERS, BY PAY GRADE, 1997 AND 2000

Pay Grade	Demand			Number of Nuclear Surface Officers in the Service	Difference
	Sea	Shore	Total		
<b>1997</b>					
Ensign	166	129	295	316	+21
Lieutenant Junior Grade	267	29	296	177	-119
Lieutenant	151	172	323	208	-115
Lieutenant Commander	79	88	167	92	-75
Commander	39	77	116	75	-41
Captain	<u>11</u>	<u>38</u>	<u>49</u>	<u>28</u>	<u>-21</u>
Total	713	533	1,246	896	-350
<b>2000</b>					
Ensign	157	127	284	282	-2
Lieutenant Junior Grade	257	29	286	168	-118
Lieutenant	146	169	315	183	-132
Lieutenant Commander	80	87	167	84	-83
Commander	38	75	113	73	-40
Captain	<u>8</u>	<u>37</u>	<u>45</u>	<u>38</u>	<u>-7</u>
Total	686	524	1,210	828	-382

SOURCE: Congressional Budget Office using data from the U.S. Navy.

TABLE 6. NUMBER OF SUBMARINE OFFICER BILLETS THAT REQUIRE NUCLEAR TRAINING COMPARED WITH NUMBER OF NUCLEAR OFFICERS, BY PAY GRADE, 1997 AND 2000

Pay Grade	Submarine Officer Billets Requiring Nuclear Training			Number of Nuclear Submarine Officers in the Service	Difference
	Sea	Shore	Total		
<b>1997</b>					
Ensign	261	5	266	556	+290
Lieutenant Junior Grade	116	1	117	556	+439
Lieutenant	238	99	337	1,308	+971
Lieutenant Commander	250	66	316	333	+17
Commander	81	66	147	317	+170
Captain	<u>32</u>	<u>51</u>	<u>83</u>	<u>204</u>	<u>+121</u>
Total	978	288	1,266	3,274	+2,008
<b>2000</b>					
Ensign	199	4	203	581	+378
Lieutenant Junior Grade	89	1	90	499	+409
Lieutenant	181	94	275	996	+721
Lieutenant Commander	190	63	253	306	+53
Commander	62	62	124	282	+158
Captain	<u>24</u>	<u>48</u>	<u>72</u>	<u>207</u>	<u>+135</u>
Total	745	272	1,017	2,871	+1,854

SOURCE: Congressional Budget Office using data from the U.S. Navy.

TABLE 7. NUMBER OF SURFACE OFFICER BILLETS THAT REQUIRE NUCLEAR TRAINING COMPARED WITH NUMBER OF NUCLEAR OFFICERS, BY PAY GRADE, 1997 AND 2000

Pay Grade	Surface Officer Billets Requiring Nuclear Training			Number of Nuclear Surface Officers in the Service	Difference
	Sea	Shore	Total		
<b>1997</b>					
Ensign	54	0	54	316	+262
Lieutenant Junior Grade	105	0	105	177	+72
Lieutenant	46	21	67	208	+141
Lieutenant Commander	41	17	58	92	+34
Commander	18	3	21	75	+54
Captain	<u>4</u>	<u>3</u>	<u>7</u>	<u>28</u>	<u>+21</u>
Total	268	44	312	896	+584
<b>2000</b>					
Ensign	48	0	48	282	+234
Lieutenant Junior Grade	98	0	98	168	+70
Lieutenant	41	21	62	183	+121
Lieutenant Commander	42	17	59	84	+25
Commander	17	3	20	73	+53
Captain	<u>2</u>	<u>3</u>	<u>5</u>	<u>38</u>	<u>+33</u>
Total	248	44	292	828	+536

SOURCE: Congressional Budget Office using data from the U.S. Navy.

life, the vast majority of officers view matters differently. According to the Bureau of Navy Personnel's fifth annual survey of the fleet, 73 percent of the officers polled said they were satisfied with their current job.<sup>6</sup> Moreover, 84 percent indicated that they were pleased with what they were doing in the Navy, and 78 percent said they were enjoying their Navy career.<sup>7</sup> Those results notwithstanding, the rigors of life at sea figure prominently in the decision of some nuclear-trained officers not to stay in the Navy.

### Civilian Job Opportunities

One major reason for officers to leave the military is the lure of job opportunities outside it. In the Navy's survey of the fleet, 48 percent of the officers polled said they "would leave the Navy at the end of [their] current [obligation] if suitable civilian employment was available."<sup>8</sup> In practice, many nuclear-trained officers find civilian employment as nuclear engineers. Others develop postmilitary careers in a variety of managerial, professional, and technical occupations. One civilian sector in which nuclear-trained officers tend to seek job opportunities, the civilian nuclear industry, currently offers mixed prospects for employment and pay.

Employment Outlook. Nuclear-trained officers who consider leaving the Navy in the near future will most likely face less competition from their newly trained civilian counterparts than in the past. Between 1983 and 1993, the number of nuclear engineering degrees awarded fell by nearly 30 percent. That drop is likely to continue through 2000.<sup>9</sup>

Although civilian competition is declining, former naval officers may also face a dwindling supply of civilian nuclear jobs. About three-quarters of nuclear engineers employed in the civilian sector are concentrated in three areas: reactor operations and maintenance, reactor and facility design and redesign/better-

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6. John Burlage and Ernest Blazar, "Sounding Off," *Navy Times*, August 28, 1995, p.13. Not all of the officers in the survey were nuclear-trained officers.

7. Ibid.

8. Ibid., p.12.

9. Norman Seltzer, Larry M. Blair, and Joe G. Baker, *Labor Market Trends for Nuclear Engineers Through 2000* (Oak Ridge, Tenn.: Oak Ridge Institute for Science and Education, 1995), p. 6.

TABLE 8. EMPLOYMENT OF CIVILIAN NUCLEAR ENGINEERS,  
BY TYPE OF WORK, 1993

	Number <sup>a</sup>	Percent
Weapons Development	370	3.3
Waste Management and Decommissioning	370	3.3
Reactor and Facility Design and RBB	2,070	18.7
Reactor Operations and Maintenance	2,610	23.5
Nonuniversity Research and Development	780	7.0
Fuel Cycle	110	1.0
Government	3,660	33.0
University	500	4.5
All Other	<u>630</u>	<u>5.7</u>
Total	11,100	100.0

SOURCE: Norman Seltzer, Larry M. Blair, and Joe G. Baker, *Labor Market Trends for Nuclear Engineers Through 2000* (Oak Ridge, Tenn.: Oak Ridge Institute for Science and Education, 1995), Table 1.

NOTES: The types of work are by primary activity of the employing establishment.

RBB = redesign/betterment/backfit.

a. Rounded to the nearest ten.

**Military Versus Civilian Compensation.** A key feature of the lure of the civilian sector for naval officers is the prospect of high salaries. As in other occupations, the salaries of nuclear engineers vary from one geographic location to another, depending in part on local demand and the cost of living. The salaries of civilian nuclear engineers and other managerial, professional, and technical personnel might provide a reasonable gauge of the compensation that nuclear-trained naval officers could expect in the private sector.

The compensation of a nuclear surface officer with a rank of O-4 or O-5 (lieutenant commander or commander) is competitive with the salaries earned by people with similar years of experience in the private sector (see Table 9). The compensation of submarine officers with the same rank is more than competitive.

TABLE 9. COMPENSATION FOR NUCLEAR PROFESSIONALS IN THE MILITARY AND CIVILIAN SECTORS (In 1996 dollars)

	Annual Compensation
<b>Nuclear Officers in the Navy<sup>a</sup></b>	
Grade O-4 with 10 Years of Service	
Surface	70,909
Submarine	78,049
Grade O-5 with 16 Years of Service	
Surface	85,855
Submarine	92,995
<b>Civilian Workers</b>	
Nuclear Engineer <sup>b</sup>	
Five to nine years of experience	57,336
Ten to 14 years of experience	70,675
Fifteen to 19 years of experience	82,240
Managerial, Professional, or Technical Position <sup>c</sup>	
Ten years of experience	42,036
Sixteen years of experience	54,965

SOURCE: Congressional Budget Office based on data from the Department of Defense Compensation Office; National Society of Professional Engineers, *Professional Engineer Income and Salary Survey, 1995* (prepared by Abbott, Langer & Associates, May 1995), p. 128; and the Census Bureau.

- a. Compensation includes regular military compensation, nuclear officer incentive pay, sea duty pay, and submarine duty incentive pay where applicable.
- b. Compensation is 1995 median income adjusted by the 1996 employment cost index wage and salary deflator.
- c. Compensation is 1996 mean income. The majority of these positions are not in the nuclear field, but they are the type of jobs that nuclear officers seek out in the civilian sector.

BOX 2.  
SPOT PROMOTION OF LIEUTENANTS

An overall shortage of nuclear officers, not necessarily an imbalance among pay grades, is at the center of the Navy's problem. Nonetheless, because of the Navy's decisions governing assignments, the shortage of personnel to man lieutenant commander billets is at times magnified. Currently, the Navy resorts to a quick fix to fill selected lieutenant commander positions by using "spot promotions" of deserving lieutenants. That involves selectively promoting highly qualified lieutenants who are recommended by their commanding officer and chosen by a special selection board. Those who are spot-promoted assume the rank of lieutenant commander as long as they remain in their assigned billet. Should they leave that assignment, they revert to their former rank of lieutenant. But in general, officers who are spot-promoted become eligible for regular promotion to lieutenant commander before their spot tour is over. Their chances of receiving a regular promotion are usually excellent.

(Note, however, that officers' pay includes NOIP and other bonuses.) Despite the competitive salaries, some officers might view a civilian job with comparable pay more favorably than a naval position, based on personal preferences and family circumstances.

### DEALING WITH THE SHORTFALL OF OFFICERS

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The Navy hopes sufficient retention will alleviate its perceived shortage of nuclear-trained officers. A short-term but temporary approach it sometimes takes involves the "spot promotion" of selected lieutenants (see Box 2). But a long-term approach to the shortfall might be for the Navy to reevaluate its requirements for nuclear officers. It is already doing that in part because of current downsizing efforts, which involve reducing the number of ships and accompanying sea billets.<sup>19</sup> But the real issue concerns the requirements for billets that do not require nuclear training. A concomitant reduction in those requirements would immediately alleviate the Navy's overall shortage of nuclear officers. Some of the non-nuclear-specific billets are needed to give nuclear officers access to assignments that afford them the opportunity to develop management skills and enhance their careers. Billets in that category, however, make up two-thirds of the total requirement for nuclear submarine officers and three-fourths for nuclear surface officers. Whether that many non-nuclear-specific billets are needed is questionable. Moreover, offering additional pay to fill more of those positions than necessary would be inefficient.

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19. Blazer, "Retention of Junior Sub Officers Dives," p. 4.

## **CHAPTER III**

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### **AN ANALYSIS OF ALTERNATIVE**

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### **COMPENSATION PLANS**

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The Navy provides nuclear officer incentive pay, along with some other types of special pay, in an attempt to ensure sufficient retention to offset its projected shortages of nuclear-trained officers. The Navy believes that NOIP is essential in recruiting and retaining the nuclear officers it needs.<sup>1</sup> But under the program, the Navy expects to have only 85 percent of the nuclear submarine officers it requires next year and only 72 percent of the nuclear surface officers. The percentage will increase slightly for submarine officers by the end of the decade but will worsen for surface officers. Given those projections, together with today's tight budget environment and what could be viewed as the Navy's overly broad requirements for nuclear officers, the Congress may wish to consider whether the NOIP program could be changed without significantly affecting the Navy's supply of nuclear-trained officers.

### **ALTERNATIVE BONUS PLANS**

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To cover the range of possible alternatives, the Congressional Budget Office (CBO) examined three possible bonus plans for nuclear submarine and surface officers in addition to the current program.

#### **Alternative Plans for Nuclear Submarine Officers**

Under the NOIP program, nuclear submarine officers who agree to remain in the Navy under a three-, four-, or five-year contract receive continuation pay of \$10,000 per year (see Table 10). Those officers who opt to extend without a contract receive an annual incentive bonus of \$7,200. Alternative 1 would decrease COPAY to \$7,200 a year under a four-year contract and the AIB to \$6,000 a year.<sup>2</sup> Alternative 2 would offer a slightly lower COPAY of \$6,000 per year for a four-year contract but no AIB. The rationale underlying that plan is to encourage officers who would

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1. Statement of Vice Admiral Frank L. Bowman, Chief of Naval Personnel, before the Subcommittee on Personnel of the House Committee on National Security, March 14, 1995.
  2. In all of the alternative plans analyzed in this paper, the current accession bonus would remain in effect regardless of changes in COPAY and the AIB.

TABLE 10. CURRENT NUCLEAR OFFICER INCENTIVE PAY PROGRAM AND THREE ALTERNATIVE PLANS

	Current Program	Alternative 1	Alternative 2	Alternative 3
<b>Nuclear Submarine Officers</b>				
Continuation Pay	\$10,000 per year for three-, four-, or five-year contract	\$7,200 per year for four-year contract	\$6,000 per year for four-year contract	0
Annual Incentive Bonus	\$7,200 per year without a contract	\$6,000 per year without a contract	0	0
<b>Nuclear Surface Officers</b>				
Continuation Pay	\$10,000 per year for three-, four-, or five-year contract	\$6,000 per year for four-year contract	\$4,000 per year for four-year contract	0
Annual Incentive Bonus	\$7,200 per year without a contract	\$3,200 per year without a contract	0	0

SOURCE: Congressional Budget Office.

otherwise extend their service without a contract to do so instead with a contract. Such a move would result in more contracted years of service, which in turn would ensure a more stable force over time. Alternative 3 would do away with both continuation pay and the annual incentive bonus.

#### Alternative Plans for Nuclear Surface Officers

Because the Navy's projected shortfall of nuclear officers is smaller for surface ships than for submarines, CBO examined less generous alternatives for surface officers (see Table 10). Alternative 1 would provide a \$6,000 per year COPAY for officers reenlisting under a four-year contract and a \$3,200 per year AIB for those extending without a contract. Under Alternative 2, officers would receive COPAY of \$4,000 a year but no AIB. Alternative 3 would eliminate both COPAY and AIB for nuclear surface officers.

### CBO's Method of Analysis

CBO used data from several sources to analyze the effects of the alternative bonus plans. Its major source of data was the Navy's Officer Master Tapes, which contain a great deal of information about the demographic, educational, and military characteristics of nuclear officers. CBO also relied on data from the Census Bureau for information about employment conditions and compensation in the civilian sector and on a survey of salaries received by civilian nuclear engineers.

CBO evaluated the various bonus plans using a model of officer retention (described in greater detail in the appendix) that was developed at the Center for Naval Analyses and later refined at the Navy Personnel Research and Development Center (NPRDC). CBO used results from the model that were provided by NPRDC. The model is based on the notion that nuclear officers approaching their minimum service requirement (MSR) of four years or later decision points are faced with the decision to remain in the Navy or leave the service. If they choose to remain, they also decide simultaneously between staying with or without a contract and the accompanying bonus plan. In the model, the decision to stay or leave is determined by officers' choosing the alternative that maximizes their satisfaction ("utility" to economists). The utility that officers can expect in turn depends on their military pay (including a bonus, if any) and nonmonetary factors that affect retention. The model was estimated using the multinomial logit technique. (See the appendix for the variables included in the analysis and more detail on the estimation and results.)

### IMPACT OF THE ALTERNATIVE PLANS

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Because all three alternative plans would reduce continuation pay and the annual incentive bonus from their current levels, they would yield savings to the government compared with the current NOIP program (see Tables 11 and 12). Alternative 3 would result in the largest savings--up to \$49 million over the 1997-2000 period for the surface and submarine communities combined--since it would eliminate payments for both COPAY and AIB. Alternative 1 would come the closest to matching the current program in terms of the percentage of total and nuclear-specific billets filled as well as the number of officers who would remain in the service at the MSR point. It would save \$12 million over the four-year period. Alternative 2 falls in between the first and the third on both savings and number of officers.

Perhaps the most surprising finding is that Alternative 3, which would eliminate the bonuses, would still manage to satisfy well over 200 percent of the Navy's nuclear-specific requirements and nearly 80 percent of its total requirements for submarine officers and 60 percent for surface officers. Compared with the current

TABLE 11. EFFECTS OF ALTERNATIVE BONUS PLANS FOR NUCLEAR SUBMARINE OFFICERS

	Current Plan (\$10,000 COPAY, \$7,200 AIB)		Alternative 1 (\$7,200 COPAY, \$6,000 AIB)		Alternative 2 (\$6,000 COPAY, no AIB)		Alternative 3 (No COPAY or AIB)	
	1997	2000	1997	2000	1997	2000	1997	2000
<b>Number of Nuclear Officers at MSR who</b>								
Stay	231	159	222	152	198	136	180	123
Leave	106	73	115	80	139	96	157	109
<b>Nuclear Officers as a Percentage of Billets Requiring Nuclear Training<sup>a</sup></b>								
	259	282	256	272	253	265	247	249
<b>Nuclear Officers as a Percentage of Total Billet Requirements</b>								
	85	87	84	84	84	82	82	77
<b>Cost of Plan (In millions of dollars)</b>								
1997	18		17		14		14	
2000	15		11		7		1	
Total, 1997-2000	65		56		41		25	

SOURCE: Congressional Budget Office based on data from the U.S. Navy.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus; MSR = minimum service requirement.

a. The Navy identifies these positions with an Additional Qualification Designator/Nuclear Subspecialty Code.

TABLE 12. EFFECTS OF ALTERNATIVE BONUS PLANS FOR NUCLEAR SURFACE OFFICERS

	Current Plan (\$10,000 COPAY, \$7,200 AIB)		Alternative 1 (\$6,000 COPAY, \$3,200 AIB)		Alternative 2 (\$4,000 COPAY, no AIB)		Alternative 3 (No COPAY or AIB)	
	1997	2000	1997	2000	1997	2000	1997	2000
<b>Number of Nuclear Officers at MSR who</b>								
Stay	45	47	34	35	21	22	20	21
Leave	44	46	55	58	68	71	69	72
<b>Nuclear Officers as a Percentage of Billets Requiring Nuclear Training<sup>a</sup></b>								
	287	284	279	263	272	244	269	238
<b>Nuclear Officers as a Percentage of Total Billet Requirements</b>								
	72	68	70	63	68	59	67	57
<b>Cost of Plan (In millions of dollars)</b>								
1997		3		3		2		2
2000		3		2		1		0
Total, 1997-2000		12		9		6		3

SOURCE: Congressional Budget Office based on data from the U.S. Navy.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus; MSR = minimum service requirement.

a. The Navy identifies these positions with an Additional Qualification Designator/Nuclear Subspecialty Code.

NOIP, it would retain just 50 and 25 fewer officers, respectively, at the MSR point. Since only about one-third of the total billets for nuclear submarine officers and roughly one-fourth for nuclear surface officers require nuclear training, all three alternatives would yield enough officers to fill the critical billets as well as many of the career-enhancing assignments.

**Nuclear Submarine Officers.** All three alternative plans would satisfy nearly 80 percent of the total requirements for nuclear submarine officers as projected by the Navy. Moreover, both next year and at the end of the decade, each plan would greatly exceed the requirements for billets that must be filled by a submarine officer with nuclear training.

Alternative 1, which calls for a 28 percent decrease in COPAY, would fill 84 percent of the total requirements for nuclear submarine officers in 1997--only 1 percentage point less than the current bonus plan. Similarly, Alternative 1 would satisfy 256 percent of the nuclear-specific requirements--those with an Additional Qualification Designator/Nuclear Subspecialty Code (AQD/NSC)--compared with 259 percent for the current plan. Alternative 1 would result in just nine fewer nuclear submarine officers out of 337 remaining in the Navy at the critical MSR point in 1997 and seven fewer in 2000. That would be accomplished at a savings of \$9 million over the 1997-2000 period.

The second alternative would eliminate payments for the AIB and at the same time reduce COPAY. Consequently, Alternative 2 would be less costly than Alternative 1, saving \$24 million over four years. Compared with the current program, however, Alternative 2 would result in 33 more officers leaving the service at MSR in 1997. Nonetheless, it would still fill 84 percent of the total requirements and 253 percent of the nuclear-specific requirements.

Under Alternative 3, the Navy would no longer offer COPAY or the AIB. Thus, this plan would yield the most savings--\$40 million over the 1997-2000 period. Even though 51 fewer nuclear submarine officers would remain in the Navy at MSR than under the current plan, Alternative 3 would more than satisfy the nuclear-specific billets (249 percent in 2000) and fill the great majority of the total requirements (77 percent in 2000).

**Nuclear Surface Officers.** The alternative plans for nuclear surface officers yield results comparable with those for nuclear submarine officers. All of the plans would fill well over 200 percent of the requirements for AQD/NSC billets, while satisfying nearly 60 percent or more of the total requirements.

Under Alternative 1, COPAY for nuclear surface officers would be reduced by 40 percent and the AIB by 56 percent. Even with those reductions, the Navy would still be able to fill 279 percent of its AQD/NSC requirements and 70 percent of its total requirements in 1997. By 2000, the percentages would be 263 and 63, respectively. Moreover, Alternative 1 would accomplish that by retaining only 11 fewer nuclear surface officers at the MSR decision point in 1997, and 12 fewer in 2000, than under the current bonus plan. Savings would total \$3 million over the 1997-2000 period.

Alternative 2 calls for larger reductions (60 percent in COPAY and no payments for the AIB), which in turn would yield greater savings--\$6 million through 2000. In addition, Alternative 2 would fill 272 percent of the nuclear-specific requirements for surface officers and 68 percent of the total requirements in 1997, while retaining 24 fewer officers at MSR. In 2000, it would satisfy 244 percent of the AQD/NSC requirements and 59 percent of the total requirements, with 25 fewer officers remaining in the service at MSR.

The third alternative would eliminate bonus payments for both COPAY and the AIB. Consequently, it would produce the largest savings--\$9 million over four years. Otherwise, Alternative 3 would have a similar impact to Alternative 2 in terms of the percentage of requirements filled and the number of officers retained at MSR.

### IMPLICATIONS FOR POLICY

As outlined above, CBO's analysis indicates that retention rates among nuclear-trained officers are relatively insensitive to the level and structure of the Navy's special pay. That finding suggests that the Congress and the Navy may want to examine targeted options that would use resources more efficiently. For example, special pay could be offered only to those nuclear-trained officers actually assigned to critical billets.<sup>3</sup> Such an approach might have less impact on retention than an across-the-board cut in COPAY and AIB because it would attract officers with a preference for sea duty. Thus, the Navy might be able to realize savings of the magnitude estimated above but with fewer officers deciding to leave the service.

Consideration of targeted bonuses might elicit a sharper analysis by the Navy of what its requirements for nuclear-trained officers really are. However, the Navy might view that approach, as well as any of the other alternatives examined by CBO, as disrupting its overall force management and the career planning of nuclear officers.

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3. The Navy has targeted other pay within a community; for instance, it targets bonuses for its pilots by type of aircraft.



## **APPENDIX**

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### **ANALYTIC METHOD**

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A nuclear officer nearing the completion of his minimum service requirement (MSR) or at a subsequent decision point must decide whether to remain in the Navy or leave the service. (There are no female nuclear-trained officers at present.) If the officer chooses to continue military service, he must decide on the contractual nature of his extension and its accompanying bonus. Currently, a nuclear officer can reenlist with a contract of three, four, or five years and receive a continuation pay (COPAY) bonus or extend without a contract and receive a nuclear career annual incentive bonus (AIB). In addition to the existing bonus program, the Congressional Budget Office (CBO) analyzed three alternative compensation plans.

CBO used data from the Navy's Officer Master Tapes as the major source of information on nuclear officers. More specifically, it used information on officers in the fiscal year 1974 through 1989 cohorts (officers with the same commissioning date). In addition, CBO used data from the Census Bureau's 1990 Public Use Microdata Samples and salary data on civilian nuclear engineers from a survey conducted by the National Society of Professional Engineers. Finally, CBO employed a model of officer retention that was developed at the Center for Naval Analyses and later refined at the Navy Personnel Research and Development Center (NPRDC). The model employs a variety of variables, which are summarized in Box A-1.

### **THE NUCLEAR OFFICER CONTINUATION MODEL**

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In the model CBO used, a nuclear officer at the end of his MSR or at a later decision point may choose to continue military service with a contract, extend without a contract, or leave the Navy. The model assumes that the officer will choose the option that maximizes his expected utility. The utility from each alternative outcome consists of two parts. The first component is the annualized income stream stem-

BOX A-1.  
SUMMARY OF VARIABLES USED IN  
THE NUCLEAR OFFICER CONTINUATION MODEL

$Y_R$	Real (inflation-adjusted) salary in 1989 dollars for male, college-educated veterans who are civilian professionals or engineers.
DEPEND	Number of dependents.
$Y_C$	Real military salary in 1989 dollars for an extension with a contract.
$Y_{NC}$	Real military salary in 1989 dollars for an extension without a contract.
USNA	A dummy variable equal to 1 if the officer came from the Naval Academy.
ROTC	A dummy variable equal to 1 if the officer came from the Reserve Officer Training Corps.
WHITE	A dummy variable equal to 1 if the officer is white.

ming from the option.<sup>1</sup> The second is the monetary equivalent (expressed in dollars) of the annualized value of the nonmonetary factors associated with the outcome.

1. In the case of submarine officers under a four-year contract, this component would equal the annualized value of regular military compensation plus submarine duty incentive pay plus continuation pay. For surface officers under a four-year contract, the annualized income would be computed similarly but without submarine duty pay. Assuming an income stream  $Y_1, \dots, Y_T$  and a discount rate  $r$ , the annualized discounted value of the stream can be written as:

$$Y^* = \frac{\sum_{t=1}^T Y_t (1+r)^{-t}}{\sum_{t=1}^T (1+r)^{-t}}$$

It follows that a constant income stream of  $Y^*$  has the same present discounted value over  $T$  periods as the original income stream,

$$\sum_{t=1}^T Y^* (1+r)^{-t} = \sum_{t=1}^T Y_t (1+r)^{-t}$$

CBO's analysis assumed a discount rate of 10 percent.

Moreover, the process of annualization allowed CBO to reduce income streams to a summation measure that is independent of the time horizon. Thus, it could compare income streams generated over different time periods, such as a four-year horizon of reenlistment with a contract and a one-year horizon of an extension without a contract. For more details, see John Warner, *Alternative Military Retirement Systems: Their Effects on Enlisted Retention*, Research Contribution 376 (Alexandria, Va.: Center for Naval Analyses, September 1979).

Thus, the expected utility (EU) for each possible decision is:

$$EU_C = Y_C + \Theta_C \quad (1)$$

$$EU_{NC} = Y_{NC} + \Theta_{NC} \quad (2)$$

$$EU_R = Y_R + \Theta_R \quad (3)$$

where  $Y_C$  is annualized military income over the period of continued service with a contract,  $Y_{NC}$  is annualized military income over the period of an extension without a contract, and  $Y_R$  is annualized civilian income.<sup>2</sup> The annualized monetary equivalents of the nonmonetary factors are represented by  $\Theta_C$ ,  $\Theta_{NC}$ , and  $\Theta_R$ . Those nonmonetary factors can be explained in part by a vector ( $X$ ) of variables representing measurable characteristics of the service member and an unmeasured disturbance ( $\delta$ ) stemming from unobservable variables and remaining errors. The observable variables include the number of dependents, years of education, race, and source of commission. Those nonmonetary factors can be approximated in linear form for the  $i$ th outcome for the  $j$ th nuclear officer as follows:

$$\Theta_i = \beta_i X_j + \delta_{ij} \quad (4)$$

Thus, the expected utility for each possible decision becomes:

$$EU_C = Y_C + \beta_C X + \delta_C \quad (5)$$

$$EU_{NC} = Y_{NC} + \beta_{NC} X + \delta_{NC} \quad (6)$$

$$EU_R = Y_R + \beta_R X + \delta_R \quad (7)$$

At the completion of the MSR and subsequent decision points, a nuclear officer will reenlist with or without a contract if  $EU_C$  is greater than  $EU_R$  or  $EU_{NC}$  is greater than  $EU_R$ . Otherwise, the officer will resign from the Navy. Multinomial

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2. The measures of pay used in this analysis do not include retirement income (either military or civilian). In general, as long as military retired pay is greater than its civilian counterpart, omitting retirement income from the calculation serves to overstate the elasticity of continuation with respect to pay. For officers early in their careers, however, the receipt of retired pay is many years away, and thus its economic (present) value is so small that it has little effect on their decisions about staying in the service. For officers who are closer to retirement age, the value of retired pay is much greater, but because their continuation rates are very high, the elasticity of continuation with respect to pay (including retirement) is very low. Thus, omitting retirement income has little empirical impact, but to the extent that it matters, the analysis in this paper overestimates the effect of reducing bonuses to nuclear officers.

logit is used in estimating the parameters.<sup>3</sup> This maximum-likelihood procedure is preferable since it guarantees consistent estimates of parameters.<sup>4</sup>

The probability (P) that a nuclear officer will choose to extend his service with a COPAY contract can be represented as follows:

$$P_C = \frac{\exp(\alpha Y_C + \beta_C X)}{\exp(\alpha Y_R + \beta_R X) + \exp(\alpha Y_C + \beta_C X) + \exp(\alpha Y_{NC} + \beta_{NC} X)} \quad (8)$$

Similarly,

$$P_{NC} = \frac{\exp(\alpha Y_{NC} + \beta_{NC} X)}{\exp(\alpha Y_R + \beta_R X) + \exp(\alpha Y_C + \beta_C X) + \exp(\alpha Y_{NC} + \beta_{NC} X)} \quad (9)$$

is the probability of extending without a contract and receiving an annual incentive bonus instead.

Finally,

$$P_R = \frac{\exp(\alpha Y_R + \beta_R X)}{\exp(\alpha Y_R + \beta_R X) + \exp(\alpha Y_C + \beta_C X) + \exp(\alpha Y_{NC} + \beta_{NC} X)} \quad (10)$$

is the probability of resigning from the service.

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3. The multinomial logit model has as its basis the cumulative logistic probability function, which can be represented as follows:

$$P_i = \frac{1}{1 + e^{-(\alpha + \beta X_i)}}$$

where  $P_i$  is the probability that an individual will make a particular choice given information represented by  $X_i$ .

4. Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, 2nd ed. (New York: McGraw-Hill, 1981), p. 305.

## CHANGES THAT AFFECT RETENTION

CBO's analysis focused on changes that the Navy can undertake that would have a favorable impact on the retention of nuclear officers. The two types of changes examined here are changes in military pay, which includes the Nuclear Officer Incentive Pay (NOIP) program, and changes in selected nonmonetary factors that may affect retention. The NOIP changes are explored further through selected elasticities.

### Effects of Changes in Military Pay

To estimate the effects that changes in military pay (including bonuses) under a COPAY contract would have on the probability of nuclear officers' remaining in the Navy, CBO used the following formulations:

$$\frac{\partial P_R}{\partial Y_C} = -\alpha P_R P_C \quad (11)$$

$$\frac{\partial P_{NC}}{\partial Y_C} = -\alpha P_{NC} P_C \quad (12)$$

$$\frac{\partial P_C}{\partial Y_C} = \alpha P_C (1 - P_C) \quad (13)$$

The positive sign on the coefficient  $\alpha$  in equation (13) coupled with the negative signs for  $\alpha$  in equations (11) and (12) means that an increase in military pay under a COPAY contract causes  $P_C$  to increase and overall retention to rise (by lowering the number of officers who leave,  $P_R$ ), but leads to a decrease in  $P_{NC}$  (noncontract, AIB participation).

Likewise, the effects of changes in military pay under an AIB agreement on the probability of retention of nuclear officers can be represented as follows:

$$\frac{\partial P_R}{\partial Y_{NC}} = -\alpha P_R P_{NC} \quad (14)$$

$$\frac{\partial P_C}{\partial Y_{NC}} = -\alpha P_C P_{NC} \quad (15)$$

$$\frac{\partial P_{NC}}{\partial Y_{NC}} = \alpha P_{NC}(1 - P_{NC}) \quad (16)$$

Accordingly, an increase in noncontract pay will increase AIB participation, lower COPAY participation, and increase retention.

#### Effects of Changes in Nonmonetary Factors in the Vector X

To capture the influences of the various nonmonetary factors on retention, CBO estimated the following equations:

$$\frac{\partial P_C}{\partial X_i} = \beta P_C(1 - P_C) \quad (17)$$

$$\frac{\partial P_{NC}}{\partial X_i} = \beta P_{NC}(1 - P_{NC}) \quad (18)$$

$$\frac{\partial P_R}{\partial X_i} = -\frac{\partial P_C}{\partial X_i} - \frac{\partial P_{NC}}{\partial X_i} \quad (19)$$

#### Selected Elasticities

An important focus of CBO's analysis is the percentage change in the probability of an officer's staying in the Navy that results from a percentage change in the nuclear bonus--that is, the elasticity of staying with respect to an increase in the bonus. Similarly, the analysis is also concerned with the elasticity of staying with respect to a change in civilian income. CBO derived those critical elasticities in the following way.

If one begins with the equation  $P_S = P_C + P_{NC}$ , where  $P_S$  is the probability of staying in the military, the elasticity of staying with respect to civilian income is:

$$\begin{aligned}
 \epsilon_{P_S, Y_R} &= \frac{Y_R}{P_S} \frac{\partial P_S}{\partial Y_R} & (20) \\
 &= \frac{Y_R}{P_S} \left[ \frac{\partial P_C}{\partial Y_R} + \frac{\partial P_{NC}}{\partial Y_R} \right] \\
 &= \frac{Y_R}{P_S} \left[ -\alpha P_C P_R - \alpha P_{NC} P_R \right] \\
 &= -\alpha P_R Y_R \frac{P_C + P_{NC}}{P_S} \\
 &= -\alpha P_R Y_R \frac{P_C + P_{NC}}{P_C + P_{NC}} \\
 &= -\alpha P_R Y_R & (21)
 \end{aligned}$$

Similarly, the elasticity of staying in the military with respect to COPAY income is:

$$\begin{aligned}
 \epsilon_{P_S, Y_C} &= \frac{Y_C}{P_S} \frac{\partial P_S}{\partial Y_C} & (22) \\
 &= \frac{Y_C}{P_S} \left[ \frac{\partial P_S}{\partial Y_C} + \frac{\partial P_{NC}}{\partial Y_C} \right] \\
 &= \frac{Y_C}{P_S} \left[ \alpha P_C (1 - P_C) - \alpha P_{NC} P_C \right]
 \end{aligned}$$

$$\begin{aligned}
 &= \alpha P_C Y_C \frac{1 - P_C - P_{NC}}{P_S} \\
 &= \alpha \frac{1 - P_S}{P_S} P_C Y_C \quad (23)
 \end{aligned}$$

Substituting  $Y_{NC}$  for  $Y_C$  in equation (23) yields the elasticity of staying in the military with respect to noncontract income:

$$\epsilon_{P_S, Y_{NC}} = \alpha \frac{1 - P_S}{P_S} P_{NC} Y_{NC} \quad (24)$$

#### ESTIMATION OF THE MODEL

CBO's estimation of the nuclear officer continuation model is based primarily on information about nuclear officers in the fiscal year 1974 through 1989 cohorts contained in the Navy's Officer Master Tapes. The information was compiled by tracking nuclear officers by their Social Security numbers. After making several adjustments to the data, CBO was left with 6,755 observations as the basis for its estimation.<sup>5</sup>

The model was estimated separately for submarine and surface officers using maximum-likelihood methods (see Table A-1 for the mean values of the variables used in the estimation). Although most of the variables are self-explanatory, two require additional explanation. The civilian pay variable ( $Y_R$ ) was estimated by ordinary least squares using a cross-sectional sample of veterans drawn from the Census Bureau's 1990 Public Use Microdata Samples. The sample was composed only of male veterans who were college graduates employed in engineering and managerial occupations.  $Y_R$  was assumed to have a four-year horizon and does not include bonuses or benefits. The estimating equation and resulting coefficients (t-statistics in parentheses) are as follows:<sup>6</sup>

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5. Observations were dropped if officers had not yet completed their minimum service requirement, if they had left the service before their MSR, or if they had data missing from their file.
  6. This equation was supplied by the Navy Personnel Research and Development Center. All of the coefficients far exceed statistical significance at the 5 percent level. A low  $R^2$  such as the one here is quite common in cross-sectional analyses.

TABLE A-1. MEAN VALUES OF VARIABLES USED IN THE MODEL

Variable	Description	Mean Value	
		Submarine Model (N=5,448)	Surface Model (N=1,307)
CONTRACT	= 1, if staying in Navy at MSR with a 3-, 4-, or 5-year contract; 0, otherwise	.243	.166
NONCONTRACT	= 1, if staying in Navy at MSR without a 3-, 4-, or 5-year contract; 0, otherwise	.426	.394
LEAVE	= 1, if leaving Navy at MSR; 0, otherwise	.331	.440
Y <sub>c</sub>	= Annualized military pay over a 4-year horizon; military pay includes RMC, SUBPAY (submarines only), and COPAY (in fiscal year 1989 dollars)	\$53,654	\$48,853
Y <sub>NC</sub>	= Annualized military pay over a 1-year horizon; military pay includes RMC, SUBPAY (submarines only), and AIB (in fiscal year 1989 dollars)	\$51,550	\$46,755
Y <sub>R</sub>	= Annualized civilian earnings over a 4-year horizon (in fiscal year 1989 dollars) <sup>a</sup>	\$24,575	\$24,382
COPAY345	= 1, if MSR occurred in fiscal year 1986 or later; 0, otherwise	.604	.611
ACA	= 1, if U.S. Naval Academy accession; 0, otherwise	.374	.423
NROTC	= 1, if NROTC accession; 0, otherwise	.292	.324
WHITE	= 1, if officer is white; 0, otherwise	.952	.930
DEPEND	= Number of dependents at MSR	.752	.640

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: MSR = minimum service requirement; RMC = regular military compensation; SUBPAY = submarine-duty incentive pay; COPAY = continuation pay; AIB = annual incentive bonus; NROTC = Navy Reserve Officers Training Corps.

a. Annualized civilian earnings represent the earnings that a nuclear officer with four years of military service and no civilian experience could expect to receive in 1989 dollars in civilian engineering and managerial positions. They are based on data from the Census Bureau. Alternatively, a civilian with 10 years of experience, the counterpart of a nuclear officer with the rank of lieutenant commander (O-4), could expect to earn \$32,268 in fiscal year 1989 dollars. Similarly, the civilian counterpart of a commander (O-5) with 16 years of experience could expect earnings of \$42,193. Table 9 shows similar income figures after those two figures were adjusted with wage and salary deflators.

$$\begin{aligned} \text{LnY} = & 9.7060 + 0.0701*\text{MILEXP} - 0.0014*\text{MILEXP}^2 + 0.0785*\text{CIVEXP} \\ & (132.62) \quad (6.74) \qquad \qquad (-4.84) \qquad \qquad (15.01) \\ & - 0.0013*\text{CIVEXP}^2 - 0.0025*\text{MILEXP}*\text{CIVEXP} - 0.2366*\text{NONWHITE} \\ & (-13.53) \qquad \qquad (-7.18) \qquad \qquad (-7.25) \\ & + 0.1053*\text{BAPLUS} \\ & (6.20) \end{aligned}$$

$$R^2 = 0.064$$

where:

LnY = the natural logarithm of annual earnings in 1989 dollars  
MILEXP = years of military experience  
CIVEXP = years of civilian experience  
NONWHITE = 1, if the veteran was nonwhite; 0, otherwise  
BAPLUS = 1, if the veteran had more than a four-year degree;  
0, otherwise

Since 1985, nuclear officers have had the option of a three-year or five-year contract along with a four-year contract. To capture the influence of the additional contract options, a dichotomous dummy variable (COPAY345) was constructed. COPAY345 takes on the value of 1 if a nuclear officer's MSR or subsequent retention decision occurred in fiscal year 1986 or later, and 0 otherwise.

Results of the estimations for nuclear submarine and surface officers facing the choice of whether to remain in the Navy at their minimum service requirement are presented in Tables A-2 and A-3. Similar estimations were undertaken to capture the continuation decisions of nuclear officers at subsequent decision points. The results of these estimations give rise to retention elasticities.

As an overall measure of the quality of the model's fit, the Chi-square ( $\chi^2$ ) statistic for both the submarine and surface estimations exceeds the 5 percent level of statistical significance. Likewise, many of the coefficients in the two estimations are statistically significant at the 5 percent level (see Tables A-2 and A-3). In particular, the coefficients on the compensation variables ( $Y_C$ ,  $Y_{NC}$ , and  $Y_R$ ) are positive and statistically significant.<sup>7</sup> However, they are rather small. Thus, although pay matters to an officer who is deciding whether to remain in the Navy, its impact

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7. In accordance with the model presented above, the coefficients on the three compensation variables are the same.

TABLE A-2. ESTIMATION RESULTS FOR NUCLEAR SUBMARINE OFFICERS UNDER A CONTINUATION PAY CONTRACT OR ANNUAL INCENTIVE BONUS (t-statistics in parentheses)

Variable	COPAY Coefficient	AIB Coefficient
Constant	-3.373 (-6.533)	-1.424 (-3.016)
$Y_C, Y_{NC}, Y_R$	0.0000417 (2.790)	0.0000417 (2.790)
COPAY345	0.960 (13.078)	0.960 (13.078)
ACA	0.624 (5.913)	0.454 (4.764)
NROTC	0.256 (2.451)	0.285 (3.152)
WHITE	0.618 (3.004)	0.270 (1.622)
DEPEND	0.401 (9.364)	0.075 (1.900)
Log Likelihood Function		-5,642.102
Chi-square		408.18

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.

TABLE A-3. ESTIMATION RESULTS FOR NUCLEAR SURFACE OFFICERS UNDER A CONTINUATION PAY CONTRACT OR ANNUAL INCENTIVE BONUS (t-statistics in parentheses)

Variable	COPAY Coefficient	AIB Coefficient
Constant	-9.074 (-7.080)	-6.203 (-5.368)
$Y_C, Y_{NC}, Y_R$	0.0002015 (4.730)	0.0002015 (4.730)
COPAY345	1.196 (6.522)	1.196 (6.522)
ACA	0.990 (4.393)	0.368 (2.133)
NROTC	0.224 (0.924)	0.113 (0.655)
WHITE	1.669 (3.937)	1.469 (4.339)
DEPEND	0.376 (3.920)	0.032 (0.400)
Log Likelihood Function		-1,292.036
Chi-square		126.62

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.

is not very large. The coefficient on the COPAY345 variable is also positive and significant, which implies that the three-year and five-year contract options increase retention. The positive coefficient on the race variable (WHITE) suggests that white nuclear officers are more likely to stay in the Navy than their nonwhite counterparts.

Moreover, the coefficients on the Naval Academy accession variable (ACA) are positive and significant for the two nuclear communities in both contract and noncontract choices. That implies that Naval Academy accessions have a higher propensity to remain in the service than accessions from other sources. Similarly, accessions to the submarine community from the Navy Reserve Officers Training Corps (NROTC) have higher propensities for retention than other groups (the coefficients are positive and significant). That is not the case in the surface community, however.

Another implication of the estimation worth noting is that the variable representing the number of dependents that an officer had at his MSR (DEPEND) has positive coefficients in all cases, but for both communities they are only statistically significant in the contract choice. In general, that finding implies that the greater the number of dependents, the more likely an officer is to stay in the Navy. More specifically, the more dependents an officer has, the greater is his likelihood to remain in the Navy under a contract.

#### IMPACT OF ALTERNATIVE COMPENSATION PLANS

The nuclear officer continuation model used the estimated probabilities described above to derive retention elasticities (see Tables A-4 and A-5). CBO then evaluated the alternative plans by using the elasticities for each community, which were estimated by NPRDC, to adjust the continuation rates in each year-of-service cell for that community. Applying the adjusted continuation rates to the number of officers in a community yielded the number of officers under a specific compensation plan. CBO compared that figure with the projected number of officers under the current NOIP program to estimate the changes resulting from each compensation alternative.

TABLE A-4. RETENTION ELASTICITIES UNDER ALTERNATIVE BONUS PLANS FOR NUCLEAR SUBMARINE OFFICERS

Year of Service	Current Plan (\$10,000 COPAY, \$7,200 AIB)	Alternative 1 (\$7,200 COPAY, \$6,000 AIB)	Alternative 2 (\$6,000 COPAY, no AIB)	Alternative 3 (No COPAY or AIB)
4	.696	.668	.595	.541
5	.865	.850	.844	.808
6	.732	.710	.701	.651
7	.721	.699	.689	.638
8	.922	.912	.908	.882
9	.937	.929	.925	.903
10	.680	.671	.667	.644
11	.882	.869	.863	.830
12	.939	.931	.927	.906
13	.904	.892	.887	.858
14	.850	.834	.827	.790
15	.788	.769	.760	.715

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.

TABLE A-5. RETENTION ELASTICITIES UNDER ALTERNATIVE BONUS PLANS FOR NUCLEAR SURFACE OFFICERS

Year of Service	Current Plan (\$10,000 COPAY, \$7,200 AIB)	Alternative 1 (\$6,000 COPAY, \$3,200 AIB)	Alternative 2 (\$4,000 COPAY, no AIB)	Alternative 3 (No COPAY or AIB)
4	.574	.431	.269	.255
5	.713	.677	.659	.620
6	.824	.796	.782	.750
7	.855	.830	.817	.789
8	.858	.834	.821	.793
9	.882	.861	.849	.824
10	.917	.900	.891	.871
11	.908	.890	.880	.858
12	.875	.853	.841	.815
13	.923	.907	.898	.879
14	.957	.947	.941	.928
15	.894	.874	.863	.840

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.