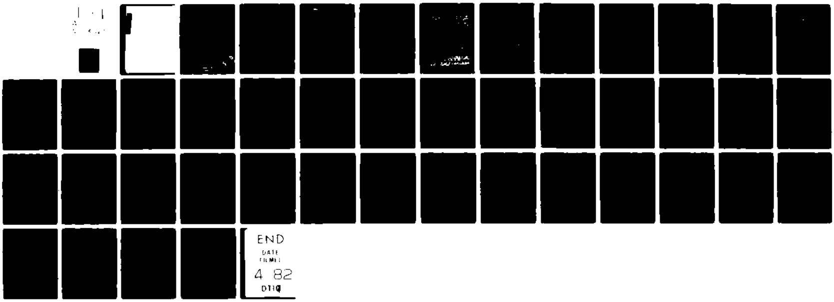
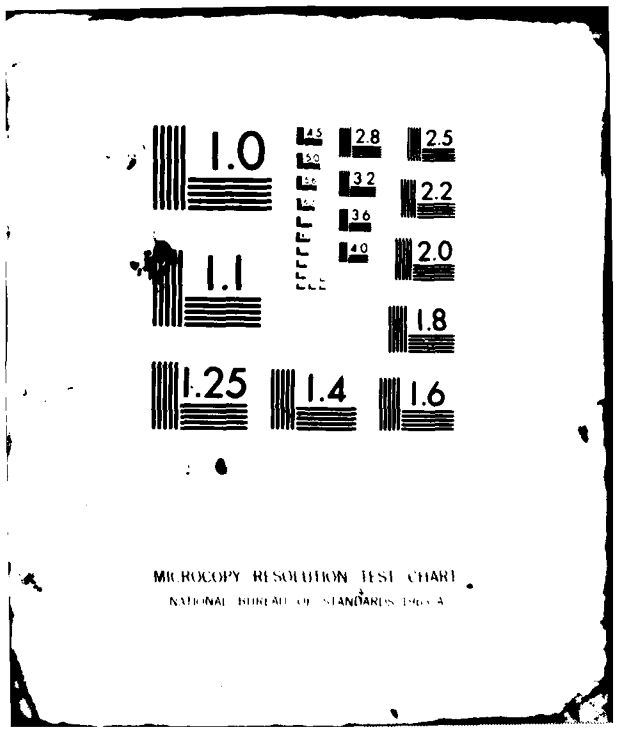
AD-A113 197 NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER SAN D--ETC F/G 5/1
ASSESSING THE PERSONNEL GEOGRAPHIC STABILITY PROGRAM FOR BOILER--ETC(U)
MAR 82 T A BLANCO, P G BULETZA
UNCLASSIFIED NPRDC-TR-82-40 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

(12)

NPRDC TR 82-40 March 1982

ASSESSING THE PERSONNEL GEOGRAPHIC STABILITY PROGRAM FOR BOILER TECHNICIANS

Thomas A. Blanco
Peter G. Buletza

Reviewed by
Joe Silverman

Released by
James F. Kelly, Jr.
Commanding Officer

Navy Personnel Research and Development Center
San Diego, California 92152

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE — READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NPRDC TR 82-40	2. GOVT ACCESSION NO.: AD-A113197
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): ASSESSING THE PERSONNEL GEOGRAPHIC STABILITY PROGRAM FOR BOILER TECHNICIANS	5. TYPE OF REPORT & PERIOD COVERED: Final 1 Apr 1981-1 Mar 1982
	6. PERFORMING ORG. REPORT NUMBER: 11-82-6
7. AUTHOR(s): Thomas A. Blanco, Peter G. Buletza	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Navy Personnel Research and Development Center, San Diego, California 92152	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 63707N Z1583-PN
11. CONTROLLING OFFICE NAME AND ADDRESS: Navy Personnel Research and Development Center, San Diego, California 92152	12. REPORT DATE: March 1982
	13. NUMBER OF PAGES: 43
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)

18. SUPPLEMENTARY NOTES

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

Personnel geographic stability (PEGS)
Homesteading
Boiler technicians
Retention incentives
Mar[illegible]ilization
Enlisted [illegible]ribution
Assignment policy
Preferred assignment

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

The objective of this report is to document development efforts to assess the Navy's capability for a personnel geographic stability (PEGS) program. Work to date has focused on a single rating--boiler technician (BT)--with particular attention being given to the complexities of the problem. A set of assumptions were developed to form a "homesteading strategy" based on considerations of Navy-wide manning balance, CNO priority manning objectives, regional billet structure, and sea-shore rotation equilibrium.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Because a significant portion of BT shore billets located outside of fleet concentrations are designated CNO priority 2 (i.e., they must be filled), personnel in grades E-5 through E-9 are allowed to "buy" their way into the PEGS program by first serving in a CNO priority 2 billet outside their desired PEGS region. Once the initial "priority away" shore assignment is met, the PEGS participant receives preferential treatment; that is, an attempt is made to give him all future sea and shore duty assignments in a previously agreed upon PEGS region. Results indicate that 42 percent of the E-5--E-9 BT community can be accommodated by the PEGS program while still maintaining an overall Navy-wide manning balance. The results were most sensitive to changes in projected loss rates for PEGS participants.

FOREWORD

This research and development was performed in support of Navy decision coordinating paper Z1583-PN (Geographic Stability), under the sponsorship of the Deputy Chief of Naval Operations (Manpower, Personnel, and Training). The objective of this project is to conduct a systematic assessment of the feasibility and impact of implementing a formal personnel geographic stability (PEGS) program.

This report describes the main effort conducted during FY 1982--the assessment of a "pilot" PEGS program for the boiler technician (BT) rating. The complexities of the problem are described, including (1) assumptions made to develop a "homesteading strategy," (2) assignment policy tradeoffs, and (3) model development. The results of the capability assessment can be used by personnel managers as a guide in implementing a formal PEGS program for BTs.

Acknowledgements are due the project personnel of Rehab Group, Inc., San Diego, California, who contributed to data base and model development.

JAMES F. KELLY, JR.
Commanding Officer

JAMES J. REGAN
Technical Director

[illegible]

[illegible]

Problem

The [illegible] could be a [illegible] very costly [illegible] on the retention of high quality personnel.

On the other hand, if a [illegible] it could result in a loss of [illegible] negative impact on the retention of high quality [illegible] personnel could be negatively impacted by [illegible] provisions.

Objective

The objective of this report is to [illegible] capability in establishing and maintaining a [illegible] single rating (sailor-technician) with particular [illegible] of the problem.

Approach

The approach consisted of four major stages:

1. A set of assumptions were developed to [illegible] considerations of Navy-wide manning balance, priority [illegible] retention equilibrium.

2. A baseline data set was developed by [illegible] technicians.

3. The [illegible]

4. [illegible]

Results

[illegible]

Over 100 models [illegible] PEGS personnel [illegible].

Conclusions

1. "Payment" at the front end of the program [illegible] outside a PEGS region) is [illegible]. To fill priority away billets, the Navy [illegible] satisfying priority shore assignments. PEGS participants [illegible] a priority away billet initially may be required to do so later in the program.

2. Explicit tradeoffs can be made among sea and shore billets, manning levels, and tour lengths. If care is not taken in managing sea manning levels and shore tour lengths, undesirable sea tour lengths will result.

3. The projected PEGS program participation is much higher for pay grade group E-7--E-9 than for pay grade group E-5/6 because the E-5/6 group has a [illegible] sea-shore billet ratio, and a PEGS program for this group [illegible] treatment as to Navy assignments.

4. The results of the sensitivity analysis showed that the model [illegible] very sensitive to changes in certain parameters. For example, a 20 percent change in the E-5/6 PEGS personnel loss rate, the variable that influenced the [illegible], resulted in only a 10 percent change in the overall model results for the E-5/6 PEGS personnel.

Recommendations

1. The strategy and models that have been developed should be [illegible] 01/NMPC and used as planning tools. These models should be [illegible] "user friendly" computer software to give personnel managers the [illegible] "what if" questions concerning the location of new billets and [illegible] participation due to changes in personnel losses and manning levels.

2. In implementing a PEGS program, care should be [illegible] flow of entries into the program should be [illegible] "bow-wave" effect on the distribution system.

3. Additional research is needed before [illegible] other enlisted ratings and/or [illegible]. The [illegible]

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Problem

The Navy's distribution system is designed to rotate people from sea to shore and from one job to another. Increasingly, the process of relocating from one geographic location to another has become very costly, particularly for homeowners and/or two-income families. A personnel geographic stability (PEGS) program that would give individuals a preferred assignment to a single geographic location for one or more follow-on tours has been proposed. The intent is to ensure the retention of high quality personnel, among other reasons.

On the other hand, a PEGS program, if not carefully implemented, could have a negative impact on the retention of high quality personnel. For example, CNO priority 2 shore billets (e.g., instructors) must be filled with high quality people. The majority of these billets, however, are outside of homeport areas that are conducive to geographic stabilization (e.g., Great Lakes). If a PEGS program only involved back-to-back tours (sea-shore) in the same area, the high quality personnel needed to fill these CNO high priority billets might be excluded from the program.

Other disadvantages arising from a formal PEGS program involve a potential loss of fleet balancing flexibilty, as well as limited career opportunities, particularly for officers. One of the major functions of the enlisted distribution projection system is to balance projected personnel assets among the manpower control authorities (MCAs). In general, after CNO priority 1 and 2 billets are filled, the remaining personnel assets are used to balance the fleets. Since a PEGS program could "fence" a certain amount of these assets in selected geographic locations, the number of personnel assets available for balancing the fleets could be reduced.

At the very least, it is necessary to estimate the extent to which geographic stability can be provided for each officer/enlisted category so as to minimize the risk of "false promises" or a loss in fleet readiness. Consequently, the purpose of this development is to make a systematic assessment of the feasibility and impact of implementing a formal PEGS program.

Objective

The objective of this report is to describe the work underway to assess the feasibility of establishing and maintaining a PEGS program for enlisted personnel in terms of a single rating (boiler technician (BT)), with special attention directed toward the complexities of the problem.

APPROACH

The approach used in this work involved four steps: (1) strategy development, (2) development of a baseline data set by performing assignment policy tradeoffs, (3) formulation of a mathematical model, and (4) sensitivity analysis.

Strategy Development

Before a PEGS program is implemented, careful consideration must be given to fleet balance, priority manning objectives, sea-shore rotation equilibrium, and career path opportunities (especially for officers). For enlisted personnel, only pay grades E-5 and above are considered eligible for PEGS. Before the Navy's capability to implement a formal PEGS program can be analyzed, a number of assumptions must be made. These assumptions, taken together, can be called a "homesteading strategy."

The BT rating has been selected by the Naval Military Personnel Command (NMPC) as the initial pilot rating to be examined in terms of developing a feasible PEGS program. The journeymen BT pay grades, E-5 and E-6, are burdened with a severe sea-shore billet ratio of about three to one. Moreover, 57 percent of the BT E-5--E-6 shore billets are outside areas conducive for PEGS, and half of these "away" billets are designated as CNO priority 2 (i.e., they must be filled).

Ninety-five percent of the E-5 through E-9 BT shore billets are located in the United States, with the second largest geographical concentration in the United States being in the Great Lakes area (Figure 1). Since the BT billets in Great Lakes are mostly instructor positions, over 90 percent are designated as CNO priority 2.

The Navy would like to "homestead" high quality personnel but also have these same people fill CNO priority 2 shore billets. Since many of these billets are not in areas conducive to PEGS, a strategy was developed that attempts to resolve these conflicting goals. The main idea of the strategy is to use PEGS program participants to fill CNO priority 2 shore billets (in and outside PEGS regions) when at all possible. Personnel, E-5 through E-9, are allowed to "buy" their way into the PEGS program by first serving in a CNO priority 2 billet outside their desired PEGS region. Once the initial priority away shore assignment is met, the PEGS participant receives preferential treatment; that is, an attempt is made to give him future assignments in a previously agreed upon PEGS region.

"Payment" at the front end of the program is believed to be the only feasible solution. Personnel would have an incentive to fill a billet away from their home base. They would receive preferential treatment in terms of their future assignments, and their financial investments could be planned (i.e., they could rent their homes for a few years while serving in their away tours). In this way, the Navy detailers would be helped in meeting their goals for priority shore assignment.

Assignment Policy Tradeoffs

The problem of maintaining an overall fleet manning balance and sea-shore rotation equilibrium involves the analysis of assignment policy tradeoffs. In general, to achieve sea-shore rotation equilibrium, the following equation must hold.

$$\frac{P_{sea}}{T_{sea}} = \frac{P_{shore}}{T_{shore}}$$

The annual number of people rotating from sea to shore (sea population (P_{sea}) divided by sea tour length in years (T_{sea})) must be equal to the annual number of people rotating from shore to sea (shore population (P_{shore}) divided by shore tour length in years (T_{shore})). The above relationship is complicated by two factors. First, if personnel shortages exist, not all billets can be manned. Second, CNO priority 2 shore billets usually have significantly different tour lengths and manning rates than do lower priority shore billets. Taking these factors into account, the above equation can be expressed as,

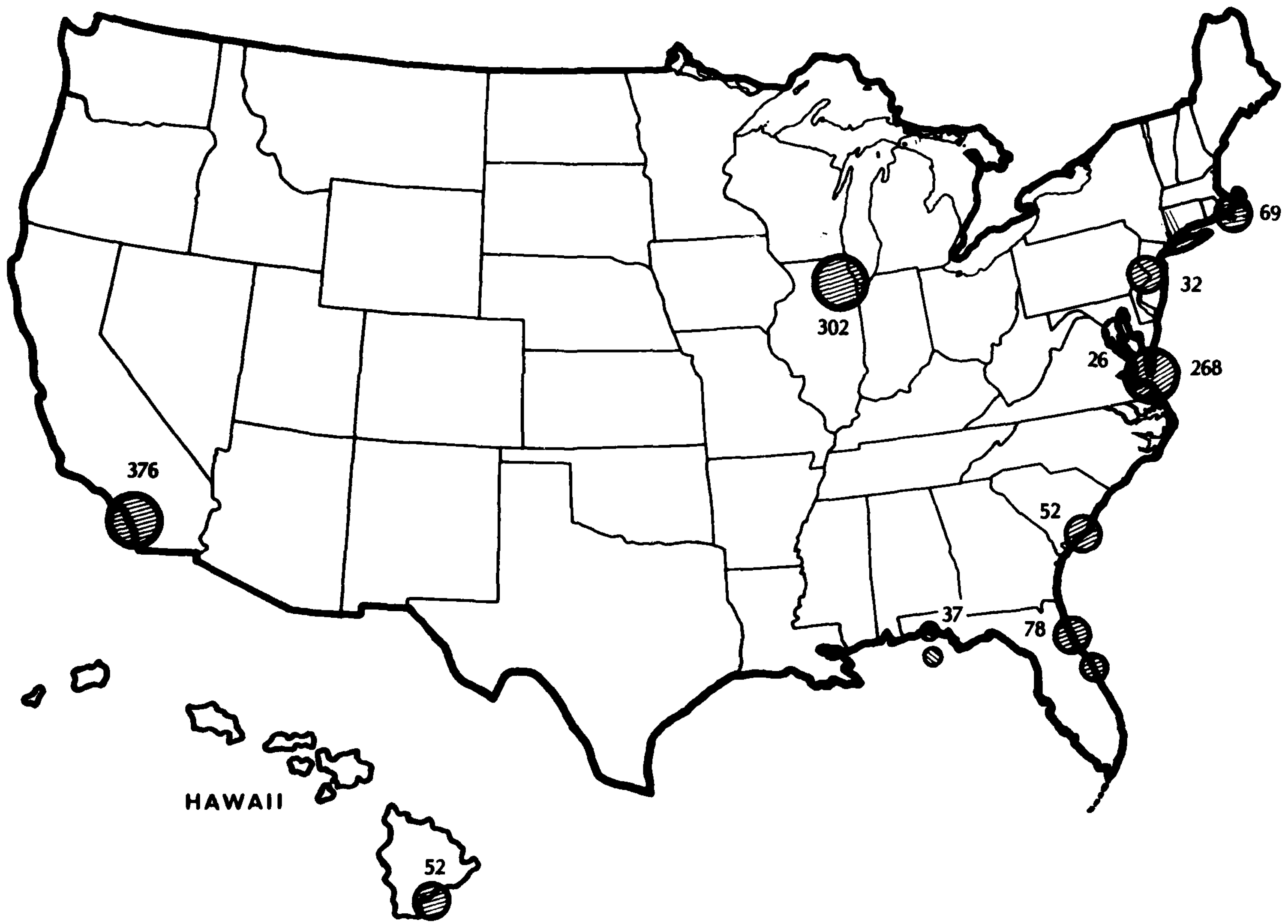


Figure 1. U.S. distribution of BT shore billets, pay grades E-5--E-9.

$$\frac{\rho_{sea} B_{sea}}{T_{sea}} = \frac{\rho_{pshore} B_{pshore}}{T_{pshore}} + \frac{\rho_{shore} B_{shore}}{T_{shore}} \qquad (1)$$

where

B_{sea} = number of sea billets,

B_{pshore} = number of CNO priority 2 shore billets,

B_{shore} = number of nonpriority (below CNO priority 2) shore billets,

ρ_{sea} = percentage of sea billets manned,

ρ_{pshore} = percentage of CNO priority 2 shore billets manned,

ρ_{shore} = percentage of nonpriority shore billets manned,

T_{sea} = sea tour length,

T_{pshore} = CNO priority 2 shore tour length, and

T_{shore} = nonpriority shore tour length.

In addition, the number of people filling the three types of billets (sea, shore, priority shore) is constrained by the total personnel available (sometimes referred to as "distributable" population).

Therefore,

$$\rho_{sea} B_{sea} + \rho_{pshore} B_{pshore} + \rho_{shore} B_{shore} = P_T \qquad (2)$$

where P_T equals the total personnel available.

Equations (1) and (2) can be used together to analyze assignment policy tradeoffs by showing how a change in one variable results in a change in some of the others. Solving equations (1) and (2) for sea tour length (T_{sea}), equation (3) is obtained.

$$T_{sea} = \frac{T_{shore}\, \rho_{sea}\, B_{sea}}{\frac{\rho_{pshore} B_{pshore}}{T_{pshore}} (T_{shore} - T_{pshore}) + P_T - \rho_{sea} B_{sea}} \qquad (3)$$

In equation (3), if all the terms are fixed except sea tour length (T_{sea}) and sea manning percentage (ρ_{sea}), sea tour versus sea manning tradeoffs can be easily performed. These tradeoffs are first illustrated with some numerical examples and then graphically.

The examples use projected billets for January 1983, empirical shore tour lengths as of 31 March 1981, and average CY 1979-CY 1981 personnel levels for the BT E-5/6 community. The numerical assumptions of the examples include:

1. 3101 sea billets (B_{sea}),
2. 316 CNO priority 2 shore billets (B_{pshore}),
3. 33-month tour length for CNO priority 2 shore billets (T_{pshore}),
4. 817 nonpriority shore billets (B_{shore}),
5. 27-month tour length for nonpriority shore billets (T_{shore}),
6. 100 percent CNO priority 2 shore manning (ρ_{pshore}), and
7. 3599 total personnel (P_T).

As shown in this example, BT sea-shore billet ratios and manning levels are quite severe for the journeyman pay grades, E-5 and E-6. They are 2.74 (3101/316+817) and 85 percent (3599/3101+316+817) respectively.

Equation (3) for this numerical example becomes:

$$T_{sea} = \frac{27\,(\rho_{sea})\,3101}{\frac{1.0\,(316)}{33}\,(27-33) + 3599 - \rho_{sea}(3101)},$$

which reduces to

$$T_{sea} = \frac{83{,}727\,\rho_{sea}}{3541.55-3101\rho_{sea}}.$$

With sea manning set at .72,

$$T_{sea} = \frac{83{,}727(.72)}{3541.55-3101(.72)} = \frac{60{,}283.44}{3541.55-2232.72}$$

$$T_{sea} = \frac{60{,}283.44}{1308.83} = 46.06 \text{ months.}$$

With sea manning set at .85,

$$T_{sea} = \frac{83{,}727(.85)}{3541.55-3101(.85)} = 78.58 \text{ months.}$$

Because of the severe sea-shore billet ratios and total manning levels, tradeoffs between acceptable sea tour lengths and sea manning levels are also quite severe. As shown above, and as depicted by point (a) in Figure 2a, a 78-month sea tour would be required to keep sea manning at 85 percent "fair share" manning. Sea manning of 72 percent (the CY 1979-CY 1981 average) reduces the required sea tour length to 46 months (point (b) in Figure 2a). In this example, when sea manning is at 72 percent, nonpriority shore manning is at 129 percent; when sea manning is at 85 percent, nonpriority shore manning is at 79 percent.[1]

If overall manning were higher, the sea tour vs. sea manning tradeoffs would be a lot less severe, even with the same sea-shore billet ratio of 2.74. Figure 2c shows these tradeoffs for the BT E-5/6 community at different levels of total manning. As the BT E-5/6 inventory increases, shorter and shorter sea tours are required to achieve the same sea manning levels. For example, with total manning at 100 percent (P_T = 4234), equation (3) becomes:

$$T_{sea} = \frac{27(\rho_{sea})\ 3101}{\frac{1.0\ (316)}{33}\ (27-33)+4234-\rho_{sea}(3101)}$$

which reduces to:

$$T_{sea} = \frac{83{,}727\rho_{sea}}{4176.55-3101\rho_{sea}}.$$

With sea manning set at .72, T_{sea} = 31.0 months. Therefore, with total manning at 100 percent, only a 31-month sea tour is required to achieve 72 percent sea manning (point (c) in Figure 2c). Likewise, a 60-month sea tour would allow a 93 percent sea manning (point (d) in Figure 2c).

From equation (3), it can be shown that shore tour lengths also impact the relationship between sea tour lengths and sea manning levels. Reenlistment and assignment incentives that lengthen shore tours for some individuals also lengthen sea tours for others, or else degrade sea manning. Programs like GUARD III and assignments to CNO priority 2 shore billets (e.g., instructors, recruiters) usually come with a 3-year shore tour, vice the prescribed 2-year shore tour. The impacts of increased shore tour lengths on sea tour vs. sea manning tradeoffs are shown graphically in Figure 3. As of March 1981, the average shore tours for BT E-5/6s were 27 months for nonpriority assignments and 33 months for CNO priority 2 assignments. Figure 3 shows that, to achieve 79 percent sea manning (CY81 avg.) with the prescribed 2-year shore tour and 85 percent total manning, a 50-month sea tour would be required (point (a)). However, with the historically averaged shore tours, a 60-month sea tour would be required (point (b)). The net impact of the increased shore tour lengths is a 10-month increase in the required

---

[1]Although not demonstrated numerically, there is also a tradeoff between sea tour length and nonpriority shore manning, as illustrated in Figure 2b.

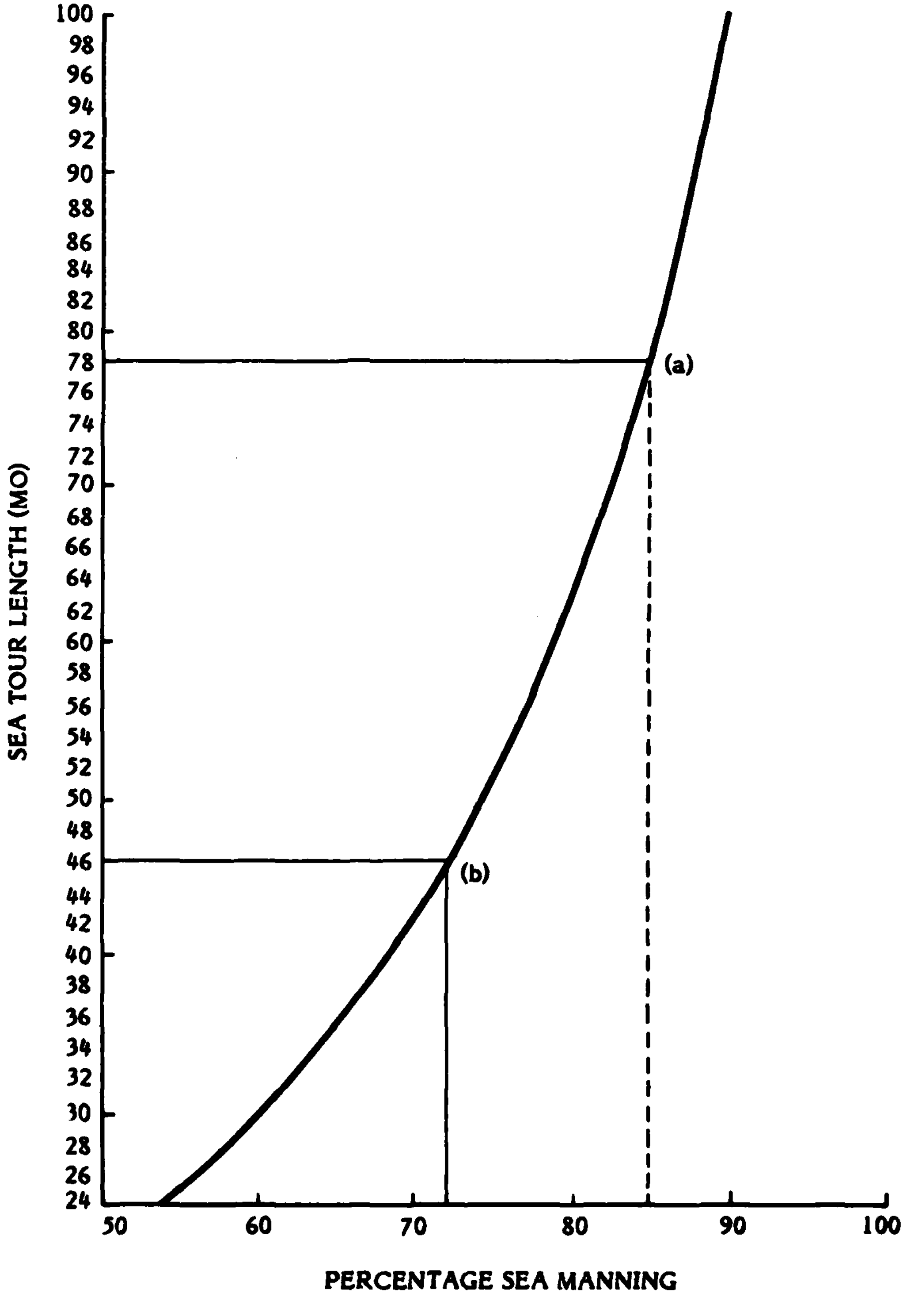


Figure 2a. Sea tour length vs. percentage sea manning, BT E-5/6 (total manning = 85%).

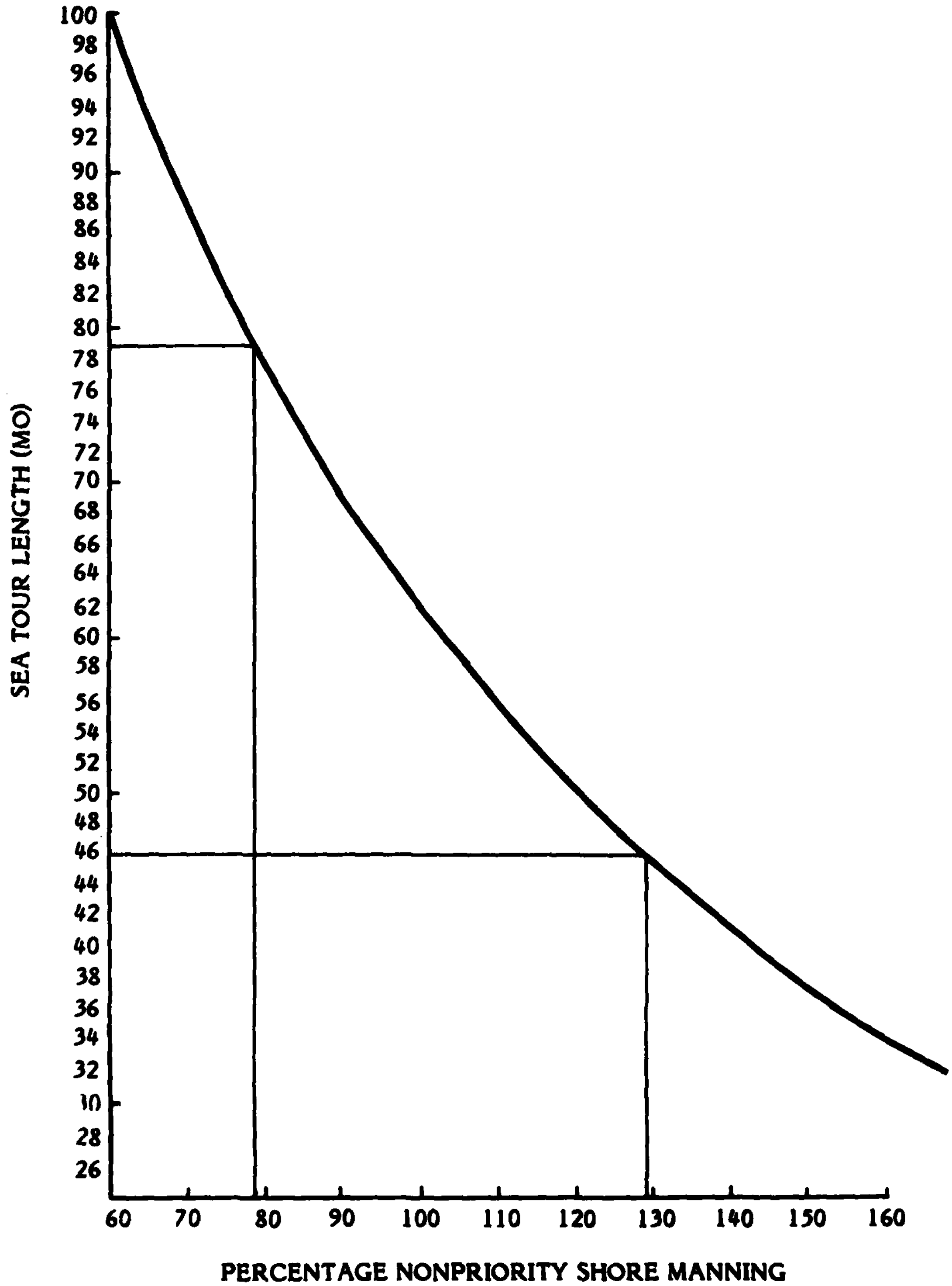


Figure 2b. Sea tour length vs. percentage nonpriority shore manning, BT E-5/6 (total manning = 85%).

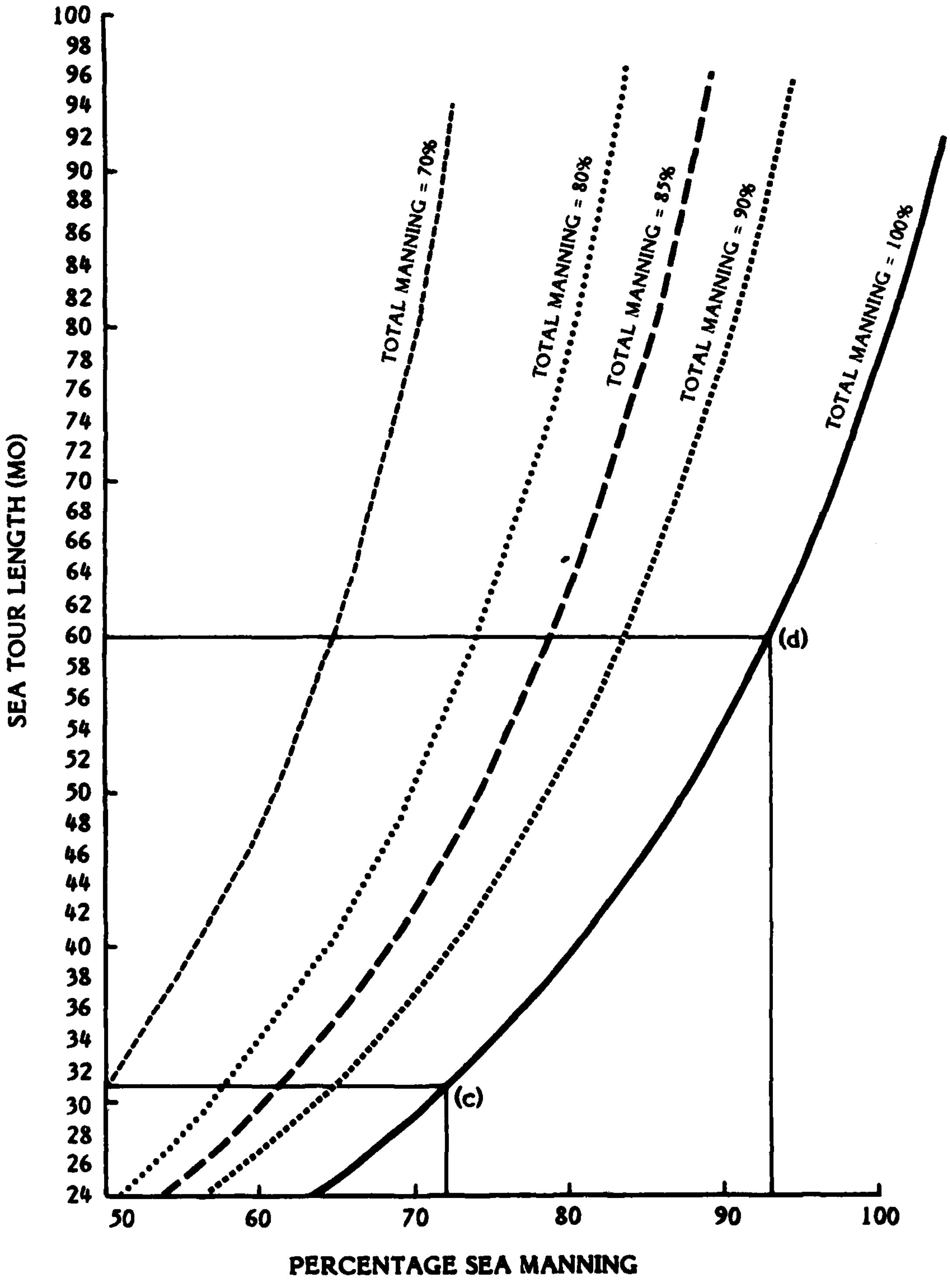


Figure 2c. Sea tour length vs. percentage sea manning for different total manning, BT E-5/6.

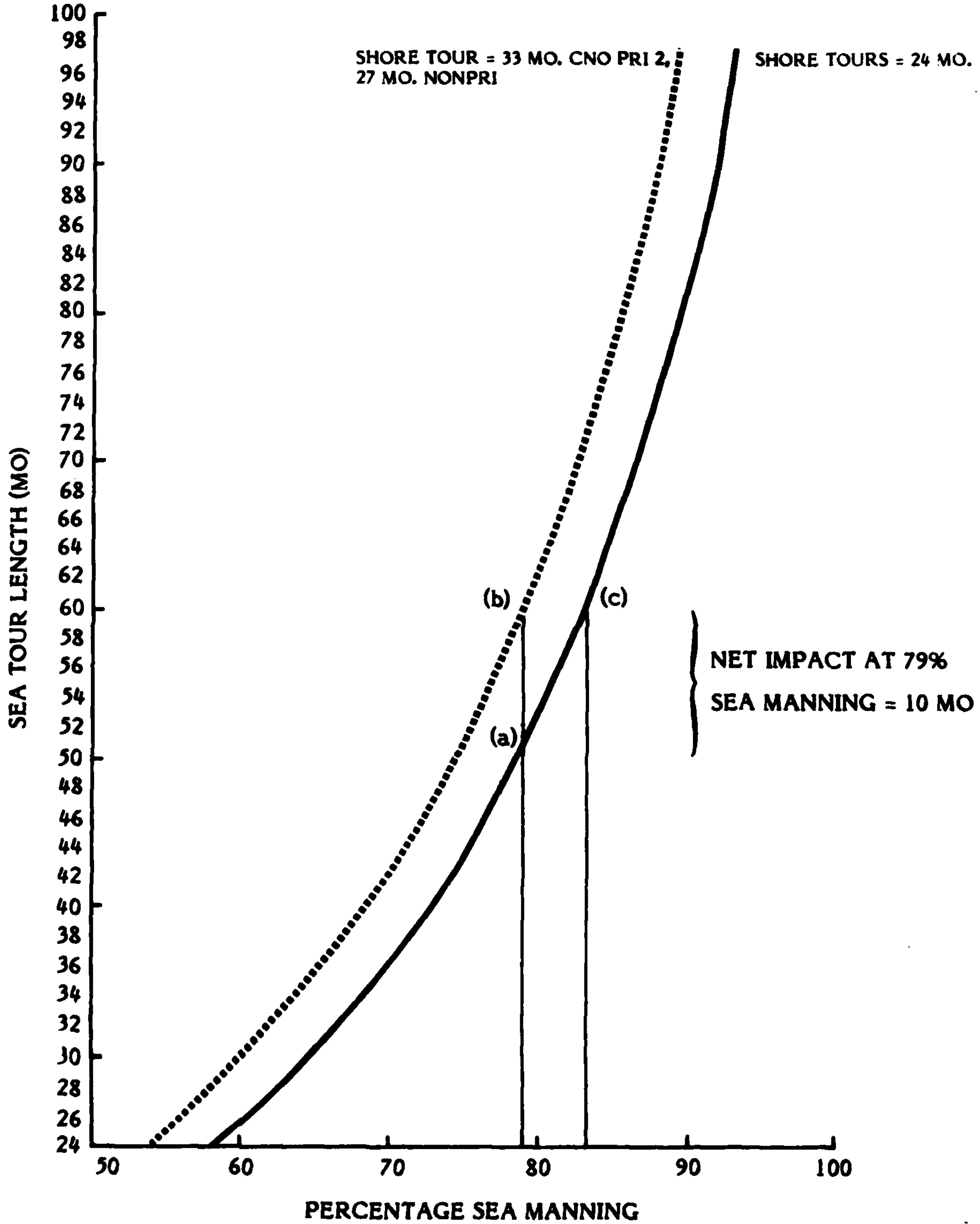


Figure 3. Sea tour length vs. sea manning tradeoffs for current shore tour lengths and prescribed 2-year shore tour length (total BT manning = 85%).

average sea tour. Of this 10-month increase, approximately 5 months is due to CNO priority 2 tour lengths of 33 months; the remaining 5 months is due to nonpriority shore tours in excess of 24 months (GUARD III, extensions, etc.). If all shore tours were held at 24 months, an increased sea manning of 83 percent would be realized (point (c)). If only nonpriority shore tours were held at 24 months, sea manning would increase to 81 percent.

The above tradeoffs emphasize the steepness of curves relating sea tour lengths to sea manning levels. One of the previous numerical examples showed that an 18 percent increase in sea manning levels (from 72% to 85%) resulted in a 70 percent increase in required sea tour lengths (from 46 months to 78 months).

If care is not taken in managing sea manning levels (x axis), undesirable sea tour lengths (y axis) will result--quickly putting the program "behind the power curve." By analogy, every jet aircraft has a particular thrust versus velocity curve. For some, the curves are steep relative to the thrust required; that is, small changes in thrust can result in a wide range of velocities. Due to the characteristics of the system, care must be taken in certain flight regimes to avoid "getting behind the power curve." Likewise, care must be employed to keep undesirable small changes in one variable (in this case, BT E-5/6 sea manning) from occurring in order to preclude the other variable (sea tour length) from becoming too long.

<u>Modeling Framework</u>

The assessment of the Navy's capability to implement a formal PEGS program is being done by mathematically modeling the personnel flows of a rating community. The mathematical model that has been developed represents steady-state flows of personnel in two major pay grade groups: (1) E-7--E-9 (pay grade group 1) and (2) E-5--E-6 (pay grade group 2), and encompasses PEGS program participants as well as nonparticipants. The model is formulated as a linear program. The detailed mathematical formulation will be documented in a forthcoming technical report.

Figure 4 illustrates how personnel participating in the PEGS program are modeled. PEGS program participants can be found in four types of locations:

a. CNO priority 2 shore billets outside PEGS areas.
b. PEGS area sea billets.
c. PEGS area CNO priority 2 shore billets.
d. PEGS area nonpriority shore billets.

Key variables in the model represent steady-state PEGS program participants (all variables beginning with H) and new entries or flows into the PEGS program each year (all variables beginning with F). Other PEGS program flows modeled are promotions, attrition, and sea-shore rotation. The sea-shore rotation flow needs explanation.

To calculate the number of PEGS program participants who rotate annually from sea to shore, the size of the cohort that originally went to sea duty and is due to rotate must be reduced by the members of the cohort who were lost by attrition or promotion during the entire sea tour. The number that remain at the end of the sea tour rotate to shore. For example, let IS2 be the number of E-5/6s that enter a sea tour (a cohort), P the promotion rate, and A2 the attrition rate. In the first year of the tour, P*IS2 will be promoted and A2*IS2 will attrite. At the end of the first year, (1-P-A2)*IS2 remain in the cohort. Let R2 = 1-P-A2 be the retention rate. In the second year of the sea tour, P*(R2*IS2) will be promoted and A2*(R2*IS2) will attrite. At the end of the second year,

$(1\text{-}P\text{-}A2)*(R2*IS2) = R2*R2*IS2$ remain the cohort. If the sea tour is TS2 years, $R2^{TS2}*IS2$ individuals remain in the cohort at the end of the sea tour. These individuals rotate to shore, and the annual rotation flow from sea to shore is equal to $R2^{TS2}*IS2$.

For each of the eight boxes (a to h) in Figure 4, which represent PEGS program participant locations,[2] the annual inputs are set equal to the annual outputs to achieve a steady-state. Therefore, the total number of participants in each location remains constant. The detailed input and output flow relationships can be best explained by a few illustrative examples.

For priority shore away locations, E-5/6 (box a in Figure 4), one input source (new E-5/6 entries into the PEGS program) and three output sources (attrition from the Navy, promotion from pay grade E-6 to E-7, and rotation to sea duty in a PEGS area) exist. Some representative PEGS program flows for this location are shown in Figure 5. In this example, at any one time, there is an average of 83 PEGS participants in this location. Forty new entries into the PEGS program are allowed through this location due to vacancies created by promotions (6), attrition (17), and rotations to sea duty in a PEGS area (17).

The next example is for a PEGS area sea location, E-7--E-9 (box f in Figure 4). For this location, five input sources exist:

a. New E-7--E-9 entries into the PEGS program.

b. Promotions of PEGS participants from E-6 to E-7 who are already in a PEGS area sea location.

c. Rotation of E-7--E-9 PEGS participants from priority away shore locations.

d. Rotation of E-7--E-9 PEGS participants from a PEGS area priority shore location.

e. Rotation of E-7--E-9 PEGS participants from a PEGS area nonpriority shore location.

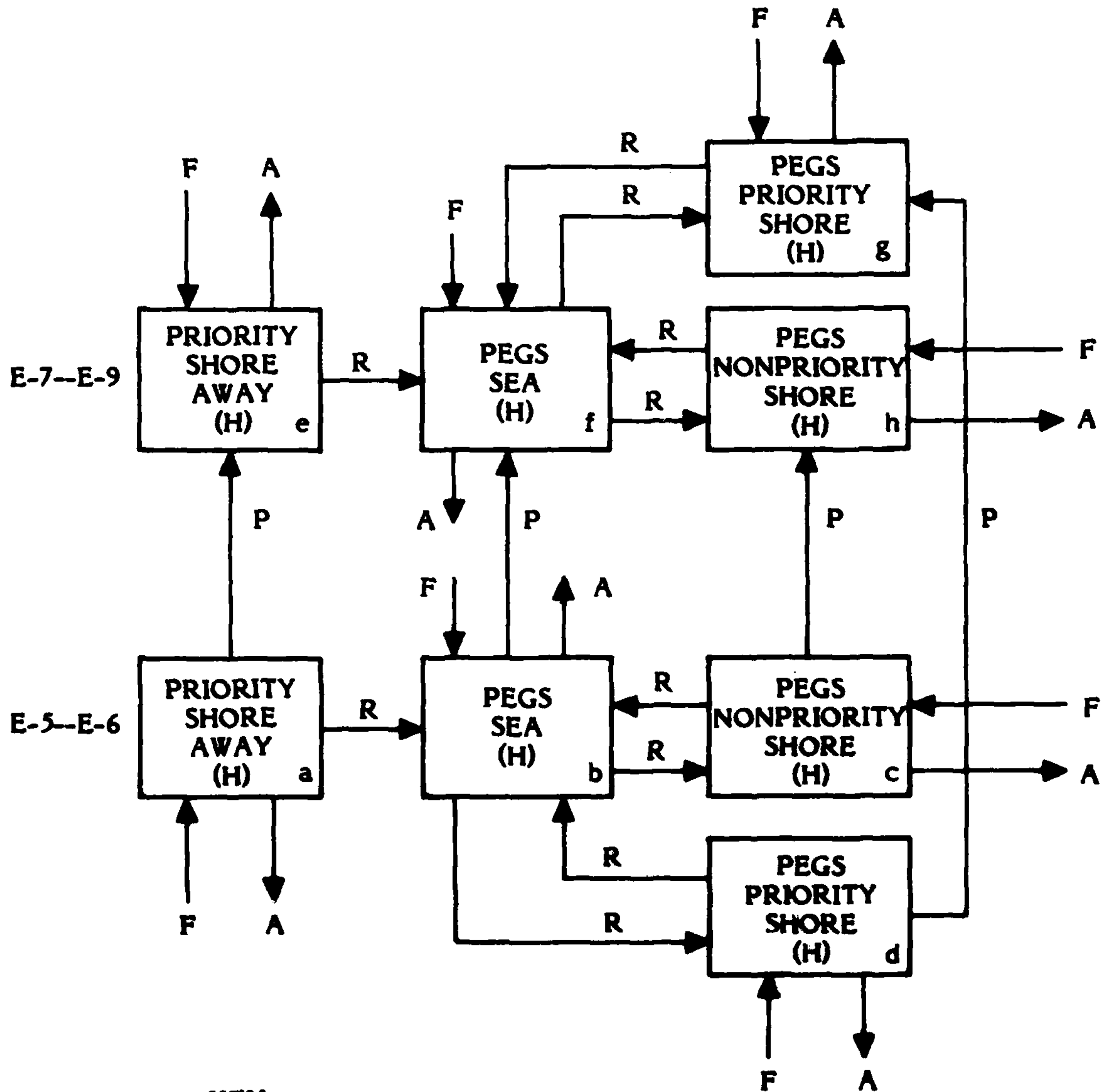
Three output sources exist:

a. Attrition from the Navy.
b. Rotation to a PEGS area priority shore location.
c. Rotation to a PEGS area nonpriority shore location.

Some representative PEGS program flows for the location are shown in Figure 6. In this example, at any one time, there is an average of 112 PEGS participants in this location. Fifty-two people flow into this location every year, made up of new entries (0), promotions (14), and rotations from three different locations (38). This annual flow is allowed by vacancies created by attrition (22) and rotations to two different locations (30).

---

[2]To simplify the graphical display of the personnel flows being modeled, only one PEGS area is shown. Participants in "priority away" shore locations are associated with that one PEGS area only.



KEY:

A - Attrition

F - New Entries into PEGS Program

H - PEGS Participants

P - Promotion

R - Rotation

Figure 4. Illustrative PEGS personnel flows, all locations.

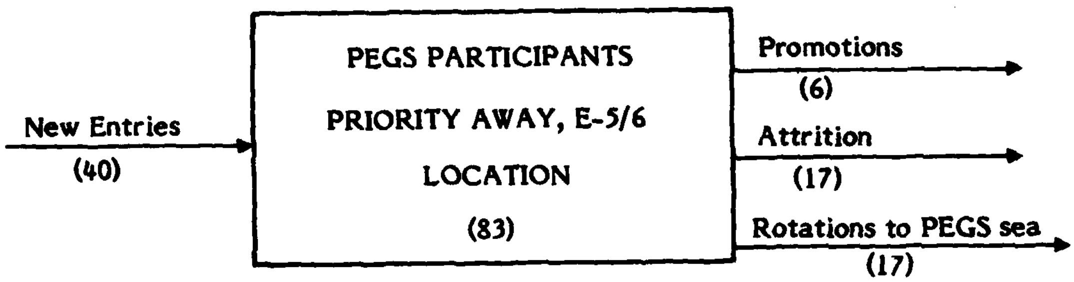


Figure 5. Illustrative PEGS personnel flows, priority shore away location, E-5/6.

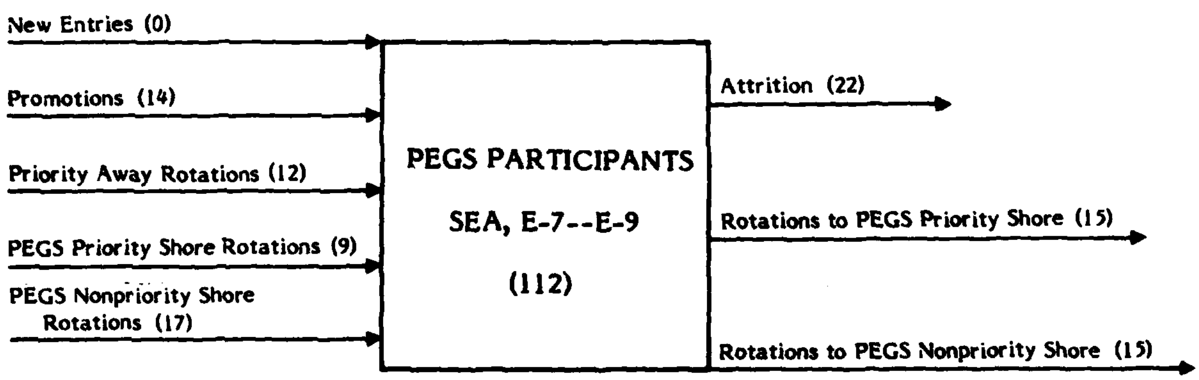


Figure 6. Illustrative PEGS personnel flows, PEGS area sea location, E-7--E-9.

Figure 7 illustrates how personnel not participating in the PEGS program are modeled. PEGS nonparticipants may be found outside as well as within PEGS areas, and in sea and shore billets. PEGS participants and nonparticipants in the model are linked together in two ways. First, requirements for each region must be filled. Therefore, the sum of the PEGS participants and nonparticipants in a region is equal to the requirements for that region. In addition, new entries or flows into the PEGS program each year must come from the pool of nonparticipants.

For each of the six boxes (a to f) in Figure 7, which represent steady-state PEGS nonparticipants by pay grade group and duty type, the annual inputs are set equal to the annual outputs to achieve equilibrium. Again, the detailed input and output flow relationships can be best explained by an illustrative example.

For E-5/6 PEGS nonparticipants at sea (box a in Figure 7), three input sources and five output sources exist. The input sources are:

a. Promotions from E-4 to E-5.
b. Rotation of E-5/6 PEGS nonparticipants from nonpriority shore billets.
c. Rotation of E-5/6 PEGS nonparticipants from priority shore billets.

The output sources are:

a. Attrition from the Navy.
b. Promotion of non-PEGS participants from pay grade E-6 to E-7.
c. Rotation of E-5/6 PEGS nonparticipants to nonpriority shore billets.
d. Rotation of E-5/6 PEGS nonparticipants to priority shore billets.
e. Flows directly into the PEGS program via E-5/6 sea duty in a PEGS region.

Sensitivity Analysis

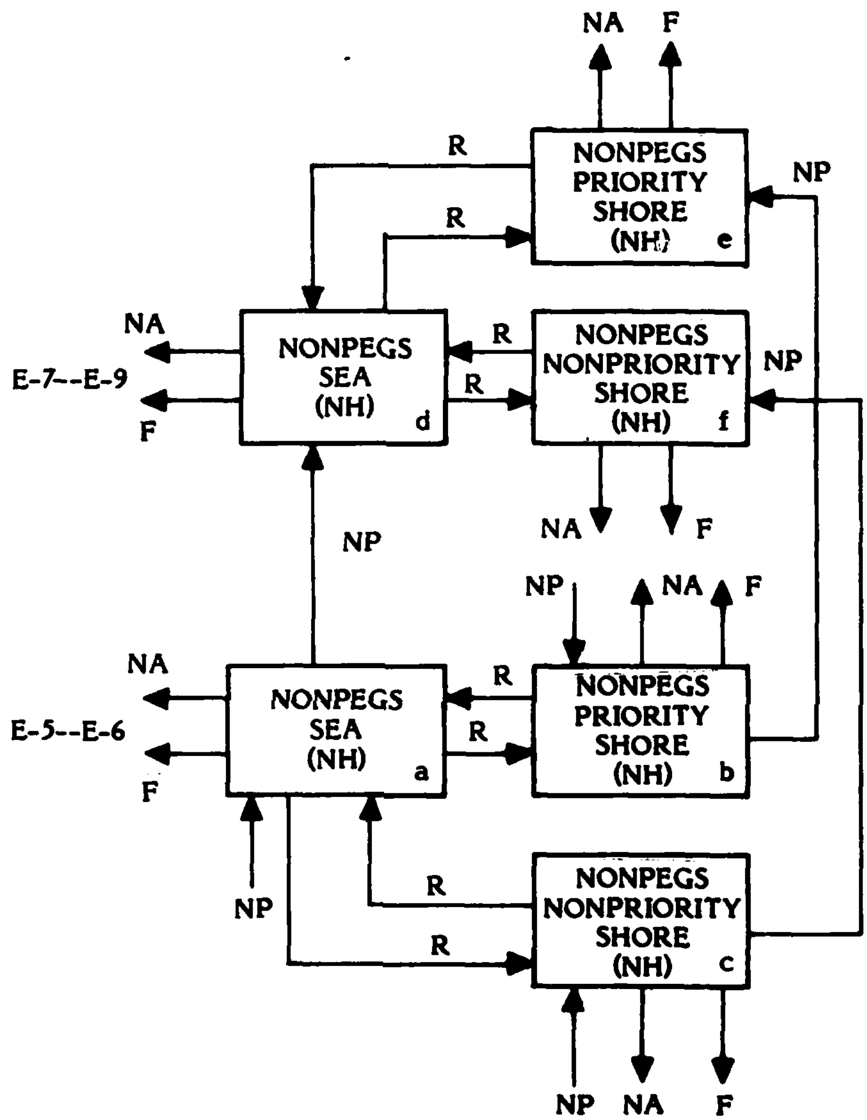
Real-world problems that are formulated as linear programming problems are seldom completely "solved" as soon as an optimal solution is obtained. The parameters of the model are seldom known with complete certainty. Therefore, it is usually advisable to perform a sensitivity analysis to determine the effect on the optimal solution if particular parameters take on other values. If the model results are relatively sensitive to changes in certain parameters, special care should be taken in estimating these parameters and in selecting a solution that does well for most of their likely values.[3]

Because of the favorable sea-shore billet ratio and seniority of pay grade group E-7--E-9, most of their parameters (e.g., manning levels, tour lengths) have been relatively stable over time and are considered to be relatively certain. In contrast, pay grade group E-5/6 involves many uncertainties. Table 1 lists the model parameters for this pay grade group and the range of values they were allowed to take in various model runs.

Over 100 model runs were made using different combinations of values for these parameters. The results were most sensitive to changes in the E-5/6 PEGS loss rate. In addition, most of the variation in results occurred in the number of PEGS personnel allowed at sea. In general, the effect of varying the values for the E-5/6 parameters did influence the results for the E-7--E-9 pay grade group but not nearly as much as they did for the E-5/6 pay grade group.

---

[3]Hillier, F. S., and Lieberman, G. J. Introduction to Operations Research, Holden-Day, Inc., San Francisco, 1967.



KEY:

NA- Attrition
F - New Entries into PEGS Program
NH- PEGS Nonparticipants
NP - Promotion
R - Rotation

Figure 7. Illustrative non-PEGS personnel flows, all locations.

Table 1

Range of E-5/6 Parameter Values

Parameter	Range of Values
Total manning	80-90%
PRI-shore manning	90-100%
PRI-shore tour length	33-36 mos.
Non-PRI-shore tour length	27 mos.
Sea tour length	46-50 mos.
Sea manning	70-77.5%
Non-PRI-shore manning	111.4-133.6%
Non-PEGS loss rate	22.5-25.0%
PEGS loss rate	9.2-25.0%

Appendix A provides a detailed description of the sensitivity of model results to changes in selected input parameters. In each model run discussed, all input variables, except one, were held at baseline levels. The exception in each run was a specific change in one of the input parameters listed below:

1. E-5/6 total manning.
2. E-5/6 PRI-shore manning.
3. E-5/6 PRI-shore tour length.
4. E-5/6 sea tour length.
5. E-5/6 PEGS loss rate.
6. E-5/6 non-PEGS loss rate.
7. E-7--E-9 PEGS loss rate.

The results of each model run are summarized in Table A-1. In addition, a mathematical formula was developed and applied to obtain a feasibility range for the baseline results in terms of the impact of regional billet cuts. The details are in Appendix B, with results displayed in Table B-1.

The capability to perform sensitivity analysis is important, not only in helping to select an initial baseline, but also as a planning tool to answer "what if" questions. Examples of "what if" questions that may be addressed are:

1. Where should new billets be located to have the best effect on the PEGS program?

2. How should PEGS program participation be changed if personnel losses are higher or lower than expected?

3. How do changes in manning levels affect the number of PEGS participants allowed in each region?

4. When should a new PEGS region be established or an existing one phased out?

BASELINE RESULTS

A baseline data set was developed using the following general guidelines:

1. Projected E-5 through E-9 billets by geographic location for January 1983 were obtained from OP-01's billet file. Six potential PEGS regions were chosen, based on sea-shore billet distributions: San Diego, Norfolk, Mayport, Charleston, Hawaii, and Newport.

2. Average CY 1979-CY 1981 sea and total manning levels were calculated using data extracted from the distributable manning subsystem of DELIS (design of executive level information system).

3. Empirical shore tours were estimated from a 31 March 1981 extract of the Enlisted Master Record (EMR) file.

4. Using the CNO goal of 100 percent CNO priority 2 shore manning and average sea and total manning levels as calculated in step 2, assignment policy tradeoffs were performed to derive the necessary sea tours.

5. Net loss rates were calculated from the FAST input module (FAIM) historical data base. A 20 percent reduction in the historical loss rate was assumed for E-5/6 personnel in the PEGS program.

Table 2 lists the baseline data input values. The baseline data were input to the mathematical model. Table 3 summarizes the model results in terms of projected steady-state levels and percentages of participation in the PEGS program by region and by duty type for pay grade groups E-5--E-9, E-7--E-9, and E-5--E-6. PEGS program participants are displayed in four types of duty types/locations: PEGS area sea billets (SEA), nonpriority shore billets (SHO-NPRI), CNO priority 2 shore billets (SHO-PRI); and CNO priority 2 shore billets outside PEGS areas (PRI-AWAY). For example, in Table 3, there are 814 San Diego E-5--E-9 PEGS program participants. Of these, 670 are in the San Diego area and 144 are serving their first PEGS program assignment in a priority away billet. The term "Manning Plan" associated with each set of numbers is obtained by applying manning rates in Table 2 against the billets in each region. "PEGS Fill" refers to the portion of the manned billets occupied by PEGS personnel.

The baseline results indicate that 42 percent (2021) of the E-5--E-9 BT community can be accommodated in the PEGS program while still maintaining an overall Navy-wide manning balance. A total of 2021 PEGS positions are established--1616 in PEGS areas and 405 in priority away shore billet locations. Over the entire six PEGS regions, 49 percent of the E-5--E-9 manned billets are reserved for PEGS personnel--35 percent at SEA and 80 and 81 percent at SHO-NPRI and SHO-PRI respectively. These results incorporate a constraint that prevents 100 percent of the shore billets in PEGS areas to be reserved for PEGS personnel, thereby locking out non-PEGS personnel from PEGS area shore duty.

The projected PEGS participation is much higher for pay grade group E-7--E-9 than for E-5/6. The model projects 59 percent overall participation for the former and 36 percent for the latter. This is due mainly to two reasons. First, since the E-5/6 group has a much more severe sea-shore billet ratio, proportionately less E-5/6 personnel are projected to participate at sea (58% for E-7--E-9 and 29% for E-5/6). Second, if someone enters the PEGS program as an E-5/6 and remains in the Navy as an E-7--E-9, the model reserves a future E-7--E-9 space for that individual. Since the number of E-7--E-9 billets is considerably less than the number of E-5/6 billets, this factor also limits PEGS participation at the E-5/6 level.

Table 2

Baseline Data Input Values

Data Element	Pay Grade Group E-5/6	Pay Grade Group E-7--E-9
Sea Billets	3101	571
CNO priority 2 shore billets	316	289
Nonpriority shore billets	817	387
Sea tour length	46 mos.	30 mos.
CNO priority 2 shore tour length	33 mos.	37 mos.
Nonpriority shore tour length	27 mos.	35 mos.
Total manning	85.0%	100%
Sea manning	72.0%	100%
CNO priority 2 shore manning	100%	100%
Nonpriority shore manning	128.5%	100%
Non-PEGS personnel loss rate	0.250	0.198
PEGS personnel loss rate	0.200	0.198

Table 3

Baseline PEGS Summary Results

Location		Duty Type				
		Sea	SHO-NPRI	SHO-PRI	Total	PRI-Away
Pay Grades E-5--E-9						
San Diego	Manning plan	808	325	102	1235	0
	PEGS fill	323	265	83	670	144
	Percentage	40	82	81	54	
Norfolk	Manning plan	713	252	51	1016	0
	PEGS fill	240	205	41	486	127
	Percentage	34	81	80	48	
Mayport	Manning plan	241	84	7	332	0
	PEGS fill	77	68	6	151	42
	Percentage	32	81	86	45	
Charleston	Manning plan	261	54	7	322	0
	PEGS fill	48	34	6	88	45
	Percentage	18	63	86	27	
Hawaii	Manning plan	194	67	1	262	0
	PEGS fill	58	54	1	114	34
	Percentage	30	81	100	44	
Newport	Manning plan	68	45	32	145	0
	PEGS fill	47	35	26	108	13
	Percentage	69	78	81	74	
Total PEGS areas	Manning plan	2285	827	200	3312	0
	PEGS fill	792	662	162	1616	405
	Percentage	35	80	81	49	
Non-PEGS areas	Manning plan	517	611	0	1128	405
	Non-PEGS fill	2002	784	38	2824	0
PEGS and Non-PEGS areas	Manning plan	2802	1438	200	4845	405
	Fill	2795	1446	200	4845	405
	Percentage	100	100	100	100	100

Total PEGS and non-PEGS areas manning plan	4845
Total PEGS participants	2021
Percentage participants/manning plan	42%

Table 3 (Continued)

Location		Duty Type				
		Sea	SHO-NPRI	SHO-PRI	Total	PRI-Away
Pay Grades E-7--E-9						
San Diego	Manning plan	166	95	57	318	0
	PEGS fill	102	76	46	224	61
	Percentage	61	80	81	70	
Norfolk	Manning plan	144	94	28	266	0
	PEGS fill	83	75	22	180	53
	Percentage	58	80	79	68	
Mayport	Manning plan	47	27	5	79	0
	PEGS fill	24	22	4	50	17
	Percentage	51	81	80	63	
Charleston	Manning plan	49	15	4	68	0
	PEGS fill	20	12	3	35	18
	Percentage	41	80	75	51	
Hawaii	Manning plan	36	25	1	62	0
	PEGS fill	19	20	1	40	13
	Percentage	53	80	100	65	
Newport	Manning plan	16	10	25	51	0
	PEGS fill	17	6	20	43	6
	Percentage	106	60	80	84	
Total PEGS areas	Manning plan	458	266	120	844	0
	PEGS fill	264	212	96	572	169
	Percentage	58	80	80	68	
Non-PEGS areas	Manning plan	113	121	0	234	169
	Non-PEGS fill	324	158	24	506	0
PEGS and Non-PEGS areas	Manning plan	571	387	120	1247	169
	Fill	588	370	120	1247	169
	Percentage	103	96	100	100	100

Total PEGS and non-PEGS areas manning plan	1247
Total PEGS participants	741
Percentage participants/manning plan	59%

Table 3 (Continued)

Location		Duty Type				
		Sea	SHO-NPRI	SHO-PRI	Total	PRI-Away
Pay Grades E-5--E-6						
San Diego	Manning plan	642	230	45	917	0
	PEGS fill	222	188	37	447	83
	Percentage	35	82	82	49	
Norfolk	Manning plan	569	158	23	750	0
	PEGS fill	157	129	19	305	73
	Percentage	28	82	83	41	
Mayport	Manning plan	194	57	2	253	0
	PEGS fill	53	47	2	101	25
	Percentage	27	82	100	40	
Charleston	Manning plan	212	39	3	254	0
	PEGS fill	28	22	2	53	27
	Percentage	13	56	67	21	
Hawaii	Manning plan	158	42	0	200	0
	PEGS fill	39	34	0	73	20
	Percentage	25	81	0	36	
Newport	Manning plan	52	35	7	94	0
	PEGS fill	31	29	6	65	7
	Percentage	60	83	86	69	
Total PEGS areas	Manning plan	1827	561	80	2468	0
	PEGS fill	528	450	66	1044	236
	Percentage	29	80	82	42	
Non-PEGS areas	Manning plan	404	490	0	894	236
	Non-PEGS fill	1678	625	14	2318	0
PEGS and Non-PEGS areas	Manning plan	2231	1051	80	3598	236
	Fill	2206	1075	80	3598	236
	Percentage	99	102	100	100	100

Total PEGS and non-PEGS areas manning plan	3598
Total PEGS participants	1280
Percentage participants/manning plan	36%

IMPLEMENTATION PLAN

Steady-state PEGS participant goals were discussed as model output in the previous two sections. The model also produces the steady-state annual flows necessary to meet these goals. The part of the annual flows that is directly controllable by management is the number of new entries into the PEGS program. At steady-state, E-5/6 new entries are only allowed through vacancies in the PEGS program caused by E-5/6 PEGS attrition and E-6 to E-7 PEGS promotions, while E-7--E-9 new entries are allowed through vacancies in the PEGS program caused by E-7--E-9 PEGS attrition that are not filled by E-6 to E-7 PEGS promotions.

For the first few years of implementation, a PEGS program can be considered to be in a phase-in period, with PEGS participation less than PEGS goals. The transition period can be reduced if the number of new entries into the PEGS program is higher than steady-state levels in the earlier years. The accelerated input can be justified because there would be little sea-shore rotation in the PEGS regions for the participants during the transition period. For example, if a PEGS participant enters the program in a PRI-away billet, rotation to PEGS sea will not occur until the end of the tour (about 3 years). An accelerated input for new entries can be developed that uses positions reserved for PEGS rotation that are vacant in the transition period.

Figure 8 shows the annual inputs by year of implementation that were developed for implementing the baseline results. For the first 2 years, over 800 new entries a year are allowed, while steady-state inputs (year 4 and beyond) are only about 400. Figure 8 also shows cumulative PEGS total participants vs. year of implementation. The accelerated input allows PEGS total participants to reach 73, 87, and 95 percent of full implementation by the end of the second, fourth, and eighth years respectively.

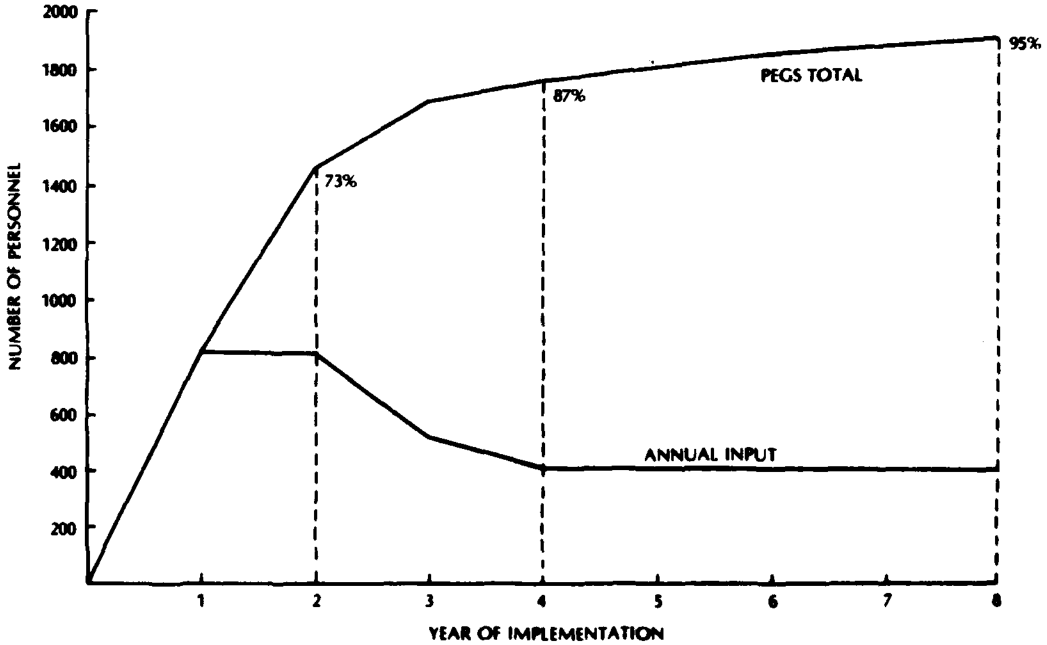


Figure 8. Annual input and PEGS total vs. year of implementation--baseline results.

In the transition period, some individuals can enter the program without serving a PRI-away tour.* Instead, they enter the PEGS program directly through PEGS area sea or shore billets and stay in their designated regions thereafter. As normal rotation to PEGS area sea and shore billets occurs, this accelerated entry is stopped.

Table 4 shows total new entries into the PEGS program for the baseline model run by transition year, detailed by pay grade group and duty type. Notice that, by year 4, entry is only allowed through a shore assignment and 40 percent of those entries are through filling PRI-away billets (78% for the E-7--E-9 pay grade group).

Table 4 also shows new entries into the PEGS program for the baseline model run for the first transition year and at steady-state, detailed by pay grade group, duty type, and region. For example, for San Diego PEGS participants in pay grade group E-7--E-9, there are 87 entries for the first transition year (38 Sea, 16 SHO-NPRI, 15 SHO-PRI, and 18 PRI-Away); at steady-state, there are only 22 new entries a year (18 PRI-Away and 4 SHO-PRI).

CONCLUSIONS AND DISCUSSION

In assessing the feasibility of implementing a PEGS program for the BT rating, a variety of complexities emerge. A PEGS program should only be implemented after careful consideration of Navy assignment policy, sea-shore rotation equilibrium, maintenance of readiness through Navy-wide manning balance, and regional billet structure.

The regional billet structure of the BT rating demonstrates the necessity of developing different strategies for individual ratings or groups of ratings being considered for inclusion in the PEGS program. For example, due to a significant portion of BT CNO priority 2 shore billets being located outside areas conducive for "homesteading," payment at the front end of the program (serving in a CNO priority 2 billet outside a PEGS region) is believed to be a desirable "homesteading strategy" for BTs. Once this priority away tour is completed, the PEGS participant receives preferential treatment; that is, an attempt is made to give him *all future assignments in a previously agreed upon* PEGS region. PEGS participants who do not serve in a priority away billet initially may be required to do so later in the program.

Using the sea-shore rotation equilibrium equations, assignment policy tradeoffs can be made among sea and shore billets, manning levels, and tour lengths. This will help maintain an overall Navy-wide manning balance. When the sea-shore billet ratios are severe, as in the case of the BT E-5/6 group (2.74), small changes in sea manning result in large changes in sea tour length. Although increasing the total manning level will lessen this effect, the importance of careful management of sea manning levels and shore tour lengths cannot be overemphasized.

The projected PEGS program participation is much higher for pay grade group E-7--E-9 than for pay grade group E-5/6 (59% vs. 36%) for two reasons. First, since the E-5/6 group has a much more severe sea-shore billet ratio, proportionately less E-5/6 personnel are projected to participate at sea (58% for E-7--E-9 and 29% for E-5/6). Second, longer preferential treatment as to Navy assignments is required when one enters the program as an E-5 or E-6.

---

*This is also true in some locations at steady-state.

Table 4

Entries in PEGS Program

Item	E-7--E-9 Sea	E-7--E-9 SHO-NPRI	E-7--E-9 SHO-PRI	E-7--E-9 PRI-Away	E-5--E-6 Sea	E-5--E-6 SHO-NPRI	E-5--E-6 SHO-PRI	E-5--E-6 PRI-Away
By Transition Year								
Year 1	100	52	32	50	183	249	32	113
Year 2	100	52	13	50	183	249	32	113
Year 3	53	1	13	50	0	249	32	113
Year 4	0	1	13	50	0	221	5	113
Year 5	0	1	13	50	0	221	5	113
By Region--Year 1								
San Diego	38	16	15	18	76	105	18	40
Norfolk	32	21	7	16	54	72	9	35
Mayport	9	5	1	5	18	26	1	12
Charleston	7	4	1	5	11	11	1	13
Hawaii	7	6	0	4	14	19	0	10
Newport	7	0	8	2	10	16	3	3
Total	100	52	32	50	183	249	32	113
By Region--Steady-state								
San Diego	0	0	4	18	0	100	0	40
Norfolk	0	0	6	16	0	65	0	35
Mayport	0	0	0	5	0	21	1	12
Charleston	0	0	0	5	0	7	1	13
Hawaii	0	1	0	4	0	15	0	10
Newport	0	0	3	2	0	13	3	3
Total	0	1	13	50	0	221	5	113

The results of the sensitivity analysis showed that the model results were not very sensitive to changes in certain parameters. For example, a 25 percent change in the E-5/6 PEGS personnel loss rate, the variable that influenced the results the most, resulted in only a 10 percent change in the overall model results for the E-5/6 PEGS personnel. Differences from the baseline results occurred mostly in PEGS sea billets.

RECOMMENDATIONS

1. The strategy and models that have been developed should be implemented in OP-01/NMPC and used as planning tools. These models should be enhanced with "user-friendly" computer software to give personnel managers the opportunity to answer "what

if" questions regarding the effect of changes in billet location, addition of new billets, and changes in manning levels and personnel loss rates on potential levels of PEGS program participation.

2. A 4- to 8-year phase-in period should be used when implementing a BT PEGS program. This will control input flows to avoid a surge or bow-wave effect on the distribution system and establish a balanced sea-shore rotation cycle among participants. Management will be able to control the annual flows by controlling the number of new entries into the program.

3. Before implementation of a formal PEGS program for other enlisted ratings and/or officers can be effected, additional analysis is necessary. The same four-step approach is needed to tailor a PEGS program to the unique characteristics of a rating or rating group. New assumptions for the development of a "homesteading strategy" will be needed, and changes to the present mathematical model to accurately describe personnel flows of the new rating group may be required. In addition, new baseline data should be developed using historical data and assignment policy tradeoffs. Finally, a sensitivity analysis should be performed to determine the effects of changes in particular parameter values.

APPENDIX A

SENSITIVITY ANALYSIS--DETAILED DISCUSSION

SENSITIVITY ANALYSIS--DETAILED DISCUSSION

The utility of performing a sensitivity analysis was discussed in the main body of this report. The effects of varying some of the input parameters are described in terms of changes from the baseline results. In each model run, all input parameters except one were held at baseline levels. The results of 10 model runs (including baseline) are discussed below and summarized in Table A-1.

Impact of Changes in E-5/6 Total Manning

Model runs were made with all parameters set at their baseline values except for E-5/6 total manning, which was allowed to vary from 80 to 90 percent. Results were not affected for pay grade group E-7--E-9. With only 80 percent E-5/6 total manning, 32 (6.1%) and 34 (7.6%) less E-5/6 personnel are projected to participate in the PEGS program in PEGS area sea and non-PRI shore billets respectively. With E-5/6 total manning at 90 percent, E-5/6 PEGS participation is projected to increase by 32 (6.1%) and 33 (7.3%) in PEGS sea and PEGS non-PRI shore billets respectively. There were no changes from the baseline results for E-5/6 PEGS participation at PEGS PRI-shore or PRI-away billets for any of the model runs when E-5/6 total manning was allowed to vary from 80 percent to 90 percent.

Impact of Changes in E-5/6 PRI-shore Manning

Model runs were also made with all parameters set at their baseline values except for E-5/6 PRI-shore manning, which was allowed to vary from 100 percent (baseline) to 90 percent. Results were unaffected for pay grade group E-7--E-9. With only 90 percent E-5/6 PRI-shore manning, 24 (10.2%) and 7 (10.6%) less E-5/6 personnel are projected to participate in the PEGS program in PRI-away and PRI-shore billets respectively. However, 12 (2.7%) more are projected to participate in PEGS non-PRI shore billets, leaving only 7 (1.3%) less PEGS sea positions to support.

Impact of Changes in E-5/6 PRI-shore Tour Length

Model runs were made where E-5/6 PRI-shore tour length was allowed to vary from 33 (baseline) to 36 months. The biggest impact was on E-5/6 PEGS sea billets, where 15 (2.8%) less participants are projected. The results are not surprising, since a longer PRI-shore tour implies lower sea manning.

Impact of Changes in E-5/6 Sea Tour Length

Model runs were made where E-5/6 sea tour length was allowed to vary from 46 (baseline) to 50 months. Results differ from the baseline primarily at E-5/6 PEGS non-PRI shore billets, where 29 (6.4%) less participants are projected. A longer sea tour clearly results in higher sea manning and lower non-PRI shore manning.

Impact of Changes in E-5/6 PEGS Loss Rate

Results were most sensitive to changes in the E-5/6 PEGS loss rate. Model runs were made with all parameters set at their baseline values except for the E-5/6 PEGS loss rate, which was allowed to vary ± 25 percent from the baseline value of .20 (.25 and .15). Differences from the baseline results occcurred primarily in terms of PEGS participation at sea for both pay grade groups--E-5/6 and E-7--E-9. The model projected 134 (25.4%) less participants at E-5/6 PEGS sea with a 25 percent higher E-5/6 PEGS loss rate and 113 (21.4%) more participants with a 25 percent lower rate. The lower E-5/6 PEGS loss rate also allowed 17 (6.4%) more participants at E-7--E-9 PEGS sea.

Table A-1

Impact of Selected Parameter Changes
on Total PEGS Participation

Scenario	Paygrade Group	PEGS Sea	PEGS SHO-NPRI	PEGS SHO-PRI	PRI-Away PEGS	PEGS Total
Baseline	E5-E9	792	662	162	405	2021
	E7-E9	264	212	96	169	741
	E5-E6	528	450	66	236	1280
E-5/6 Total	E5-E9	760(-4.0%)[a]	627(-5.3%)	162(0.0%)	405(0.0%)	1955(-3.3%)
Manning =	E7-E9	264 (0.0%)	212 (0.0%)	96(0.0%)	169(0.0%)	741 (0.0%)
80% (Low)	E5-E6	496(-6.1%)	416(-7.6%)	66(0.0%)	236(0.0%)	1214(-5.2%)
E-5/6 Total	E5-E9	824(+4.0%)	695(+5.0%)	162(0.0%)	405(0.0%)	2086(+3.2%)
Manning =	E7-E9	264 (0.0%)	212 (0.0%)	96(0.0%)	169(0.0%)	741 (0.0%)
90% (High)	E5-E6	560(+6.1%)	483(+7.3%)	66(0.0%)	236(0.0%)	1345(+5.1%)
E-5/6 PRI-Shore	E5-9	785(-0.9%)	674(+1.8%)	155 (-4.3%)	381 (-5.9%)	1995(-1.3%)
Manning =	E7-E9	264 (0.0%)	212(+0.5%)	96 (0.0%)	169 (0.0%)	741 (0.0%)
90% (Low)	E5-E6	521(-1.3%)	462(+2.7%)	59(-10.6%)	212(-10.2%)	1254(-2.0%)
E-5/6 PRI-Shore	E5-E9	775(-2.1%)	667(+0.8%)	162(0.0%)	405(0.0%)	2009(-0.6%)
Tour Length	E7-E9	262(-0.8%)	212(+0.5%)	96(0.0%)	169(0.0%)	739(-0.3%)
=36 mo.(High)	E5-E6	513(-2.8%)	455(+1.1%)	66(0.0%)	236(0.0%)	1270(-0.8%)
E-5/6	E5-E9	791(-0.1%)	633(-4.4%)	162(0.0%)	405(0.0%)	1991(-1.5%)
Sea Tour =	E7-E9	265(+0.4%)	212(0.0%)	96(0.0%)	169(0.0%)	742(+0.1%)
50 (High)	E5-E6	526(-0.4%)	421(-6.4%)	66(0.0%)	236(0.0%)	1249(-2.4%)
E-5/6 PEGS Loss	E5-E9	665(-16.0%)	665(+0.5%)	162(0.0%)	405(0.0%)	1897(-6.1%)
Rate = .250	E7-E9	271(+2.7%)	213(+0.5%)	96(0.0%)	169(0.0%)	749(+1.1%)
(High)	E5-E6	394(-25.4%)	452(+0.4%)	66(0.0%)	236(0.0%)	1148(-10.3%)
E-5/6 PEGS Loss	E5-E9	922(+16.4%)	655(-1.1%)	162(0.0%)	405(0.0%)	2144(+6.1%)
Rate = .150	E7-E9	281(+6.4%)	210(-0.9%)	96(0.0%)	169(0.0%)	756(+2.0%)
(Low)	E5-E6	641(+21.4%)	445(-1.1%)	66(0.0%)	236(0.0%)	1388(+8.45)
E-5/6 Non-PEGS	E5-E9	793(+0.1%)	662(0.0%)	162(0.0%)	405(0.0%)	2022(0.0%)
Loss Rate =	E7-E9	264(0.0%)	212(0.0%)	96(0.0%)	169(0.0%)	741(0.0%)
.225 (Low)	E5-E6	529(+0.2%)	450(0.0%)	66(0.0%)	236(0.0%)	1281(+0.1%)
E-7--E-9 PEGS Loss	E5-E9	791(-0.1%)	646(-2.4%)	162(0.0%)	405(0.0%)	2004(-0.8%)
Rate =	E7-E9	281(+6.4%)	210(-0.9%)	96(0.0%)	169(0.0%)	756(+2.0%)
.178 (Low)	E5-E6	510(-3.4%)	436(-3.1%)	66(0.0%)	236(0.0%)	1248(-2.5%)

[a]Percentage change from baseline.

Impact of Changes in E-5/6 Non-PEGS Loss Rate

Results were not sensitive to changes in the E-5/6 non-PEGS loss rate. Model runs were made with a 10 percent reduction in the E-5/6 non-PEGS loss rate from .25 to .225. Results were unchanged from the baseline.

Impact of Changes in E-7--E-9 PEGS Loss Rate

Model runs were also made where the E-7--E-9 PEGS loss rate was reduced by 10 percent from .198 to .178. This had the effect of increasing E-7--E-9 PEGS sea participants by 17 (6.4%). However, since E-7--E-9 PEGS participants had a lower loss rate, less promotion opportunity existed for E-5/6 PEGS personnel. As a result, the model projected less overall E-5/6 PEGS participants--18 (3.4%) and 14 (3.1%) in PEGS sea and non-PRI shore billets respectively.

APPENDIX B

IMPACT OF REGIONAL BILLET CUTS

IMPACT OF REGIONAL BILLET CUTS

The calculated steady-state flows/goals (baseline scenario) were used to compute the maximum "one-time" reduction in PEGS region billets (or manning plan) for each type duty that can be absorbed without forcing PEGS participants out of the PEGS region.

The reduction, R, for each type duty (i) expressed as a percentage is displayed in Table B-1 and is calculated using the following methodology:

$$G_i \leq (1-R)\, m_i B_i + (\text{Flows Out}) - (\text{Flows In})$$

where

G_i = PEGS goals,

m_i = manning for type duty$_i$, and

B_i = billets for type duty$_i$.

Flows Out is composed of:

LA_i = attrition

LP_i = promotion

LR_i = rotation.

Flows In is composed of:

IP_i = promotion

IR_i = rotation

IN_i = input from non-PEGS

Since $P_i = m_i B_i$ = manning plan for type duty$_i$,

$$G_i \leq (1-R)\, P_i + (LA_i+LP_i+LR_i) - (IP_i+IR_i+IN_i).$$

Assume $IN_i = 0$ for the case where a maximum reduction of P_i is to occur.

Then, $R \leq \dfrac{P_i - G_i + (LA_i+LP_i+LR_i) - (IP_i+IR_i)}{P_i}$

Further, for the case in the linear programming solution, where

$IN_i = 0$,

$$R \leq \frac{P_i - G_i}{P_i}$$

because Flows In = Flows Out.

Table B-1

Maximum Possible Reduction in PEGS Region Manning Plan (%)

PEGS Region	Type Duty: Sea	SHO-NPRI	SHO-PRI
San Diego			
E-7--E-9	38.7	24.1	19.8
E-5/6	65.5	61.7	18.1
Norfolk			
E-7--E-9	42.6	26.1	19.8
E-5/6	72.4	59.4	18.1
Mayport			
E-7--E-9	48.3	20.2	19.8
E-5/6	72.9	54.2	58.2
Charleston			
E-7--E-9	59.5	19.8	19.8
E-5/6	86.9	61.5	46.5
Hawaii			
E-7--E-9	46.6	21.2	52.0
E-5/6	75.3	54.1	0.0
Newport			
E-7--E-9	0.0	36.9	33.0
E-5/6	41.1	54.9	58.2

The numerical values for all the variables are found or calculated from the linear programming output. IR_i values must be derived as follows:

$$IR_{SEA} = \frac{\Sigma \text{Rotation Out from shore}}{(\text{PRI-AWAY} + \text{SHO-NPRI} + \text{SHO-PRI})}$$

$$IR_{SHO\text{-}NPRI} = \frac{\text{"To NPRI" sea flow}}{\text{"Total IN" sea flow}} \text{ X Sea Rotation Out}$$

$$IR_{SHO\text{-}PRI} = \frac{\text{"To PRI" sea flow}}{\text{"Total IN" sea flow}} \text{ X Sea Rotation Out.}$$

Table B-1 shows that the manning plan billets for the E-5/6 group in San Diego could be reduced by a maximum of 65.5 percent and still allow the Navy to give preferential assignments to those participants already in the program. Inputs to the program in San Diego would have to be held to zero in the maximum reduction case. New program participants could be admitted in the case of a lesser reduction. The number of these participants would be calculated based upon the magnitude of the billet reduction. Simultaneous reductions in each type duty could be done and still maintain preferential assignments for current participants as long as new program inputs did not exceed the recalcuated levels.

In the case of the E-5/6 group in Hawaii for shore-PRI type duty, the reduction is zero becasue there are no billets from which to reduce (Table B-1). For the E-7--E-9 group in Newport sea type duty, all billets are filled by PEGS participants. A billet reduction there would definitely cause preferential assignment problems.

DISTRIBUTION LIST

Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics)
Assistant Secretary of the Navy (Manpower and Reserve Affairs)
Principal Deputy Assistant Secretary of the Navy (Manpower and Reserve Affairs) (OASN(M&RA))
Deputy Assistant Secretary of the Navy (Manpower) (OASN(M&RA))
Director of Manpower Analysis (ODASN(M))
Chief of Naval Operations (OP-01) (3), (OP-11), (OP-11D), (OP-11G), (OP-12) (2), (OP-13), (OP-13B), (OP-14), (OP-15), (OP-16), (OP-110), (OP-110C), (OP-110P), (OP-115) (2), (OP-120), (OP-120F), (OP-121), (OP-122), (OP-130), (OP-131C3), (OP-132), (OP-132E), (OP-132E4) (6), (OP-134), (OP-135), (OP-136), (OP-140F2), (OP-167), (OP-433P), (OP-964D), (OP-987H)
Chief of Naval Material (NMAT 08L)
Chief of Naval Research (Code 200), (Code 411), (Code 440) (3), (Code 442), (Code 448)
Chief of Information (OI-213)
Chief of Naval Education and Training (N-5)
Commander in Chief U.S. Atlantic Fleet (5)
Commander in Chief U.S. Pacific Fleet (5)
Commander Fleet Training Group, Pearl Harbor
Commander Naval Air Force, U.S. Atlantic Fleet (3)
Commander Naval Air Force, U.S. Pacific Fleet (3)
Commander Naval Surface Force, U.S. Atlantic Fleet (5)
Commander Naval Surface Force, U.S. Pacific Fleet (5)
Commander Naval Military Personnel Command
Commander Naval Military Personnel Command (NMPC-013C), (NMPC-4), (NMPC-40), (NMPC-46), (NMPC-47), (NMPC-49), (NMPC-164), (NMPC-1643), (NMPC-16434), (NMPC-461), (NMPC-472C), (NMPC-493G), (NMPC-40BB)
Commanding Officer, Naval Regional Medical Center, Portsmoutn, VA (ATTN: Medical Library)
Director, Naval Civilian Personnel Command
President, Naval War College (Code E114)
Superintendent, Naval Postgraduate School
Secretary Treasurer, U.S. Naval Institute
Commander, Army Research Institute for the Behavioral and Social Sciences, Alexandria (PERI-ASL)
Chief, Army Research Institute Field Unit, Fort Harrison
Commander, Air Force Human Resources Laboratory, Brooks Air Force Base (Manpower and Personnel Division)
Commander, Air Force Human Resources Laboratory, Brooks Air Force Base (Scientific and Technical Information Office)
Commander, Air Force Human Resources Laboratory, Lowry Air Force Base (Technical Training Branch)
Commander, Air Force Human Resources Laboratory, Williams Air Force Base (AFHRL/OT)
Commander, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base (AFHRL/LR)
Commandant Coast Guard Headquarters
Superintendent, U.S. Coast Guard Academy
President, National Defense University (3)
Director, Science and Technology, Library of Congress
Defense Technical Information Center (DDA) (12)

DAT

FILM