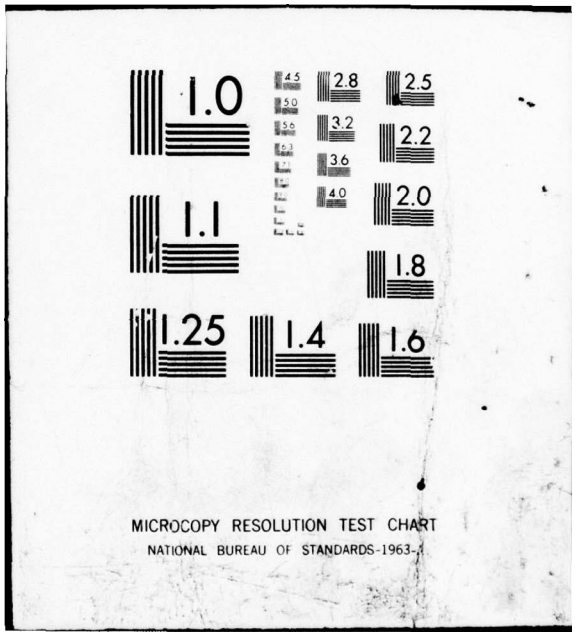
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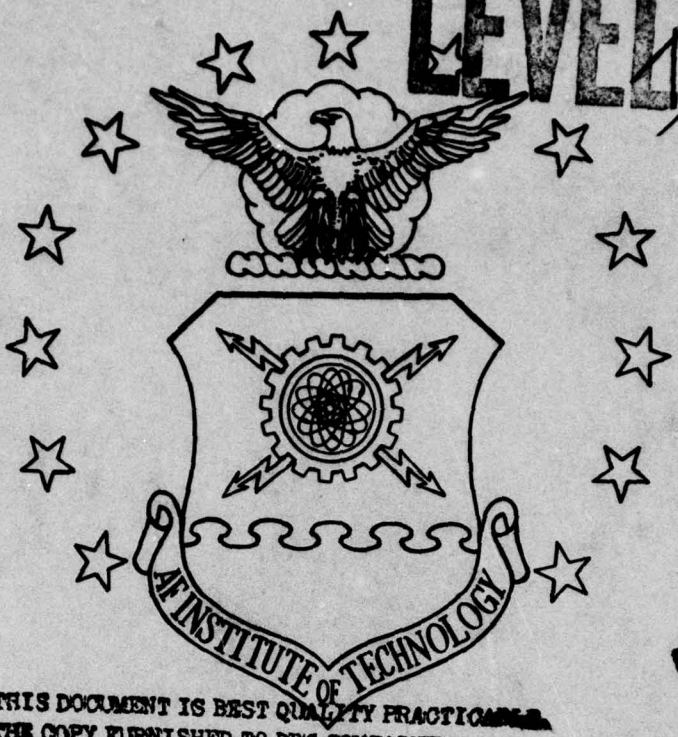



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A PRELIMINARY SYSTEM DYNAMICS INVESTIGATION OF ALTERNATIVE MILITARY RETIREMENT PROGRAMS

THESIS

AFIT/GOR/SM/77D-3

Michael F. Carpenter
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Requirements for the Degree of

Master of Science

by

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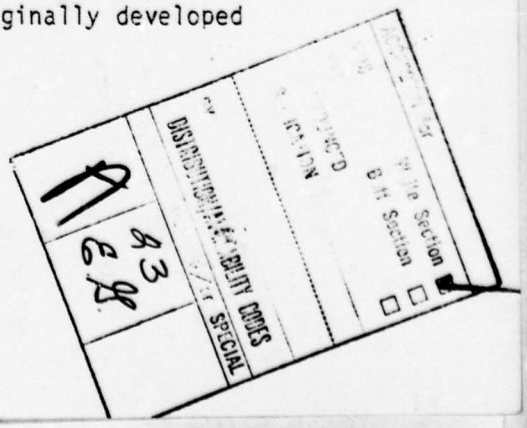
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Preface

Proposals to change the military retirement system have led to some interesting debates. Unfortunately, a good portion of these debates has been in the form of impassioned pleas and myopic analyses, neither of which are likely to produce beneficial changes. A fundamental problem is that retirement policies are inextricably tied to other aspects of the personnel system. A retirement change which alters retention patterns (as most would do) will affect turnover and possibly promotions, with significant cost implications. Thus, it is inappropriate to consider only retirement costs when analyzing retirement proposals.

The analysis presented in this report represents a preliminary attempt in applying the system dynamics methodology to a part of the Air Force officer personnel system. Since system dynamics offers a powerful technique for investigating complex systems, we hope that our efforts will inspire a follow-on analysis incorporating the enlisted force. Such an analysis might allow more far reaching conclusions to be drawn about alternative retirement programs.

A number of people provided us with invaluable assistance in helping us complete this thesis. We would like to thank Captain Jon Knight, our advisor, for his perceptive guidance and instructive critiques. Mr. Robert Emmerichs, of the Armed Services Committee staff of the House of Representatives, also provided us with many helpful comments. Additionally, this thesis incorporates many ideas originally developed in a paper authored, in part, by Mr. Emmerichs.



We would also like to mention the efforts of Mr. Barney Leslie and Mr. Dick Sauer of AFIT/ADS, who spent a considerable amount of time working on computer software to enable us to complete this report on time.

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Michael F. Carpenter

Michael R. Lacey

Table of Contents

		Page
Preface		ii
List of Figures		vi
List of Tables		xiii
Abstract		xv
I.	INTRODUCTION	1
	The Retirement Issue	1
	The Purpose of the Thesis	2
	The Personnel and Retirement System	3
II.	THE PERSONNEL SYSTEM	5
	The Nature of the System	5
	Attritions	8
	Promotions	10
	Accessions	10
	A Brief History of Officer Personnel Management	12
	Defense Officer Personnel Management Act	13
III.	RETIREMENT	17
	The Current Retirement System	17
	The Retirement Modernization Act	19
IV	THE MODEL	21
	The Approach	21
	The Voluntary Separation Decision	23
	Management Decision Making	25
	Accession Policy	25
	Promotion Policies	26
	Attrition Policies	27
	The System Dynamics Methodology	28
	The Model Design	32
	Using the Model	36
V	ANALYSIS OF THE RETIREMENT MODERNIZATION ACT	39
	Costing	40
	Behavioral Hypotheses	42
	Structure of the Analysis	43
	Results	46
	Conclusions	52
Bibliography		54

Page

APPENDIX A: Model Documentation. 56

APPENDIX B: Costing. 138

APPENDIX C: Model Validation 150

APPENDIX D: RMA Analysis Output. 247

APPENDIX E: Computer Program Listing 283

Vitae 299

List of Figures

Figure		Page
1	Force Profile.	6
2	Pay Feedback Loop.	22
3	System Dynamics Model.	30
4	Rate Equation.	31
5	Multiplier for Career Expectations	35
6	Deferred Annuity Costing	42
A-1	Model Flow Chart	60
A-2	Dimensions and Characteristics of Defense Officer Promotion System	63
A-3	Causal Loop for Career Expectations.	65
A-4	Causal Loop for Voluntary Separations.	65
A-5	Flow Chart Representation of Death and Residual Separation Rates	71
A-6	Promotion Management for O-3s.	78
A-7	Promotion to O-3	82
A-8	Promotion Opportunity for Captains	88
A-9	Reduction-in-force Rate.	89
A-10	Promotion to O-4	90
A-11	Promotion Opportunity for Majors	95
A-12	Promotion to O-5	96
A-13	Promotion to O-6	97
A-14	Career Expectation Indifference Curves	107
A-15	Multiplier From Career Expectations.	108
A-16	Responsiveness of Military Pay to Voluntary Separations.	114

Figure		Page
A-17	Multiplier from Military Pay (MFMP3).	115
A-18	Voluntary Separations from O12.	117
A-19	Voluntary Separations from O3	118
A-20	Voluntary Separations from O4	119
A-21	Voluntary Separations from O5	120
A-22	Retirements from O3P.	129
A-23	Retirements from O4P.	130
A-24	Retirements from O5P.	131
A-25	Retirements from O6	132
A-26	Accession Rate.	136
C-1	Line Officer Force Equilibrium.	157
C-2	Force Buildup (Hypothesis A), Accessions and Total Force	165
C-3	Force Buildup (Hypothesis A), Grade Distribution.	166
C-4	Force Buildup (Hypothesis A), Inventories of Selected Officers	167
C-5	Force Buildup (Hypothesis A), O-3 Promotion Parameters.	168
C-6	Force Buildup (Hypothesis A), O-4 Promotion Parameters.	169
C-7	Force Buildup (Hypothesis A), O-5 Promotion Parameters.	170
C-8	Force Buildup (Hypothesis B), Accessions and Total Force	172
C-9	Force Buildup (Hypothesis B), Grade Distribution.	173
C-10	Force Buildup (Hypothesis B), Inventories of Selected Officers	174
C-11	Force Buildup (Hypothesis B), O-3 Promotion Parameters.	175

Figure		Page
C-12	Force Buildup (Hypothesis B), O-4 Promotion Parameters.	176
C-13	Force Buildup (Hypothesis B), O-5 Promotion Parameters.	177
C-14	Force Buildup (Hypothesis C), Accessions and Total Force	179
C-15	Force Buildup (Hypothesis C), Grade Distribution.	180
C-16	Force Buildup (Hypothesis C), Inventories of Selected Officers	181
C-17	Force Buildup (Hypothesis C), O-3 Promotion Parameters. .	182
C-18	Force Buildup (Hypothesis C), O-4 Promotion Parameters. .	183
C-19	Force Buildup (Hypothesis C), O-5 Promotion Parameters. .	184
C-20	Force Drawdown (Hypothesis A), Accessions and Total Force	187
C-21	Force Drawdown (Hypothesis A), Grade Distribution	188
C-22	Force Drawdown (Hypothesis A), Inventories of Selected Officers	189
C-23	Force Drawdown (Hypothesis A), O-3 Promotion Parameters .	190
C-24	Force Drawdown (Hypothesis A), O-4 Promotion Parameters .	191
C-25	Force Drawdown (Hypothesis A), O-5 Promotion Parameters .	192
C-26	Force Drawdown (Hypothesis B), Accessions and Total Force	194
C-27	Force Drawdown (Hypothesis B), Grade Distribution	195
C-28	Force Drawdown (Hypothesis B), Inventories of Selected Officers	196
C-29	Force Drawdown (Hypothesis B), O-3 Promotion Parameters .	197
C-30	Force Drawdown (Hypothesis B), O-4 Promotion Parameters .	198
C-31	Force Drawdown (Hypothesis B), O-5 Promotion Parameters .	199
C-32	Force Drawdown (Hypothesis C), Accessions and Total Force	202

Figure		Page
C-33	Force Drawdown (Hypothesis C), Grade Distribution.	203
C-34	Force Drawdown (Hypothesis C), Inventories of Selected Officers.	204
C-35	Force Drawdown (Hypothesis C), O-3 Promotion Parameters. .	205
C-36	Force Drawdown (Hypothesis C), O-4 Promotion Parameters. .	206
C-37	Force Drawdown (Hypothesis C), O-5 Promotion Parameters. .	207
C-38	Decreased Retention (Hypothesis A), Accession and Attrition Rates.	209
C-39	Decreased Retention (Hypothesis A), Grade Distribution . .	210
C-40	Decreased Retention (Hypothesis A), O-3 Promotion Parameters	211
C-41	Decreased Retention (Hypothesis A), O-4 Promotion Parameters	212
C-42	Decreased Retention (Hypothesis A), O-5 Promotion Parameters.	213
C-43	Decreased Retention (Hypothesis B), Accession and Attrition Rates.	214
C-44	Decreased Retention (Hypothesis B), Grade Distribution . .	216
C-45	Decreased Retention (Hypothesis B), O-3 Promotion Parameters	217
C-46	Decreased Retention (Hypothesis B), O-4 Promotion Parameters	218
C-47	Decreased Retention (Hypothesis B), O-5 Promotion Parameters	219
C-48	Decreased Retention (Hypothesis C), Accession and Attrition Rates.	221
C-49	Decreased Retention (Hypothesis C), Grade Distribution . .	222
C-50	Decreased Retention (Hypothesis C), O-3 Promotion Parameters	223
C-51	Decreased Retention (Hypothesis C), O-4 Promotion Parameters	224

Figure		Page
C-52	Decreased Retention (Hypothesis C), O-5 Promotion Parameters	225
C-53	Increased Retention (Hypothesis A), Accession and Attrition Rates.	227
C-54	Increased Retention (Hypothesis A), Grade Distribution	228
C-55	Increased Retention (Hypothesis A), O-3 Promotion Parameters	229
C-56	Increased Retention (Hypothesis A), O-4 Promotion Parameters	230
C-57	Increased Retention (Hypothesis A), O-5 Promotion Parameters	231
C-58	Increased Retention (Hypothesis B), Accession and Attrition Rates.	232
C-59	Increased Retention (Hypothesis B), Grade Distribution	233
C-60	Increased Retention (Hypothesis B), O-3 Promotion Parameters	234
C-61	Increased Retention (Hypothesis B), O-4 Promotion Parameters	235
C-62	Increased Retention (Hypothesis B), O-5 Promotion Parameters	236
C-63	Increased Retention (Hypothesis C), Accession and Attrition Rates.	237
C-64	Increased Retention (Hypothesis C), Grade Distribution	238
C-65	Increased Retention (Hypothesis C), O-3 Promotion Parameters	239
C-66	Increased Retention (Hypothesis C), O-4 Promotion Parameters	240
C-67	Increased Retention (Hypothesis C), O-5 Promotion Parameters	241
C-68	Force Buildup (Hypothesis A), Sensitivity on TTAF.	243
C-69	Force Drawdown (Hypothesis A), Sensitivity on TTAF	244

Figure		Page
C-70	Decreased Retention (Hypothesis A), Sensitivity on TTAF.	245
C-71	Increased Retention (Hypothesis A), Sensitivity on TTAF.	246
D-1	RMA Accessions, Weak Intended Response, No Military Pay Feedback	252
D-2	RMA Grade Distribution, Weak Intended Response, No Military Pay Feedback.	253
D-3	RMA O-3 Promotion Parameters, Weak Intended Response, No Military Pay Feedback	254
D-4	RMA Accessions, Moderate Intended Response, No Military Pay Feedback	256
D-5	RMA Grade Distribution, Moderate Intended Response, No Military Pay Feedback	257
D-6	RMA O-3 Promotion Parameters, Moderate Intended Response, No Military Pay Feedback	258
D-7	RMA Accessions, Strong Intended Response, No Military Pay Feedback	260
D-8	RMA Grade Distribution, Strong Intended Response, No Military Pay Feedback.	261
D-9	RMA O-3 Promotion Parameters, Strong Intended Response, No Military Pay Feedback	262
D-10	RMA Accessions, Reverse Intended Response, No Military Pay Feedback	264
D-11	RMA Grade Distribution, Reverse Intended Response, No Military Pay Feedback.	265
D-12	RMA O-3 Promotion Parameters, Reverse Intended Response, No Military Pay Feedback	266
D-13	RMA Accessions, Weak Intended Response, Assumed Military Pay Feedback.	268
D-14	RMA Grade Distribution, Weak Intended Response, Assumed Military Pay Feedback.	269
D-15	RMA O-3 Promotion Parameters, Weak Intended Response, Assumed Military Pay Feedback.	270
D-16	RMA Accessions, Moderate Intended Response, Assumed Military Pay Feedback.	272

Figure		Page
D-17	RMA Grade Distribution, Moderate Intended Response, Assumed Military Pay Feedback.	273
D-18	RMA O-3 Promotion Parameters, Moderate Intended Response, Assumed Military Pay Feedback.	274
D-19	RMA Accessions, Strong Intended Response, Assumed Military Pay Feedback.	276
D-20	RMA Grade Distribution, Strong Intended Response, Assumed Military Pay Feedback.	277
D-21	RMA O-3 Promotion Parameters, Strong Intended Response, Assumed Military Pay Feedback.	278
D-22	RMA Accessions, Reverse Intended Response, Assumed Military Pay Feedback.	279
D-23	RMA Grade Distribution, Reverse Intended Response, Assumed Military Pay Feedback.	280
D-24	RMA O-3 Promotion Parameters, Reverse Intended Response, Assumed Military Pay Feedback.	281

List of Tables

Table		Page
I	Grade Authorizations.	14
II	Promotion Objectives.	15
III	Estimated Cost Implications of the Retirement Modernization Act Under the Assumption of No Military Pay Responsiveness to Retention	47
IV	Force Profile Implications of the Retirement Modernization Act Under the Assumption of No Military Pay Responsiveness to Retention	49
V	Estimated Cost Implications of the Retirement Modernization Act Under the Assumption of Military Wage Responsiveness to Retention.	51
VI	Force Profile Implications of the Retirement Modernization Act Under the Assumption of Military Wage Responsiveness to Retention.	52
A-I	Goals for Promotion Parameters Under DOPMA.	72
B-I	Precommissioning Costs.	140
B-II	Initial Training Costs.	142
B-III	Standard Pay Rates.	143
C-I	OUTPUT Interpretation for Test Cases.	161
C-II	Air Force Officer Force Reduction	201
D-I	Symbol Definitions.	248
D-II	Present System Cost Streams	249
D-III	RMA Costs Streams, No Personnel Response.	250
D-IV	RMA Cost Streams, Weak Intended Response, No Military Pay Feedback.	251
D-V	RMA Cost Streams, Moderate Intended Response, No Military Pay Feedback	255
D-VI	RMA Cost Streams, Strong Intended Response, No Military Pay Feedback	259

Table		Page
D-VII	RMA Costs Streams, Reverse Intended Response, No Military Feedback.	263
D-VIII	RMA Costs Streams, Weak Intended Response, Assumed Military Pay Feedback.	267
D-IX	RMA Cost Streams, Moderate Intended Response, Assumed Military Pay Feedback.	271
D-X	RMA Cost Streans, Strong Intended Response, Assumed Military Pay Feedback.	275
D-XI	RMA Cost Streams, Reverse Intended Response, Assumed Military Pay Feedback.	279

Abstract

Numerous proposals for restructuring the military retirement system have been prompted by increasing concern over the growth of personnel costs. In particular, the Retirement Modernization Act, now before Congress, has generated a considerable amount of controversy over its provisions for reducing the size of benefits for 20 year retirees. When future costs are used as a measure of effectiveness for alternative retirement programs, a problem arises because of the interactions between the retirement system and the personnel system. Changes in retirement benefits can induce significant changes in retention patterns, with serious cost implications. This report develops a dynamic model of the Air Force officer personnel system suitable for analyzing the long range effects of alternative retirement programs. The cost impacts of hypothesized changes in retention indicate that any savings in retirement costs may not be large enough to effect a net reduction in total system costs. Furthermore, if unanticipated changes in retention in the lower grades should develop, the increased turnover costs could completely swamp any savings in retirement costs.

A PRELIMINARY SYSTEM DYNAMICS INVESTIGATION OF ALTERNATIVE MILITARY RETIREMENT PROGRAMS

I. INTRODUCTION

The Retirement Issue

Both Congress and the Department of Defense (DOD) are currently investigating several proposals which would significantly reconstruct the military retirement system. Impetus for these investigations comes from what many observers believe to be an alarming (and unacceptable) increase in the size of personnel expenditures. Such expenditures already consume approximately 57 percent of the DOD budget (Ref 1:14). Furthermore, under the present retirement system, the annual outlay for retirement pay is expected to hit $30 billion by the year 2000. A common theme in all the proposals is a trend to reduce the outlays for retirement pay. (Actually, some proposals call for a slight increase in payments for the first few years, followed by significant reductions after the 'save pay' transition period).

The basic problem is that the potential benefits from reduced retirement outlays will most likely be realized only at some cost to the personnel system in general. For example, decreased retirement payments may be reflected in increased recruitment costs, higher turnover (which increases training costs), and/or decreased quality in the personnel. This type of cost-benefit tradeoff makes the comparison of alternative retirement schemes an exceedingly complex effort. In some cases, proponents of the proposals have attempted to provide some very general estimates of the total impact, but the conflicting assumptions and data make comparison of

the various plans difficult. The more cost-effective retirement system would be that one which reduces the DOD budget the most (assuming, of course, that mission performance is not degraded), not necessarily the one which reduces retirement costs the most.

The Purpose of the Thesis

The purpose of this thesis is to make a relative evaluation of the present retirement system and that which would exist if a retirement system similar to the Retirement Modernization Act (RMA) were enacted. RMA is the most prominent of all the new proposals and has received the most support. In order to facilitate the comparison a model was developed in the research for this thesis which simulates the Air Force (line) officer force structure in a dynamic compensation environment. Other retirement scenarios could be evaluated with the model but time constraints have prevented them from being included in this report. A few minor alterations would enable the model to be applied to the line officer forces of the other services; the enlisted force, however, cannot be simulated without major changes to the model.

The model employs a very highly aggregated representation of the Air Force personnel force. It does not attempt to forecast the actions of individual officers, and it is not intended to provide accurate point estimates of the costs of the two retirement systems. These tasks are, quite literally, impossible. Instead, the purpose is to trace out the behavior of the system under specific environmental assumptions, to analyze the cost implications of this behavior, and to discriminate between alternative systems on the basis of relative costs. In addition

to this discrimination between retirement plans, the construction of the model also allows some analysis of personnel force management policies.

The Personnel and Retirement Systems

The nature of the problem addressed in this thesis is such that the simulation model developed for this thesis is basically a representation of the personnel promotion system, a retirement structure, and a module to monitor and accumulate cost flows generated by the system. Capturing the personnel system and the interactions with its environment constituted the majority of the effort.

The personnel system incorporated in the model does not correspond exactly with the system in effect today. Congress has required DOD to develop a comprehensive new personnel force management system by September of 1978. Such a system is embodied in the Defense Officer Personnel Management Act (DOPMA) which is now before Congress. The model reflects the grade authorizations, promotion policies, and separation policies contained in DOPMA. Furthermore, at the time DOPMA was written it was envisioned that RMA would be passed as a part of DOPMA (Ref 2:31). However, it now appears that DOPMA may be passed before RMA is even considered. The President's Blue Ribbon Commission on military compensation issues is presently studying the current methods of military compensation, and, until the Commission reports its finding in April of 1978, no action will be taken on RMA.

Since the personnel system is so important to the retirement issue, the next chapter will be devoted to an analysis of the dynamics of the Air Force's personnel system and how DOPMA will affect it. Chapter III covers the design of retirement systems. In particular, the present

retirement system is explained and some of its drawbacks are explored. Chapter III also includes a section on the proposed Retirement Modernization Act. Chapter IV contains an introduction to the methodology of system dynamics and examines the basic construction of the model in non-technical terminology. All the major assumptions and hypotheses are included in this section. The reader interested in the specific equations used in the model can refer to the appendices for a fully documented presentation of the computer program. Finally, the results and conclusions are presented in Chapter V.

While the model is written in DYNAMO (Version IIIF), a high level simulation language, the body of this report has been written for the reader who is unfamiliar with the language. The appendices, however, do presume a basic familiarity with the language. The introduction to system dynamics in Chapter IV explains the general nature of the language but does not include sufficient information to enable the reader to understand all the equations in the program. Those readers who are interested in further information on DYNAMO should refer to the bibliography for several references.

II. THE PERSONNEL SYSTEM

As previously noted, the personnel system to be discussed in this report is concerned with the management of only the line officers of the Air Force. This chapter is intended to provide the reader with an understanding of the nature of the system in terms of desired system performance and real world constraints.

The Nature of the System

The word system can be defined very simply as "a class of objects, processes, and relationships that can be associated with one another by a common purpose" (Ref 3:7). With this definition as a framework, the elements of the personnel system can be clearly specified. The line officers (the objects) carry out the mission of the Air Force (the common purpose) in an environment regulated by personnel policies (producing the processes). The reactions of the personnel to this environment and subsequent environmental changes (the relationships) provide the dynamic nature of the system.

To carry out the mission of the Air Force the personnel force managers must insure that the required mix and quantity of human capital inputs (as determined by the manpower side of the operation) are available (Ref 3:7). One method of insuring this is to manage the force so as to achieve a specific force profile, such as the one shown in Figure 1. A profile consists of a desired number of officers in each of the grades as well as a distribution by years-of-service (YOS) in each grade. Any particular profile is a function of the Congressionally authorized total strength; that is, a given percentage change in total strength does not

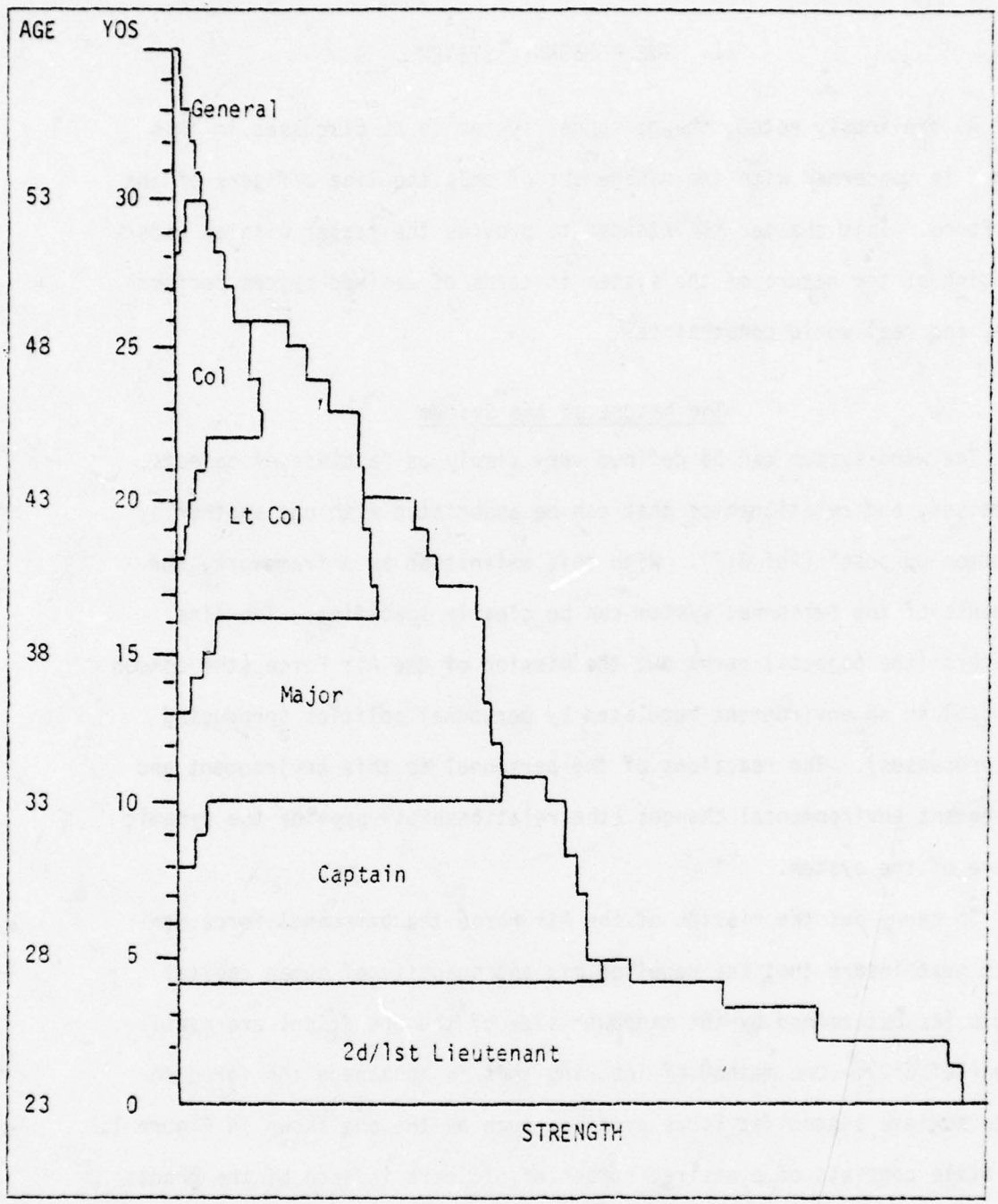


Figure 1. Force Profile

produce an equivalent percentage change in each of the grades. Instead, the lower year groups absorb more of the change than do the more senior officers. This is indicative of a peculiar feature of the military--officers enter the service, generally speaking, only as lieutenants, and are 'aged' through the system. Since it requires, for example, about 20 years to "produce" a colonel and only about four to "produce" a captain, this disproportionate profile adjustment provides flexibility in coping with changes in force authorizations.

Any number of policies can be employed by the force managers to regulate or adjust the shape of the force profile. Selective reductions-in-force (RIFs) can be used to reduce the number of officers in a particular grade or year gourp. Increasing the promotion opportunities and/or shortening the promotion points (the number of years in grade required before promotion) will, among other things, reallocate personnel within the profile. The optional retirement at 20 YOS policy of the services (which is a policy and not a legal entitlement) can have a profound impact on the profile. A major effect of this policy, at least according to some critics (Ref 4:78-81), has been to cause an excess in the number of officers with 12 to 20 YOS and a shortage of those in the 20 to 30 YOS group. Of course, if such a problem does in fact exist it should not be attributed solely to one policy since there are a great number of policies being employed at any one time. The multiple interactions between all of these policies make it difficult to accurately predict changes in the profile caused by new (or adjusted) policies. The force profile is also affected by factors which are not controllable by the personnel managers, such as military pay, the public attitude toward the

military, the unemployment rate, and wage differentials in the civilian economy. Some of these (e.g., pay) can be regulated by the Congress to aid the force managers in attaining the desired force profile. Others, though, must be considered as exogenous to the system in that the personnel system does not perceptibly affect them. Nevertheless, personnel force managers must react to observed (or predicted) discrepancies in the force profile through decisions guided by personnel policies.

A future force profile is a function of the current profile inflows (accessions), through-flows (promotions), and outflows (attrition). Thus accession, promotion and attrition policies are what force managers must manipulate if they are to control the force profile. Each of these is briefly discussed (in reverse order) below.

Attrition

Attrition is the only method of leaving the force profile. It includes such components as death, retirement, voluntary separation, and disciplinary discharge. Obviously, some types of attrition are uncontrollable, but in general, various policies can be employed to control, or at least influence, aggregate attrition. The single most important type of attrition, at least from the force managers point of view, is voluntary separation. Voluntary separations can occur anywhere in the profile from the four year point (when some officers' initial obligations expire) to the 30 year point (although voluntary separations after the 20 year point are actually retirements). The decision to separate is a function of many variables, including personal preferences (see Chapter IV for a discussion of the economics of occupational choice). The issue is compounded when one realizes that the military is considered to be, at least by some, an institution as opposed to an occupation

(Ref 5). The implication is that many officers will be willing to serve in the military even though they could be receiving greater monetary return from a job in the civilian sector.

Nevertheless, it is a reasonable assumption that voluntary attrition will be affected by certain changes in personnel policy. For instance, if military pay fails to keep pace with salaries in comparable civilian jobs it is likely that more people will make the decision to separate, since not everyone will have the same degree of "institutional" inclination. Also, if backlogs in the system begin to slow down promotions many officers might opt for a better career opportunity in the civilian market.

Voluntary attrition can be either desirable or undesirable, depending on timing. If every officer accessed into the force remained until retirement after 20 or more years, retirement costs would be astronomical. Furthermore, the entire force would "age" due to the decreased turnover, something which is definitely undesirable given the mission of the Air Force--"to fly and fight." Thus a certain amount of turnover (hopefully from voluntary separations) is desirable, especially from the five to ten years of service groups. However, much lower attrition is desired from the 20 to 30 year groups in order to maintain a corps of experienced high-level managers.

Involuntary separations (RIFs and forced retirements) are generally used as a last resort by force managers since they tend to have a negative impact on the entire force. Also, they are expensive, with the current average readjustment pay around $14,000 for RIFed officers (voluntary separatees are paid nothing).

Promotions

According to the United States Air Force (USAF) Personnel Plan, the purpose of promotions is to "...insure that there are the required numbers of officers in the grades necessary to carry out the mission....Promotion is not a reward for past service" (Ref 6:3-10). In other words, the promotion system is used to internally modify the shape of the force profile (or to maintain a particular shape). Decreasing the number of promotions will, ceteris paribus, alter the grade distribution by shifting proportionately more officers into the lower grades. Increasing promotions will have an opposite affect. Promotion policy is restricted to some degree by grade ceilings which are established by Congress. These ceilings exist for the grades of major through colonel so that a promotion cannot occur to these ranks unless there is a "vacancy." Either the promotion point or opportunity (probability) can be at the discretion of the force managers. A change in the promotion policy for any one grade will probably have repercussions throughout the entire force profile. For example, an increase in the promotion opportunity to major of, say, from 70 to 80 percent will decrease the number of captains. This will probably result in an increased promotion opportunity for lieutenants but the larger number of majors will eventually cause a reduction in the promotion opportunity to lieutenant colonel, and finally to colonel. The net result will be a significantly altered force profile.

Accessions

The immediate determinant of the level of accessions in any year is the level of attrition, because the force is usually maintained at or near the total authorized strength. The obvious implication is that the number of accessions is not determined by the desired shape

of the force profile. The number of accessions from the Air Force Academy and Reserve Officer Training Corps (ROTC) usually remains fairly stable and Officer Training School (OTS) is used to provide flexibility. Historically, the Air Force has never encountered difficulty in accessing the number and quality of officers which were required. However, the costs associated with inducing young men to enter the officer corps should probably be considered as variable.

In general, assessions are expensive. Pre-commissioning costs (the Academy, ROTC, and OTS) are considerable, but the highest cost is for initial training. The average initial training cost is approximately $75,000 (due primarily to the large cost of training pilots--about $165,000). From this point of view, therefore, it would be desirable to keep the number of accessions to a minimum. But, as noted above, higher accession rates (implying higher turnover) aid in maintaining a youthful force (and have significant implications for the ability to maintain reserve forces).

To briefly summarize, attrition, promotions, and accessions determine changes in the shape of the force profile, and therefore, are what force managers hope to influence through the application of personnel policies. However, intuitive evaluations of the ultimate effects of various policies are frequently very difficult because of the very nature of the system. Changes in the promotion policies will impact on the attrition, which affects the accessions, thus altering the profile in three different ways. In fact, changes in any one of the three policy areas will have impacts in each of the three. In the case to be analyzed later in this report, where the proposed change is very profound (a new

retirement plan), estimating the effects on accessions, promotions, and attrition becomes extremely complex.

A Brief History of Officer Personnel Management

NOTE: This and the following sections are taken primarily from the Report of the Committee on Armed Services (House of Representatives) to accompany H.R. 5503.

Prior to the Korean conflict this country had a history of maintaining an officer corps unfit for fighting a war. The first retirement law (enacted in 1861) was designed not to provide retirement benefits, but to remove "aged and infirm officers from positions of command." Until 1947 there was no comprehensive management system for maintaining an efficient force profile (of course, there was no Air Force either). The Officer Personnel Act (OPA) of 1947 (under which the Air Force was born) initiated the controversial "up-or-out" system and established tenure points for the various grades. The law provided for grade-distribution ceilings with respect to permanent grades (which varied by service).

In 1954 the Officer Grade Limitation Act (OGLA) was passed to correct deficiencies in OPA. The services had been using temporary promotions (which were not regulated under OPA) to maintain promotion opportunities at desirable levels. The result was a top heavy force structure. OGLA redefined grade limitations for each service for both Regular and Reserve officers. However, OGLA specified lower limits in the grades O-5 and O-6 for the Air Force than for the Army and Navy because the grade distribution for the Air Force was (at that time) much younger than that for the other services. This has set off a chain of events leading up to the present.

By 1959 the Air Force began having difficulty with its lower grade ceilings and Congress passed temporary grade relief legislation for the Air Force. In 1962 further grade relief was necessary to preclude massive separations and/or demotions. In 1965 the DOD submitted the Bolte Bill to Congress to provide for permanent legislation in the area of grade authorizations, but the Bill was never enacted into law. Consequently the Air Force has been forced to request temporary relief four times since 1966. The last relief was approved in 1974, at which time the Congress indicated that "it would not in the future consider individual legislation for the Air Force independent of a review of the grade distribution requirements of the Armed Forces as a whole." The 1974 grade relief expires in September of 1978 so that it can be assumed that new legislation will be enacted in the very near future (if it is not there will be serious consequences for the Air Force). The DOD proposal to satisfy the demands of the Congress is the Defense Officer Personnel Management Act.

Defense Officer Personnel Management Act

In a letter to the Speaker of the House of Representatives the DOD has explained the purposes of DOPMA as follows:

> (1) establish new permanent statutory limitations on the numbers of these officers who may serve in certain grades:
> (2) provide common provisions of law for the appointment of regular officers and for the active-duty service of reserve officers;
> (3) provide uniform provisions of law for their promotion, eliminating the existing temporary promotion systems; and
> (4) establish common, uniform provisions of law for their tenure and mandatory separation or retirement, for reasons other then (sic) physical disability (Ref 2:47).

Table I shows the statutory grade limitations that would apply to the Air Force. The table illustrates the "sliding scale principle" which is

TABLE I

Grade Authorizations

Total Officer Strength	Authorizations (% of total)		
	Major	Lt Col	Colonel
85,000	19.432	12.752	5.185
90,000	19.246	12.492	5.119
95,000	19.080	12.262	5.059
100,000	18.930	12.054	5.007
105,000	18.795	11.866	4.959
110,000	18.671	11.695	4.915
115,000	18.423	11.450	4.849
120,000	18.244	11.259	4.793

designed to stabilize the number of senior officers with regard to changes in total force authorizations. There are no grade limitations on the grades of second lieutenant through captain. The House of Representatives has recommended a reduction of three percent in the authorizations for lieutenant colonels and colonels from the levels shown in this table.

The second major provision of DOPMA is the implementation of the all-Regular force at the 11 year point. This would provide more equitable treatment for what are currently termed career Reserve officers. Under current law these officers are more vulnerable to forced attrition than are Regular officers. Under DOPMA an officer who is neither offered a regular commission nor promoted to O-4 by his eleventh year of service will be separated from active duty. Any reserve officer who is promoted to O-4 would automatically be offered a regular commission.

DOPMA would also institute a single promotion system, replacing the current temporary and permanent promotions. In addition, the measure also establishes promotion objectives in the form of "promotion windows" and promotion opportunities. These objectives are illustrated in Table II. The figures shown in the table for the promotion windows are total years of active duty service, but in actuality promotions will be based on time in grade.

TABLE II

Promotion Objectives

Grade	Promotion Window (Yrs of Service)	Promotion Opportunity (% of Eligibles)
O-1		
O-2	2	100
O-3	4	95
O-4	10 ± 1	80
O-5	16 ± 1	70
O-6	22 ± 1	50

The fourth major provisions of DOPMA concerns separations and retirements. The "up-or-out" provision first established by OPA would be maintained by providing for mandatory separation (or retirement, if appropriate) for officers twice nonselected for promotion. Those officers who are involuntarily separated (with more than five years of service) prior to reaching eligibility for retirement would be given a separation payment based on their length of service (up to a maximum

of $15,000). Mandatory retirement points (tenure) are established at 30 YOS for colonels, 26 YOS for lieutenant colonels, and 20 YOS for majors.

It should be noted that DOPMA was written under the assumption that a new retirement plan would simultaneously be enacted which would provide for a vesting of retirement benefits. Under such a system an officer spearated with less than 20 YOS would be entitled to some retirement benefits (usually in the form of a deferred annuity). Since plans for a new retirement program have been temporily shelved pending the report from the President's Blue Ribbon Commission, the Congress has included as a part of DOPMA these large separation payments. According to Congress, this enables "the bill to operate independently of retirement law changes" (Ref 2:31).

The following chapter gives a brief description of both the present retirement system and that which would exist if the Retirement Modernization Act were enacted. While RMA was designed to operate in conjunction with DOPMA both systems are compatible with it.

III. RETIREMENT

The following discussion pertains only to nondisability retirement under Title 10 of the United States Code.

The Current Retirement System

The current military retirement system is the result of legislation enacted in the late 1940's. The basic provisions call for voluntary retirement between 20 and 40 years of service at the discretion of the Secretary of the Military Department, not at the discretion of the individual. Nevertheless, retirement at 20 years of service has more or less been viewed as a right by most military members (Ref 7:22). A retiree's annuity is computed by multiplying his annual basic pay (on the day he retired) by 2½ percent of his years of service. After retirement, annuities are adjusted upward to keep pace with increases in the cost of living, as measured by the Consumer Price Index (CPI). The annuity is payable immediately upon retirement and continues until the retiree's death (the retiree can elect to "purchase" the survivors benefits plan which provides an annuity to his beneficiaries after his death, with the cost of the survivor's annuity being paid by a decreased retirement annuity).

This system has generated a considerable amount of controversy. Detractors claim that the benefits are far in excess of what is required to acquire and retain qualified personnel (Ref 8). In fact, the military retirement system is relatively "generous" when compared with most private and public retirement plans (Ref 9:24). For example, the Civil Service retirement program does not pay members an annuity until at

at least age 55 (an officer retiring with 20 YOS typically is 43 years old); furthermore, it is a contributory system, requiring members to contribute seven percent of their salaries toward retirement benfits. Another frequently cited problem is that the current retirement system encourages retirement at 20 YOS, thus depriving the services of valuable, experienced personnel.

On the other side of the coin, there are important reasons why a military retirement system should be unique. The military is significantly different from civilian occupations, exposing its members to much higher risks. In many cases military personnel have no training suitable for a job outside of the service. The services also require a younger work force than do most civilian jobs.

Most of these arguments, however, miss the real issue. The important question is whether or not the present retirement system is achieving its objective at a reasonable cost. The objective is simply to maintain a desired force profile (Ref 10:3-4; 9:24). The Department of Defense Retirement Study Group has identified some deficiencies in the current system:

--no vesting of retirement benefits for members who leave before 20 YOS.

--inappropriate separation payments for most members

--insufficient financial incentive to continue on active duty after 20 YOS (Ref 10:6).

The Study Group concluded that these (and other) factors have had undesirable impacts on attrition from the active duty force. The Retirement

Modernization Act was submitted to Congress by DOD in the interest of correcting these deficiencies. Although it is not the only proposal which has been forthcoming, it is representative of several in its overall design. Since RMA is included in the analysis performed later in this report, a brief discussion of its more prominent features is provided below.

The Retirement Modernization Act

RMA was designed to alter retention patterns throughout the force profile and to reduce total retirement costs. The following paragraphs describe the means by which RMA attempts to achieve these objectives.

In order to decrease attrition in the lieutenant and captain ranks and to increase attrition in the major rank, RMA has incorporated vesting for officers separating with more than 10 and less than 20 YOS. Vesting means that officers with more than 10 YOS are entitled to some retirement benefits. In this case the benefits are payed in the form of a deferred annuity (payable at age 60) equal to 2½ percent of annual base pay times YOS. It is presumed that vesting will induce more officers to serve for at least 10 years while simultaneously reducing the incentive to remain for 20 years. The Congressional Budget Office has claimed that this will not significantly alter the age distribution of the force (Ref 9:28).

Most observers agree that the current retirement system does not offer sufficient incentive to remain for 30 years of service. RMA would alter the incentives in two ways. First, retirement annuities for officers separating with between 20 and 29 YOS would be decreased by 15 percent until the time at which the officer would have achieved 30 YOS

had he or she remained in the service. Second, the amount of the annuity would be increased for those serving for 25 to 30 years (the current maximum is 75% of base pay for 30 YOS--under RMA this would increase to 78%).

In the interest of holding down costs RMA proposes to change the method used to determine the base pay for computing the annuities. Under the present system the base pay used in the computation is that which the officer received on his last day of active duty. RMA employs a "high-1" provision which calls for averaging the salary received over the last year of service.

Another significant provision of RMA is the reduction of the annuity at age 65. Since military members pay into the social security program while on active duty they are eligible for benefits at age 65. RMA would reduce the military retirement annuity "...by half the amount of the social security annuity 'attributable to military service.' This provision reflects the military's matching of the member's social security contributions while he was on active duty" (Ref 9:28). This has presented a problem because it is difficult, if not totally impossible, to determine the amount of social security "attributable to military service."

RMA also includes a "save-pay" transition period which guarantees that anyone who has reached a certain point in his career would be guaranteed to receive at least as much under RMA as he would have had under the current system.

IV. THE MODEL

This chapter covers several issues concerning the construction of the computer model used in this thesis. The first section discusses the general approach taken in developing the model. The second section contains an explanation of the system dynamics methodology and the DYNAMO computer language. The third section presents a nontechnical description of the model design. The final section sets forth the assumptions made in constructing the model and provides some guidelines for utilizing the model.

The Approach

The personnel system is managed by the DOD force managers who must operate within Congressional directives. The objective of their efforts is to attain (or maintain) a desired force profile. As noted earlier, the profile is a function of accessions, promotions, and attrition. The first two can be readily controlled, but attrition, especially in the form of voluntary separations, is difficult to regulate. When voluntary separations begin to cause discrepancies in the desired force profile the personnel managers will attempt to adjust policies to induce a change back to the desired voluntary separation rate. If this fails, and the situation warrants it, Congress may step in to adjust pay or benefits. As an example, consider the situation in which civilian wages have risen significantly faster than military wages. The situation is shown in the form of a causal loop diagram (Ref 11).in Figure 2. The proportionately lower military wage rate will cause higher than normal attrition, generating a force profile discrepancy. This in turn will

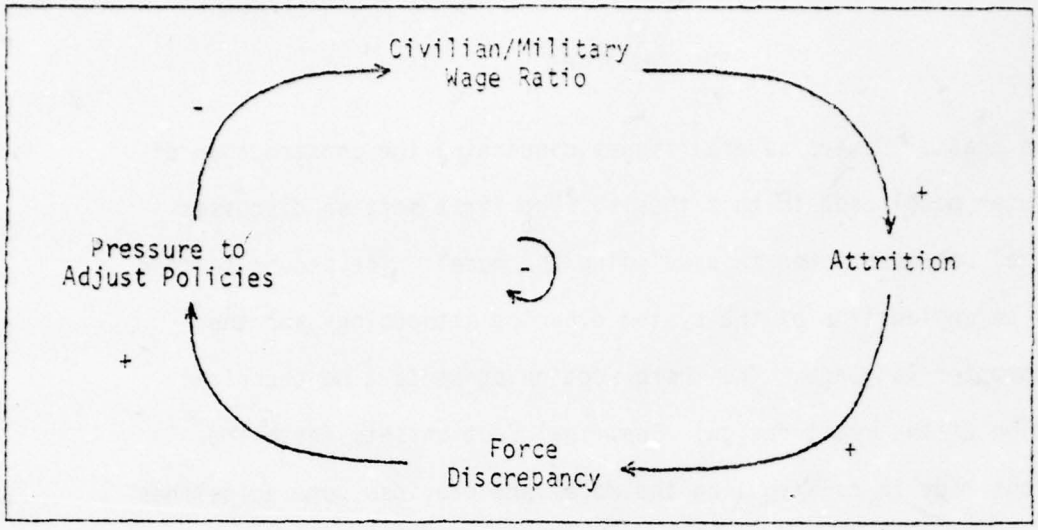


Figure 2. Pay Feedback Loop

increase pressure on management (to include Congress) to reduce the discrepancy through, perhaps, increased military pay (this is, of course, only one of the many options). The plus and minus signs indicate the direction of change that is induced for an increase in the previous factor.

This cycle typifies the information-feedback nature of the personnel system. Whenever a discrepancy (or projected discrepancy) occurs, management takes action to stabilize the system at the desired state. The approach taken in building the model was to design an information feedback system representation of the Air Force (line) officer personnel system. This required the development of definite causal hypotheses about how the state of the system at any time interacts with the goals of the system to motivate changes. These causal hypotheses were developed from descriptive information available in policy statements,

regulations, and past responses of the system to changes. Further, it was important to determine the time lags involved in traversing various causal loops to determine how various information flows interact to generate behavior. These causal hypotheses can be represented by causal loop diagrams, such as the one shown in Figure 2. These loops can be combined and used to develop a flow chart for the model.

Before the causal loops can be converted into a flow chart, however, the causal mechanisms must be carefully analyzed to determine the nature of the important variables composing them. The two critical mechanisms at work in the personnel system are the voluntary separation decision and the policies guiding the reaction of management to separations (or anticipation of separations).

The Voluntary Separation Decision

The decision to voluntarily separate is a concern of occupational choice theory. Gary Becker, in Economic Theory, discusses the economics of occupational choice by considering a two occupation world in which the individual can divide his time among occupation A, occupation B, and non-labor time (Ref 12:166). The optimal allocation of time between the two jobs would occur when

$$w_A - w_B = \frac{1}{\lambda} (MU_B - MU_A) \qquad (1)$$

where w is the wage rate for the occupation, MU is the marginal utility of time spent in the occupation, and $\frac{1}{\lambda}$ is the monetary equivalent of a unit of utility. This approach can be generalized to a military versus nonmilitary occupational choice and applied at an aggregate level. The w_A could represent the expected lifetime income from the

civilian occupation and w_3 would be the military counterpart. Obviously, then, as the marginal utility of time spent in the military approached the marginal utility of time spent in the civilian market, the more nearly equal the wage rates would have to be to maintain equilibrium.

In a survey of Air Force officers holding the position of commander (Ref 13), it was determined that among the most important factors (although not the most important) entering into the decision to separate were pay, promotions, and retirement. Taken together, these factors can be viewed as determining a lifetime expected income for the officer. The survey also concluded that

> "...in concert with the Institutional-Occupational thesis verbalized by Moskos, shifts from what originally was the most influential career decision factor to what is most influential today, seem to support the notion of the military as an occupation rather than a calling" (Ref 13:4-52).

This implies that voluntary separations are more sensitive today to changes in pay, promotion, and retirement than ever before, and that the amount of "psychic income" derived from being in the military is declining. In terms of Becker's model, the marginal utility of a military career is approaching that of a civilian career.

The approach taken in developing the model was that aggregate voluntary separations could be formulated as a function of pay, career expectations (promotions), retirement benefits, and an "environmental" index. The environmental index was assumed to remain constant in the two retirement scenarios. This factor includes such things as job satisfaction and family separation (which were the two most important items in the above mentioned survey). As the civilian/military wage ratio increased, voluntary separations were assumed to increase; as career

expectations (as measured by deviations from DOPMA goals for promotion point and opportunity) decreased, voluntary separations were again assumed to increase; and as retirement benefits decreased (determined by the present value of retirement benefits receivable in each grade) voluntary separations increased. The specific functional form is discussed later in this chapter (and developed in detail in Appendix A).

Management Decision Making

The feedback control nature of the system cannot be completely described until the form of the personnel force managers' reactions can be determined. The decisions made by the managers are regulated by policy. The approach taken in developing the model was to attempt to capture only the most general and persistent policies which regulate the force profile. In order to be consistent, these policies will be covered under the general headings of accessions, promotions, and attrition.

Accession Policy. The basic accession policy of the Air Force requires that almost all personnel access through a single port of entry into the grade structure. The military seldom uses lateral accession. A shortage of lieutenant colonels cannot be offset by an excess of new lieutenants, nor can an excess of lieutenant colonels be adequately taken care of by reducing accessions. Ideally, promotion and attrition policies will prevent such excesses and shortages, so that the accession rate does not become too volatile.

The accession rate can be considered as having two components: (1) accessions to compensate for attrition, and (2) accessions to adjust total force size during force buildups or drawdowns. The latter component can be either positive or negative. The policy incorporated into the

model dictates that accessions be based on these two components. The supply of new officers is considered to be unrestricted (although the cost per accession can change - see Appendix B). The attrition adjustment component of accessions must be based on a prediction of future attrition. The model employs a two year exponential average of past attritions to forecast the current attrition rate. The exponential averaging tends to emphasize the more current trends, as well as to smooth out the effects of sudden peaks and valleys in the attrition rate. When the total force authorization is changing the second component of accessions is activated.

Promotion Policies. As explained in Chapter III, DOPMA contains objectives for both promotion point and promotion opportunity. The USAF Personnel Plan states that promotion policy must

> "...provide career incentive. It must offer opportunity for advancement at reasonably spaced intervals to attract officers to an Air Force career. Active duty promotions should be relatively stable and provide each year group of officers comparable opportunity with other year groups" (Ref 6 :3-10).

This policy is formulated in the model through the use of a simplified, single track promotion system. Since promotion opportunity is probably the more "visible" of the two variables (in that a change in the promotion probability is more important to the average officer than is a change in promotion point), maintaining the promotion opportunity at the goal stated in DOPMA has the highest priority. In fact, the opportunity is not changed unless the promotion point has shifted at least a year and a half beyond the goal or a half year earlier than the goal. If these preset limits are reached, however, the opportunity will be

adjusted accordingly. In the event that the promotion point and opportunity cannot be maintained within specified limits, RIFs or forced retirements will be used. Appendix A covers, in detail, the methods involved in carrying out this policy.

Attrition Policies. Air Force attrition policy covers both voluntary and involuntary attrition. The USAF Personnel Plan states that the personnel managers will "To the maximum extent consistent with the needs of the Air Force, honor requests from all officers who desire to leave active duty" (Ref 6:3-12). The approach taken in this model was to allow unrestricted voluntary separations in response to the factors noted earlier. This oversimplification should be of little consequence since there is always a large portion of the force which is not under a commitment.

Attrition in the form of death, disability, hardship, or undesirable discharge was considered to be a fixed percentage of the numbers in each grade. Thus, this attrition was not controlled by management. Involuntary separations were governed by promotion policies. All officers passed over for promotion were separated after reaching an average year of service for their grade (an input parameter). Also, when promotion standards could not be maintained, as explained above, RIFs or forced retirements were used.

As noted previously, voluntary attrition was assumed to be a function of pay, promotions, and retirement benefits. As depicted in the causal loop in Figure 2, the model assumes that pay adjustments are a function of attrition. Pay was assumed to respond (through Congressional action) to long term trends in attrition. In other words, attrition

management included a pay adjustment decision. No such decision was available, however, with regard to promotions or retirement. Promotion decisions were assumed to be entirely governed by the phase point and promotion opportunity. Retirement benefit adjustments were exogenously input and did not respond to anything in the model.

Obviously, personnel management decision making is far more complex than is indicated here. The level of abstraction is indicated, however, because a very large proportion of the decision making activities involve a relatively small number of exceptional problems and events. Their effect on aggregate behavior is probably very small. Since the purpose of the model was only to indicate overall trends in the system, it was necessary to capture only the structure of the major policies, whose form and effects persist for many years. A high degree of aggregation was specified in this model so that the important dynamics of the complete system could be analyzed without becoming bogged down in details.

The System Dynamics Methodology

System Dynamics refers to a modeling methodology developed by J. W. Forrester of Massachusetts Institute of Technology (M.I.T.) and based on information-feedback control theory. According to Forrester, "The general concepts of information-feedback systems are essential because such systems exhibit behavior as a whole which is not evident from examination of the parts separately. The pattern of system interconnection, the amplification caused by decisions and policy, the delays in actions, and the distortion in information flows combine to determine stability and growth" (Ref 14:16). The basic structure of a System Dynamics model

consists of a number of "levels" and "flows" such as shown in Figure 3. The levels represent accumulations within the system (for example, the number of majors or the number of retirees at a given time); the flows are used to provide the inputs and outputs for the levels (for example, promotions into the major level or deaths out of the major level). The flows are controlled by decision functions which depend only on information about the levels.

The value of a level is computed by integrating (over time) the net flow rate. In equation form:

$$L \quad LEVEL.K = LEVEL.J + (DT)*(IN.JK - OUT.JK) \qquad (2)$$

The L to the left of the equation indicates that this equation defines a level. The value of the level at time K is equal to its value in the previous time period (J) plus the difference between the flow in (IN.JK) and the flow out (OUT.JK) during the time increment (DT). The time script K is used to represent the current time; J indicates the previous time (i.e., K-DT); and L is used to indicate the next time (K+DT). Flows have double time scripts to indicate that they remain constant over the time increment used for integration. This approximates the integrating of a continuous function when DT is small. The flow equations are designated with an R (for rate):

$$R \quad OUT.KL = LEVEL.K/DELAY \qquad (3)$$

Equation (3) indicates that the flow OUT which will exist over the next time increment is equal to the current value of the level divided by a

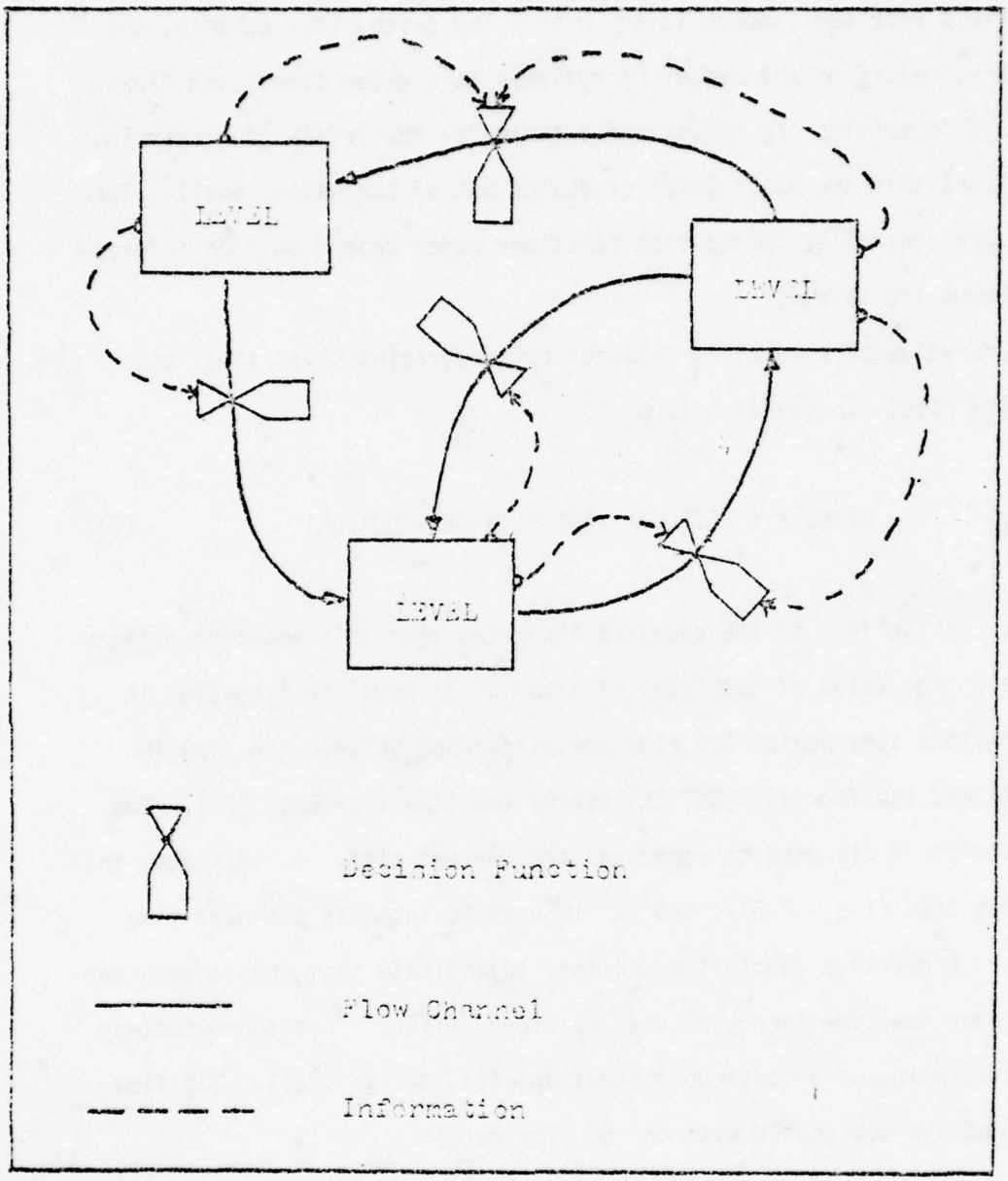


Figure 3. System Dynamics Model (Ref 14:67)

constant (labeled DELAY). For example, OUT might represent the annual death rate of majors. If one percent of all majors died each year then DELAY would be set equal to 100. The flow OUT would then remove one percent of the level of majors each year. Figure 4 shows the flow OUT and the information used to determine it. The rate equations are used

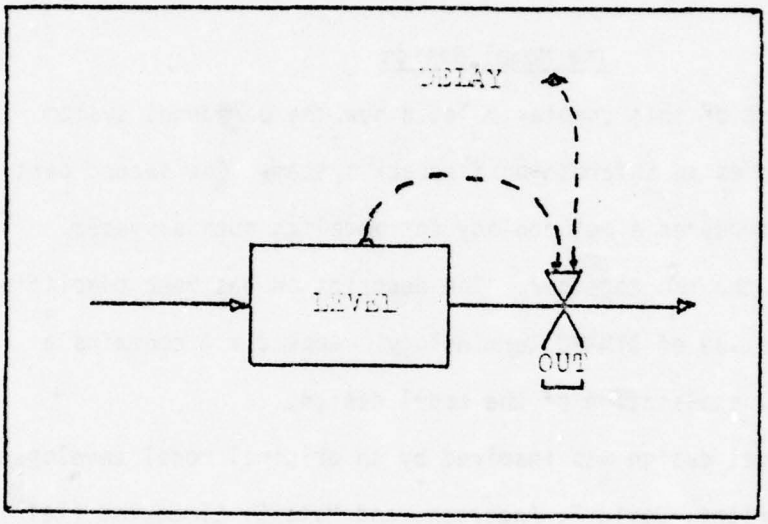


Figure 4. Rate Equation

used to create the decisions in the system. Some of the decisions are "implicit," such as in Equation (3), in that they are unavoidable results. "Overt" decisions, however, can be formulated in the rate equations to simulate management or personnel decisions. A closed loop feedback system can be represented by alternating level and rate equations. Future rates are determined by information about present levels and then used to determine the future value of the levels.

To provide ease in programming several other types of equations are used in building a model. Auxiliary equations (designated by an A) can be used as intermediate equations to keep the level and rate equations from becoming unwieldy. Constant (C), initial condition (N), and table (T) equations are used for inputting parameters and data. The programming language is called DYNAMO; additional information on it can be obtained from the DYNAMO User's Manual (Ref 15).

The Model Design

The first part of this chapter related how the personnel system could be described as an information feedback system. The second part of the chapter introduced a methodology for modeling such a system. This section puts the two together. The description has been simplified to avoid excessive use of DYNAMO terminology. Appendix A contains a thorough technical explanation of the model design.

The basic model design was inspired by an original model developed by Robert M. Emmerichs, David F. Anderson, and Mats G. Lindquist (Ref 16). Their approach was geared toward a DOD-wide analysis of the military at a very high level of aggregation. The active duty force was represented by four levels, defined by years of service. It was felt that this level of aggregation was too high to adequately capture the trends of the system under the two retirement scenarios. Therefore a completely new model was designed, although many techniques are borrowed from this original effort.

Figure A-1, Appendix A, shows the flow chart from which the model was built. Levels were used to represent the active duty grades (through

colonel). Second and first lieutenants were combined into one level; captains were represented by three levels in order to segregate those captains who had already been passed over for promotion to major and those who had already been selected for promotion (since there can be a lengthy delay between selection and promotion); majors and lieutenant colonels were also accumulated in three levels; colonels required only one level. It was felt that aggregation by grade permitted more accurate specification of decision functions.

The only other levels in the system (except for pipelines and wage indices (see Appendix A) are the retirement pools. The levels shown in dashed lines in Figure A-1 are used only for retirement costing purposes. The different retirement levels are needed because of the differences in retired pay (see Appendix B). Retirement pool levels are used only for costing purposes. Except for the death rates out of these levels, no decision functions (rate equations) use any information about retirement levels.

All rates, therefore, are based ultimately on the active duty grade levels (i.e., the force profile). The rate equations can be classified into five separate categories: accessions, promotions, voluntary separations, residual separations (death, hardship, disability, etc.), and retirement/separation. The accession rate was covered earlier in this chapter. Each of the other four rate categories will be briefly explained below.

Included in the promotion category are the selection rate, nonselection rate, and the promotion rate. The selection rate is determined by applying the promotion opportunity (which is a function of the grade

levels) to the number of eligible officers (determined by years of service). Below the zone promotions are ignored in the model; all officers have only one chance at promotion. Those officers selected for promotion move in to a selected-for-promotion level. The rate at which they leave this level, the promotion rate, is determined by the promotion point (the farther out the promotion point, the longer they wait in this level). The nonselection rate is used to transfer officers to the passed-over level.

The use of the selected-for-promotion and passed-over levels does not exactly correspond to the real situation. For example, selection or nonselection for promotion to major always occurs at the nine year point in the model. The selected level is used as a "holding tank" until the officers reach the promotion point (which is varying). In reality, of course, the selection point varies in conjunction with variations in the promotion point.

The voluntary separation rates are applied to the captain, major, and lieutenant colonel levels (but not to the selected or passed-over levels). The formulation of these rates represents a key behavioral hypotnesis. Equation (4) shows the form of the decision function for the voluntary separation rate of captains (VSR3).

R VSR3.KL = FVSR3.K*O3.K (4)

O3.K is the level of captains; the fractional voluntary separation rate (FVSR3) is calculated in an auxiliary equation:

A FVSR3.K = FVSR3N*MFCE3.K*MFMP3.K*MFRB3.K (5)

The last three terms on the right of Equation (5) are multipliers for career expectations, military pay, and retirement benefits. FVSR3N is a "normal" fractional voluntary separation rate. The multipliers are computed from table functions similar to the one shown in Figure 5.

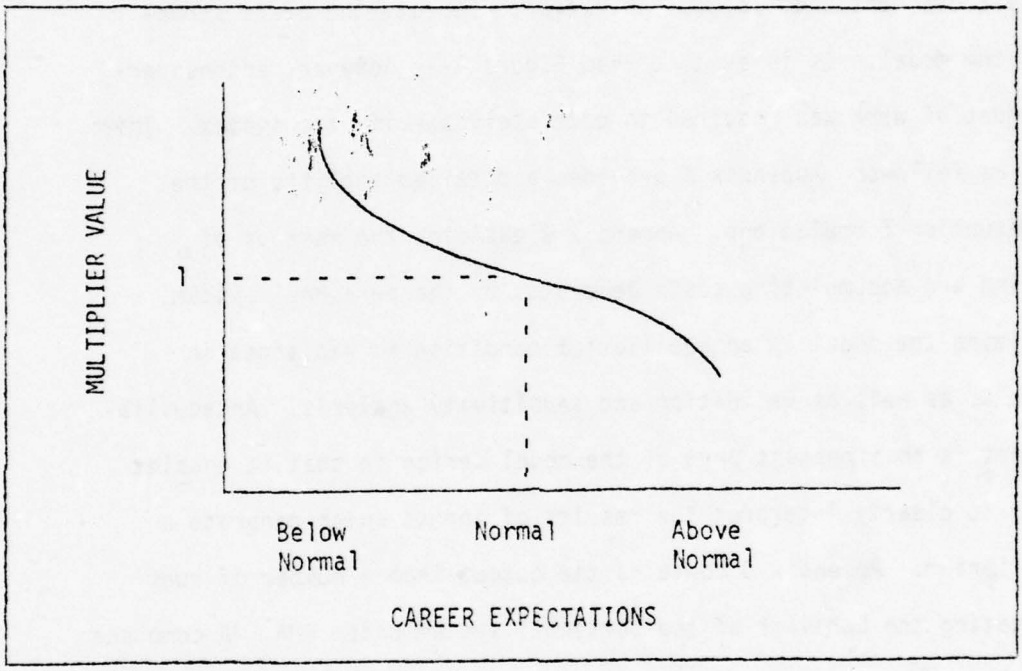


Figure 5. Multiplier for Career Expectations

The shape and slope of the curve constitute a specific hypothesis about personnel reactions to changes in career expectations. The nature of the hypotheses is covered in greater detail later in this report.

Residual separation rates are formulated in a very straightforward manner. The rate is set equal to a fixed percentage of the level from which it flows, such as was shown in Figure 4. Every active duty level and retirement level has some form of residual separations.

The retirement/separation rates include involuntary separations for nonselection for promotion, retirements at tenure, and voluntary retirements. Involuntary separations are determined by the passed-over levels. The voluntary retirement rates are based on an average years of service in the grades (these can be varied to reflect the differing retention effects of different retirement programs.

The above mentioned levels and rates constitute the basic structure of the model. As is evident from Figure A-1, however, a considerable amount of work was required to completely specify the system. This is done as follows. Appendix A provides a detailed analysis of the DYNAMO equation formulations. Appendix B explains the methods of monitoring and accumulating costs generated by the personnel system. Initializing the model in an equilibrium condition is explained in Appendix C, as well as validation and sensitivity analysis. An equilibrium start is an important part of the model design in that it enables the user to clearly interpret the results of inputs which generate a disequilibrium. Appendix D contains the output from a number of runs investigating the behavior of the personnel system under RMA. A complete program listing is provided in Appendix E.

Using the Model

This model, like any other, is based on a number of assumptions and simplifications. It is important that these be clearly understood by anyone examining the model output. The major assumptions and restriction embodied in the model are listed below:

--The force profile initialized into the model represents the TOPLINE D force structure prescribed in the USAF Personnel Plan. This

profile is substantially different from the current Air Force profile. It should be understood, however, that the model could be initialized at any set of values for the profile.

--The model assumes that DOPMA is in effect.

--Stable economic conditions were assumed to prevail for the time horizon under study. In fact, civilian wages were assumed to rise in concert with the CPI, which in turn rose at a constant annual rate of five percent. Little can be said in defense of this assumption except that it is probably as good as any and it simplified pay calculations considerably.

--Under RMA, whenever personnel had an option of a deferred annuity or an immediate lump sum an assumption was that they would always opt for the lump sum.

--The costing module does not account for personnel already retired (although it easily could).

--Some discrete events were treated in the model as continuous in nature. As an example, officers are continually selected for promotion in the model. In actuality, the selection process is a discrete event occurring approximately once each year.

--No distinction was made between regular and reserve officers. It was assumed that the level of aggregation obviated the need for such a distinction. Also, under DOPMA, the importance of the distinction is diminished.

--Below-the-zone promotions were assumed to be inconsequential in terms of overall system behavior.

--Accessions were assumed to have an infinite supply, with recruiting costs dependent only on the civilian/military wage ratio.

--Voluntary separations were also assumed to be unconstrained. Service obligations beyond the initial obligation were ignored.

The most important consideration in using this model is understanding its purpose. The predicted system costs are only intended for relative trend analysis, not for specific estimates. The lack of accurate costing data (in some cases different sources provided radically different cost figures) makes this approach a necessity.

V. ANALYSIS OF THE RETIREMENT MODERNIZATION ACT

This analysis of the Retirement Modernization Act is intended to investigate both the cost trends and officer force profile implications resulting from a range of hypothesized reactions of Air Force officers to implementation of the retirement proposal. The personnel force component included in the model, Air Force line officers, are only a small segment of the total DOD personnel which would be affected by RMA; therefore, broad conclusions concerning the benefits of RMA cannot be drawn from this analysis. The results, however, can be logically extended to include the total DOD active duty officer force. It is hoped that this analysis will encourage a similar study of DOD enlisted personnel so that a better total understanding of RMA's possible impacts can be established.

RMA was designed to ultimately reduce retirement costs and to induce a particular pattern in retention rates. Most previous analyses of RMA show an eventual modest savings in retirement outlays, but fail to reflect the trends in other system costs (active duty pay, recruitment/training, etc.) created by the induced changes in retention. Of equal importance are the changes in force profile which may occur when retention is altered. Although a particular desired change in the retention pattern is identified with RMA, it is not clear that the full impact of these changes has been adequately explored.

In order to investigate all major cost trends and simultaneously examine changes in officer force profiles, a hypothetical force is used for the analysis. An officer force of 78,800, in perfect balance under

DOPMA objectives, is aged over a fifty year horizon (see Figure C-1 for the exact profile). The only disturbances imposed on this perfect force are in the form of hypothesized behavioral response to the implementation of RMA. Consequently, changes in force profile or promotion goals are easily detected. Further, because of the explicit structure of the model, the cause can be traced to specific policies or decision points. The desirability of these changes must be evaluated against the state of the current or anticipated force. The basic cost trends resulting from the hypothetical force should remain valid under a wide range of profiles. Additionally, the use of a hypothetical force lessens the temptation to make point cost predictions. The comparative results, therefore, are oriented towards relative differences and direction of change in the components of total system costs.

Costing

Three broad cost categories will be reported in each simulation run under the various behavioral hypotheses:

(1) Accession Costs, to include precommissioning, recruitment, and initial training costs,

(2) Total Active Duty Pay

(3) Total Nondisability Retirement Pay, to include separation pay and lump sum annuity payments.

The cost of the present retired force is treated as sunk and thus irrelevant for comparisons between retirement systems. Therefore, the retirement cost presented is the cost of new retirees only. The sum of these costs will be used as an indicator of total relevant system costs. Of course, tradeoffs between these cost categories will evolve depending on

the assumed changes in retention. Accession cost, for instance, is a direct function of total force retention, as is active duty pay if one assumes that military wages are responsive to retention. Also, total retirement pay will fluctuate as the force profile changes. To further compound the problem, alterations in force profile will affect career progression which may lead to additional changes in retention.

RMA is gradually phased into the system during the simulations, such that the full change in retirement costing coefficients is not realized until ten years after implementation. This procedure is used to approximate the effects of a save pay transition period. The reduction in RMA retirement benefits at age 65 due to Social Security contributions attributable to military service is not accounted for in this analysis. A constant inflation rate of five percent is used for future costing, and any present values reported are derived from continuous discounting at seven percent. Only cumulative costs to year 2010 will be presented in this chapter. Appendix D contains full cost streams to year 2028.

Deferred annuities are treated as incurred obligations which have some implied cost to the system from the start of RMA (1981), even though actual outlays will not be made unitl approximately 2005 (Figure 6). The total cumulative retirement costs reported will therefore be somewhat larger than required outlays. This treatment of deferred annuities is analogous to establishing a fund from which to finance the obligations being presently incurred. A full treatment of the costing methods and assumptions is contained in Appendix B.

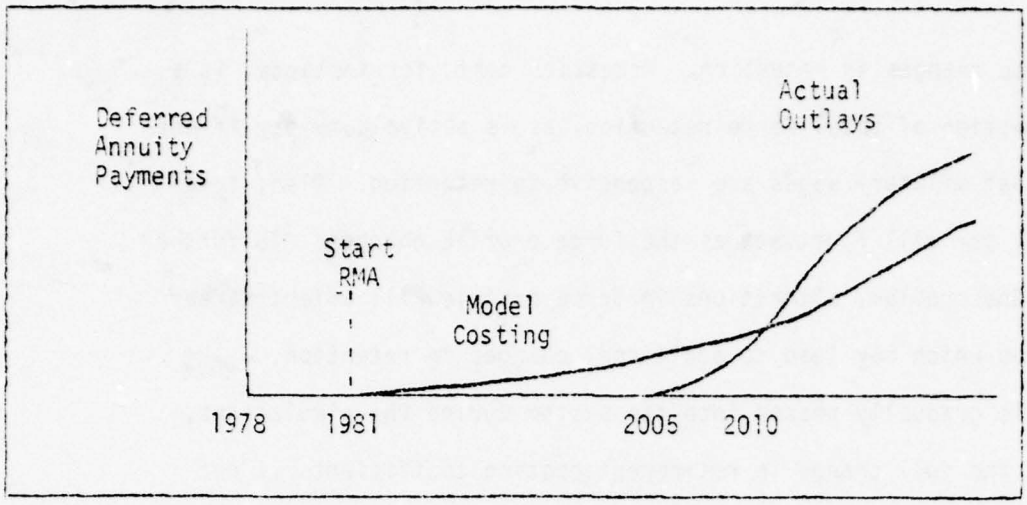


Figure 6. Deferred Annuity Costing

Behavioral Hypotheses

The crux of the analysis lies in the formulation of a set of behavioral hypotheses concerning personnel reaction to an RMA type retirement proposal. As presented in Chapter III, RMA is designed to produce three major trends in retention:

(1) increase retention for year groups up to 10 YOS

(2) decrease retention between 10 and 20 YOS

(3) increase retention between 20 to 30 YOS.

This set of reactions will hereafter be referred to as the "intended system response." The intended response is certainly plausible and is included in this investigation. The vesting feature of RMA provides strong support for the hypothesis of decreased retention between 10 and 20 YOS since the present retirement system offers absolutely no incentive for separation during these years. Likewise, retention from 20 to 30 YOS

should increase due to the reduction in retirement payments during these years, along with the increased payment multiplier from 25 to 30 YOS. The proposed increase in retention for officers with less than 10 YOS is not as intuitively clear. This group of officers can be divided into two broad categories: (1) those who under the present retirement system intend to voluntarily separate, and (2) those who under the present retirement system intend to continue military service until at least 20 YOS. Some of those in the first group might be enticed by the RMA vesting feature to continue service until at least 10 YOS. However, a portion of those in the second group may perceive the reduction in retirement payments from 20 to 30 YOS as an erosion of benefits and, consequently, decide to separate from service. Note, also, that the officers with less than 10 YOS are not protected by save pay under the assumed 10 year transition period. It is not clear which of the two categories will dominate in the determination of overall change in retention for these year groups. Consequently, a second hypothesis is formulated which reverses the intended response for officers with less than 10 YOS.

Structure of the Analysis

As a base case for comparing hypotheses, the model was run under the present retirement system without any changes in retention. A transition to RMA was also run with no changes in retention so that the effects of behavioral hypotheses could be further isolated. The remainder of the simulation runs involve some degree of personnel reaction to RMA.

The hypothesis of intended system response is investigated on three levels of intensity. The parameter values chosen to represent these

intensities are selected only to show cost and profile trends, and no attempt is made to select the most likely personnel response. The model inputs used to achieve these responses are summarized below:

Weak Intended System Response

-Retention in O-1s/O-2s increased 5%

-Retention in O-3s increased 10%

-Retention in O-4s decreased 10%

-Retention in O-5s (prior to 20 YOS) decreased 5%

-Average Year of Retirement for O-5s and O-6s increased by .5 year

Moderate Intended System Response

-Retention in O-1s/O-2s increased by 10%

-Retention in O-3s increased by 20%

-Retention in O-4s decreased by 20%

-Retention in O-5s (prior to 20 YOS) decreased by 10%

-Average Year of Retirement for O-5s and O-6s increased by 1 year

Strong Intended System Response

-Retention in O-1s/O-2s increased by 20%

-Retention in O-3s increased by 30%

-Retention in O-4s decreased by 30%

-Retention in O-5s (prior to 20 YOS) decreased by 20%

-Average Year of Retirement for O-5s and O-6s increased by 1.5 years.

These responses are gradually phased into the system over a ten year period, beginning in 1981 (simulated RMA implementation).

The hypothesis of reverse intended response for officers with less than 10 YOS is examined on only one response level. It is included to illustrate a contrast with the intended system responses. The inputs used to achieve the reverse response are also gradually phased into the system.

Reverse Intended System Response

-Retention in O-1s/O-2s decreased by 20%

-Retention in O-3s decreased by 10%

-Retention in O-4s decreased by 20%

-Retention in O-5s (prior to 20 YOS) decreased by 10%

-Average Year of Retirement for O-5s and O-6s increased by 1 year

Each of the four response patterns is evaluated against two hypotheses on the responsiveness of military wage to retention. The first set of simulations assumes that military wage is not responsive to change in retention. One could interpret the changes in retention from these runs as being desirable, with no effort being made to counter the trends with pay. The second set of simulations assumes a definite but weak relationship between wage and retention. Of course this relationship is completely hypothesized and included only to show changes in trend. All simulation runs assume a "moderate" sensitivity between career expectations and retention.

Results are presented for the two sets of simulations (with and without military wage response) in the form of cost trends and force profile changes. Cumulative costs to year 2010 are presented for the base case, and the costs from all other simulations are presented as

the increase (+) or decrease (-) from the base case figures. Changes in force profile are presented in a separate table, but in a similar fashion. It should be explained that under the assumptions of a fixed total officer force and fully filled grade ceilings for O-4s, O-5s, and O-6s the only major profile changes due to retention alterations will occur in the ratio of lieutenants and captains, the accession rate, and promotion points or opportunities (see Appendix C for a discussion of basic behavior in the Military Personnel System (MPS)). A change in retention first produces a corresponding change in accessions (in order to maintain force level), which in turn changes the lieutenant/captain ratio. The change in the number of captains produces a change in the promotion point (promotion opportunity, also, if the change is severe enough) to O-4. This effect is transferred eventually to all downstream promotion points. The system behavioral modes are generally oscillatory in nature, but representative values at about year 2000 for accessions, lieutenants, captains, and promotion point to O-4 are tabled to identify the trends. Appendix D graphs the continuous trajectory of these profile changes.

Results

I. Results under the Hypothesis of No Military Pay Responsiveness to retention. Table III indicates that the Retirement Modernization Act, under the assumption of no personnel response, results in slightly more cost for retirement and, thus, a slightly higher total system cost. However, if the retirement cost is reduced by the implied cost of future annuities, a net savings of approximately .5 billion will be realized.

TABLE III

Estimated Cost Implications of the Retirement Modernization Act Under the Assumption of No Military Pay Responsiveness to Retention

CASE	Cumulative Costs in Billions to Year 2010				
	Accession Costs	Active Duty Pay	Retirement Pay	Total System Costs	Discounted Total System Costs
Present System	53.7	140.4	37.0	231.1	66.0
RMA, No Personnel Response	NC	NC	+.5	+.5	+.1
RMA, Weak Intended Response	-1.7	+.4	+.6	-.7	-.2
RMA, Moderate Intended Response	-3.1	+.7	+.8	-1.6	-.4
RMA, Strong Intended Response	-5.0	+1.1	+1.0	-2.9	-.7
RMA, Reverse Intended Response	+2.4	-.5	NC	+1.9	+.5

NOTE:
1. Accession Costs include precommissioning, recruitment, and initial training costs.
2. Retirement Pay includes Separation Pay. Captains involuntarily separated are assumed to choose the lump sum option. Retirement pay of persons retiring before 1978 and of all disability retirees is not included.
3. Annual rate of inflation is assumed at 5%. Total System Costs are discounted at 7%.
4. Minus (-) reflects lower cost. Plus (+) reflects higher cost. NC reflects no change in cost.
5. Implementation of RMA is 1981 with a 10 year save pay transition.
6. The retirement pay column for RMA cases may be reduced by approximately 1 billion if deferred annuity obligation is excluded.

This slight savings is consistent with most other RMA costing analyses (Ref 17:38). As intended system response increases, more obligation for deferred annuities is incurred, and thus the upward trend in retirement costs. Again, actual outlays for retirement would remain about the same as the intended response increased. This occurs due to offsetting effects of slightly reduced retirement pools and increased retirement pay per retiree (the increase in average year of retirement produces both of these effects). Active duty pay increases slightly for these cases due to a resulting force which is somewhat senior in grade. The real payoff for RMA under intended system response is the savings realized through decreased accessions. The case of RMA under a reversal in intended response shows effects which are exactly opposity from intended response. An examination of changes in force profile will support the trends in accession cost and active duty pay, as well as present a more complete picture of RMA impacts.

Table IV illustrates that when there is no response to RMA, the force profile moves as before. As intended system response increases, overall retention increases, and thus the system requires a smaller accession rate for the fixed force size. Therefore the accession cost falls as previously shown in Table III. The decreased accession rate results in less lieutenants and more captains. This more senior force causes an increase in active duty pay. Finally, the increased number of captains causes some stagnation in the promotion system, as illustrated in Table IV by the promotion points to O-4. The promotion points to O-5 and O-6 also increased as intended system response increases, but to a lesser degree than the promotion point to O-4.

TABLE IV

Force Profile Implications of the Retirement Modernization Act Under the Assumption of No Military Pay Responsiveness to Retention

Point Approximations at Year 2000				
Case	Accessions	Lts	Capts	Promotion Point to O-4
Present System	6950/yr	27200	21200	10 YOS
RMA, No Personnel Response	NC	NC	NC	NC
RMA, Weak Intended Response	-250/yr	-900	+900	+.3 yrs
RMA, Moderate Intended Response	-450/yr	-1700	+1700	+.6 yrs
RMA, Strong Intended Response	-850/yr	-2400	+2400	+.9 yrs
RMA, Reverse Intended Response	+400/yr	+1200	-1200	-.5 yrs

For the case of reverse intended response, overall force retention is decreased. The effects on the profile are the opposite of those under the intended response.

Table III and IV must be considered jointly in judging the value of RMA to the officer force. Although it appears that RMA might result in some savings if response is in the intended direction, the savings result more from the change in retention than the retirement scheme itself. If officer personnel with less than 10 YOS react negatively toward RMA, total system costs may rise due primarily to decreased retention. Any cost implication, however, must be simultaneously weighed against the resulting trends in force profile.

II. Results under the Hypothesis of Military Wage Responsiveness to Retention. These simulations are included to illustrate how the Military Personnel System (MPS) might counter undesired changes in retention with changes in military wage. The beginning force profile in these simulations is ideal under DOPMA objectives, and any change the retention patterns would be undesirable. In order to determine how responsive military wage should be to separation rates, one must somehow place a value on proper force profile. Even if this value is determined, there exists a basic tradeoff between retention and accessions which further compounds the problem. For instance, if military wage were reduced in order to encourage separations, the full cost saving in active duty pay would be somewhat (if not entirely) offset by increased accession cost. These relationships deserve the attention of a full analysis, and the results here are only examples of likely trends and basic cost tradeoffs.

The basic hypothesis at work for this example is that no change in force profile is desired as a result of RMA implementation, and that military wage will be increased or decreased as necessary to counter the personnel response introduced. Table V contains the cost implications for these simulations. When the results are compared to Table III, where military wage is assumed insensitive to retention, one sees that the column for active duty pay is markedly different. For the three cases of intended system response, the increases in retention cause a decrease in military wage, resulting in active duty pay savings over the present system despite the fact that the force is more senior. A close comparison of the accession cost between Tables V and III shows that some savings in active duty pay have been absorbed by increased

TABLE V

Estimated Cost Implications of the Retirement Modernization Act Under the Assumption of Military Wage Responsiveness to Retention

	Cumulative Costs in Billions to Year 2010				
	Accession Costs	Active Duty Pay	Retirement Pay	Total System Costs	Discounted Total System Costs
Present System	53.7	140.4	37.0	231.1	66.0
RMA, No Personnel Response	NC	NC	+.5	+.5	+.1
RMA, Weak Intended Response	-1.2	-1.7	+.6	-2.3	-.5
RMA, Moderate Intended Response	-2.1	-3.4	+.8	-4.7	-1.0
RMA, Strong Intended Response	-3.5	-5.5	+.9	-8.1	-1.6
RMA, Reverse Intended Response	+1.8	+3.4		+4.9	+1.0

accessions. Nevertheless, total system cost has decreased under this particular hypothesized relation between wage rates and retention. In the last RMA case, where overall retention has decreased, military wage is increased. Instead of the previous savings in active duty pay (Table III), the cost is substantially more. This increase in active duty pay is offset somewhat by a decreased accession cost, but the total system cost for this case is still more in Table V than Table III. Finally, Table VI, when compared to Table IV shows that the changes in force profile have been partially suppressed.

TABLE VI

Force Profile Implications of the Retirement Modernization Act Under the Assumption of Military Wage Responsiveness to Retention

Point Approximations at Year 2000				
Case	Accessions	Lts	Capts	Promotion Point to O-4
Present System	6959/yr	27200	21200	10 YOS
RMA, No personnel Response	NC	NC	NC	NC
RMA, Weak Intended Response	-150/yr	-500	+500	+.2 yrs
RMA, Moderate Intended Response	-250/yr	-1300	+1300	+.5 yrs
RMA, Strong Intended Response	-450/yr	-1900	+1900	.7 yrs
RMA, Reverse Intended Response	+250/yr	+900	-900	-.4 yrs

Conclusions

Any confidence in the results presented in this chapter must be derived through confidence in the model as a reasonable representation of the MPS. The reader is encouraged to investigate Appendices A through E for a detailed development of the model. At the least, it is hoped that the method developed for examining total personnel system behavior is judged as viable and useful. The approach was aimed at exposing as many relevant factors as possible when internal or external changes are imposed on the Military Personnel System. The RMA analysis was used as a vehicle for preliminary joint testing of the system dynamics methodology as applied to the personnel system and the retirement issue. The results

must be interpreted in the context of all model assumptions. Although the trends identified were consistent, the magnitudes involved were small relative to total system cost. However, the analysis should demonstrate that retirement proposals cannot necessarily be evaluated on retirement cost alone. In this analysis, the RMA retirement cost was generally the least influential factor. It seems that the success or failure of RMA, in terms of cost and force profile, will depend mostly on personnel acceptance of the proposal.

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APPENDIX A

Model Documentation

APPENDIX A

MODEL DOCUMENTATION

This appendix presupposes a familiarity with the system dynamics methodology and the DYNAMO simulation language.

General Description of the Model

The model used in this analysis consists of a structural representation of the Military Personnel System (MPS) with a costing model superimposed for comparative purposes. The structural portion was constructed as a general purpose model which can be used independently of the costing module in order to evaluate force management policy. This appendix will reconstruct the structural model, while the costing module will be presented in Appendix B.

The overriding consideration during the building of the model was to represent the MPS in a simple, continuous, and highly aggregated fashion, with special emphasis on how and why personnel enter the system, leave it, and progress through it. The model only considers line officers from grade O-1 through O-6. This category of officers not only makes up the bulk of the officer force, but also determines the direction of most management policy. Management policy for other categories of officers (Medical, JAG, etc.) is often made under special and unique considerations not typical of the general force.

The most unique characteristic of the MPS is that it is essentially a closed system--personnel only enter from the bottom (grade O-1) and requirements in one grade must be supplied by the grade immediately

below it. The only exception to the closed system for line officers results when Reserve officers are moved laterally into the system during wartime circumstances. This lateral capability is not reflected in the model, even though it could conceivably be exercised during peacetime. The closed nature of the system places great formal emphasis on long range personnel planning and is directly responsible for much of the management policy implemented. Under this limitation, personnel planners are faced with the primary objectives of (1) maintaining the officer force near the level authorized by Congress, (2) maintaining a balanced grade structure as prescribed by Congress, (3) providing reasonable and predictable career progression for the officers. The last objective is necessary in order to keep retention rates in check and to fulfill an "obligation" to the force. However, as previously discussed in the body, retention is determined by many factors beyond the control of personnel management, including military pay and retirement benefits. When personnel management is faced with changing retention rates, the alternatives for responding are limited. Although other short term policies are sometimes available, usually a change in career progression for some officers is made in order to fulfill the first two objectives. For instance, an increase in retention of O-4s would have the following immediate effects:

(1) Captains would be promoted to major at a later time in their career (a change in promotion point) or fewer from each year group would be promoted (a change in promotion opportunity) or a combination of both.

(2) Since more majors are available for selection to lieutenant colonel, a decrease in promotion opportunity will occur, or a change in promotion point, or a combination of both.

(3) A decrease in accessions into the system in order to meet the overall force level.

Of course once these interactions are set in motion, the process is then a continuous chain of reactions. The captains, sensing a turn for the worse in career progression, may decide to exit the system at a higher rate. By now having fewer captains, the career progression may once again approach the "desired" parameters. Add to this chain some delays to account for officers perceiving changes in the system, and one has a process which is next to impossible to second guess by intuition alone. The model, then, is an attempt to capture some of the important interactions of the MPS in order to understand better the dynamic behavior of the system. Figure A-1 is a general flow chart of the structural model which illustrates the rates and levels chosen to represent the system. The following is a general discussion of the major features of the model; a detailed description follows later in this appendix.

Model Aggregation. Unless one choses to track each individual and all his characteristics, some degree of aggregation is necessary in any model. The extent of the aggregation is dependent on the purpose of the model. What may be considered a homogeneous group for one model may not be for another. For this model, fairly homogeneous groups were required for costing, behavioral responses to changes within the system, and for

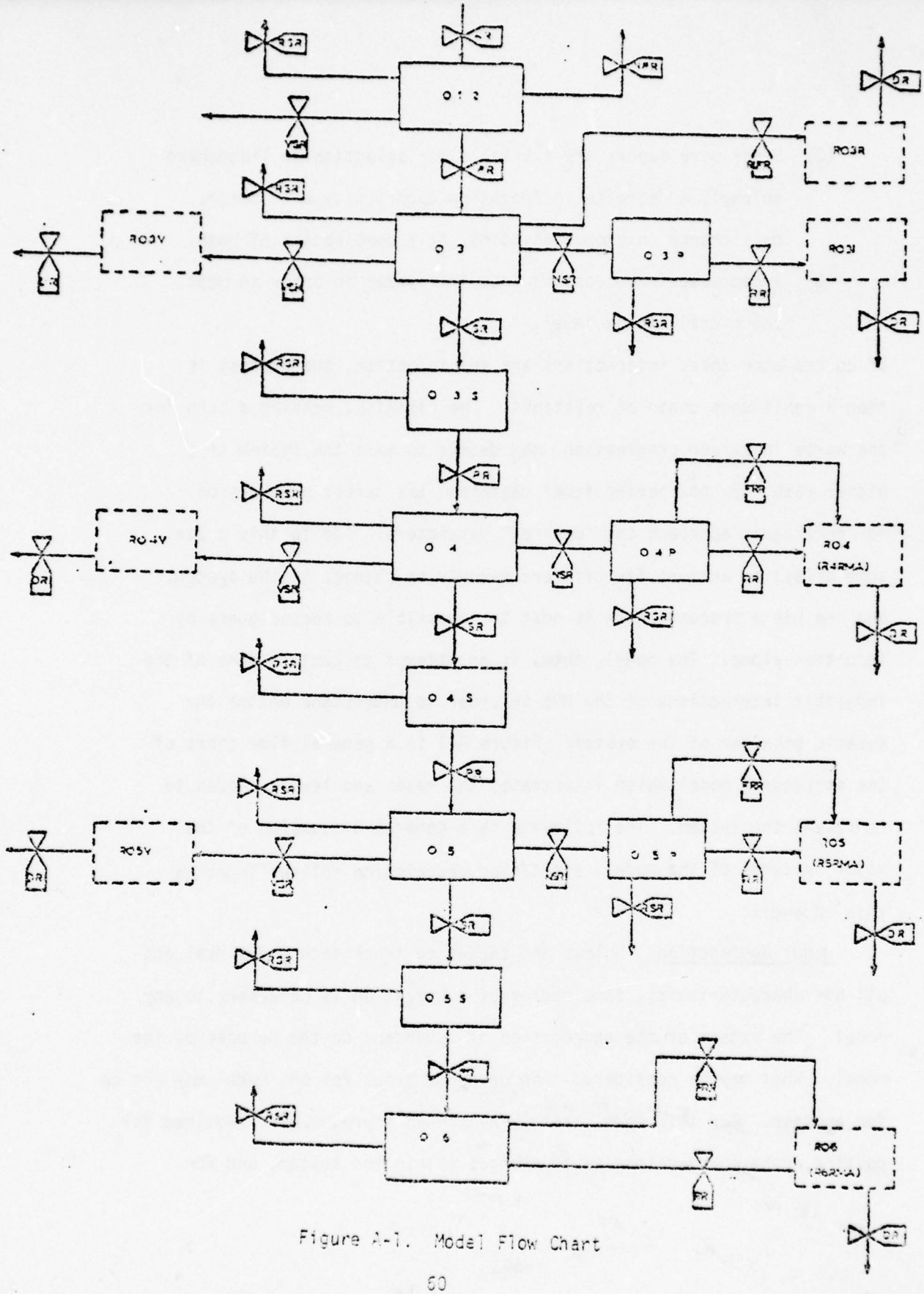


Figure A-1. Model Flow Chart

analysis of personnel policy application. Officer grade was chosen as the primary means of aggregation to fulfill these requirements.

Figure A-1 illustrates how the aggregation was accomplished. The outer lefthand and righthand columns of levels (dashed blocks) are retired levels. The two inner columns represent the active duty force. Grades O-1 and O-2 were aggregated as one level (O12). In each of the grades O-3 through O-5, it was felt that the officers could be placed in one of three categories: (1) a member of the grade who has not yet been considered for promotion (03, 04, 05), (2) a member of the grade considered and selected for promotion, but not yet promoted (03S, 04S, 05S), and (3) a member of the grade considered for promotion, but passed over (03P, 04P, 05P). These distinctions within grade were made in order to better represent the promotion system, and to provide groups of officers within grade who would have distinctly different behavioral responses to changes within the military personnel system. O-6s were aggregated into a single level (06).

The lefthand column of retired levels represents those officers who have retired from each grade (O-3 through O-5) prior to consideration for promotion to the next grade (R03V, R04V, R05V). The top level in the far right column represents O-3s who have been separated from active duty service due to some force reduction policy (R03R). The remaining levels in the right column are those officers who have retired after being passed over for promotion (R03I, R04, R4RMA, R05, R5RMA, R06, R6RMA). Each of the grades O-4 through O-6 has two retired levels on the right. The second level is used during a transition to a new retirement system. The distinction between retired pools (left and right columns) is made

because of the different reasons for officers leaving service prior to consideration for promotion and after being passed over for promotion. Also, the methods of costing left and right retirements levels are very different (See Appendix B).

Personnel Management Policy Incorporated in the Model. Management policy is included in the model which strives to maintain force structure, promotion, and tenure parameters set forth by DOPMA. Accessions (AR) are created based on predicted attrition and total force deficiencies. Uniform reductions in O-3s occur when total force surplus occurs. Sufficient numbers are promoted to O-4, O-5, and O6 to maintain the authorized percentage of total force in each of the grades. The system strives to maintain the desired promotion opportunities and promotion points outlined in DOPMA. Forced retirements occur in grades 04-05-06 when a surplus exists in these grades. Figure A-2 outlines the numeric parameters which serve as goals for the system and the model.

Ways Through and Out of the System. For an officer to successfully progress through the system, he must follow the center column in Figure A-1. He must be selected through a selection rate (SR) and then promoted (PR) to the next grade as positions become available. (Selection and promotion occur simultaneously from O-2 to O-3.) Officers not selected for promotion (NSR) are put into the passed-over pools (03P, 04P, 05P) until retirement (forced (FRR) or voluntary (RR)). For each active duty level, residual rates (RSR) are included to reflect separations due to death, disability, hardship, etc. The only other way out of the active duty pools is

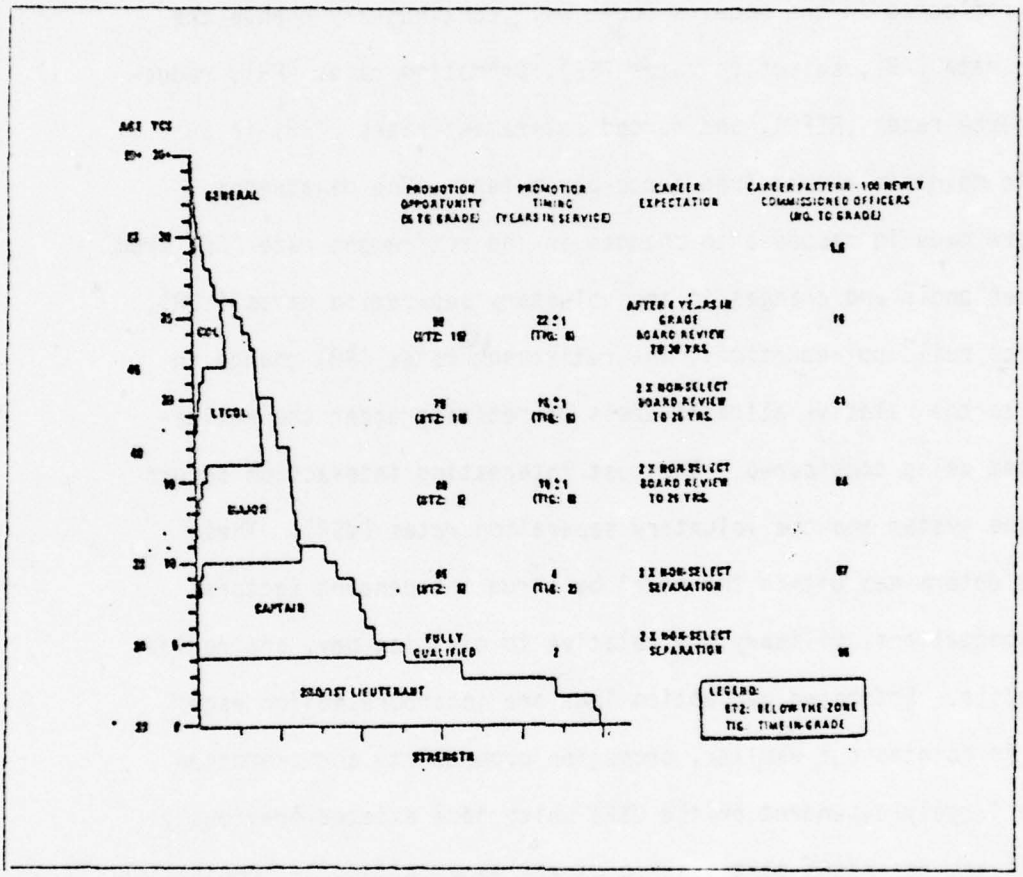


Figure A-2. Dimensions and Characteristics of Defense Officer Promotion System (Ref 2)

through the voluntary separation rates (VSR). The only outrates from the retirement levels are death rates (DR).

The only rates which are fixed and constant in the model are the residual separation rates (RSR) and death rates (DR). The management policies reflected in the model's logic will continuously change the accession rate (AR), selection rates (SR), promotion rates (PR), reduction in force rates (RIFR), and forced retirement rates (FRR) in an attempt to maintain the desired force parameters. The management changes are made in response to changes in the retirement rate (RR) from passed-over pools and changes in the voluntary separation rates (VSR), or to force build up/reduction. The retirement rates (RR) change in response to the relative attractiveness of retiring under the retirement system being considered. The most interesting interaction occurs between the system and the voluntary separation rates (VSR). These rates are determined within the model by three independent factors: career expectations, military pay relative to civilian pay, and retirement benefits. Estimated perception lags are incorporated for each factor. As pointed out earlier, promotion opportunity and promotion point are largely dependent on the VSRs which have existed previously. Since VSRs are dependent partially on career expectations (a combination of promotion opportunity and promotion point), a negative feedback loop is in effect, as illustrated in Figure A-3. Military pay has also been linked partially to VSRs, such that sustained increases in VSRs will lead to larger increases in military pay. This creates another negative feedback loop.

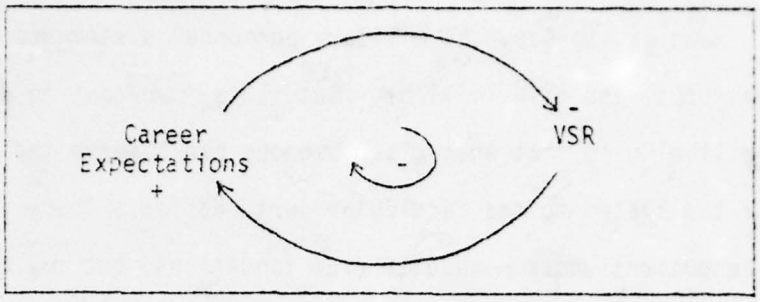


Figure A-3. Causal Loop for Career Expectations

As shown in Figure A-4, an increase in retirement benefits causes a decrease in VSR, but the loop is not closed due to relative constancy of retirement policies.

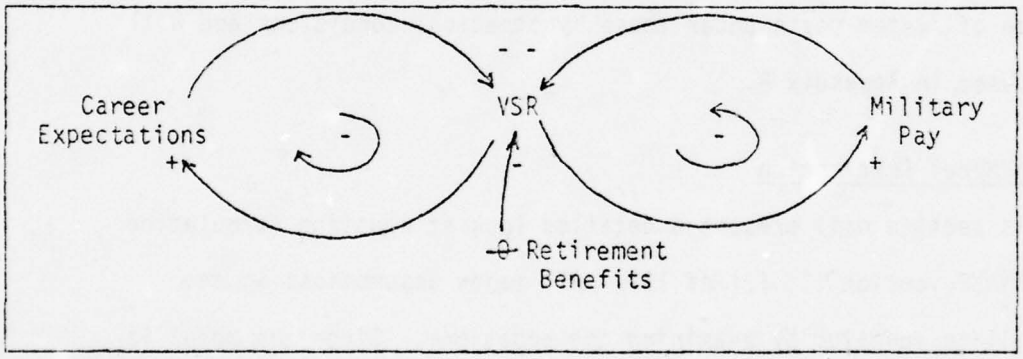


Figure A-4. Causal Loop for Voluntary Separations

Initialization and Interpretation. It should be reemphasized at this point that the force examined within the model is hypothetical, and may or may not bear resemblance to the present force or any past force. To the student of system dynamics the reasons are obvious. The model is started in a state of equilibrium such that a constant force level is maintained, a constant accession rate feeds the system, and all management goals are met.

In short, the system is started at an optimum and will sustain itself until disturbed. Needless to say, the military personnel system has never been in this state and never will be. But it is important to start the system in equilibrium so that when disturbed one can observe the exact response of the system to the particular perturbation. These responses would be present under nonequilibrium conditions, but may be obscured by the normal oscillations in the system. If the system proves inherently stable or unstable when disturbed in equilibrium, then the same characteristics will prevail from an out of equilibrium start. From the equilibrium start we are better able to identify problem areas in the system and to make the correcting adjustments to management policy. Special considerations also must be made to interpretation of system costs under these hypothetical conditions and will be discussed in Appendix B.

Detailed Model Description

This section will present a detailed look at equation formulation using DYNAMO, version III F, (Ref 15). All major assumptions in the model will be revealed by examining the equations. Since the model is somewhat repetitive in structure from one grade level to the next, only representative equations will be explicitly covered. Level equations will be covered first, followed by an examination of five functional categories of rate equations.

Level Equations. All level equations are constructed in the standard DYNAMO format and can be formulated by reference to Figure A-1. The content of any level at the present time K is simply the content brought forward from

the previous time J plus the net flow in or out of the level for the DT period between J and K. Examples are shown below (Refer to Figure A-1):

L 012.K = 012.J + (DT)(AR.JK-RSR2.JK-VSR2.JK-NPR2.JK-PR2.JK)

012: Level of 0-1s and 0-2s (men)

AR: Accession Rate (men/year)

RSR2: Residual Separation Rate from 012 (men/year)

VSR2: Voluntary Separation Rate from 012 (men/year)

NPR2: Nonpromoted Rate from 012 (men/year)

PR2: Promotion Rate from 012 (men/year)

DT: Fraction of year between computations

The level of lieutenants (012.K) is simply the previous level (012.J) plus accessions during DT minus the three attritions (residual, voluntary, nonpromotion) and minus the promotions during the period DT.

L 03.K = 03.J + (DT)(PR2.JK-RSR3.JK-VSR3.JK-NSR3.JK-RIFR.JK-SR3.JK)

03: Level of 0-3s prior to selection for 0-4 (men)

PR2: Promotion Rate of 0-2s to 0-3 (men/year)

RSR3: Residual Separation Rate from 0-3 (men/year)

VSR3: Voluntary Separation Rate from 0-3 (men/year)

NSR3: Nonselection Rate from 0-3 (men/year)

RIFR: Reduction in Force Rate (men/year)

SR3: Selection Rate of 0-3s for promotion to 0-4 (men/year)

Levels 04 and 05 are structured as the 03 level except that there is no reduction in force rate (RIFR) from these levels.

L 06.K = 06.J+(DT)(PR5.JK-RSR6.JK-FRR6.JK-RR6.JK)

06: Level of O-6s (men)

RSR6: Residual Separation Rate from 06 including promotions to General Officer (men/year)

FRR6: Forced Retirement Rate of O-6s (men/year)

RR6: Normal Retirement Rate of O-6s (men/year)

L 03S.K = 03S.J+(DT)(SR3.JK-PR3.JK-RSR3S.JK)

03S: O-3s Selected to O-4 and awaiting promotion (men)

SR3: Selection Rate of O-3s to O-4 (men/year)

PR3: Promotion Rate of O-3s to O-4 (men/year)

RSR3S: Residual Separation Rate from 03S. (men/year)

From management's point of view, 03S is an inventory from which officers can be supplied to the O-4 level. The inventory can be adjusted by changes in the selection rate or promotion rate. Levels 04S and 05S are identical in structure to 03S.

L 04P.K = 04P.J+(DT)(NSR4.JK-RSR4P.JK-RR4.JK-FRR4.JK)

04P: O-4s Passed Over (men)

NSR4: Nonselection Rate of O-4s to O-5 (men/year)

RSR4P: Residual Separation Rate form 04P (men/year)

RP4: Normal Retirement Rate from 04P (men/year)

FRR4: Forced Retirement Rate from 04P (men/year)

05P is identical in structure to 04P, and 03P is similar except for the exclusion of a Forced Retirement Rate.

The retirement levels (dashed blocks in Figure A-1) were formulated to facilitate costing and transitions between retirement systems. The formulations of these levels, which is not critical to the structural portion of the model, are addressed in Appendix B.

Rate Equations. The levels and rates of the model determine the representation of the MPS's structure, but the exact formulation of the rates determine how management policy and personnel behavior are represented. Some simplifying assumptions were used to represent the basic structure of the system, and, likewise, assumptions were made in formulating management policy and human behavior. These assumptions will be discussed as the specific rate equations are formulated. The rates have been assembled into five functional categories.

(1) Rates which are determined by constants (DR,RSR)

(2) Rates determined by promotion policy (SR, NSR, PR, RIFR)

(3) Voluntary separation rates

(4) Retirement rates

(5) Accession and reduction-in-force rates.

Death Rates and Residual Separation Rates (DR and RSR). These are determined by historical constants (Ref 18), and are the easiest to formulate. For the residual separation rates (RSR) historical data is converted to a fraction (%) of the aggregate group who separate due to disability, death, etc. per year. The RSR is then calculated as this constant fraction (FRSR) times the level in question:

FRSR*Level = RSR

Fraction/year*Men = Men/year

For RSR2:

R RSR2.KL = FRSR2*O12.K

RSR2: Residual Separation Rate from O12 (men/year)

FRSR2: Fractional RSR for O12 (fraction/year)

O12: Level of O-1s and O-2s (men)

All other RSRs are identical in structure.

Death rates are formulated in a similar way. Fractional death rates (FDR) are computed and multiplied times the retired level in question.

For DRR3V:

R DRR3V.KL = FDRR3R*RO3V.K

DRR3V: Death Rate for O-3s who voluntarily retired prior to consideration for promotion (men/year)

FDRR3R: Fractional DRR3V (fraction/year)

RO3V: Level of O-3s voluntarily retiring prior to consideration for promotion (men)

All other DRs are identical in structure.

Since DRs and RSRs depend on both a constant fractional rate and the level, the detailed flow chart representation of the equations illustrated would appear as illustrated in Figure A-5. All DRs and RSRs are deposited into sinks (discarded). For costing, this implies that disability retirements are being ignored and that survivor benefits are not being included.

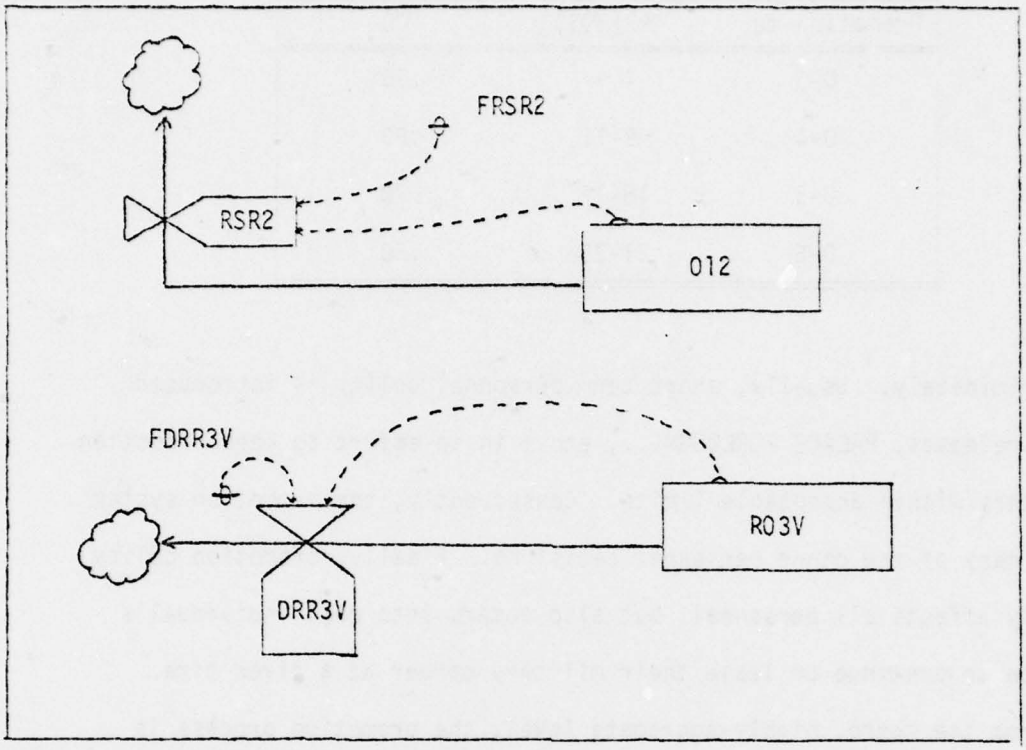


Figure A-5. Flow Chart Representation of Death and Residual Separation Rates

Rates Determined by Promotion Policy (SR, NSR, PR, RIFR).

Promotion policy is the most important management process contained in the model. Much of the model's structure was designed specifically to accommodate a fairly accurate representation of this process. Promotion policy is important to personnel managers for several reasons. First of all, it is a continuous process for which definite goals are set (Table A-I) and performance is easily tracked. Secondly, the force can almost always maintain a desired profile through adjustment to the promotion policy parameters; however, due to the high visibility of the parameters both to personnel and Congress, the parameters are not allowed to vary

TABLE A-I

Goals for Promotion Parameters Under DOPMA

Promotion to	PP(YOS)	PO
O-3	4	.95
O-4	9-11	.80
O-5	15-17	.70
O-6	21-23	.50

indiscriminately. Usually, short term personnel policy is introduced (early releases, PALACE FURLOUGH..., etc.) in an effort to keep promotion parameters within acceptable limits. Consequently, the promotion system drives many of the other personnel decisions. Finally, promotion policy not only affects all personnel, but also enters into each individual's decision to continue or leave their military career at a given time.

From the macro, highly-aggregate level, the promotion process is fairly straightforward. For each grade level, officers spend some minimum time in grade (MTIG) after which they are considered for selection to the next grade. A promotion board meets (approximately yearly for each grade) for the selection process. A certain percent of the officers considered are selected for promotion. This percentage is an indicator of the promotion opportunity (PO) for this group of officers. The year-of-service (YOS) at which these officers are selected (or nonselected) is referred to as the selection point (SP). The newly selected officers join the bottom of a list of previously selected officers awaiting promotion to the next grade (except for O-2 to O-3 promotions, which are fairly simultaneous with selection). The actual YOS in which the officer is promoted is referred to as the phase or promotion point (PP).

The key parameters identified by DOPMA are PO and PP, and the desired values are listed in Table A-I. These goals are to be met while simultaneously meeting a specified percent of the authorized force in the grades of O-4 through O-6. Since there is no grade limitation of O-3s, promotion parameters to that grade can (and usually are) met closely; however, discrepancies can later emerge during promotion to O-4, O-5, or O-6.

While maintaining relatively constant strengths of O-4s, O-5s, and O-6s, personnel managers have limited alternatives for controlling PP and PO. For a fixed PO, PP will seek its own value based on previous retention in the grade and on the available positions in the next grade (which is dependent on retention and promotion policy for that grade). In order to control PP, PO must be altered. Consequently, managers can maintain PO until PP reaches unacceptable limits, at which time PO must be changed. The choice is always between PO or PP. Current practices have disguised the process somewhat by moving the selection point or considering groups of varying sizes in order to maintain PO and/or keep the inventory of selectees at a relatively constant level. The resulting PP, however, will not be changed by simple adjustments to the SP since the promotion rate is basically a function of available positions upstream.

Since there is a basic tradeoff situation between PO and PP, it is important to understand the possible consequences of changes in each. Consider first the case of holding PO at a constant and allowing PP to vary. Minimum-time-in-grade (MTIG) requirements will prevent PP from occurring too early, but PP could very well shift outside of the desired "window" on the long end. When this occurs for one grade, the effect could eventually cascade to all grades above due to MTIG requirements.

However, if PP is held fixed and PO varied to maintain it, no cascading will occur to higher grades. It might seem desirable then to hold PP steady while varying PO. This practice is undesirable because personnel place a higher premium on PO than PP since PO in essence represents job security within the "up-or-out" system. Traditionally, then, PO has commanded a higher priority than PP.

The promotion system has been simplified in structure for inclusion in the model, and some assumptions/hypotheses have been made about the process itself. First of all, below the zone and secondary zone promotions are aggregated into the primary zone, thus increasing slightly the percentage promoted in this zone while avoiding the complexity of modeling all three promotion zones. Consequently, only one selection point (SP) is used for selection to each grade. O-2s are selected and promoted to O-3 after four YOS, O-3s are selected for O-4 after nine YOS, and O-4s and O-5s are selected after serving a MTIG which is specified for each simulation run. Therefore, it is implicit that four years are spent in level O12, five in O3, and that MTIG is spent in levels O4 and O5. After selection, the time spent in O3S, O4S, and O5S is variable depending on the promotion rate (PR). The selection rates (SR as men/year) must be determined as PO (determined by management policy to be described later) times a certain portion of the levels O12, O3, O4, and O5. Since the levels are completely homogeneous using the system dynamics methodology, one could assume that year groups were uniformly distributed within each level. For the O12 level, for instance, promotion opportunity (PO) could be multiplied by O12/4 to determine SR2. This assumption would imply that ¼ of the O12 level was eligible for

promotion each year. However, using this assumption would eliminate some interesting dynamic behavior which is caused by different sized year groups, commonly referred to as "humps," moving through the system. Consequently a different approach was used which would capture these humps and their effects on system behavior. Figure A-1 shows that the accession rate (AR) is the only inflow into O12, and that promotion rates (PR) are the inflow rates to levels O3, O4, and O5. As these rates enter the levels, they are placed also into a pipeline vector until the selection point (SP) for the grade. Then PO is applied to the rates arriving at the SP rather than some portion of the level. For instance, each accession rate (AR) as men/year is held in the pipeline vector for four years (the SP for O-3), after which the rate is reduced by an average number of residual and voluntary separations. Then the PO is multiplied by this remaining group of eligibles to determine the selection/promotion rate (PR2) and nonselection rate (NPR2 = 1-PR2).. This PR2, which enters level O3, is then held in another five year pipeline vector to be used as a basis for determining the number of captains eligible for selection to major. The same process occurs for majors and lieutenant colonels. It should be reemphasized that the selection process in the model is a continuous process, such that if the DT is .1 year, then personnel will be selected every .1 year even though selection is normally a yearly event in the MPS. The continuous representation of a discrete event will not impact the results of such a highly aggregated model designed for investigation of long run system behavior.

Promotion opportunity (PO) is determined by management policy. Some assumptions were made as to how and why PO is changed. Basically,

management can observe the average promotion points, and then decide whether PO should be changed in an attempt to move future PPs forward or backward. The model is designed to give PO a higher priority than PP, so that the target PO as set forth in DOPMA is maintained until one of two situations arise: (1) PP drifts beyond the target windows by more than six months. PO would then be gradually reduced until PP is within six months of the window, at which time PO would revert to the target. (2) PP is occurring within the first six months of the target window. PO would then be gradually increased until PP moved beyond the first six months of the window.

Average promotion points for each grade can be continuously computed by knowing how much time elapses between selection and promotion, or the time spent in O3S, O4S, and O5S. These average promotion delays can be estimated by taking a yearly exponential average of O3S/PR3, O4S/PR4, and O5S/PR5. That is, the contents of the levels divided by the promotion rate out of the level will give an average time spent in the level. Therefore, the PP3 for captains will be nine years plus the average promotion delay as computed above. For majors, the PP4 will be the PP3 plus MTIG plus the average promotion delay to lieutenant colonel, and similarly for the PP5 of lieutenant colonel. For instance, if a captain is selected for promotion after nine YOS and experiences a one year promotion delay, his PP3 to major will be 10 years. If he then serves a MTIG of five years and is then selected for lieutenant colonel and finally promoted after another one year delay, his PP4 to lieutenant colonel will be PP3 + MTIG + Ave. Prom. Delay = 10 + 5 + 1 = 16 YOS. These PPs are then used through table functions to determine the PO as described earlier.

Promotion rates (PR) offer management another opportunity to control PP, although a limited one. Presently, promotions are made at the quickest rate possible without exceeding congressionally mandated grade limitations. Under DOPMA, ceilings will be placed on grades O-4, O-5, and O-6 based on a percentage of authorized officer force. Management could enhance its own capabilities if it is feasible to strive for grade levels which are slightly (1-5%) below the actual authorized ceilings. With these additional "pads," if PP's are moving beyond the desired windows, PR could temporarily be increased to halt the PP movement. In this way, PO may not have to be changed at all. Also, by maintaining grade levels below those authorized, force reductions could be absorbed without massive releases of field grade officers. While these buffers in grade strengths would be desirable, the feasibility is debatable. Nevertheless, the capability is incorporated in the model. As long as the average promotion delay is less than two years, the PR is computed to meet a preset percentage of the grade ceiling, say 95 percent. When promotion delays exceed two years, then the PR is gradually increased until a maximum PR is met which completely fills the full grade ceiling.

A summary of the promotion policy, then, is as follows: Selection and promotion to O-3 occur simultaneously at four YOS with a constant PO of .95. These parameters are met exactly since there will exist no grade limitations for O-3. Target PO and PP (2 year width) exist for promotions to O-4, O-5, and O-6. If PP occurs in the first six months of the target windows, PO is increased slightly until PP shifts beyond the six month point. If PP shifts beyond the window, PR is increased to halt the movement. If PP continues to move after PR has reached its maximum,

then PO will decrease when PP is six months beyond the window. In the case of promotions to major only, if forward movement of PP cannot be halted by a decrease in PO to a minimum acceptable, then a reduction in force will be made uniformly to the O3 level in order to reduce the number of captains being considered for future promotion. This reduction in force rate (RIFR) will be steadily increased as PP moves further out of the window (it begins when PP is 1.5 years out of tolerance). The exact means of thinning the O3 level is unimportant to this study, only that it would be accomplished in order to prevent such a radical departure from target promotion parameters from cascading through the remaining levels of the system. The entire process is illustrated in Figure A-6 using the promotion process for O-3s as an example.

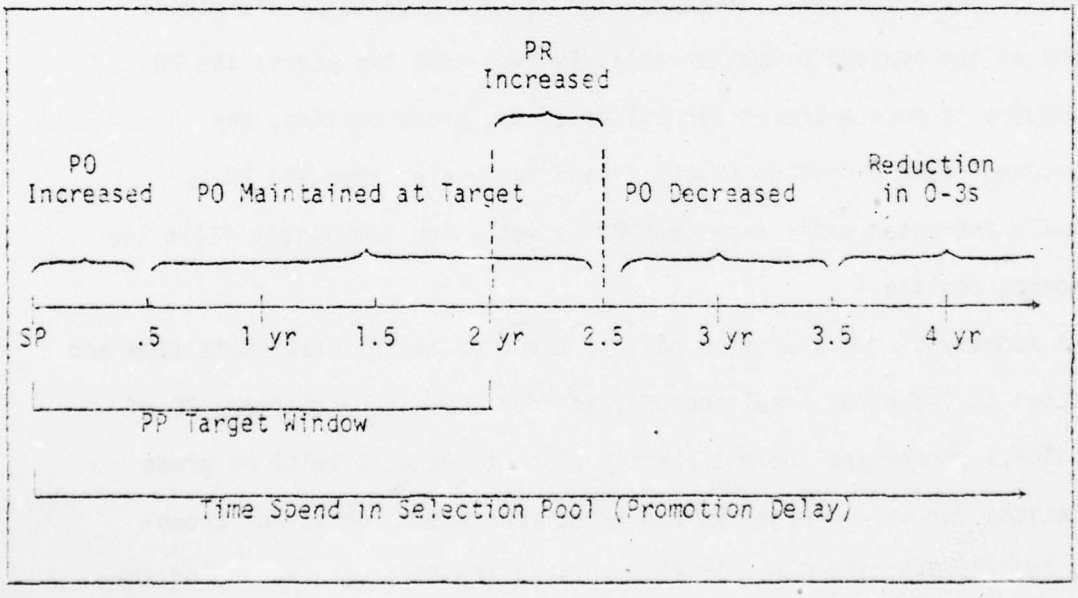
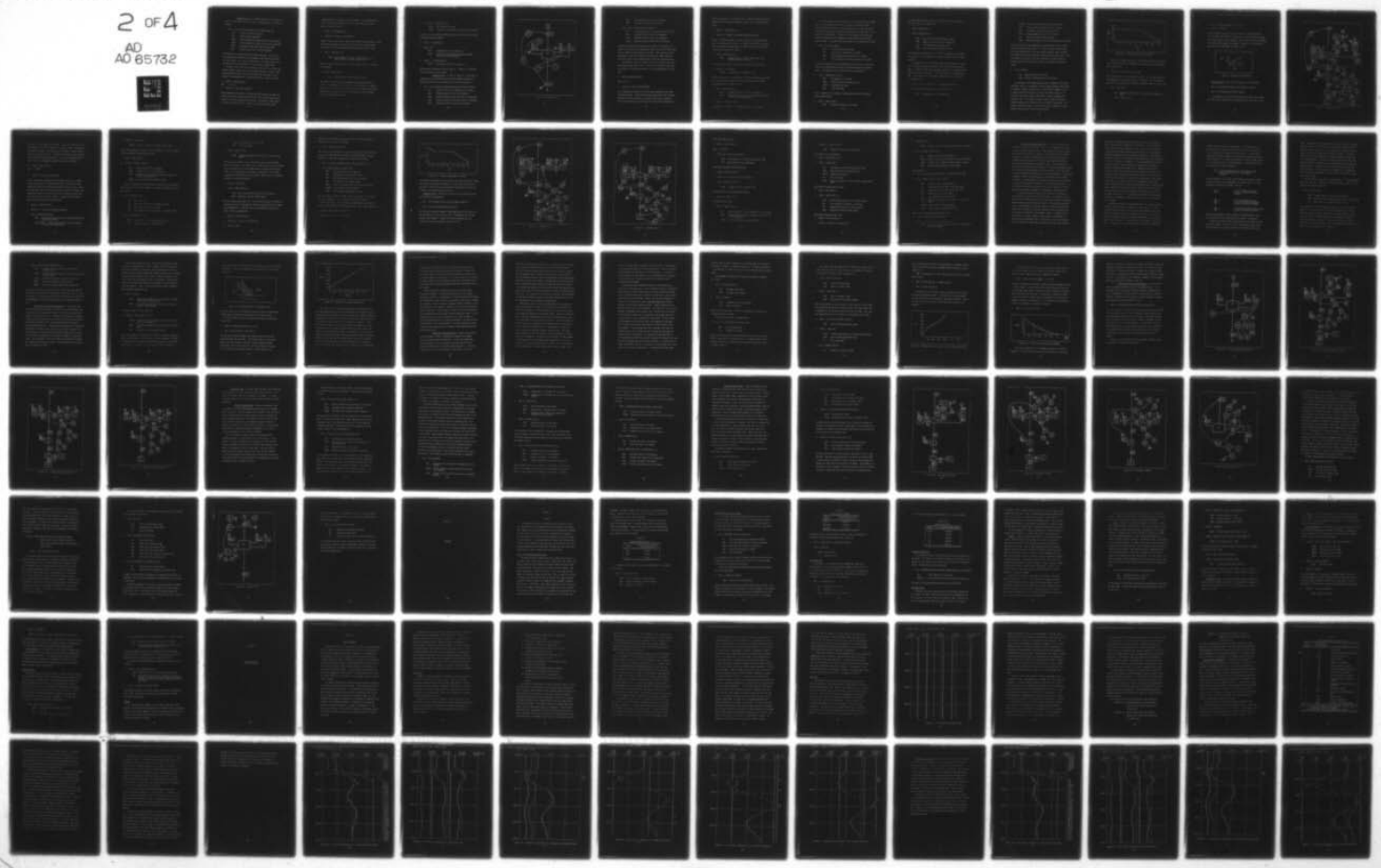


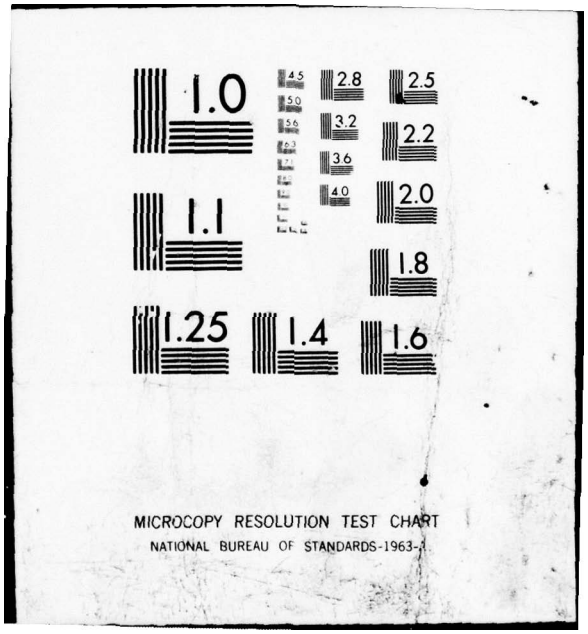
Figure A-6. Promotion Management for O-3s.

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Promotion to O3. As presented earlier and illustrated in Figure A-1, the level of O-1s and O-2s is represented by the following equation:

```
L    O12.K = O12.J+(DT)(AR.JK-RSR2.JK-VSR2.JK-NPR2.JK-PR2.JK)
```

O12: Level of O-1s and O-2s (men)

AR: Accession Rate (men/year)

RSR2: Residual Separation Rate from level O12 (men/year)

VSR2: Voluntary Separation Rate from level O12 (men/year)

NPR2: Nonpromotion Rate from level O12 (men/year)

PR2: Promotion Rate from level O12 (men/year)

The computation of RSR2 has been previously explained. This section will examine the formulation of the promotion rate (PR2) and nonpromotion rate (NPR2). Auxiliaries or rates used in the formulation of PR2 and NPR2 but not fully explained will be covered in detail later.

Accession rates (AR) into the officer force are held in a four year pipeline vector through the use of the SHIFTL function. The AR is then examined after this four year period to determine the number of O-2s which will be promoted to O3. The SHIFTL function is used as follows:

```
A    OUT2.K = SHIFTL(PIP2.K,1)
FOR       W = 1,4
L    PIP2.K(1) = PIP2.J(1)+(DT)(AR.JK)
```

OUT2.K represents the number of accessions which occurred four years ago. However, during the four year period the O12 level has been continuously reduced by a residual separation rate (RSR). Consequently, before applying promotion opportunity (PO) to OUT2.K, it must be reduced by some

average RSR for the year group being considered. This is accomplished again with the SHIFTL function by storing RSRs from the last four years in a pipeline vector:

```
A    OUTR2.K = SHIFTL(PIPR2.K,1)

L    PIPR2.K(1) = PIPR2.J(1)+(DT)(RSR.JK)
```

PIPR2, a four by one vector, contains the previous four years RSRs. These four RSRs are summed and divided by four to give the average number of personnel which have separated from the group contained in OUT2.K.

```
A    AVR2.K = SUM(PIPR2.K)/4
```

AVR2: Average number of residual separations from year group accessed four years previous (men)

OUT2.K is now reduced by AVR2.K in order to obtain a group of eligibles for promotion:

```
A    EL2.K = OUT2.K-AVR2.K
```

EL2: O-2s eligible for promotion to O-3 (men)

This group of eligibles must be reduced once more before applying the PO. It is assumed that for O-2s the first opportunity to separate voluntarily is at the four year point due to initial service obligation. Consequently, the group of eligibles is reduced by that percentage which will voluntarily separate:

A NETEL2.K = (1-FVSR2.K)(EL2.K)

NETEL2: Net Eligible O-2s (men)

FVSR2: Fraction of fourth year O-2s Separating Voluntarily

The PO can now be applied to NETEL2 to obtain the promotion rate (PR2) and Nonpromotion Rate (NPR2):

R PR2.KL = FPR2*(NETEL2.K)

C FPR2 = .95

PR2: Promotion Rate to O-3 (men/year)

FPR2: Fractional Promotion Rate or Promotion Opportunity to O-3 (fraction/year)

R NPR2.KL = (1-FPR2)(NETEL2.K)

NPR2: Nonpromotion Rate to O-3 (men/year)

PR2 and NPR2 are outflows from the level O12. Figure A-7 illustrates the flow charting of this process.

Promotion to O4. As shown in Figure A-1, the levels O3 (captains prior to selection point) and O3S (captains selected and awaiting promotion) are represented by the following equations:

L O3.K = O3.J+(DT)(PR2.JK-RSR3.JK-VSR3.JK-NPR3.JK-RIFR.JK-SR3.JK)

O3: Level of O-3s prior to selection for O-4 (men)

PR2: Promotion Rate of O-2s to O-3 (men/year)

RSR3: Residual Separation Rate from level O-3 (men/year)

VSR3: Voluntary Separation Rate from level O-3 (men/year)

NSR3: Nonselection Rate from level O3 (men/year)

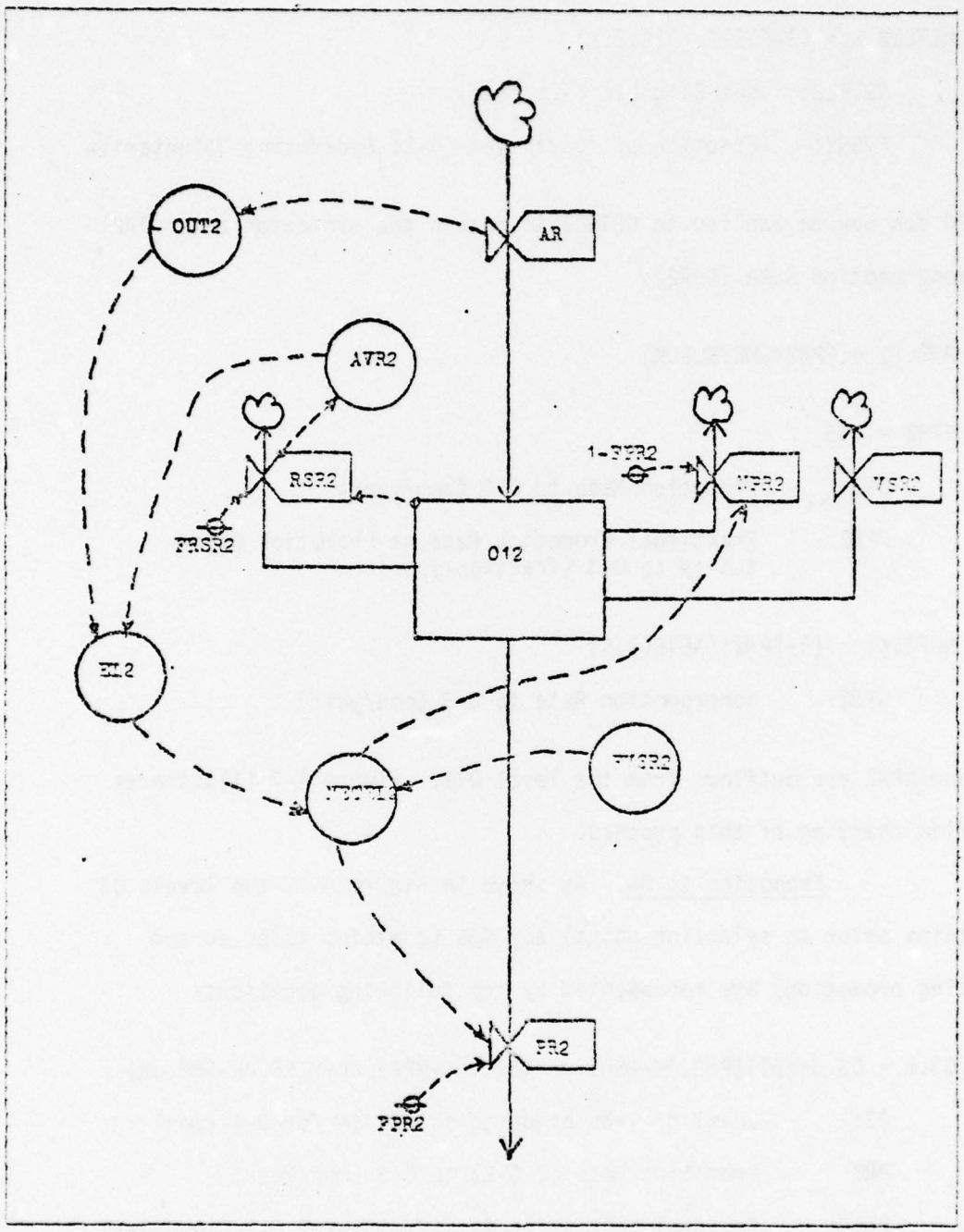


Figure A-7. Promotion to O-3

SR3: Selection Rate from level 03 (men/year)

RIFR: Reduction in Force Rate (men/year)

L 03S.K = 03S.J+(DT)(SR3.JK-PR3.JK-RSR3S.JK)

03S: 0-3s Selected to 0-4 and awaiting promotion (men)

SR3: Selection Rate of 0-3s to 0-4 (men/year)

PR3: Promotion Rate of 0-3s to 0-4 (men/year)

RSR3S: Residual Separation Rate from 03S (men/year)

The RSRs and PR2 have been previously discussed. This section will examine the selection and nonselection rates of 0-3s to 0-4 (SR3, NSR3) and the promotion rate of 0-3s to 0-4 (PR3). Also, one input to the reduction in force rate (RIFR) will be explained. Other rates and auxiliaries used in these formulations will be fully explained later.

The promotion rate to 0-3 (PR2) is held in a pipeline vector until the selection point (SP) to 0-4. The SP is at nine YOS, so the pipeline vector is of length five years (4 YOS are accounted for in level 012):

A OUT3.K = SHIFTL(PIP3.K,1)

FOR X = 1,5

L PIP3.K(1) = PIP3.J(1)+(DT)(PR2.JK)

OUT3.K represents the group of 0-3s who were promoted to that grade five years earlier. During the five year period the 03 level has been reduced by residual, forced, and voluntary separations; therefore, OUT3.K must be reduced by the average attrition which occured during

the five year period. The forced (RIFR), voluntary (VSR3) and residual (RSR3) separation rates are summed and stored in a five year pipeline vector:

```
A    OUTR3.K = SHIFTL(PIPR3.K,1)

L    PIPR3.K(1) = PIPR3.J(1)+(DT)(RSR3.JK+VSR3.JK+RIFR.JK)
```

PIPR3, a five by one vector, contains the sum of the separations for each of the previous five years. The vector is summed and divided by five to obtain the average number of losses which have occurred from the year group contained in OUT3.K:

```
A    AVR3.K = SUM(PIPR3.K)/5
```

AVR3: Average number of losses from the year group promoted five years previous

The net group of captains eligible for promotion is OUT3.K-AVR3.K:

```
A    NETEL3.K = OUT3.K-AVR3.K
```

NETEL3: O-3s Eligible for promotion to O-4

Promotion opportunity, represented by a fractional selection rate (FSR3), can now be applied to NETEL3.K to obtain the selection rate (SR3) and nonselection rate (NSR3) to O-4:

```
R    SR3.KL = FSR3.K*NETEL3.K
```

SR3: Selection Rate of O-3s to O-4 (men/years)

FSR3: Fractional Selection Rate or Promotion Opportunity of O-3s to O-4 (fraction/year)

```
R    NSR3.KL = (1-FSR3.K)*NETEL3.K
```

The computation of FSR3 will be discussed later in this section.

The SR3 provides the inflow to O3S. The outflows from O3S are RSR3S and PR3. The promotion rate (PR3) is based on the expected losses against available positions in the active duty O-4s. A one year smooth of O-4 attrition is used to estimate the number of positions that will be available for promotions. Promotions will be based on this estimation unless a discrepancy exists between the actual number of O-4s and the desired number. The actual total active duty O-4s is computed as follows:

A TO4.K = O4.K+O4P.K+O4S.K

TO4: Total active duty O-4s (men)

O4: O-4s prior to selection to O-5 (men)

O4P: O-4s Passed over for selection to O-5 (men)

O4S: O-4s Selected and awaiting promotion to O-5 (men)

As previously described, one management practice may strive to keep the total O-4s at some desired fraction of the Congressionally authorized level. A discrepancy from this desired goal is expressed as:

A DO4.K = (DFA4*AUTH4.K)-TO4.K

DO4: Discrepancy in O-4s (men)

DFA4: Desired Fraction of Authorized O-4s

AUTH4: Authorized O-4s (men)

TO4: Total O-4s (men)

Also, a maximum O-4 discrepancy is computed against the full Congressional authorization:

A MDO4.K = AUTH4.K-TO4.K

MDO4: Maximum Discrepancy in O-4s (men)

One additional auxiliary computation is necessary before the promotion rate (PR3) can be determined:

```
A    XPD3.K = 03S.K/PR3.JK

A    APD3.K = SMOOTH(XPD3.K,1)
```

XPD3: Exact Predicted Promotion Delay (years)

PR3: Promotion Rate of O-3s to O-4 (men/year)

03S: O-3s Selected for promotion (men)

APD3: One year exponential average of XPD3

The average promotion delay for O-3s (APD3) is computed as an exponential average to allow management to react to trends rather than random movements.

The promotion rate of O-3s (PR3) is set to the expected O-4 losses plus (or minus) a correction factor for DO4 if APD3 is less than two years. If APD3 is greater than two years, then a rate is selected which would return APD3 to two years. This rate, however, is constrained by MDO4. This process allows management the opportunity to reduce APD3 by increasing PR3:

```
R    PR3.KL = CLIP(A4.K,SMOOTH(OFLOW4.K,1)+DO4.K/TTA4,APD3.K,2)

A    A4.K = MIN(03S.K/2,SMOOTH(OFLOW4.K,1)+MDO4.K/TTA4)
```

PR3: Promotion Rate of O-3s (men/year)

OFLOW4: Total losses from active duty O-4s (men/year)

TTA4: Time-to-Adjust discrepancies in O-4s (years)

DO4: Discrepancy from desired O-4 level (men)

APD3: Average Promotion Delay for O-3s (years)

A4: Auxiliary Promotion Rate (men/year)

MDO4: Maximum Discrepancy of O-4s from authorized level (men)

The CLIP function selects DO4/TTA4 as the correction factor if APD3 is less than two years, and selects A4 if APD3 is greater than two years. A4 is then set to O3S.K/2 until the maximum allowable rate is reached. By setting PR3 to O3S.K/2, APD3 will start returning to two years. Since the selection point was at nine YOS, an APD3 of two years places the promotion point of O-3s (PP3) at 11 YOS, the far edge of the target window.

A PP3.K = APD3.K+9

PP3: Promotion Point to O-4 (YOS)

APD3: Average Promotion Delay for O-3s (years)

If increases in PR3 cannot prevent further increases in APD3 (and thus PP3), then PO, as reflected in the fractional selection rate (FSR3), is changed. Figure A-8 shows that as long as APD3 is between .5 and 2.5 years (placing PP at 9.5 to 11.5 YOS), the FSR3 is equal to .8. If APD3 is less than .5 years, then FSR3 is linearly increased to a maximum of .85. If the delay is greater than 2.5 years, the FSR3 is linearly decreased to a minimum of .65 at an APD3 of four years. The maximum and minimum values, as well as the rates of change, are very general assumptions which can be easily varied.

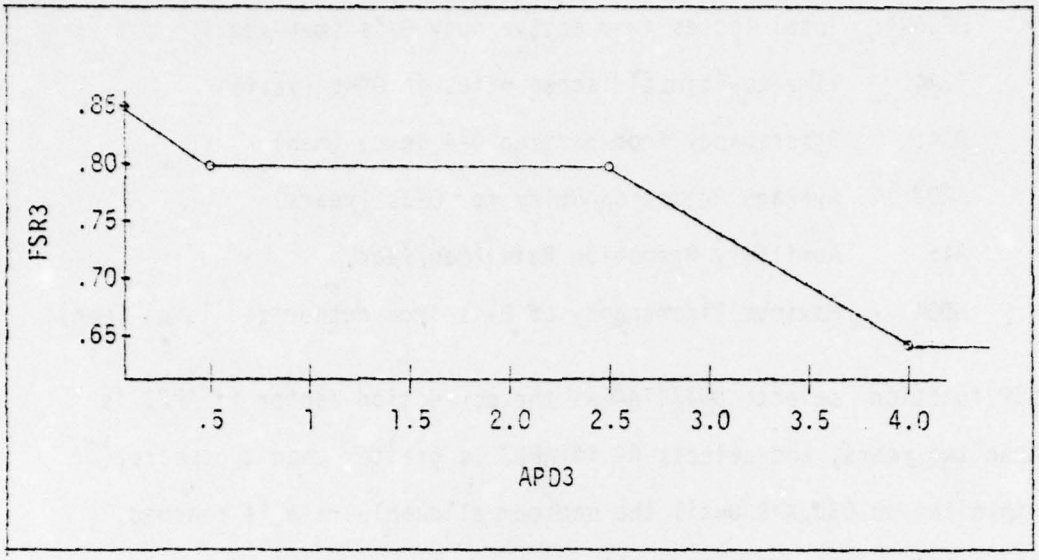


Figure A-8. Promotion Opportunity for Captains

APD3 also influences one input to the reduction in force rate (RIFR). RIFR is determined from two components, one involving total force excess and the other APD3.

R RIFR.KL = CLIP(TFE.K,RIF.K,TFE.K,1000)

Total force excess (TFE) will be examined later. RIF is determined when APD3 exceeds 3.5 years (PP3 would be at 12.5 years). At this point and beyond, RIF is calculated as a fractional reduction (FRIF) in the 03 level.

A RIF.K = FRIF.K*03.K

RIF: Component of Reduction in Force Rate which depends on APD3

FRIF: Fractional RIF

A FRIF.K = TABHL(TRIF,APD3.K, 3.5, 4.5, .5)

T TRIF = .00/.04/.08

Figure A-9 shows that the FRIF will be linearly increased from zero to .08 as APD3 moves from 3.5 to 4.5 years. The RIFR represents managements' last resort in controlling PP3. Only highly unusual circumstances will activate this segment of the model. Figure A-10 illustrates the flow charting for the promotion process to O-4.

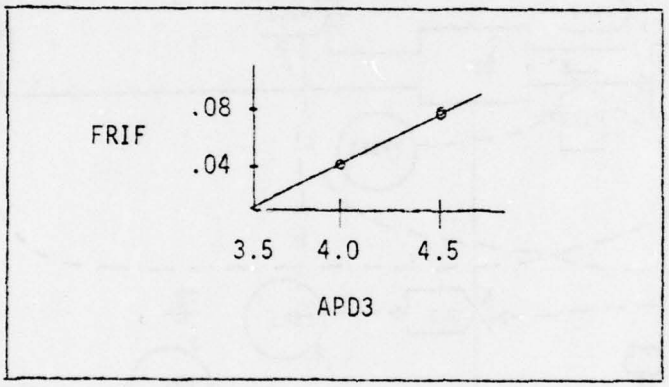


Figure A-9. Reduction-in-force Rate

Promotion to O5. Recall the level equations for O4 and O4S:

L O4.K = O4.J+(DT)(PR3.JK-VSR4.JK-SR4.JK-RSR4.JK-NSR4.JK)

L O4S.K = O4S.J+(DT)(SR4.JK-RSR4S.JK-PR4.JK)

The formulation of the selection rate of O-4s (SR4), the nonselection rate of O-4s (NSR4), and the promotion rate of O-4s (PR4) is very

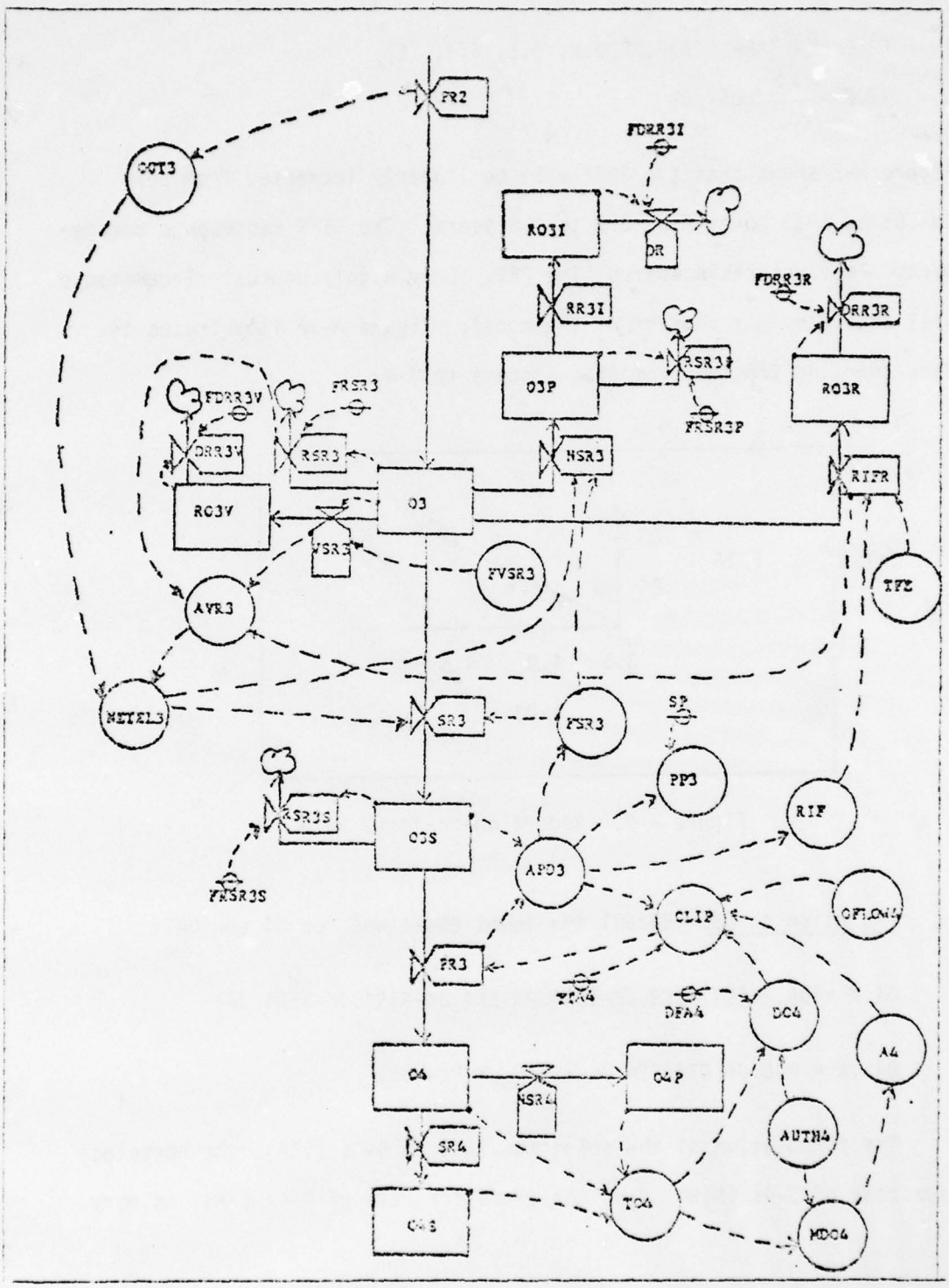


Figure A-10. Promotion to O-4

similar to the corresponding O-3 rates. As O-3s are promoted to O-4, the promotion rate (PR3) is placed in a pipeline vector. The length of the pipeline depends on the minimum time in grade O-4 (MTIG4) before O-4s can be selected for O-5. Therefore, the promotion point to major (PP3) plus MTIG4 establishes the SP to O-5 for each entering group of O-4s. The SP is consequently variable since PP3 is variable.

```
A    OUT4.K = SHIFTL(PIP4.K,1)
FOR  Y = 1,MTIG4

L    PIP4.K(1) = PIP4.J(1)+(DT)(PR3.JK)
```

OUT4.K, the number of promoted O-3s MTIG4 years previous, is reduced by the average number of voluntary separations (VSR4) and residual separations (RSR4) that would have occurred in the year group. Again, the separations from level 04 are saved with the SHIFTL function, then summed and divided by MTIG4 to arrive at the average attrition from the year group held in OUT4.K. OUT4.K is reduced by this number to obtain the net eligible O-4s for selection:

```
A    OUTR4.K = SHIFTL(PIPR4.K,1)

L    PIPR4.K(1) = PIPR4.J(1)+(DT)(RSR4.JK+VSR4.JK)

A    AVR4.K = SUM(PIPR4.K)/MITG4
```

AVR4: Average attrition from the year group entering MTIG4 years previous (men)

PIPR4: MTIG4 x 1 vector containing the attrition from each of the last MTIG4 years (men)

A NETEL4.K = OUT4.K-AVR4.K

NETEL4: Net O-4s eligible for selection to O-5 (men)

The fractional selection rate of O-4s is now applied to NETEL4 to determine the selection and nonselection rates:

R SR4.KL = FSR4.K*NETEL4.K

R NSR4.KL = (1-FSR4.K)(NETEL4.K)

SR4: Selection Rate of O-4s (men/year)

NSR4: Nonselection Rate of O-4s (men/year)

FSR4: Fractional Selection Rate or Promotion Opportunity of O-4s (fraction/year)

NETEL4: Net O-4s Eligible for selection (men)

Several intermediate calculations must be made before the promotion rate (PR4) for O-4s can be formulated. First the O-5 discrepancies must be identified:

A TO5.K = O5.K+O5S.K+O5P.K

TO5: Total O-5s (men)

O5: O-5s prior to selection for promotion (men)

O5S: O-5s Selected for promotion (men)

O5P: O-5s Passed over during selection for promotion (men)

A DO5.K = (DFA5*AUTH5.K)-TO5.K

DO5: Discrepancy in O-5s from desired goal (men)

DFA5: Desired Fraction of Authorized O-5s

AUTH5: Authorized level of O-5s (men)

T05: Total O-5s (men)

A MD05.K = AUTH5.K-T05.K

MD05: Maximum Discrepancy of O-5s from full authorization (men)

PR4 will be at a rate so as to correct D05 as long as the promotion point to O-5 (PP4) is less than 17 YOS. Otherwise, PR4 will be increased up to a maximum rate to correct MD05 based on a time-to-adjust factor (TTA5). Three components are necessary to compute PP4: PP3, MTIG4, and Average Promotion Delay for O-4s (APD4). MTIG4 is set as a constant, and APD4 is calculated as before:

A XPD4.K = 04S.K/PR4.JK

A APD4.K = SMOOTH(XPD4.K,1)

SPD4: Exact Promotion Delay each DT for O-4s (years)

APD4: Exponential Average of XPD4 (years)

But PP3 presents some difficulty. The current PP3 at each DT cannot be accurately used as an indication of when the present selected O-4s (04S) were promoted to O-4. The PP3 from at least MTIG4 years ago must be saved in order to compute PP4:

A OUTPP3.K = SHIFTL(PIPP3.K,1)

L PIPP3.K(1) = PIPP3.J(1)+(DT)(INPP3.JK)

R INPP3.KL = PP3.K

OUTPP3.K will therefore contain the PP3 from MTIG4 years previous. An approximation to PP4 can now be made:

```
A     PP4.K = OUTPP3.K+MTIG4+APD4.K
```

This PP4 will not represent the actual promotion points which are occurring, only an estimated PP4 for those O-4s being selected. The estimated PP4 is then used to formulate the promotion rate (PR4):

```
R     PR4.KL = CLIP(A5.K,SMOOTH(OFLOW5.K,1)+DO5.K/TTA5,PP4.K,17)

A     A5.K = SMOOTH(OFLOW5.K,1)+MDO5.K/TTA5
```

PR4: Promotion Rate of O-4s (men/year)

DO5: Discrepancy from desired goal (men)

PP4: Estimated Promotion Point of O-4s (years)

O4S: O-4s Selected for promotion (men)

MDO5: Maximum Discrepancy from full authorization (men)

OFLOW5: Total losses from O-5s (men/year)

TTA5: Time-To-Adjust discrepancies in O-5s

The CLIP function corrects for DO5.K if PP4 is less than 17 YOS; otherwise A5.K is selected. A5.K is computed to correct for MDO5.K.

PP4 is also used in determining the promotion opportunity as expressed in the fractional selection rate of O-4s (FSR4) (see Figure A-11):

```
A     FSR4.K = TABHL(FSR4T,PP4.K,15,19,.5)

T     FSR4T = .8/.7/.7/.7/.7/.7/.65/.6/.55
```

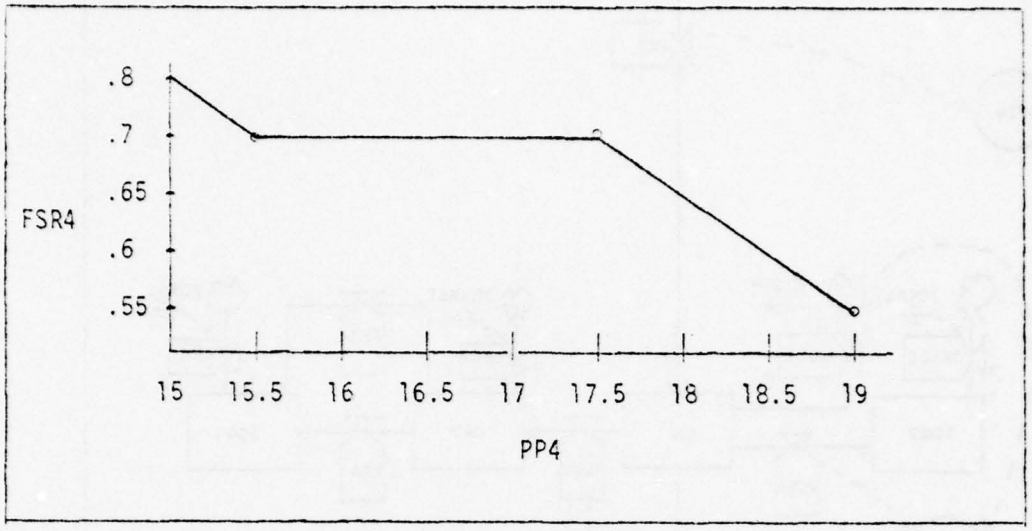


Figure A-11. Promotion Opportunity for Majors

The maximum and minimum selection rates, as well as the rates of change, were made on very general assumptions, and the values can be easily adjusted. Figure A-12 shows the detailed flow charting of the entire selection and promotion process for O-4s.

Promotion to O-6. Referring to Figure A-1 recall that the levels O5 and O5S are represented by:

L O5.K = O5.J+(DT)(PR4.JK-VSR5.JK-SR5.JK-RSR5.JK-NSR5.JK)

L O5S.K = O5S.J+(DT)(SR5.JK-RSR5S.JK-PR5.JK)

The logic and structure involved in the formulation of SR5, NSR5, and PR5 are identical to that used for O-4s. The equations will be presented without comment. Figure A-13 contains the detailed flow charting of the entire promotion process for O-5s.

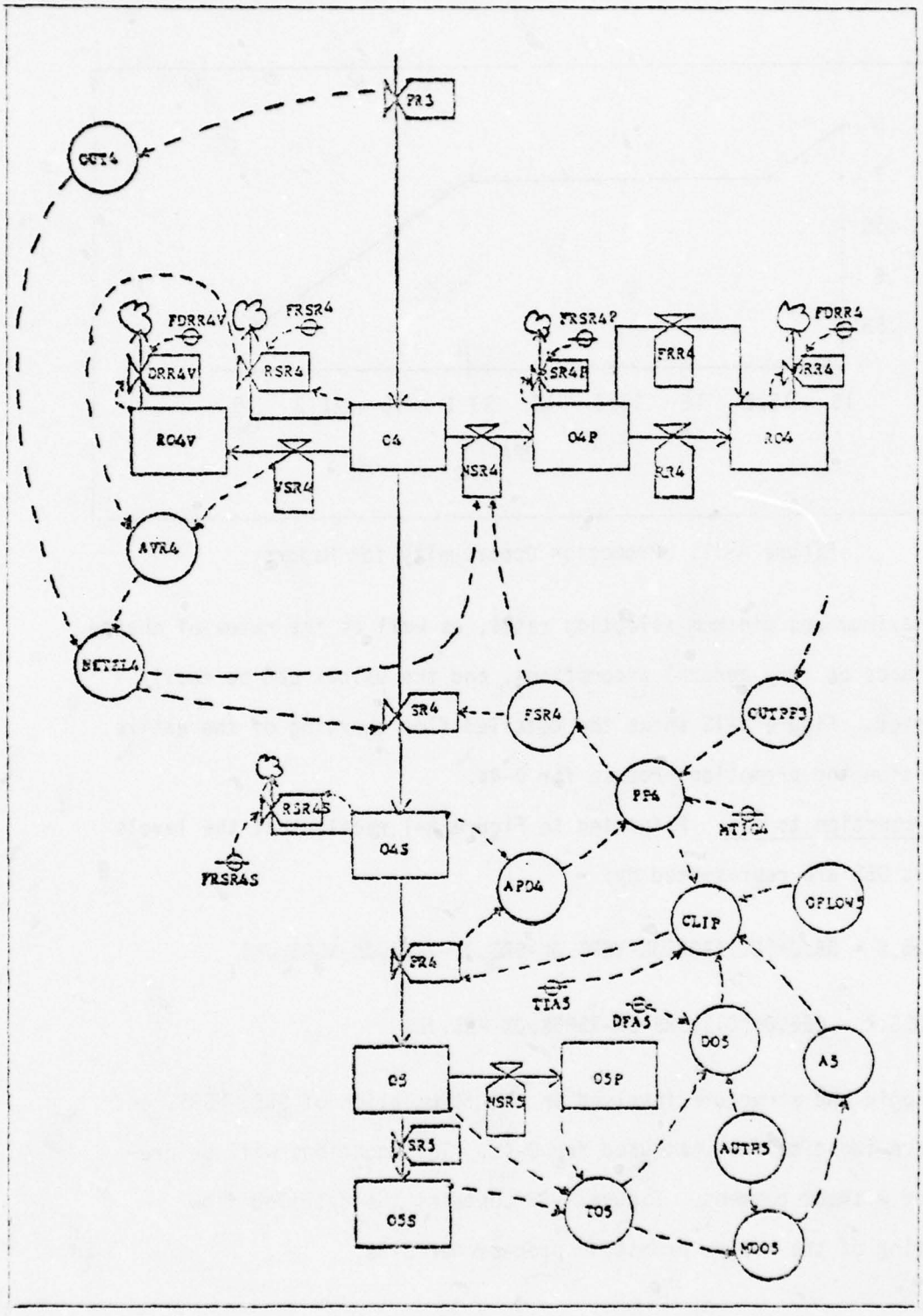


Figure A-12. Promotion to O-5

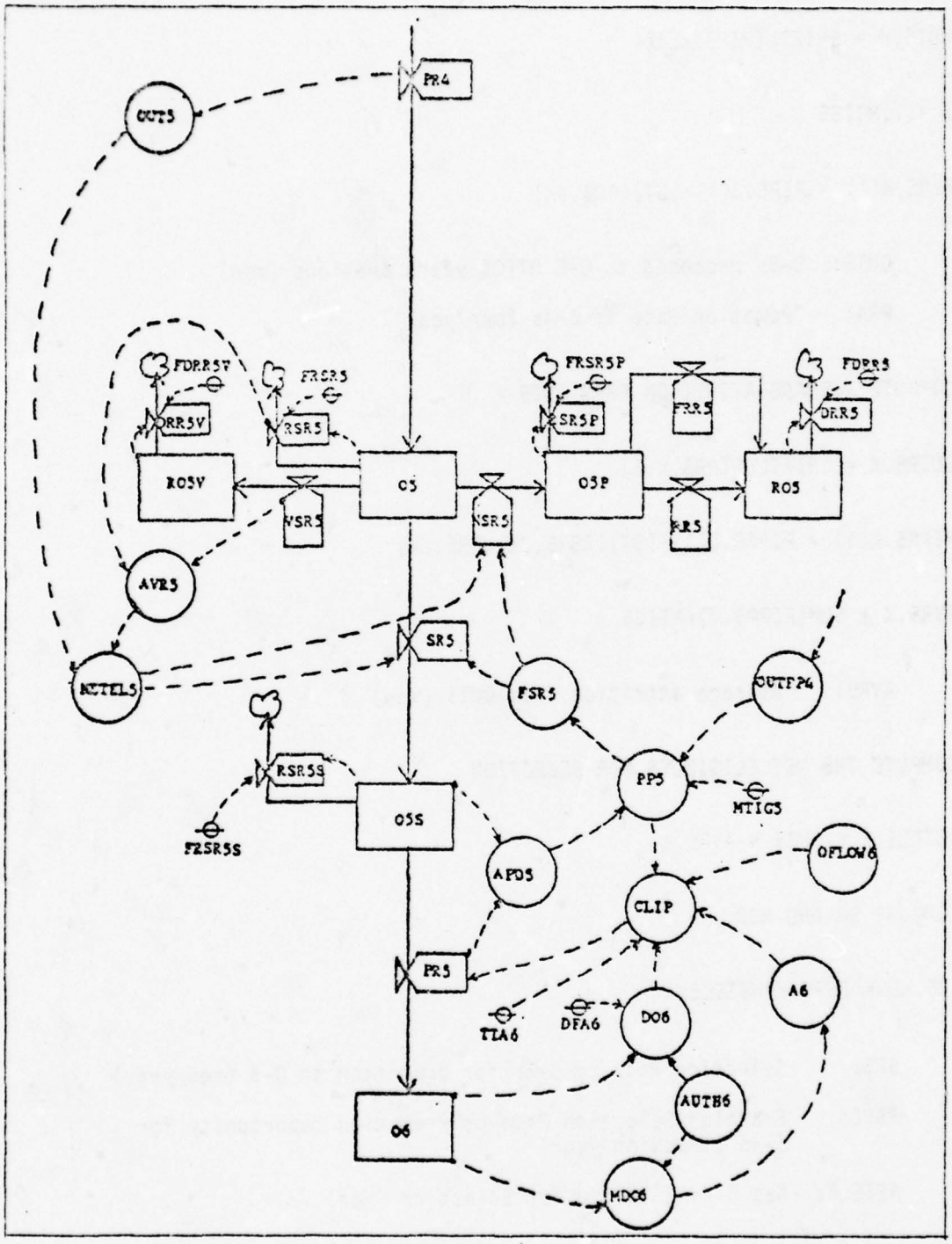


Figure A-13. Promotion to 0-6

```
NOTE SHIFT NEW O-5s TO SP

A    OUT5.K = SHIFTL(PIP5.K,1)

FOR  Z = 1,MTIG5

L    PIP5.K(1) = PIP5.J(1)+(DT)(PR4.JK)
```

OUT5: O-5s promoted to O-5 MTIG5 years previous (men)

PR4: Promotion Rate of O-4s (men/year)

```
NOTE COMPUTE AVERAGE ATTRITION FROM OUT5

A    OUTR5.K = SHIFTL(PIPR5.K,1)

L    PIPR5.K(1) = PIPR5.J(1)+(DT)(RSR5.JK+VSR5.JK)

A    AVR5.K = SUM(PIPR5.K)/MTIG5
```

AVR5: Average attrition from OUT5 (men)

```
NOTE COMPUTE THE NET ELIGIBLES FOR SELECTION

A    NETEL5.K = OUT5.K-AVR5.K

NOTE COMPUTE SR AND NSR

R    SR5.KL = FSR5.K*NETEL5.K
```

SR5: Selection Rate of O-5s for promotion to O-6 (men/year)

FSR5: Fraction Selection Rate or Promotion Opportunity for O-4s (fraction/year)

NETEL5: Net O-4s Eligible for Selection (men)

```
R    NSR5.KL = (1-FSR5.K)*NETEL5.K
```

NSR5: Nonselection Rate of O-4s (men/year)

```
NOTE COMPUTE O-6 DISCREPANCIES
A    DO6.K = (DFA6*AUTH6.K)-O6.K
A    MDO6.K = AUTH6.K-O6.K
```

DO6: Discrepancy in O-6s from desired goal (men)

DFA6: Desired Fraction of Authorized O-6s

AUTH6: Authorized O-6s (men)

O6: Total O-6s (men)

MDO6: Maximum Discrepancy in O-6s from full authorization (men)

```
NOTE COMPUTE AVERAGE PROMOTION DELAY
A    XPD5.K = O5S.K/PR5.JK
A    APD5.K = SMOOTH(XPD5.K,1)
```

XPD5: Exact Promotion Delay per DT for O-5s (years)

O5S: O-5s Selected for promotion to O-6 (men)

PR5: Promotion Rate of O-5s to O-6 (men/year)

APD5: Exponential Average of XPD5 (years)

```
NOTE COMPUTE PROMOTION POINT (PP5)
A    OUTPP4.K = SHIFTL(PIPP4.K,1)
L    PIPP4.K(1) = PIPP4.J(1)+(DT)INPP4.JK)
```

```
R    INPP4.JK = PP4.K
```

OUTPP4: Promotion Point for O-4s MTIG 5 years previous (years)

```
A    PP5.K = OUTPP4.K+MTIG5+APD5.K
```

PP5: Promotion Point for O-5s (years)

OUTPP4: Promotion Point for O-4s MTIG5 years previous (years)

MTIG5: Minimum Time in Grade O-5 before selection (years)

APD5: Average Promotion Delay for O-5s (years)

```
NOTE COMPUTE PR5
R    PR5.KL = CLIP(A6.K,SMOOTH(OFLOW6.K,1) + DO6.K/TTA6,PP5.K,23)
A    A6.K = SMOOTH(OFLOW6.K,1)+MDO6.K/TTA6
```

PR5: Promotion Rate of O-5s (men/year)

A6: Alternate Promotion Rate of O-5s (men/years)

DO6: Discrepancy in O-6s from desired goal (men)

PP5: Promotion Point of O-5s (years)

O5S: O-5s Selected for Promotion (men)

MDO6: Maximum Discrepancy of O-6s from full authorization (men)

OFLOW6: Total losses from O-6s (men/year)

TTA6: Time-to-Adjust discrepancies in O-6s

```
NOTE COMPUTE FRACTIONAL SELECTION RATE OF O-5s
A    FSR5.K = TABHL(FSR5T,PP5.K,21,26,.5)
T    FSR5T  = .6/.5/.5/.5/.5/.5/.48/.46/.44/.42/.4
```

FSR5: Fractional Selection Rate or Promotion Opportunity for O-5s (fraction/year)

Voluntary Separation Rates (VSR). Voluntary separations are defined as those departures from military service brought about by the officer's free and rational choice. These separations can occur due to better alternative earning streams, job dissatisfaction, poor career progression, geographical preference, as well as many other factors. Attempts at point prediction of voluntary separations from military service have been marginally successful at best. The vast amount of empirical data required and the complexity of interactions between factors will continue to make prediction a difficult problem. One of the best forecasting techniques continues to be simple extrapolation of past trends. Frequently, however, the implications of predictions are not clearly understood. An understanding of the dynamic interactions in the system can enable force managers to effectively utilize these predictions. In other words, one must realize how the system will respond to a disturbance before advanced knowledge of the pertubation can be beneficial.

The voluntary separation rate is one indicator of the relative attractiveness of military and civilian careers. The intensity of this rate directly influences the ability of the system to meet the designated promotion opportunity/promotion point goals. The rate also determines, in part, the magnitude of accessions required to comply with mandated force levels. Naturally, there are significant cost implications tied to the level of turnover in any personnel system. In competitive private industry, a certain amount of labor turnover (as measured in a portion of the unemployment rate) is necessary to insure the continuation of a competitive labor market; however, individual firms generally

strive for the lowest turnover rates consistent with profit maximizing goals since turnover increases cost of production. A curious aspect of an up-or-out military personnel system is that minimum turnover is inconsistent with other personnel structural goals, such as promotion opportunity/promotion point, and grade authorizations. The system has set goals for which a significant voluntary separation rate is necessary. As will be illustrated in Appendix C, for a given accession rate there is only one set of voluntary separation rates which will produce a perfectly balanced (equilibrium) force. Separation rates above this level will produce early promotion points accompanied by higher than desired promotion opportunities resulting ultimately in difficulty filling grade authorizations. Perhaps even more significant, lower separation rates in the higher ranks result in stagnation of the system through increased promotion points and decreased promotion opportunities. Other undesirable behavior results from deviations, both high and low, from the equilibrium voluntary separation rates (which will be fully described in Appendix C). The important point here is that reducing turnover is not necessarily desirable; some level of voluntary separation is needed.

As previously stated, voluntary separations are a function of many variables, not all of which would apply to every individual. Three variables have been identified which would be applicable to most individuals and almost certainly to the group as a whole. It is not the intent of the model to predict voluntary separations, only to indicate the direction of movement in separations due to a change in these variables. Consequently, variables were chosen for which the direction of

movement could be reasonably hypothesized. More importantly, the variables chosen represent the three broad areas over which the military and Congressional system have direct control. In other words, three major variables endogenous to the system in question were chosen. These variables are (1) career expectations, (2) military wage relative to civilian wage, and (3) retirement benefits. A function for voluntary separations is then formulated as:

$$VSR = V \text{ (Career Expectations, Military Wage/Civilian Wage, Retirement Benefits, miscellaneous variables.)}$$

For the purposes of this study, the miscellaneous variables, such as educational benefits and unemployment, are assumed fixed. The three hypotheses on direction of change in VSR are:

$\frac{\partial V}{\partial CE} < 0$ — As career expectations (CE) improve, voluntary separations decrease

$\frac{\partial V}{\partial \frac{MW}{CW}} < 0$ — As military wage relative to civilian wage (MW/CW) increases, voluntary separations decrease

$\frac{\partial V}{\partial RB} < 0$ — As retirement benefits (RB) increase, voluntary separations decrease.

The relative magnitude in these changes is also hypothesized, to act as a starting point from which sensitivity analysis is conducted.

Figure A-1 shows that voluntary separation rates are drawn from four active duty levels: 02, 03, 04, and 05. These levels contain those officers who have not yet been considered for promotion to the next

grade. Consequently, career expectations, military wage, and retirement benefits should all have some effect on separations from these levels. The other types of active duty levels, promotion selectees and passed-overs, do not have voluntary separations as an outflow. The passed-over levels (03P, 04P, and 05P) are reduced by retirement rates which will be covered later. Voluntary separation rates from 03S, 04S, and 05S were deleted for simplicity, even though there may be a slight voluntary outflow. The number of officers in these selectee levels are relatively small, and the incentives for remaining until promotion to the next grade are considered high enough to make the voluntary separations insignificant.

The four voluntary separation rates determined in the model are VSR2, VSR3, VSR4, and VSR5. The general form of each of these rates is illustrated by the rate from level 03:

R VSR3.KL = FVSR3.K*03.K

VSR3: Voluntary Separation Rate from 03 (men/year)

FVSR3: Fraction Voluntary Separation Rate from 03 (fraction/year)

03: Captains prior to selection for major (men)

The percentage of voluntary separations required for equilibrium (see Appendix C) is used as a starting fractional separation rate (FVSR). A method developed by Anderson, Emmerichs and Lindquist (Ref 16) is used to change the FVSR as career expectations, relative military pay, or retirement benefits are altered. A string of multipliers is used to change the FVSP as the variables change. The general form is again illustrated by the fractional rate from level 03:

A FVSR3.K = FVSR3N*MFCE3.K*MFMP3.K*MFRB3.K

FVSR3: Fractional Voluntary Separation Rate from 03 (fraction/year)

FVSR3N: Fractional Voluntary Separation Rate at Equilibrium (fraction/year)

MFCE3: Multiplier From Career Expectations for 0-3s

MFMP3: Multiplier From Military Pay for 0-3s

MFRB3: Multiplier From Retirement Benefits from 0-3s

The range of values for the multipliers will differ for each type and grade level being considered, but generally range from .8 to 1.3. When the system is in equilibrium, each of the multipliers has a value of one. The development of each type of multiplier will be discussed individually.

Multipliers from Career Expectations. It was assumed that promotion opportunity and promotion timing to the next grade would have the greatest career expectation impact on an individual's decision to separate from military service. Theoretically, the state of promotions further than one grade away would also enter into the decision; however, the dynamic characteristics of the system should heavily discount distant promotion behavior. Therefore, with the exception of lieutenants, each grade of officers is only looking at the promotion potential to the next grade. Lieutenants look for promotion opportunity and timing to major since the parameters for promotion to captain are relatively fixed. The calculations involved for MFCE3 will be used to illustrate the process and assumptions involved. The structural form for all the MFCE are identical to MFCE3.

Since career expectations are a function of both promotion opportunity (PO) and promotion point (PP), a method of combining both into one numerical measure was developed. Recall during the calculations required in the promotion process that promotion opportunity is reflected in the fractional selection rates, FSR3 in the case of captains. Promotion points (PP3 for captains) were also calculated. From FSR3 and PP3 an ordinal-level measurement can be developed for career expectations for captains. First, a simple calculation is made to determine the fractional nonselection rate.

A XSR3.K = 1-FSR3.K

XSR3: Fractional nonselection rate of captains for promotion to major (fraction/year)

FSR3: Fractional selection rate of captains for promotion to major (fraction/year)

The ordinal measure is then formulated:

A PP3TPO.K = SMOOTH(XSR3.K,2)(PP3.K)

PP3TPO: Promotion Point for captains times promotion opportunity (no dimensions)

XSR3: Fractional nonselection rate for captains (fraction/year)

PP3: Promotion Point for captains (years)

A two year exponential average of XSR3 is used to simulate a perception delay (recall that PP3 is calculated as a one year exponential average). Low values of PP3TPO represent high promotion opportunity and an early promotion point; conversely for high values of PP3TPO. However, a

continuum of values for PP3 and FSR3 can yield the same value for PP3TPO. Consequently, a set of indifference curves has been implicitly assumed (Figure A-14).

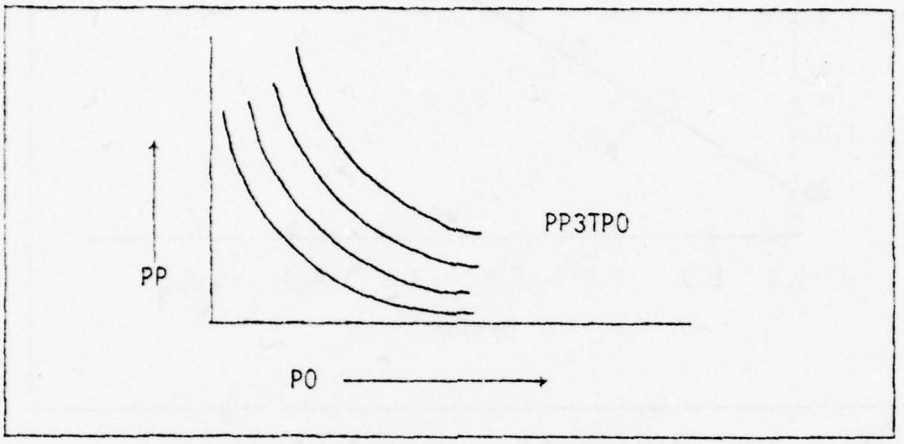


Figure A-14 Career Expectation Indifference Curves

The exact slopes of the indifference curves would have to be determined through survey instruments or some other form of empirical data.

A table function is used to determine MFCE3 based on PP3TPO (see Figure A-15).

```
A     MFCE3.K = TABHL(TCE3,PP3TPO.K,1.4,5.0,.6)

T     TCE3 = .95/1.0/1.05/1.1/1.15/1.2/1.25
```

The scaling for PP3TPO represents the range of values that will be encountered from PP3 times XSR3. High values result in a multiplier greater than one; therefore, VSR3 will increase from poor career expectations. Equilibrium conditions for PP3 and FSR3 are 10 years and .8 respectively; consequently MFCE3 = 1.0 when PP3TPO = 2.0.

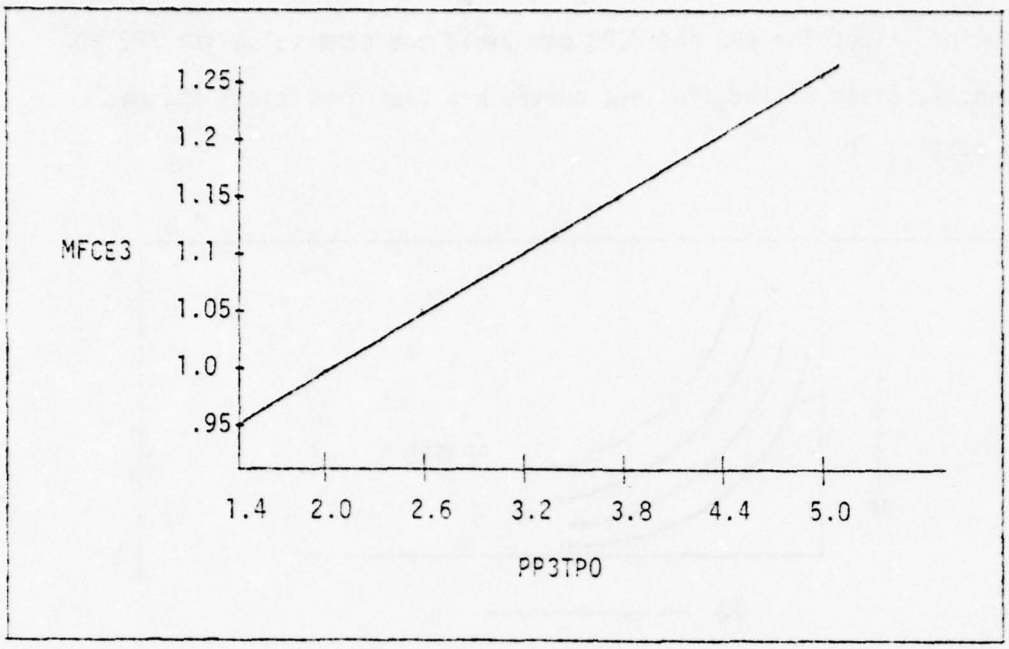


Figure A-15. Multiplier From Career Expectations

The elasticity of voluntary separations to career expectations is not known; consequently the absolute slopes used in the table functions are hypothetical and subject to sensitivity analysis. However, under the assumptions of the theory of occupational choice, the relative elasticities between different grades can be reasonably hypothesized. Under the present retirement system, it was assumed that captains would be far more sensitive to career expectations than the other grades since promotion to major guarantees tenure to retirement. Failure to be promoted to major means more than a simple downward adjustment in expected earnings; the military earning stream would be truncated far short of the 20 year retirement point. The same case applies to lieutenants, only it was assumed that reactions would be less severe. The reactions

for majors and lieutenant colonels were considered to be very mild. As different retirement proposals are evaluated with the model, the analyst will have to reassess the relative slopes used in determining the career expectation multipliers. For instance, under a fully vested retirement system one could reasonably assume that the captains would be less sensitive to career expectations than under the present retirement system.

Interesting dynamic system behavior evolves from the career expectation variables. As career expectations rise, the voluntary separation rates fall. Future groups of officers eligible for promotion will therefore be larger, initially causing more officers to be selected for promotion. As the inventory of selected officers increases, promotion points will also increase. Eventually, the promotion opportunity (FSR) may decrease. These changes will show up in the career expectation measurement and thus increase voluntary separation rates. In the broadest sense the process is stable since an initial increase in career expectations leads to an eventual decrease in the same variable. The dimensions of oscillitory behavior in voluntary separation rates caused by career expectations will depend on the assumed elasticities and perception lags.

Multipliers from Military Pay. Several broad assumptions were made in order to incorporate a feedback loop between military pay and voluntary separations. It has been established that there exists a set of voluntary separation rates which will place the officer force in equilibrium (see Appendix C). Two basic assumptions are (1) that attainment of these rates is a goal of

the system, and (2) that military pay is a viable incentive for adjustment of voluntary separation rates. It is both theoretically and empirically sound to assume that military pay is a decision criterion for occupational choice. What may not be as clear is that military pay is consciously used as a tool for controlling voluntary separations. Admittedly, the political process of determining military pay rates and annual increases becomes entangled with many considerations; however, it is assumed that separation rates are one of these considerations and that military pay will eventually respond to trends in voluntary separation rates. This response will rarely be as continuous and predictable as the model formulation implies, but the long range results can still be approximated using a continuous representation.

Absolute pay rates or raises are meaningless unless compared to some alternate means of income. Each officer will evaluate his own inventory of marketable skills and compare his military income stream to an expected alternate civilian income stream. Because of centralization of pay rate determination the military pay system does not focus on the individual as many private industries do. With the exception of rated officers, pay incentives have not been directed at large blocks of line officers with specific skills. Consequently, military pay issues are based on aggregate response from the forces. Since the restructuring of military pay scales in the late 1960s--early 1970s in an effort to achieve parity with the civilian sector, a primary concern of the average officer has probably been the decline or rise in purchasing power achieved through annual pay raises. This is done through a simple comparison of the percentage annual increase in wage to the

officially stated rate of inflation over the last year. These perceptions may have no impact on voluntary separations if the civilian wage has experienced the same change in purchasing power. In a positive growth economy, one could expect that civilian wages would increase at a rate greater than inflation; conversely for a negative (net of inflation) growth economy.

There are two basic hypotheses involved in the formulation of multipliers from military pay. First, sustained increases in purchasing power relative to the civilian sector will result in an overall reduction in voluntary separations; similarly for decreases in real military wage relative to civilian wage. Second, military pay increases will strive for parity with the civilian aggregate unless some change is desired in the voluntary separation rates. Several assumptions are made in order to apply these hypotheses. For simplicity, a zero growth economy is simulated with an annual rate of inflation of five percent. It is therefore assumed that the aggregate civilian wage index (CWI) is tied directly to the consumer price index (CPI). The actual state of the economy and the inflation rate, both exogenous to the model, will not affect the relative conclusions involving alternate system cost streams. A civilian wage index and a consumer price index are started with a value of one during the first year and increased at a constant rate of .05 annually. An index for military wage (IMW) is also started during the first year and increased at .05 annually as long as voluntary separations are at the desired rates. If separations are higher than desired, the IMW is increased at a rate greater than .05 in order to slow voluntary separations. If separations are lower than

desired, then the IMW is increased at a rate less than .05 in order to encourage an increase in voluntary separations. The equation structure is the same for all grade levels and will be illustrated with the captain level.

The consumer price index with a base year of 1978 is calculated as follows:

```
L    CPI.K = CPI.J+(DT)(IINF.JK)
```

CPI: Consumer Price Index

IINF: Increase from Inflation

```
R    IINF.KL = INF*CPI.K
```

IINF: Increase in CPI from Inflation

INF: Rate of Inflation

These equations represent a CPI which is exponentially increasing by a constant rate of inflation.

The civilian wage index is represented as:

```
A    CWI.K = CPI.K*(1+AMP*SIN(6.283*TIME.K/PER))
```

CWI: Civilian Wage Index

CPI: Consumer Price Index

The expression enclosed in parentheses allows the CWI to cycle around the CPI rather than be tied directly to it. If these fluctuations are desired, the analyst can select the amplitude and periodicity of the sinusoidal movements.

The index for military wage (IMW) is constructed similarly to CPI except that the growth rate doubling time is not necessarily constant (and therefore the growth is not "exponential"):

```
L    IMW.K = IMW.J+(DT)(MWI.JK)
```

IMW: Index of Military Wage

MWI: Rate of Increase in IMW

```
R    MWI.KI = FMWI.K*IMW.K
```

MWI: Rate of increase in IMW

FMWI: Fractional Military Wage Increase.

FMWI will determine the rate of growth in the index for military wage. FMWI represents the annual percentage increase in military wages, and is dependent on the voluntary separations from the system. The voluntary separations must be calculated as a percentage of total force:

```
A    TVSR.K = VSR2.JK+VSR3.JK+VSR4.JK+VSR5.JK
```

TVSR: Total Voluntary Separations (men)

```
A    FTVSR.K = TVSR.K/TF.K
```

FTVSR: Voluntary Separations as a Fraction of Total force

TVSR: Total Voluntary Separations (men)

TF: Total Force (men)

```
A    TVS.K = SMOOTH(FTVSR.K,2)
```

TVS: Exponential average of FTVSR

TVS is used as the final input for determination of the wage increase (FMWI) in order to incorporate a somewhat delayed response of pay to separations.

FMWI is calculated from a table function using TVS as the independent variable:

A FMWI.K = TABHL(TMWI,TVS.K,0,.08686,.021715)

T TMWI = .02/.04/.05/.06/.08

In Figure A-16, a fractional voluntary separation of .044 yields equilibrium; consequently FMWI = .05, resulting in the same growth rate for IMW as that for CWI (assuming .05 rate of inflation). Again, the slope of the curve derived from the FMWI table function is an hypothesis.

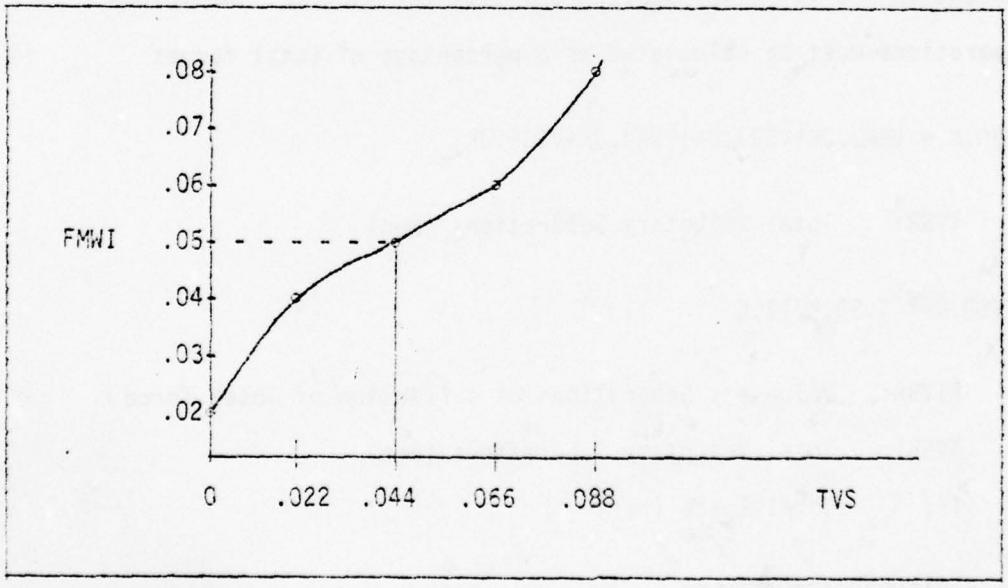


Figure A-16. Responsiveness of Military Pay to Voluntary Separations

The multiplier for military pay as applied to captains, as well as all other grades, can now be derived from a table function which uses the ratio of IMW and CWI as the independent variable:

A MFMP3.K = TABHL(TMP3,SMOOTH($\frac{IMW}{CWI}$,2),.5,2.0,.25)

IMW/CWI is averaged for two years in order to provide a perception delay in index changes. A ratio of one implies parity between civilian and military wage, resulting in a multiplier of one (no change in voluntary separations due to military pay). As the graph in Figure A-17 shows, a low ratio results in higher voluntary separations, and a high ratio produces a decrease in separations. It is assumed that the elasticity of the curve decreases as grade level increases.

T TMP3 = 1.7/1.4/1.0/.8/.7/.5/.4

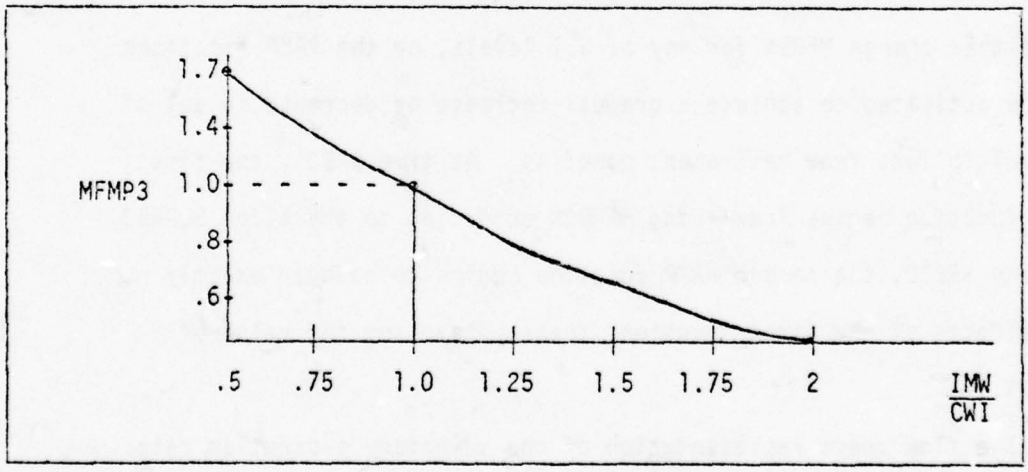


Figure A-17. Multiplier from Military Pay (MFMP3)

Oscillations generated in this feedback loop tend to be quickly damped out. As voluntary separations increase relative to force size,

increases in military pay are made at a greater rate than civilian wage increases, resulting in a faster growth rate in the index of military wage (IMW). As the ratio of IMW/CWI increases, the voluntary separation rate will decrease, and military wage increases (FMWI) will eventually fall. The intensity of this feedback is dependent on the assumed elasticities and reaction delays in the loop.

Multipliers from Retirement Benefits. The third multiplier to voluntary separation rates is an exogenous input. It is designed for use in evaluating different retirement proposals under various hypotheses on how each grade level would react to a change in benefits. The multiplier can be used to induce a change in voluntary separations due to any environmental change.

A MFRB3.K = MFRB3N+RAMP(SLPRB3,SRB31)+RAMP(-SLPRB3,SRB32)

For force equilibrium, MFRB3N is set to one and the slopes on the RAMP functions are set at zero. On the subsequent reruns, the model user can either change MFRBN for any or all levels, or the RAMP functions can be activated to achieve a gradual increase or decrease in any of the multipliers from retirement benefits. At time SRB31, the first RAMP function begins increasing MFRB3N according to the slope SLPRB3. At time SRB32, the second RAMP function begins to counter exactly the effects of the first function, thereby leveling the value of MFRB3N.

The flow chart representation of the voluntary separation rates is presented in Figures A-18 through A-21.

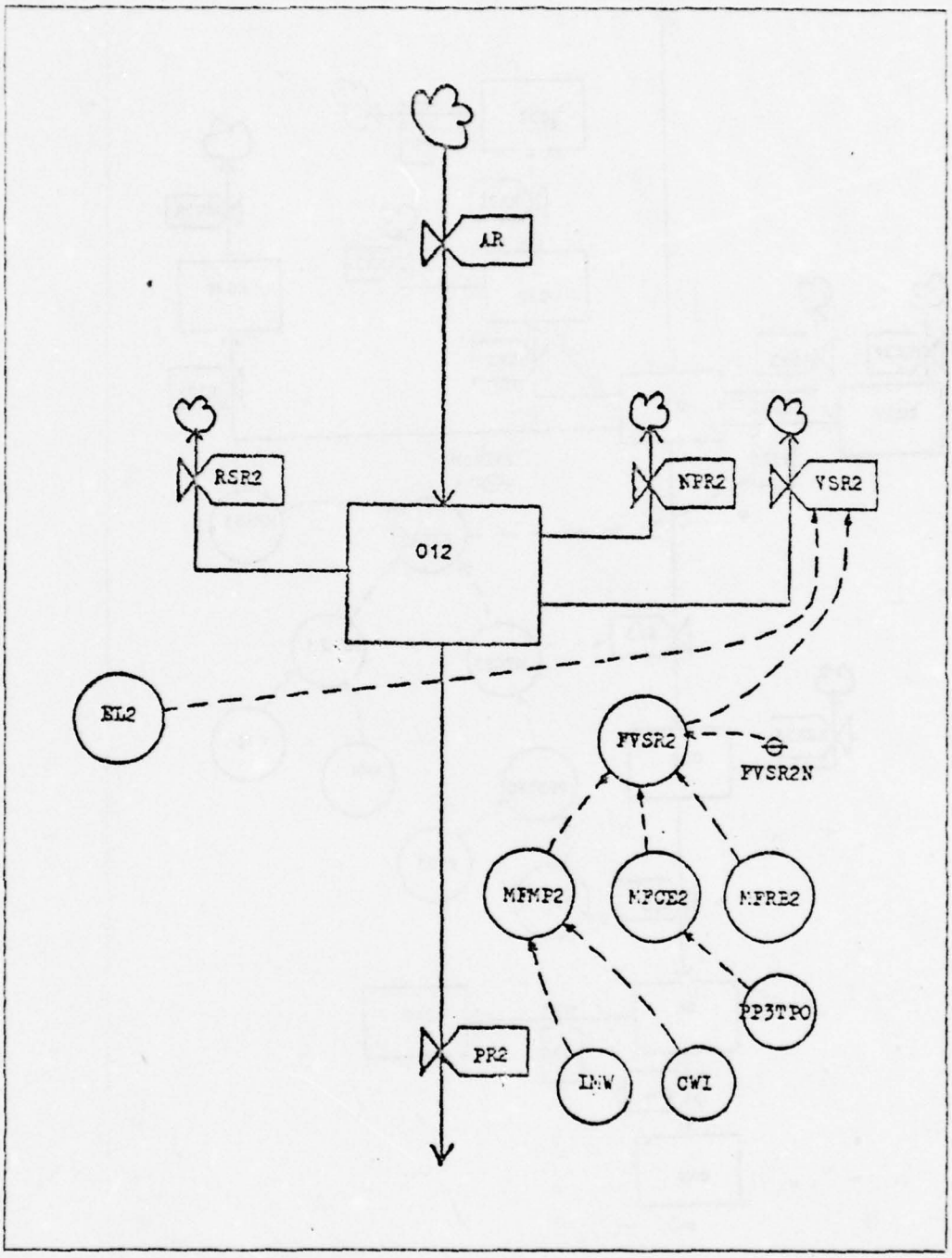


Figure A-18. Voluntary Separations from 012

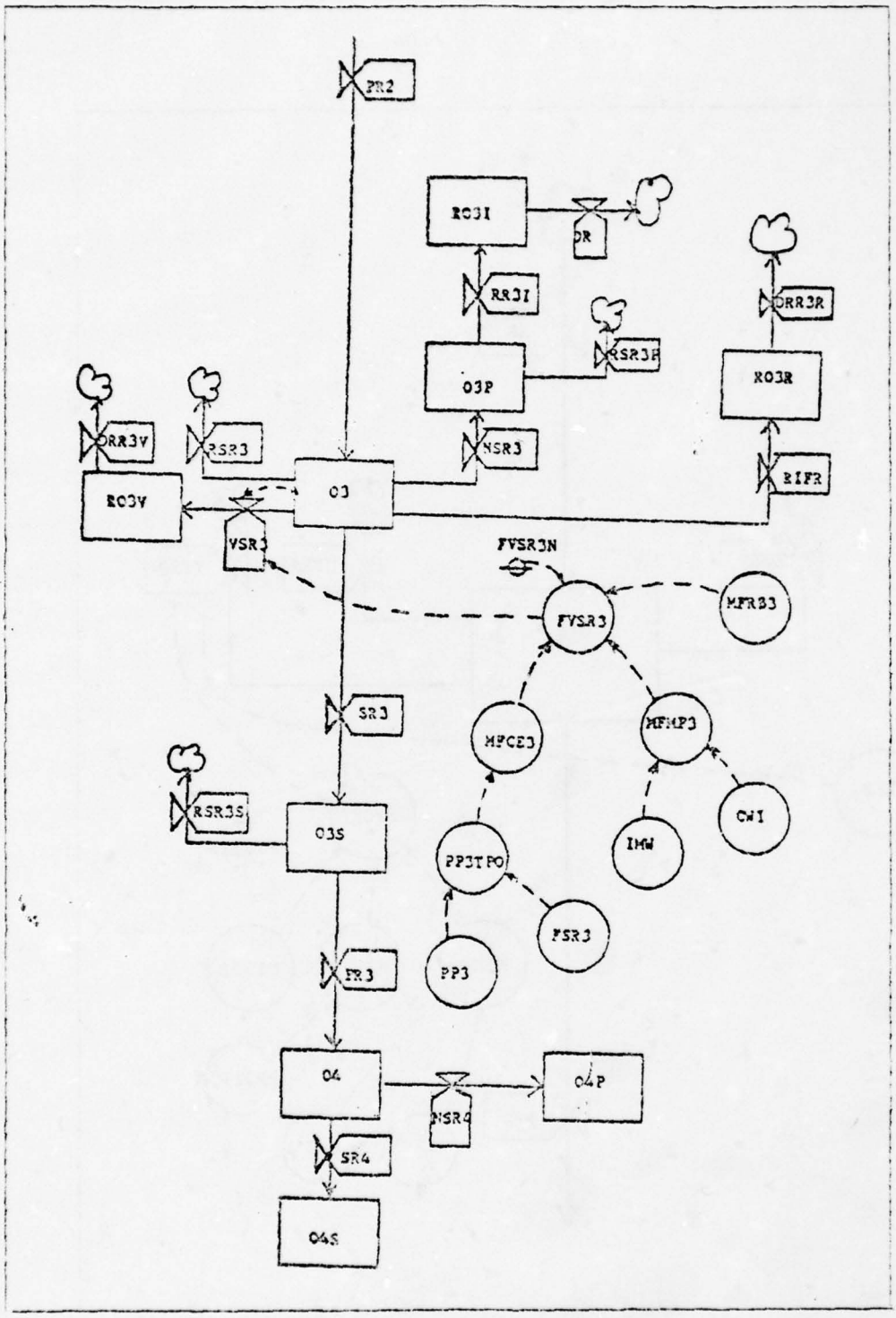


Figure A-19. Voluntary Separations from 03

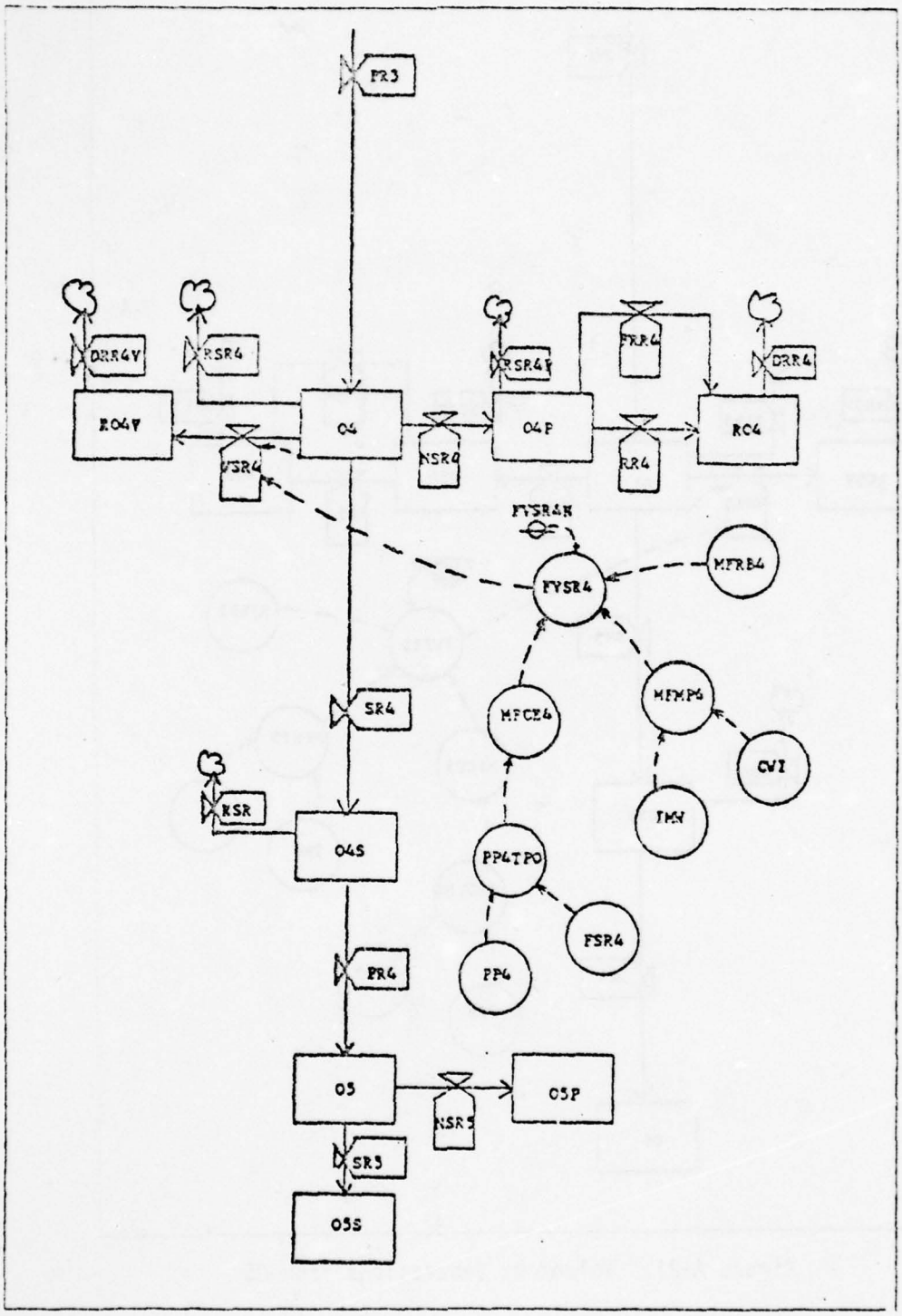


Figure A-20. Voluntary Separations from 04

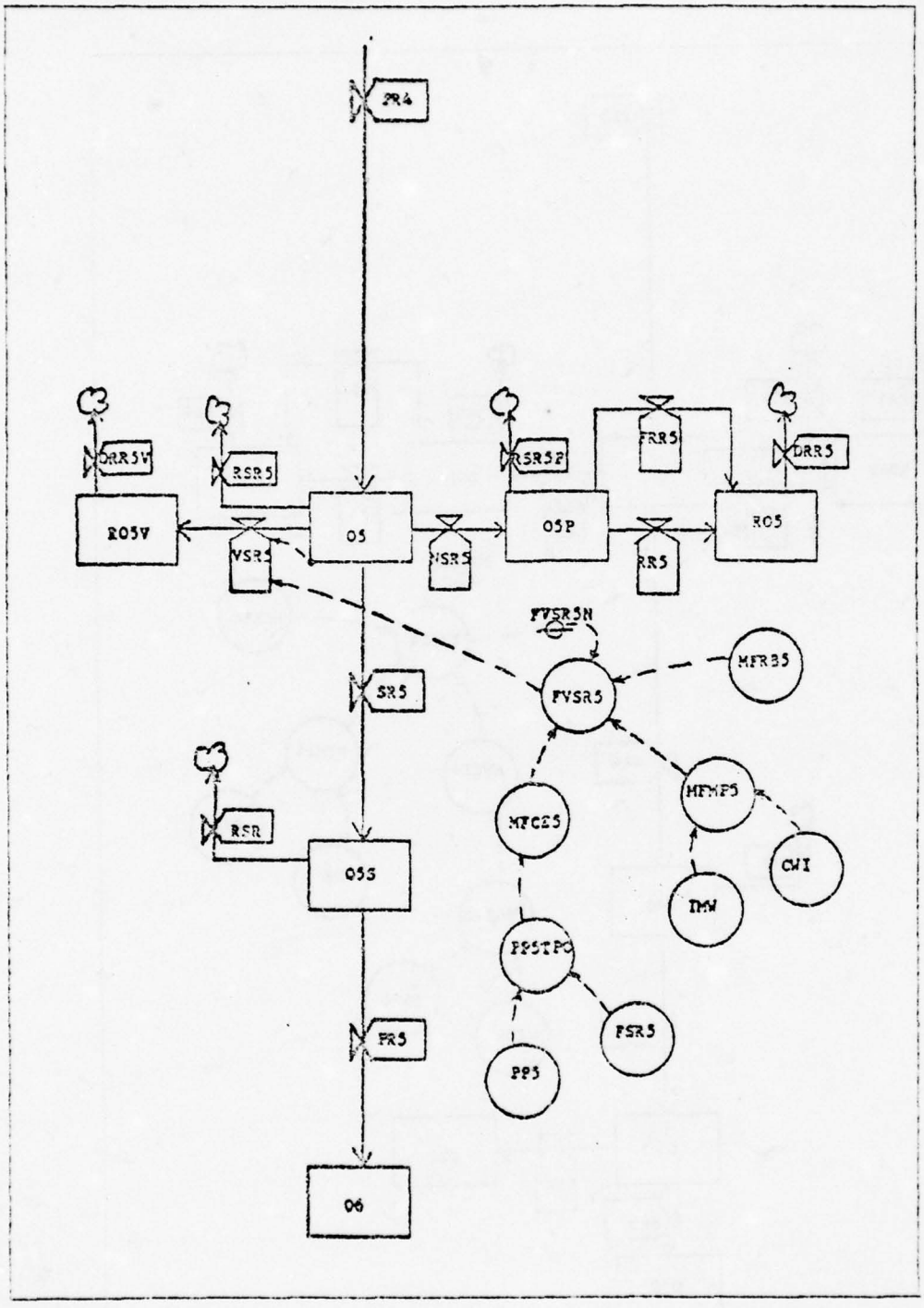


Figure A-21. Voluntary Separations from 05

Retirement Rates. Retirement rates are drawn from the passed-over levels (03P, 04P, 05P) and the O-6 level (see Figure A-1). Two types of retirement rates are represented in the model: (1) normal retirement rates, and (2) forced retirement rates imposed by personnel management.

Normal Retirement Rates. The normal retirement rates are determined by those retirements that would occur with no management intervention. The rate reflects the retirement timing voluntarily chosen by the retirement eligible officers (up to and including the point of guaranteed tenure). The Secretary of the Air Force has the legal authority to deny early retirements although this option is normally invoked on only a small portion of officers. The model does not account for retirements delayed by management, but it does include the management option of forced retirement.

All of the normal retirement rates are formulated from an average time spent in a passed-over level or the 06 level. For instance, if a major is passed-over for promotion at 16 YOS, and the average retirement point for majors is 20 YOS, then the average time spent in the passed-over level is four years. The input rates to these levels (nonselection rates for 03P, 04P, and 05P; promotion rate for 06) and appropriate average times in each level are used in third order delays as an approximation for the response lag of outflow (retirement rates) to changes in inflow.

The retirement rate of captains offers a fairly straightforward illustration of the equation formulation. Recall the level equation for O3P:

L O3P.K = O3P.J+(DT)(NSR3.JK-RR3I.JK-RSR3P.JK)

O3P: Captains Passed-over for promotion to major (men)

RR3I: Retirement Rate of captains (men/year)

RSR3P: Residual Separation Rate from O3P (men/year)

The nonselection rate (NSR3), previously determined in the promotion process, is the only inflow to O3P. After some average time in the passed-over level, the nonselected captains will exit through the retirement rate (RR3I) (except those who depart through such things as death, disability, and unsuitability).

R RR3I.KL = DELAY3(NSR3.JK,AT3P)-SMOOTH(RSR3P.JK,1)

RR3I: Retirement Rate of captains (men/year)

NSR3: Nonselection Rate of captains for promotion to major (men/year)

AT3P: Average Time Spent in O3P (years)

RSR3P: Residual Separation Rate from O3P (men/year)

The retirement rate (RR3I) is a third order delay of the nonselection rate (NSR3) for an average delay of AT3P, net of residual separations (RSR3P). The average time spent in O3P (AT3P) must be derived indirectly from the average YOS for captain retirements. Under DOPMA, passed-over captains are separated after 11 years of service. A sizable involuntary separation pay provides strong incentive for the

captains to wait for forced separation at 11 YOS. Since all passovers to major in the model occur at nine YOS, an AT3P of two years was chosen for equilibrium conditions under a DOPMA force structure. AT3P can be reduced (or increased) to evaluate hypotheses on personnel response to changes in retirement or separation pay schedules.

The equation formulations for the normal retirement rates from O4P and O5P are similar to RR3I, except for the determination of average times spent in the passed-over levels. The average YOS at retirement minus the YOS at nonselection will yield the average time spent in the passed-over level. The selection points (SP) are variables for the O-4 and O-5 levels which depend on previous promotion points. For equilibrium, though, the selection points are at 15 YOS and 21 YOS for O-4s and O-5s respectfully. With this information, average times spent in the passed-over levels were computed which would yield equilibrium in O4P and O5P. These average times were added to the selection points to arrive at the average YOS for retirement under equilibrium. The average YOS for retirement can be used as an exogenous variable to test various behavioral hypotheses under different retirement proposals. With SP as an endogenous variable, any change from equilibrium requires a continuous change in the average time spent in the passed-over levels. The structure for the O-4 and O-5 levels is identical:

A SP4.K = OUTPP3.K+MTIG4

SP4: Selection Point for majors for promotion to Lt Col (years)

OUTPP3: Average Promotion point to major MTIG4 years previous (years)

MTIG4: Minimum Time In Grade for majors prior to selection (years)

```
A     AYS4P.K = AYS4PN+RAMP(SLPYS4,SYS41)+RAMP(-SLPYS4,SYS42)
```

AYS4: Average Year of retirement for O-4s (years)

AYS4PN: Average Year of retirement for O-4s in equilibrium (years)

```
A     XT4P.K = AYS4P.K-SP4.K
```

XT4P: Exact Time spent in O4P (years)

AYS4P: Average Year of retirement for O-4s (years)

SP4: Selection Point of majors for promotion to Lieutenant Colonel (years)

```
A     AT4P.K = SMOOTH(XT4P.K,3)
```

AT4P: Average Time spent in O4P (years)

XT4P: Exact Time spent in O4P (years)

The time spent in O4P is exponentially averaged since officers enter O4P with slightly different values for XT4P. With the average time in O4P finally determined, the retirement rate from O4P can be formulated analogously to RR3i:

```
R     RR4.KL = DELAY3(NSR4.JK,AT4P.K)-SMOOTH(RSR4P.JK,1)
```

RR4: Retirement Rate of O-4s (men/year)

NSR4: Nonselection Rate of O-4s (men/year)

AT4P: Average Time spent in O4P (years)

RSR4P: Residual Separation Rate form O4P (men/years)

The retirement rate from O6 is similar to RR4 and RR5. In this case, however, the average time spent in O6 is the average YOS for retirement minus the average year of promotion to O-6 (PP6). Assuming

a PP5 of 22 YOS for equilibrium, an average time spent in O6 is calculated to place O6 in steady state, and the equilibrium YOS for retirement is calculated by the addition of PP5 and the average time in level O6. Again, the average YOS for retirement is used as an exogenous variable:

```
A     AYS6.K = AYS6N+RAMP(SLPYS6,SYS61)+RAMP(-SLPYS6,SYS62)
```

AYS6: Average YOS for O-6 retirement (years)

AYS6N: Average YOS for O-6 retirement in equilibrium (years)

```
A     XT6.K = AYS6.K-PP5.K
```

XT6: Exact Time spent in O6 (years)

AYS6: Average YOS for O-6 retirement (years)

PP5: Promotion Point from O-5 to O-6 (years)

```
A     AT6.K = SMOOTH(XT6.K,3)
```

AT6: Average Time spent in O6 (years)

XT6: Exact Time spent in O6 (years)

```
R     RR6.KL = DELAY3(PR5.JK,AT6.K)-SMOOTH(RSR6.JK,1)
```

RR6: Retirement Rate of O-6s (men/year)

PR5: Promotion Rate from O-5 to O-6 (men/year)

AT6: Average Time spent in O6 (years)

RSR6: Residual Separation Rate from O6 (years)

Forced Retirement Rates. Forced retirement rates are included as outflows from 04P, 05P, and 06 in order to assure that grade ceilings are not violated during rapid force drawdowns. A minor excess in one of these grades is generally corrected through a reduction in promotion rate from the preceding grade (see the previous formulation of promotion rates). During rapid force drawdowns the promotion rates may not be able to absorb the grade excesses since the rates correct for discrepancies based on some time-to-adjust factor. Additionally, forced retirement would probably be the preferred alternative to severe promotion stagnation during force reductions.

The forced retirement rates are not activated in the model until a "level of problem awareness" is reached. This level is expressed as a critical grade excess. Grade excesses of 300, 200, and 100 for O-4s, O-5s, and O-6s respectively were chosen as the values which would activate the forced retirement rates. These values were considered sufficient to convince personnel management that reductions in promotion rates were no longer a viable solution to the grade excess problem. Of course the critical values are subject to hypothesis testing and sensitivity analysis.

The forced retirement rate from 05P will be used to demonstrate the equation formulation:

A 05E.K = MAX(T05.K-AUTH5.K,0)

05E: Excess above O-5 grade ceiling (men)

T05: Total active duty O-5s (men)

AUTH5: Authorized O-5s (men)

A T05.K = 05.K+05P.K+05S.K

T05: Total active duty 0-5s (men)

05: 0-5s prior to the selection point (men)

05P: 0-5s Passed over for promotion (men)

05S: 0-5s Selected for promotion (men)

A AUTH5.K = AUTH5N+RAMP(SLP5,S51)+RAMP(-SLP5,S52)

AUTH5: Authorized 0-5s (men)

AUTH5N: Authorized 0-5s at start of simulation (men)

The RAMP functions provide the capability of simulating increases or decreases in the authorized level of each grade. During general force drawdowns or buildups, all field grade authorizations would change over the designated force adjustment time.

R FRR5.KL = CLIP(05E.K/TTR5,0,05E.K,200)

FRR5: Forced Retirement Rate from 05P (men/year)

05E: Excess above 0-5 grade ceiling (men)

TTR5: Time required To Reduce 0-5s (years)

The CLIP function will set FRR5 to zero if the excess in 0-5s is less than 200. When the excess exceeds 200, the rate is set to 05E.K/TTR5. A time to reduce 0-5s (TTR5) is used to reflect the delay between the decision to force retire and the actual retirements. Under DOPMA, the decision to force retirements is made by convening a Selective Continuation Board. DOPMA stipulates that the officers be separated within

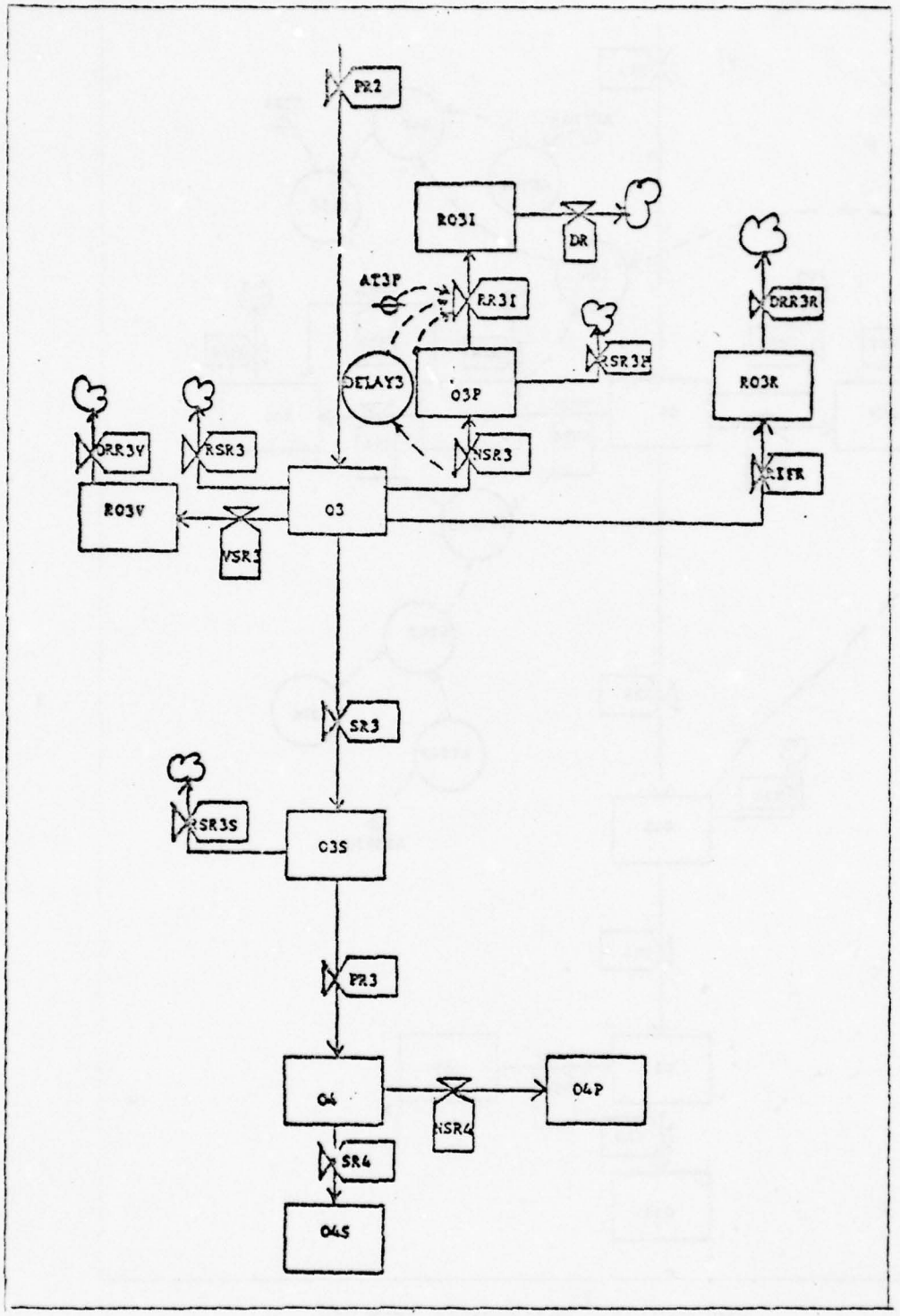


Figure A-22. Retirements from O3P

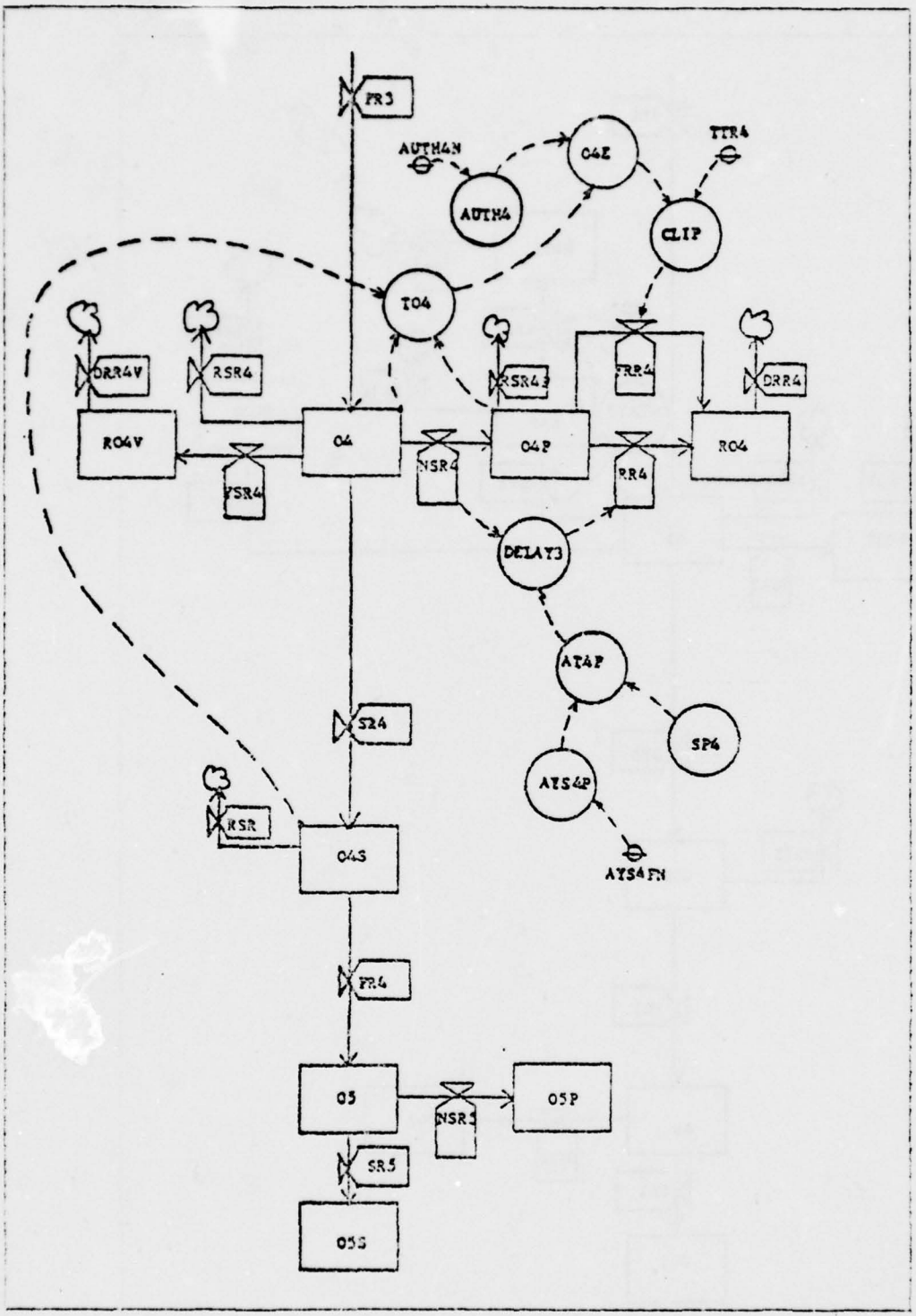


Figure A-23. Retirements from O4P

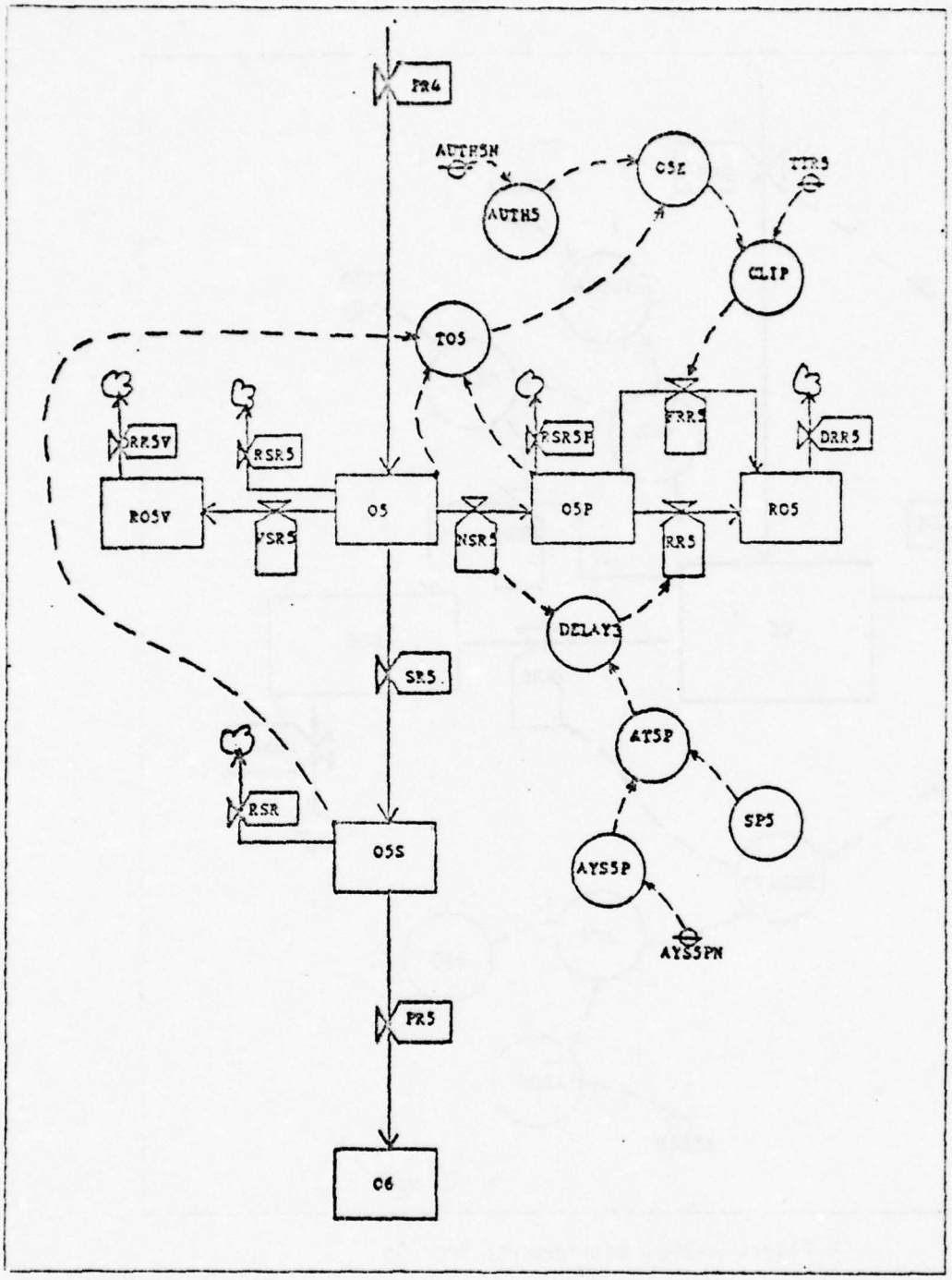


Figure A-24. Retirements from O5P

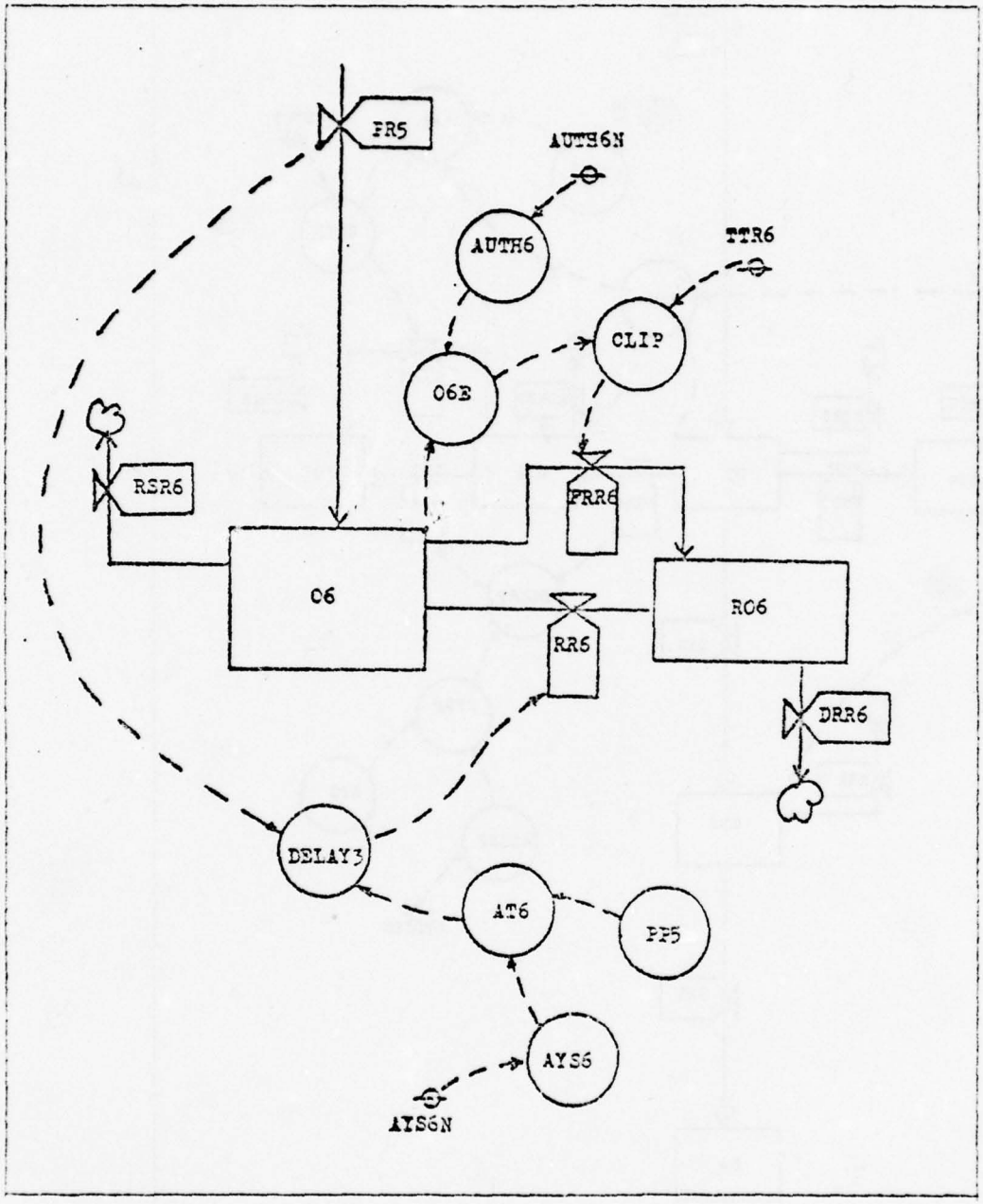


Figure A-25. Retirements from 06

some greater length of time. However, he will normally desire his production rate to be as smooth as practical. The length of time he chooses can be considered his basic inventory control policy.

In determining the officer accession rate, personnel management faces the same issues as the producer of retail goods. The military inventory is the force itself. Accessions correspond to production, and attrition is analogous to sales. Management forecasts attrition and formulates a policy about the rate of force discrepancy adjustment. The problem of officer supply has been essentially ignored in this study. It has been assumed that increases in the accession rate can be met with a rapid (within a year) increase in OTS output. Decreases in accessions can be accomplished by deferment of ROTC commissioning or reductions in OTS. This assumption is probably reasonable as long as the increase or decrease in accession rate is relatively small or the accession changes are part of a pre-planned management effort to change the total force size. In this case it is assumed that there is sufficient lead-time for changes in commissioning source output. In other cases, however, the model user should be alert for rapid changes in accessions due to unforeseen circumstances. The model is constructed to meet any demand for accessions without regard to the supply situation.

The model representation of the accession rate is as follows:

```
R    AR.KL = SMOOTH(OFLOW.K,2)+TFD.K/TTAF
```

AR: Accession Rate (men/year)

OFLOW: Total force attrition (men)

TFD: Total Force Discrepancy (men)

TTAF: Time-To-Adjust force

The first component of the accession rate equation is the forecast of attrition. A two year exponential average of past attrition was chosen as being representative of the forecast methods in general use today. Other forecasting techniques can be incorporated through reformulation of this component. The total force attrition (OFLOW) is calculated as the sum of all residual separation rates (RSR), voluntary separation rates (VSR), retirement rates (RR), and the nonpromotion rate (NPR) for lieutenants:

```
A    OFLOW.K = RSR2.JK+NPR2.JK+RSR3.JK+VSR3.JK+RSR3P.JK+RR3I.JK
                +RSR3S.JK+RSR4.JK+VSR4.JK+RSR4S.JK+RSR4P.JK
                +RR4.JK+RSR5.JK+VSR5.JK+RSR5P.JK+RR5.JK+RSR5S.JK
                +RSR6.JK+RR6.JK
```

OFLOW: Total force attrition (men)

The second component of the accession rate reflects the force discrepancy to be corrected through an increase or decrease in accessions. If the discrepancy is positive (deficient force) the accession rate will be greater than the estimated attrition (OFLOW), and conversely for a negative discrepancy (excess force). The time to adjust the force (TTAF) reflects how quickly any discrepancy will be corrected. The military traditionally tries to correct deficiencies quickly in order to meet exactly the required year end strengths. The model makes no attempt to incorporate this annual bookkeeping event, but does use a relatively short TTAF (approximately four months) for most of the analyses in this report. The results of sensitivity analysis on TTAF will be covered in Appendix C.

The force discrepancy is calculated as the desired year end strength minus the actual total force:

A TFD.K = ES.K-TF.K

TFD: Total Force Discrepancy (men)

ES: Desired year End Strength (men)

TF: Total Force (men)

A TF.K = O12.K+TO3.K+TO4.K+TO5.K+O6.K

TF: Total Force (men)

O12: Active duty lieutenants (men)

TO3: Total active duty captains (men)

TO4: Total active duty majors (men)

TO5: Total active duty lieutenant colonels (men)

TO6: Total active duty colonels (men)

A ES.K = ESN+RAMP(SLPF,SF1)+RAMP(-SLPF,SF2)

ES: Desired year End Strength (men)

ESN: Desired year End Strength at simulation start

The RAMP functions provide the capability to simulate force buildups or drawdowns. The flow chart representation of the accession rate is shown in Figure A-26.

During force drawdowns the accession rate may be unable to prevent a force excess from building, depending largely on the time-to-adjust force factor (TTAF). Consequently, when a force excess becomes too large, a reduction in force rate (RIFR) is used within the model to help

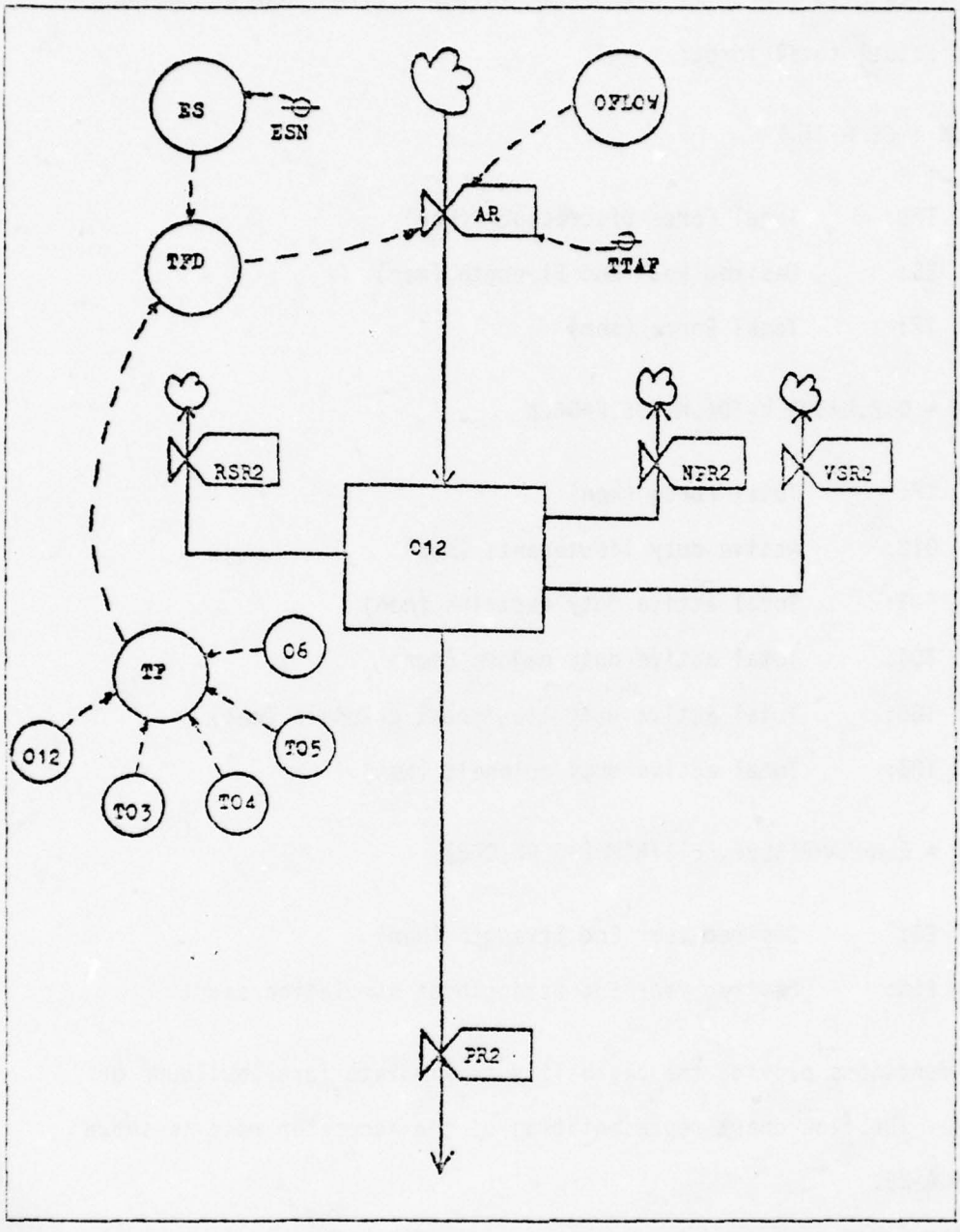


Figure A-26. Accession Rate

bring the force closer to the desired level (ES). A second function of the RIFR, as discussed earlier, is to alleviate a severely stagnated promotion system:

```
R    RIFR.KL = CLIP(TFE.K,RIF.K,TFE.K,1000)
```

RIFR: Reduction In Force Rate (men/year)

TFE: Total Force Excess (men)

RIF: Reduction In Force due to promotion stagnation

If the total force excess (TFE) is less than 1000, the RIFR is only used when the promotion system is unacceptably backed up. When the excess exceeds 1000, the annual reduction in force rate is set equal to the force excess (TFE).

APPENDIX B

Costing

APPENDIX B

COSTING

This Appendix describes the methods used to determine the cost implications of the two retirement scenarios evaluated in this report. The purpose of the costing module was not to provide specific estimates of future costs (and this point cannot be emphasized too strongly); the purpose was to indicate differences in general cost trends between the two scenarios. Six separate areas were costed: pre-commissioning training, recruitment and initial training, active duty pay, separation permanent-change-of-station (PCS) pay, retirement pay, and involuntary separation pay. Each of these areas is detailed below.

Costs for Pre-commissioning Training

The three sources of commissioning for Air Force line officers are the USAF Academy (USAFA), ROTC, and OTS. Approximately 900 officers are commissioned each year from USAFA (the model assumes that exactly 900 are commissioned). ROTC and OTS can graduate variable numbers. The model is designed so that OTS is used as a source only when the total number of accessions exceeds 5400 per year. That is, ROTC will be used to produce up to 4500 officers per year and OTS will supply anything required in excess of 5400. An average cost per graduate is used for each source. A deficiency in this type of approach is that large variations in the number of accessions should change the cost per graduate. For example, if 5500 lieutenants were accessed the real average cost per graduate from OTS would be quite high because only 100 officers were

graduated. The model, however, does not account for variable average costs. Additionally, the arbitrary cut off of 4500 ROTC graduates may be unrealistic for such a long run analysis.

The costs used are shown in Table B-I. (These particular costs were taken from data used in a computer model currently being run by DPXXA at the Pentagon. However, other sources are using substantially different cost figures.) All costs applied in the model were inflated at an annual rate of five percent.

TABLE B-I

Precommissioning Costs

Source	Average Cost Per Graduate (FY 1977 Dollars)
USAFA	$16,134
ROTC	$ 6,796
OTS	$ 8,579

The structure of the equations was very straightforward. An example is given below:

A CACCA.K = ACCA.K*CPI.K*16134

CACCA: Cost of ACCessions from the Academy

ACCA: Number of ACCessions from the Academy

CPI: Consumer Price Index

Recruitment and Initial Training

This category includes an average recruiting cost per accession, initial PCS costs, and the cost of initial training (pilot training, navigator training, or specialized training for nonrated accessions). The recruitment and PCS costs were taken from AFR 173-10. Recruitment cost was formulated as a variable:

```
A     RC.K = (RCN*MFMPI.K+PCS.K)*TOTA.K*CPI.K
```

RC: Total Recruitment Costs (including PCS move)

RCN: Recruitment Cost Normal (= $1104 per accession)

MFMPI: Multiplier From Military Pay Incentive

PCS: PCS cost per accession (= $1205)

TOTA: TOTal Accessions

It was assumed that the average recruitment cost per accession would be inversely related to the ratio of military pay to civilian pay (MFMPI is computed as a function of this ratio).

Initial training costs were formulated by calculating an average cost per trainee (ACPT):

```
A     TRNC.K = TOTA.K*CPI.K*ACPT.K
```

TRNC: total initial TRaiNing Costs

Table B-II shown the costs used to determine ACPT (source: DPXXA). The average cost depends on the percentage of pilots, navigators, and nonrated trainees, which varies with total force size (for example, with a line strength of 79,000 about 33 percent are pilots, while a line strength

TABLE B-II

Initial Training Costs

Type of Training	Average Cost Per Trainee (FY 1977 Dollars)
Pilot	$163,156
Navigator	$ 95,112
Nonrated	$ 3,277

of 98,000 calls for about 29 percent pilots). ACPT was therefore computed from a TABLE function based on total force size:

```
A     ACPT.K = TABHL(TACPT,TF.K,78800,106718,27918)

T     TACPT = 81089/71071
```

TACPT: Table for ACPT

TF: Total Force Size

Active Duty Pay

Active duty pay was computed for each grade level (lieutenant through colonel) using the annual composite standard rate from AFR 173-10. These rates are shown in Table B-III. Pay raises were accommodated through the use of the military wage index (IMW), which was explained in Appendix A. The formulation for captains was:

```
A     ADP3.K = T03.K*STP3I*IMW.K
```

ADP3: Active Duty Pay for O-3s

T03: Total O-3s

STP3I: STandard Pay for O-3s Initially

Pay for the other grade levels was computed in an analogous manner.

TABLE B-III

Standard Pay Rates

Grade	Standard Composite Pay
0-1/0-2	$14,216.5
0-3	$21,481.
0-4	$25,242
0-5	$30,521
0-6	$36,162

Separation Travel Pay

This payment was made for anyone leaving active duty, regardless of the reason. For example, if an officer died while on active duty it was assumed that his survivors would still be paid PCS costs to the home of record. The formulation was as shown below.

A STC.K = SMOOTH(OFLOW.K+RIFR.JK+FRR4.JK+FRR5.JK+FRR6.JK,1)*CPI.K*2462

STC: total Separation Travel Costs

(OFLOW+...): total departures from active duty (see Appendix A)

The source of the average termination PCS cost was AFR 173-10.

Retirement Costs

Retirement costing was complicated by the differences between the two systems. The model construction allowed for the implementation of RMA through the use of the Time for RMA variable, TRMA. On those runs used to investigate RMA, TRMA was set equal to 1981 (all runs were

initiated at 1978). Multiple STEP functions were used to transfer rates between levels at TIME = TRMA to accommodate the different benefits paid under the two systems. Personnel retiring prior to TRMA were paid, until their deaths, under the current retirement system. Those retiring between TRMA and TRMA + 10 years were paid according to transition rates. All personnel retiring after TRMA + 10 years were paid according to RMA.

The levels used for retirement (and separation) costing are drawn in dashed lines in Figure A-1. Each of these levels is discussed below.

Captains. Figure A-1 shows three levels for retirement/separation costing: R03R for RIFed captains, R03V for captains who voluntarily separated with less than 10 YOS, and R03I for captains involuntarily separated after 10 YOS. None of these categories are paid retirement benefits under the current retirement system (R03R and R03I qualify for separation payments); however, under RMA, officers departing into the R03I level are given the option of taking a lump sum readjustment payment or a deferred annuity. Technically, then, an officer who opts for the deferred annuity (payable at age 60) becomes a retiree. However, because of the relatively small present value of the annuity (assuming death occurs at age 72) it has been assumed in the model that the lump sum payment will always be selected.

No provision is included in the model for voluntarily separated captains with more than 10 YOS. Such officers would only be entitled to a deferred annuity (payable at age 60) of two and one-half percent of base pay times YOS--a fairly small amount since no captains can ever have (in the model) more than 12 YOS. Since a captain with 10 YOS is either about to make major or be involuntarily separated for nonselection, it is rather unlikely he would voluntarily separate.

The net result is that no captains enter any of the retirement pools. Therefore, the R03R, R03V, and R03I levels and the associated costing will be covered in the section on separation payments.

Majors. Three levels are used for majors: R04, R4RMA, and R04V. R04 is used for majors retiring (with 20 YOS) under the current system. They receive an immediate annuity equal to 50 percent of their annual base pay. At TRMA the rate flowing into R04 is transferred to R4RMA. Retirees in R4RMA are paid at a lower rate (which averages out to about 45 percent of annual base pay). See Chapter III for an explanation of the exact entitlements. The R04V level is used for majors voluntarily separating with less than 20 YOS. These officers are not paid anything under the current system. Under RMA they receive a deferred annuity. They have been assumed to retire with an average of 13½ YOS (which equates to an average age at retirement of 36½). The rate flowing into R04V is therefore delayed 23 years (by using a third order delay). The three level equations (with the associated rate equations) are detailed below.

L R04.K = R04.J+(DT)(RR4.JK*(1-STEP(1,TRMA))-DRR4.JK)

RR4: Retirement Rate for 20 year O-4s

DRR4: Death Rate for Retired O-4s

The expression (1-STEP(1,TRMA) terminates the rate flowing into the level at TIME = TRMA. The death rate DRR4 continues to deplete the level at a normal rate.

R RR4.KL = DELAY3(NSR4.JK,AT4P.K)-SMOOTH(RSR4P.JK,1)

NSR4: NonSelection Rate for O-4s

AT4P: Average Sime spent in level O4P

RSR4P: Residual Separation Rate from O4P

R DRR4.KL = FDRR4*RO4.K

FDRR4: Fractional Death Rate for RO4 (= .027)

L R4RMA.K = R4RMA.J+(DT)(RR4.JK*(STEP(1,TRMA))-DRRMA4.JK)

DRRMA4: Death Rate from level R4RMA

The STEP function in this equation holds the rate flowing in to R4RMA at zero until TIME = TRMA.

L RO4V.K = RO4V.J+(DT)(IN4V.JK-DRR4V.JK)

R IN4V.KL = DELAY3(VSR4.JK,23)*STEP(1,TRMA)

VSR4: Voluntary Separation Rate from O-4s

The IN4V rate does not begin until TIME = TRMA. The rate includes a 23 year delay to account for the fact that deferred annuities are not paid until age 60.

Lieutenant Colonels. The levels used for lieutenant colonels are exactly analogous to the major levels. The average YOS was assumed to be 24½ for RO5 and R5RMA and 18 for RO5V. The annuity for RO5V was delayed for 19 years.

Colonels. Only two levels were used for costing retired colonels: R06 and R6RMA. The rate flowing in was switched from R06 to R6RMA at TIME = TRMA. The average years of service was 29. All retiring colonels receive an immediate annuity.

Costing Equations. As noted above, only majors, lieutenant colonels, and colonels, are permitted to "retire" in the model. The equations used to calculate the retirement costs are similar for each of these grades. The O-4 equations are shown below.

```
A       TRP04.K = RPR04.K*R04.K+RPR04V.K*R04V.K+RPR4RM.K*R4RMA.K
```

RPR04: Retired Pay for level R04

RPR04V: Retired Pay for level R04V

RPR4RM: Retired Pay for level R4RMA

TRP04: Total Retired Pay for O-4s

```
A       RPR04.K = .025*20*12*BPR04.K
```

BPR04: Base Pay for R04

```
A       BPR04.K = 1822*CPI.K
```

All military wages (for the purpose of computing base pay at time of retirement only) were assumed to have grown at the same rate as the consumer price index instead of the index for military wage. This is a shortcoming of the model which tremendously simplified the costing task.

```
A       RPR04V.K = .025*13.5*12*BPR04V.K
```

BPR04V: Base Pay for R04V

A BPR04Y.K = 1680*CPI.K

A RPR4RM.K = BPR04.K*12*(.5+RAMP(-.005,TRMA)+RAMP(.005,TRMA+10)

The RAMP functions are used to "phase in" RMA over a 10 year period and to adjust the annuity to reflect the 15 percent reduction in the multiplier until the time at which the officer would have attained 30 YOS.

Social Security. It is important to note that RMA includes a provision to reduce the amount of the annuities at age 65 for those receiving social security benefits. The reduction would be equal to one half of the social security payments "attributable to military service." The model does not incorporate this feature at all and thus underestimates retirement cost savings for RMA.

Separation Costs

Separation payments are made to officers in three categories: RIFed captains (R03R), captains involuntarily separated for nonselection (R03I), and involuntarily separated majors. Neither of the two retirement systems investigated in this report provided any payments for captains leaving via the R03Y level. Since separation payments are one-time payments it is not actually necessary to keep track of a level. Instead, a rate can be used to determine the number of payments made each year. The RIFed captain rate was explained in Appendix A. The costs (which are identical under both systems) are explained below.

A SP03R.K = SMOOTH(RIFR.JK,1)*SPR.K

SP03R: Total Separation Payments for O-3s RIFed

RIFR: RIF Rate

PSR: Separation Payment for a RIFED captain

A SPR.K = SPRN*(1+STEP(H1.K,1988)+STEP(H1.K,1998)+....+STEP(H1.K,2028)

SPRN: Separation Pay for SP03R iNitially (= $14,000)

H1: Step Height (approximately .63, to compensate for the five percent annual inflation rate)

The auxiliary SP03I.K was used in an analogous fashion for costing captains involuntarily separated with 10 or more years of service. The payment for these officers (under both systems) was $15,000.

Involuntarily separated majors were accounted for through the use of SP04I.K:

A SP04I.K = SPI4.K*SMOOTH(FRR4.JK,1)

SP4I: Separation pay for O-4s Involuntarialy separated

FRR4: Forced Retirement Rate for O-4s (Recall that these officers. in actuality, have an option to take a deferred annuity as do those in SP03I, hence the "retirement rate")

A SPI4.K = 15000*ISP.K*(1+STEP(1,TRMA))

This equation doubles the separation payment from $15,000 to $30,000 at TIME = TRMA. The ISP auxiliary serves the same purpose as the SPR auxiliary did previously.

Summary

All these costs were summed to give a "total system cost" (TSC). However, this should not be interpreted as an estimate of actual personnel costs since many major elements of the real system costs have been totally omitted. Only those costs which might be directly affected by a new retirement system were included.

APPENDIX C

Model Validation

APPENDIX C

Model Validation

Forrester contends that the judging of validity in a system dynamics model is largely a subjective process (Ref 15:123). The confidence in this particular model rests primarily on how well it is accepted as a representation of the military organization and the decision making processes within the system. Confidence in the model must be confirmed by demonstration that the model can generate behavior characteristic of the Air Force personnel system in areas relevant to the problems of alternative retirement programs. The model should show the direction and relative magnitude of major changes in system characteristics, such as promotion points or grade levels, due to exogenous inputs or alterations in policy.

This appendix describes the processes carried through to establish the behavioral validity of the simulation. These processes can be considered as three distinct steps: (1) determining that the conceptual model faithfully represents the structure of the system, (2) insuring that the computer program represents the conceptual model, and (3) establishing confidence that the model is sufficient for addressing the problems it was intended to address. The design of the conceptual model was discussed in Chapters II through IV and Appendix A. The second and third steps in the validation sequence are examined through an equilibrium analysis and sensitivity testing conducted in several test cases.

The comparison of the conceptual and computer models can be facilitated through the establishment of model equilibrium. Although no behavior is exhibited from an equilibrium state, it provides the base from which to examine behavior caused by external disturbances or policy changes. Additionally, the establishment of equilibrium serves as the first test of the internal logic of the model. Next, in order to examine behavior, four test cases were developed to illustrate the major features of the model and provide comparisons between the model and the actual system. Two of the test cases involve distrubances from equilibrium due to exogenous inputs, while the other two are based on internal changes in policy parameters. For each of the cases, sensitivity of model behavior is tested to variations in selected parameters.

Equilibrium

Appendix A briefly discussed the importance of equilibrium during the initial investigation of system behavior. One can selectively disturb the system and observe the isolated system response. After an understanding of basic behavior in response to test inputs is achieved, the system can be altered under nonequilibrium conditions, and much of the behavior will be explainable through the knowledge gained from previous equilibrium investigations.

Equilibrium in the military personnel system is a state in which all active duty levels remain constant over time, promotion opportunities and points are constant, and accessions are perfectly matched with a constant force attrition. The specific objectives for equilibrium in this study were:

(1) Grade levels must be proportional in accordance with DOPMA grade ceilings.

(2) A one year inventory of officers selected for promotion is maintained for each grade.

(3) Promotion points are maintained at 10 YOS to O-4, 16 YOS to O-5, and 22 YOS to O-6.

(4) Promotion opportunities are maintained at .80 to O-4, .70 to O-5, and .6 to O-6.

(5) The equilibrium accession rate is reasonably close to recent historic rates.

(6) The equilibrium voluntary separation rates are reasonably close to recent historic rates.

(7) The equilibrium values for average year of retirements are consistent with recent historic values.

The analytical determination of initial conditions that will cause the model to run in equilibrium is tied to a few basic relationships. First, the model logic assures that the promotion opportunities and promotion points will be constant if a one year inventory of officers selected for promotion is always maintained for each grade. Secondly, the annual accession rate in equilibrium will equal the total annual outflow of the system. This outflow consists of residual separations (RSR), voluntary separations (VSR), and retirements. Since residual separations (as a percentage of force) are fixed to equal historical rates, reasonable values for the fractional voluntary separation rates and average year of retirements should result in the required accession

rate for system equilibrium. Thirdly, promotion rates in equilibrium are equal to the yearly outflow from the next grade. After this outflow is established, the desired annual promotion rate is determined, which in turn specifies the level of selectees for a one year inventory. These relationships indicate that a top to bottom approach should be taken for equilibrium initialization.

One must first decide on what size force is to be put into equilibrium. The TOPLINE "D" profile (Ref 19) was used for this study for several reasons. First, the line officer strength in the "D" profile (78,300) roughly approximates the present force level. Secondly, the profile was developed under the DOPMA guidelines, so that the field grade strengths and promotion opportunities/points are in accordance with the model objectives. Thirdly, a static model has been developed which places the "D" profile in equilibrium. Although force aggregation and the concept of equilibrium are slightly different in TOPLINE, the static model served as a valuable check against the equilibrium force presented here. Also, desired levels for lieutenants and captains were specified in the TOPLINE profile, even though DOPMA places no official ceiling on these grades. Consequently, the desired equilibrium level for all grades was drawn directly from the TOPLINE "D" profile.

Initialization for equilibrium is started with the O6 level (see Figure A-1). It is initialized at the DOPMA ceiling for a force size of 78,800 (TOPLINE "D"). For equilibrium, the annual outflows (RSR6, RR6) from O6 must be equal to the inflow (PR5). The general approach is to establish the residual separations (RSR6) and retirements (RR6) from historical data (Ref 18), which will specify the promotion rate

(PR5) required for equilibrium. RSR6 will simply be the historical percentage times the initialized O6 level. To determine RR6, the historical average YOS for O-6 retirement is estimated (approximately 28 YOS). Since equilibrium conditions require promotion to O-6 at 22 YOS, a six year delay is experienced in level O6. Consequently, roughly one sixth of the initialized O6 level will retire annually when the system is in steady state. The sum of RSR6 and RR6 determines the required PR5, which in turn specifies the size of level O5S for a one year inventory of selectees (O5S must be slightly larger than PR5 to allow for residual separations (RSR5S), again determined by a historical percentage). Figure A-1 shows that for O5S to be in equilibrium, SR5 must be equal to the sum of PR5 and RSR5S. Therefore, assuming a fractional selection rate of .5, the group of O-5s eligible for selection must equal twice this sum. Recall that the net eligibles are derived by reducing the appropriate year group (OUT5) by average voluntary and residual separations. Using historic data for these separations, the size of each entering year group is determined such that after attrition, the eligibles are equal to twice the sum of PR5 and RSR5S. This entering year group size will be used to initialize the pipeline vector PIP5. The other half of eligibles determines the annual nonselection rate (NSR5) into level O5P. For equilibrium, the retirement rate from O5P, net of residual separation, must equal NSR5. The historical YOS for O-5 retirements is used to determine the average delay in O5P, assuming an equilibrium selection point of 15 YOS. O5P is then initialized at a size that will equate RR5 with NSR5. The remainder of the level of O-5s authorized by DOPMA is used to

initialize level O5 (Figure A-1). Note that the total outflow from grade O-5 is now equal to the entering year group size used to initialize PIP5. This entering year group size is the required promotion rate to O-5 (PR4), and thus the entire sequence can be started again. One can continue to work through the system until, finally, the accession rate required to sustain the force is calculated.

In most cases historical voluntary separations were not conveniently aggregated for use in the model, and the implied rates used in the TOPLINE static model were substituted. In addition to initializing all active duty levels, most rates had to be initialized also since they were used in SMOOTH functions within the model. The complete list of initialization values is contained in Appendix E with the model listing. The resulting equilibrium profile is illustrated in Figure C-1.

Test Cases

The attainment of equilibrium provides some assurance that the general formulation of the computer model is consistent with the structure of the conceptual model. However, the interaction of the variables and much of the model logic is not exercised during equilibrium simulation runs. Also, sensitivity analysis of parameters is meaningless in equilibrium (the model can be placed and maintained in equilibrium with <u>any</u> finite values for the parameters). Finally, there is no way to compare model behavior to the real system while in equilibrium. Consequently, four test cases are presented which distrub the equilibrium system so that logic and interactions can be examined, sensitivity analysis performed, and behavioral comparisons made. The first two

```
O12=2  TO3=3  TO4=4  TO5=5  O6=6  TF=T

   0.000T          10.000T          20.000T          30.000T          40.000T 27-56
   7.000T          20.000T          40.000T          60.000T          80.000T T
1978.0. - - -5- - - -.5 - - -4- - - . 3 - - - -2- - -.- - - - - - - -T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       6       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
1988.0. - - -5- - - -.5 - - -4- - - . 3 - - - -2- - -.- - - - - - - -T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
1998.0. - - -5- - - -.5 - - -4- - - . 3 - - - -2- - -.- - - - - - - -T.
        .       6       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       6       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       6       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
2008.0. - - -5- - - -.5 - - -4- - - . 3 - - - -2- - -.- - - - - - - -T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
2018.0. - - -5- - - -.5 - - -4- - - . 3 - - - -2- - -.- - - - - - - -T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       6       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
        .       5       .5       4       . 3       2       .         T.
```

Figure C-1. Line Officer Force Equilibrium

cases are designed as force ceiling disturbances. The total desired officer force is first increased by 6,000 over a six year period, and in the second case is drawn down by 3,300 over a five year span. The last two cases are designed as exogenous disturbances to the voluntary separation rates. The voluntary separation rates are continuously increased by 20 percent over a ten year period, and then decreased by 20 percent over a ten year span. These particular test cases are chosen to illustrate very basic behavior in the system, and not intended to impose a major crisis from which the system can not recover. Certainly the model should be exposed to many other cases with varying degrees of "shock" to the system, even to the point of policy breakdown. However, time constraints held this study to the four cases described above.

The first runs on these cases were made with parameters set at "reasonable" values. The parameters in the model fall into three broad categories: (1) Time-to-adjust parameters (TTAF, TTA4, TTA5, TTA6), (2) Information delay and perception lag parameters, and (3) Sensitivity of attrition response to career expectations and military pay. These runs were made to determine the plausibility of model results. Variable interactions or management policies which were improperly formulated showed up in results which were clearly unreasonable or illogical.

After eliminating the implausible results by correcting improper formulations, a closer examination of the model behavior was made. In particular, it was necessary to investigate the similarity between the model and the system, especially in terms of problem symptoms. In most cases, confidence in the basic model behavior is established

without extensive use of time series data from the actual system. Rather it is based primarily on the much greater volume of available descriptive knowledge of real system behavior. Although most behavior is intuitive when isolated and inevitable if one has confidence in the formulations of the individual model parts, validation will not be complete until proper empirical data is gathered from which to make direct comparisons. Unfortunately, these test cases were not designed to replicate specific patterns of available data. For future and more complete model validation, definite trends will be identified in the personnel data, and the model will be used to reproduce these trends.

As system behavior was examined in the test cases, sensitivity analysis was performed on several parameters one would expect to have important behavioral implications. In particular, the responsiveness of voluntary separations to military wage and career expectations was evaluated over a wide range of values. The nature of system behavior remained very consistent over these values, and therefore only representative cases will be presented. The time-to-adjust grade/force parameters were tested for high and low values, and these results will also be presented.

Each test case will be illustrated under three hypotheses:

Hypothesis A: Nonresponsiveness of voluntary separations to either career expectations or military pay.

Hypothesis B: Assumed responsiveness of voluntary separations to career expectations but not military pay.

Hypothesis C: Assumed responsiveness of voluntary separations to both career expectations and military pay.

The levels of responsiveness chosen for these hypotheses are representative of the ranges evaluated. After each case is presented under each hypothesis, the results from sensitivity analysis on the time-to-adjust parameters will be shown under Hypothesis A. The reader should refer to Table C-I for guidelines to the DYNAMO output interpretation.

Force Buildup, Hypothesis A. The force buildup represents a managed change in the strength goals of the system. The desired force strength is increased by 6,000 over a six year period, beginning in 1985. Figures C-2 through C-7 contain selected output under the assumption of no feedback between voluntary separations and military wage or career expectations. Figure C-2 shows the relationships between total force size (T) and desired total end strengths (E), and between total force attrition (O) and the accession rate (A). End strength and total force size are equal until 1985, at which time the desired end strength moves up by increments of 1,000 until 1991. Total force size lags slightly behind the desired end strength due to a time-to-adjust force factor. Finally, force size and desired end strength are equal in 1993, which completes the total force buildup.

The force buildup is accomplished through the accession rate. Until 1985 the accession rate is equal to total attrition. During the six year buildup, the accession rate is increased to approximately 1,000 men/year above the expected attrition. Note that the total attrition (O) rises sharply four years after the buildup is started. At this

TABLE C-I

OUTPUT Interpretation for Test Cases

Plot Symbol	Corresponding Model Variable	Definition
T	TF	Total Force
E	ES	Desired (Authorized) End Strength
O	OFLOW	Total Force Attrition
A	AR	Accession Rate
2	O12	Number of lieutenants
3	TO3	Total active duty captains
	O3S	Captains selected for promotion
4	TO4	Total active duty majors
	O4S	Majors selected for promotion
5	TO5	Total active duty lieutenant colonels
	O5S	Lieutenant Colonels selected for promotion
6	O6	Active duty colonels
V	FVSR	Fractional voluntary separation rate
P	PP	Promotion Point
S	FSR	Promotion Opportunity
W	MFMP	Multiplier from Military Wage

Note: (1) Plot symbols should be identified with the proper scales, located at the top of each figure.
(2) Always check scales when comparing two figures.

point (1989) the first year group of increased accessions has reached the end-of-obligation point, and thus the rise in separations. All six year groups which were increased during the buildup must pass this end-of-obligation point before the attrition and accession rates can fall (this occurs in 1995). From this point accessions are tied very closely to the mildly oscillating attrition rate.

Figure C-3 shows the overall effects of the buildup on grade distribution. This figure illustrates some very basic system behavior which stems from the fundamental structure of the military personnel system. The closed nature of the system coupled with the specific goals placed on the top three grades results in a hierarchy of demand. The O-6 level is the highest priority demander and receives its supply from the O-5s. The O-5s then place demands on the O-4s, who in turn use the O-3s as their supply. The O-3s, however, cannot draw freely from the lieutenant levels. The promotion point to captain is fixed in the short run, and the promotion opportunity is held consistently high, as it must be for incentive purposes. Major adjustments to the number of captains normally occur through changes in the accession rate, but there is a four year delay before these corrections influence the O-3 level. The levels of captains and lieutenants are therefore allowed to "float free" and absorb the demands of the upper three grade levels. One of the primary objectives of personnel management is to supply these upper grades without creating turmoil in the lower three grades. Many short term personnel policies directed at these lower grades are formulated in an attempt to correct trends which develop from this demand hierarchy.

The force buildup illustrates these principles very clearly. Referring again to Figure C-3, one sees that the demands made by O-4s, O-5s, and O-6s are filled at the expense of the O-3 level. The system responds with an increased accession rate, evidenced by the rise in lieutenants, but it is four years before these accessions reach the O-3 level and finally stop the decreasing trend. As the accession rate steadies, the captain and lieutenant levels both stabilize at values greater than initial conditions. The force buildup was accomplished without creating long term imbalances between captains and lieutenants, but a ten year transition period was required.

Figure C-4 shows how the force buildup affected the pools of officers selected for promotion to the next grade. In particular, the level of selected captains falls until the increased year groups reach the selected point for major (9 YOS). The selected captain level then builds due to an overall increased accession rate, and eventually oscillates with the same periodicity of the accession rate, only nine years delayed.

The change in promotion parameters for captains is shown in Figure C-5. The initial demand placed on the captains resulted in earlier promotion points and a brief period of increased promotion opportunity. The promotion point follows the same trend as the level of selected captains (Figure C-4). As this level is replenished through accessions, the promotion point climbs and oscillates toward a new value which is higher than under the old force level. This behavior is a direct result of the "sliding scale" grade authorizations. As the total authorized force increases, the authorized levels of O-4s, O-5s, and O-6s

increases at a rate less than proportional to the total force increase. Consequently, the ratio of majors to captains falls, resulting in the eventual increase in promotion point. The promotion parameters for O-4s and O-5s, shown in Figures C-6 and C-7, exhibit the same behavioral patterns as illustrated for captains.

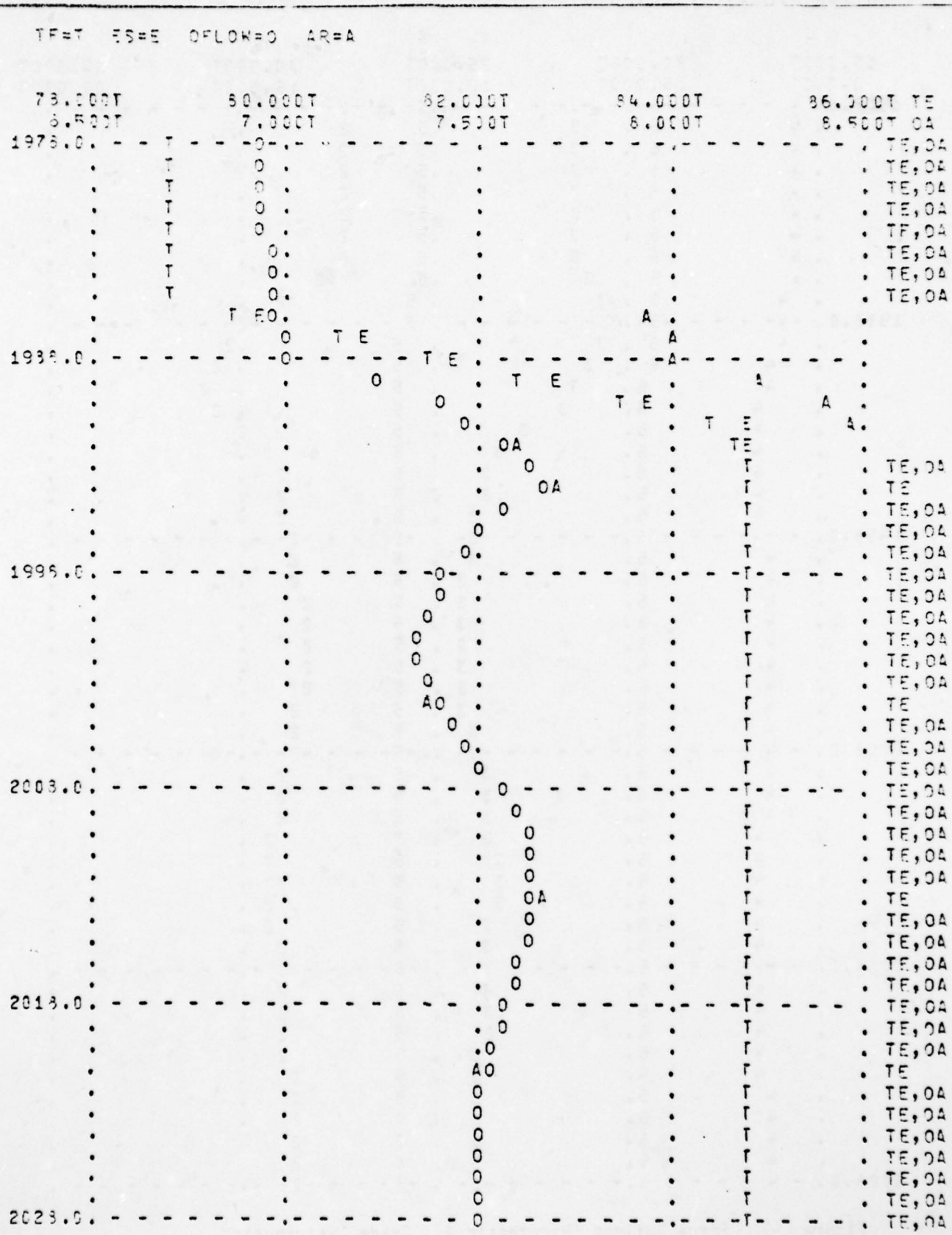


Figure C-2. Force Buildup (Hypothesis A), Accessions and Total Force

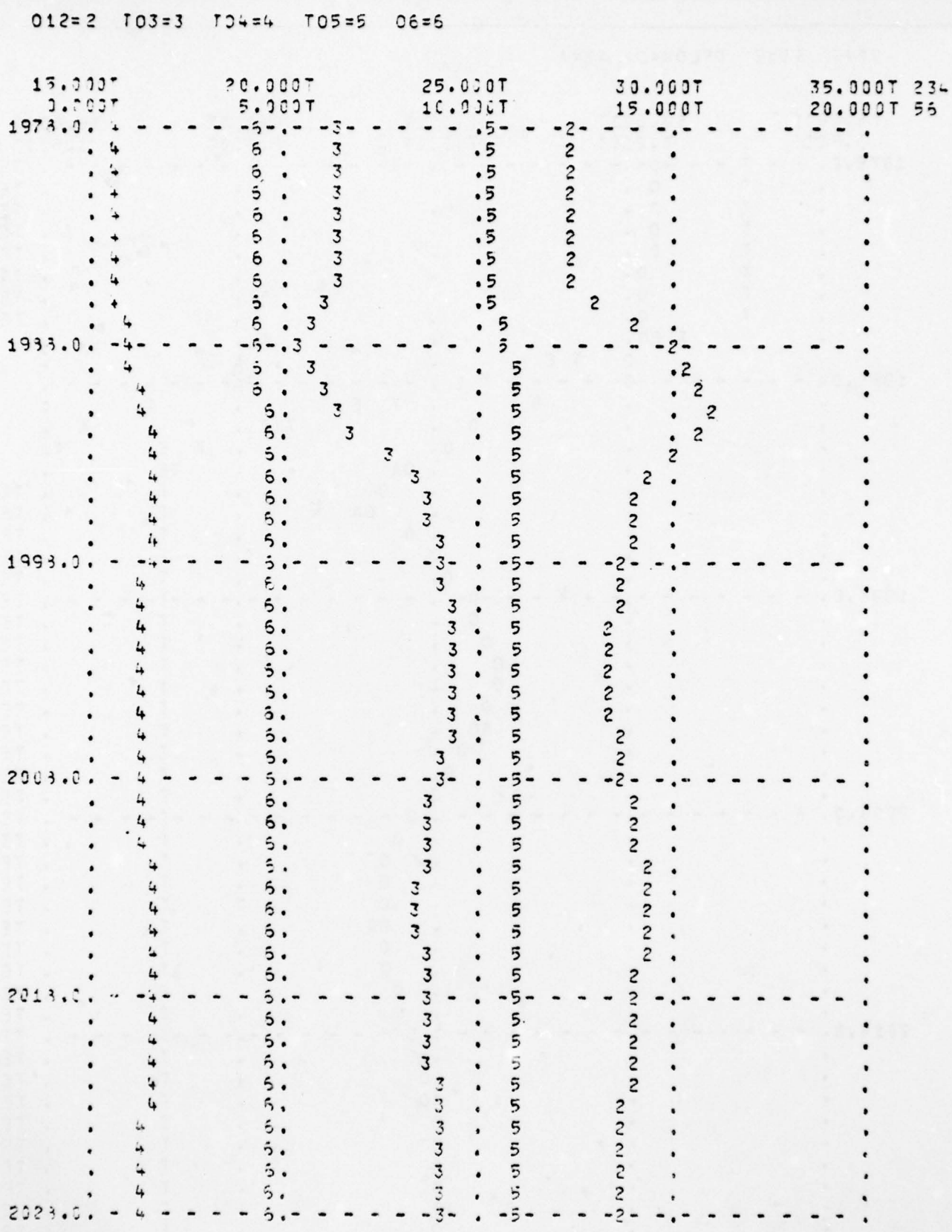


Figure C-3. Force Buildup (Hypothesis A), Grade Distribution

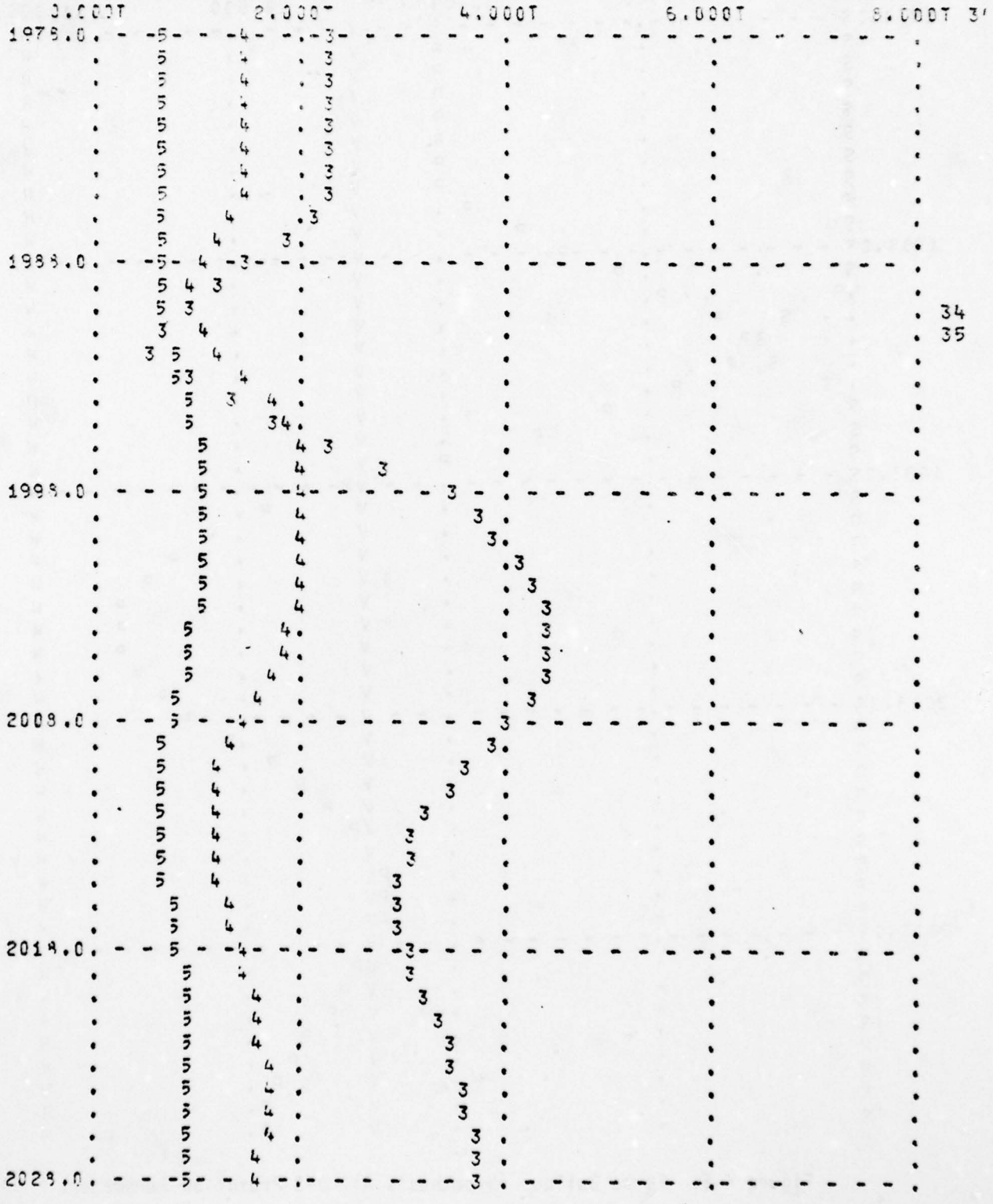


Figure C-4. Force Buildup (Hypothesis A), Inventories of Selected Officers

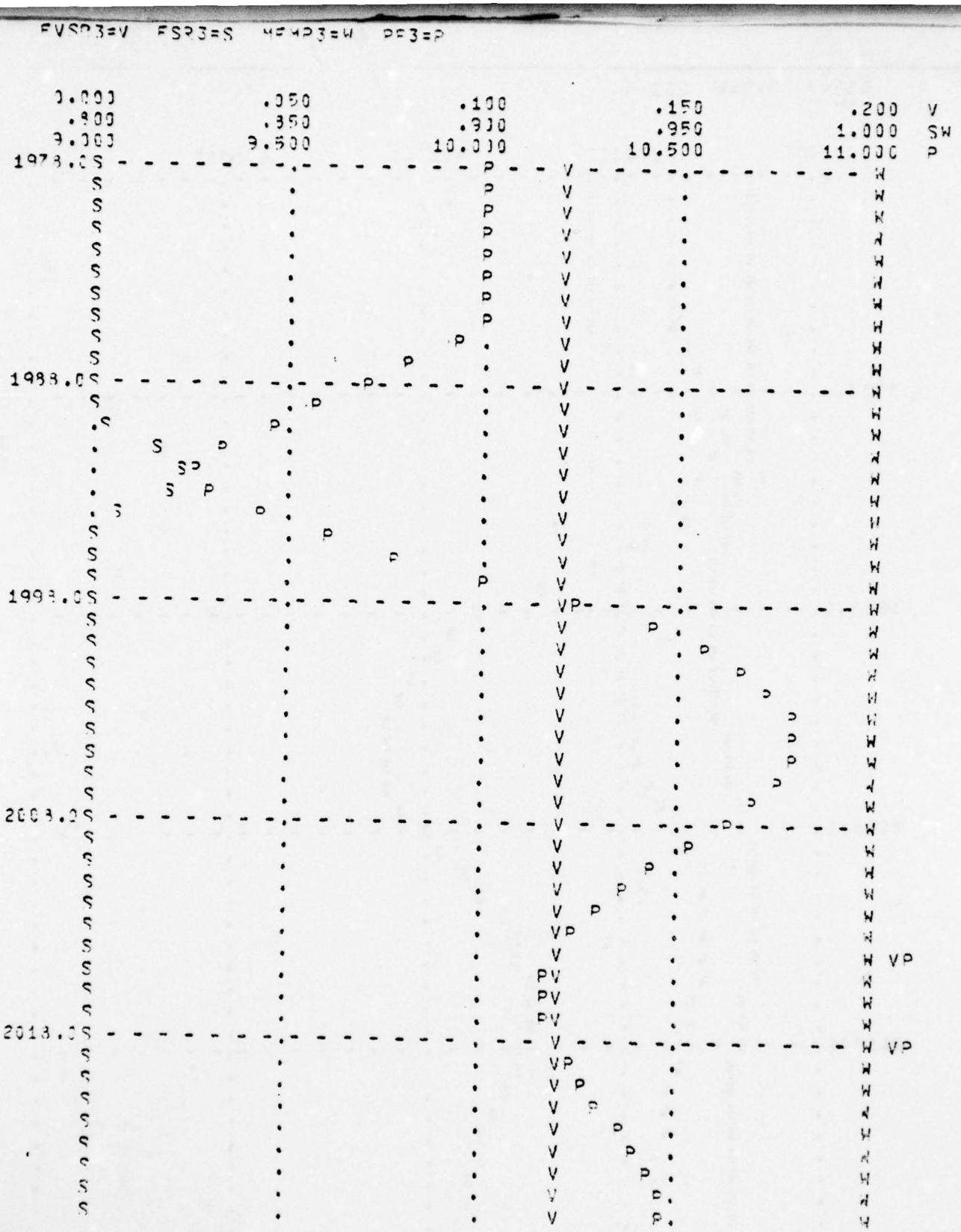


Figure C-5. Force Buildup (Hypothesis A), O-3 Promotion Parameters

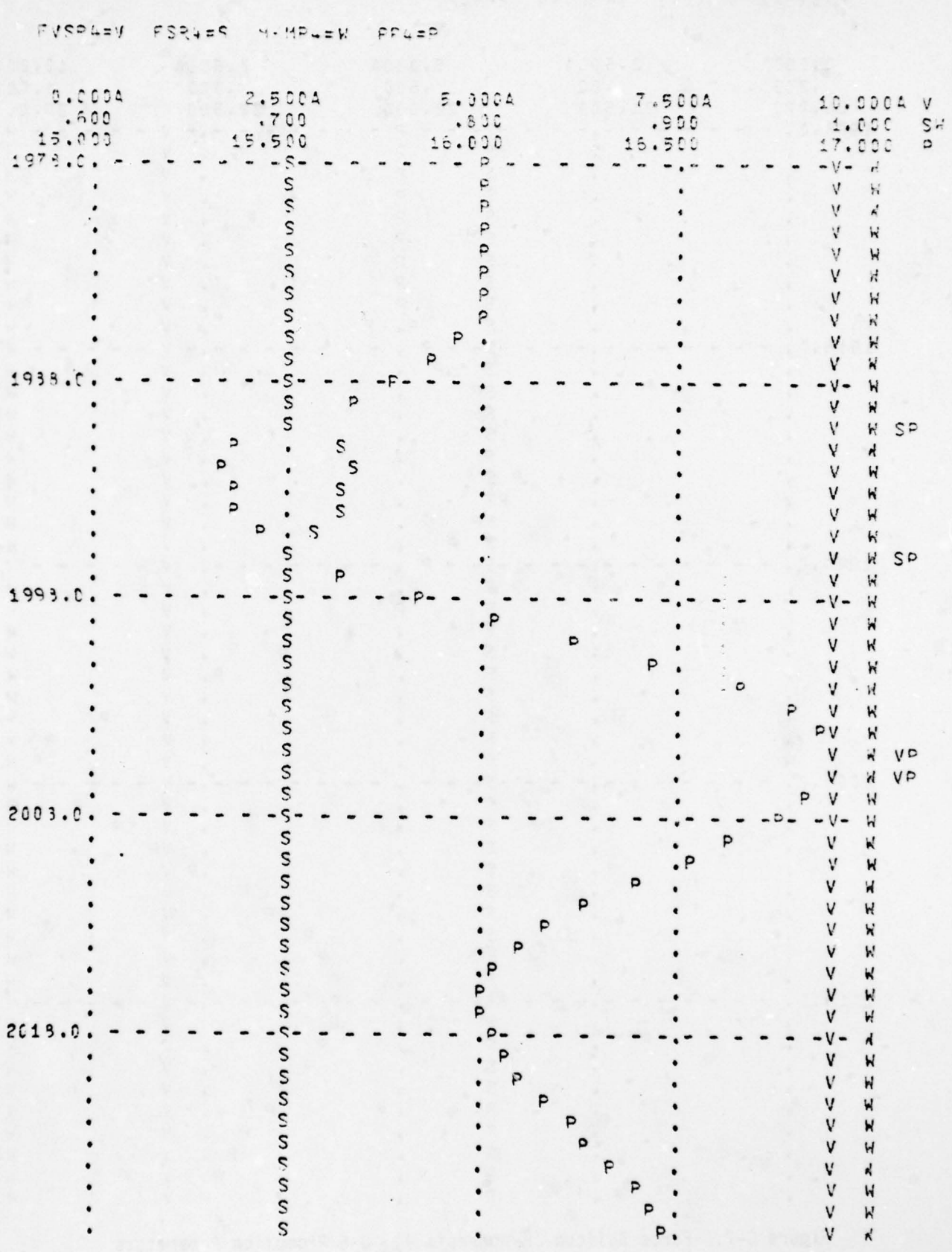


Figure C-6. Force Buildup (Hypothesis A), O-4 Promotion Parameters

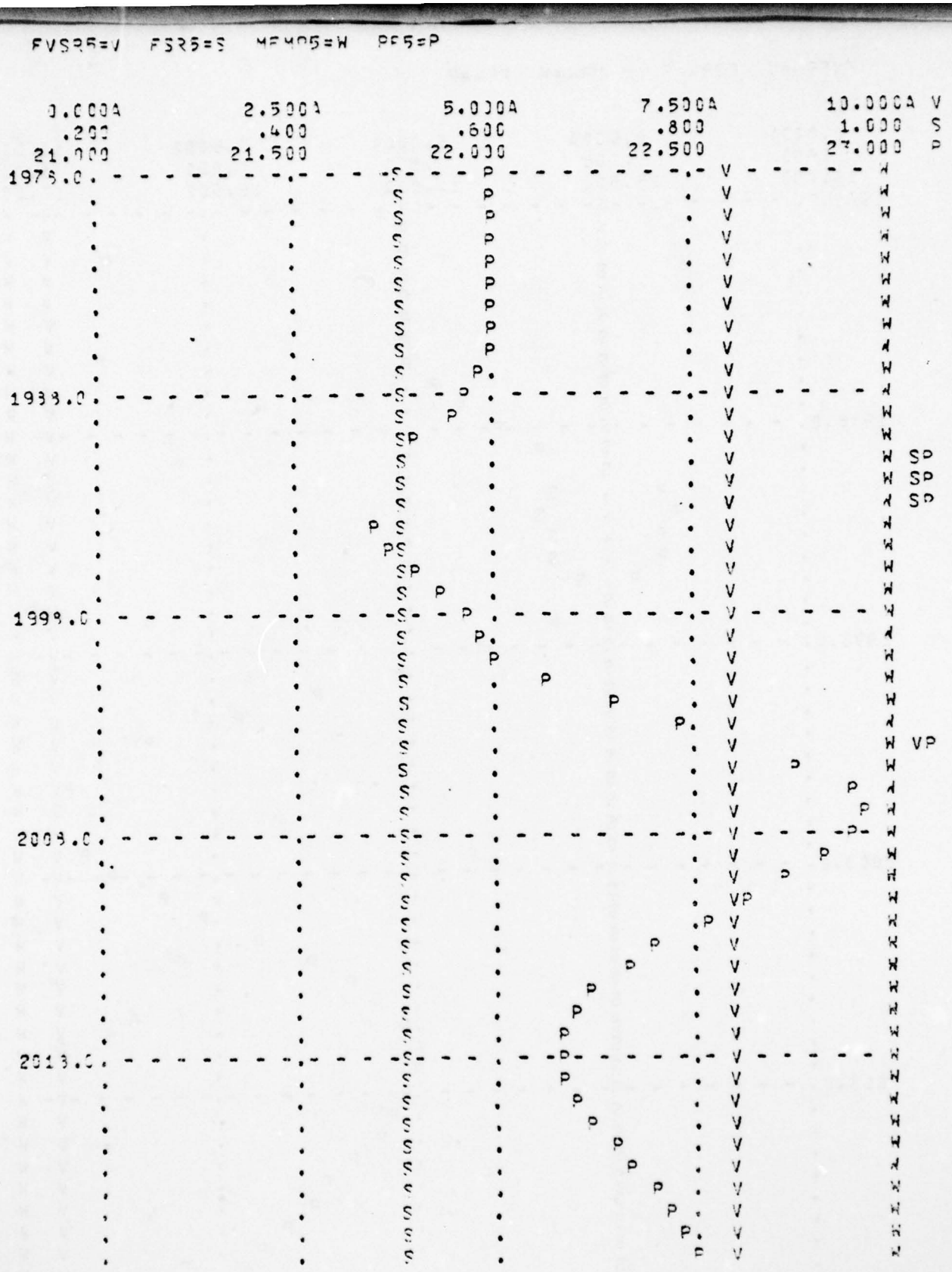


Figure C-7. Force Buildup (Hypothesis A), O-5 Promotion Parameters

Force Buildup, Hypothesis B. The force buildup was simulated under the assumption that changes in promotion parameters affect the voluntary separation rates. Figures C-8 through C-13 show subtle but plausible differences from the previous set of results. Note in Figure C-8 that the accession rate during and immediately after the buildup is not as great as before. A portion of the buildup has been accomplished through a decreased voluntary separation rate. Figure C-11 through C-13 shows that as the promotion parameters improve during the buildup, the fractional separation rates (V) decrease; thus there is a decrease in the attrition and accession rates. Figure C-9 shows that the grade distributions remain basically the same as before.

The particular voluntary separation sensitivity used for captains in this simulation resulted in about an eight percent decrease in separations due to a one-half year decrease in promotion point. The same basic behavior was exhibited using both weaker and stronger responsiveness. However, as the responsiveness became stronger, the amplitude in oscillatory behavior for promotion points became greater, and the periodicity shorter.

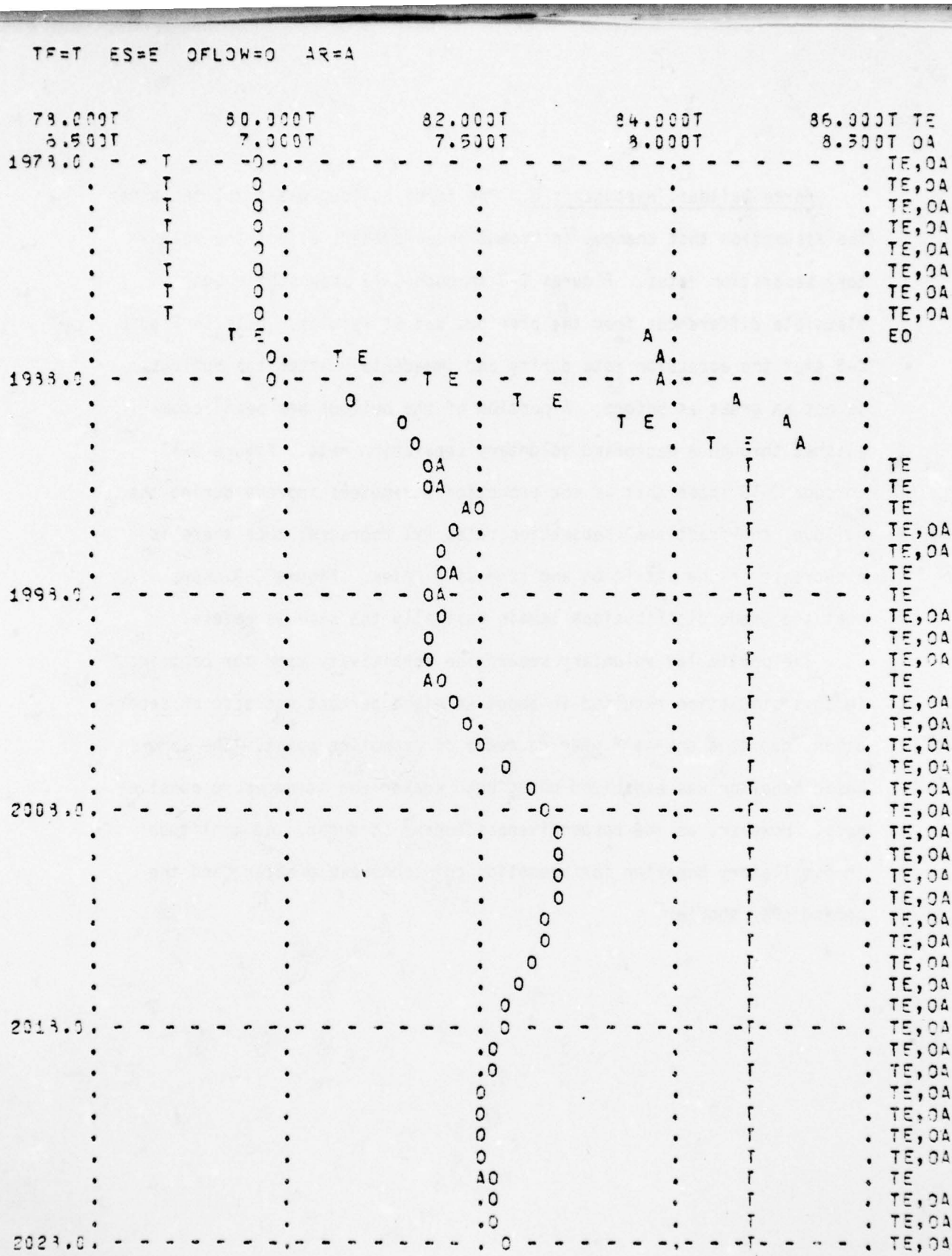


Figure C-8. Force Buildup (Hypothesis 3), Accessions and Total Force

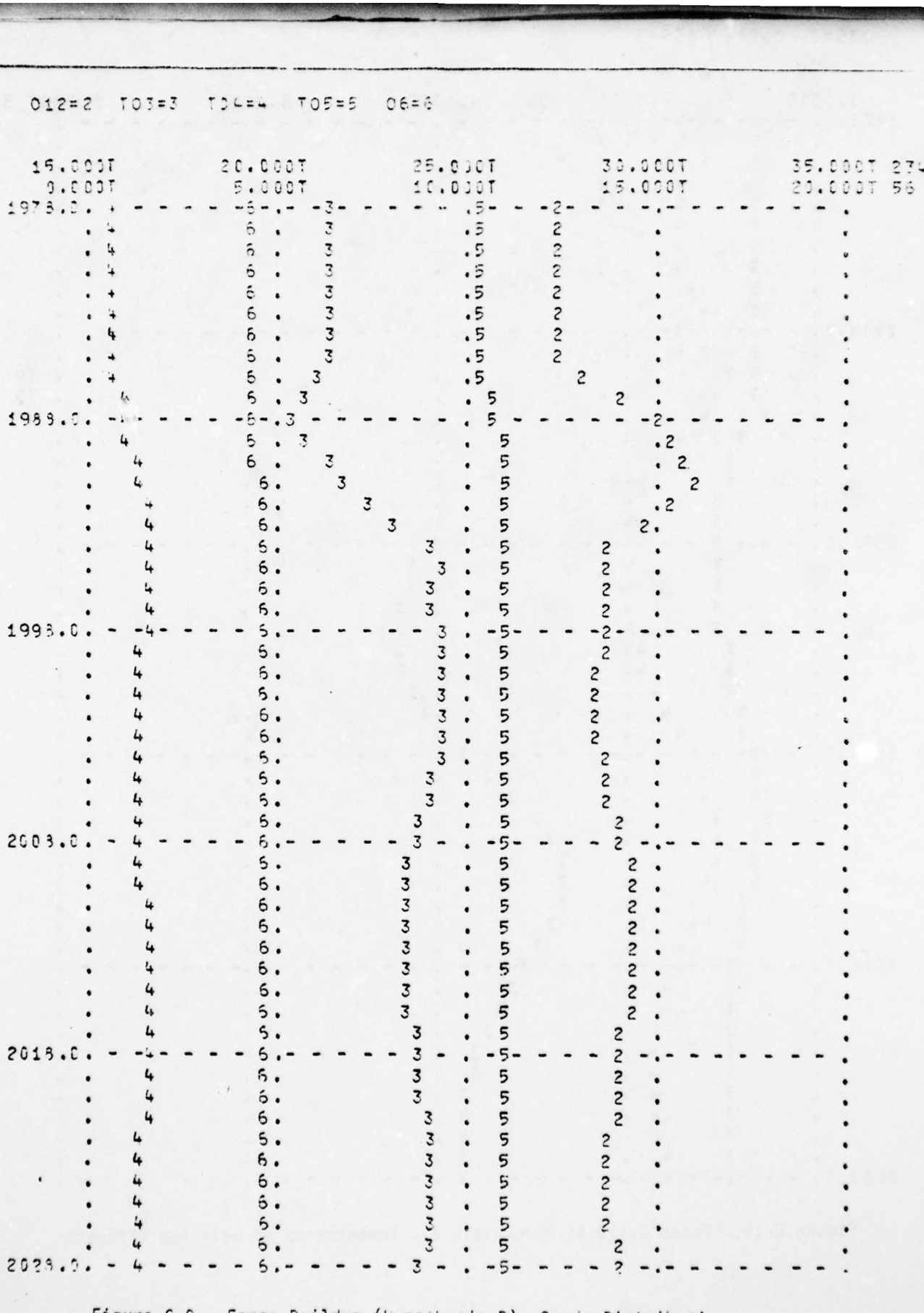


Figure C-9. Force Buildup (Hypothesis B), Grade Distribution

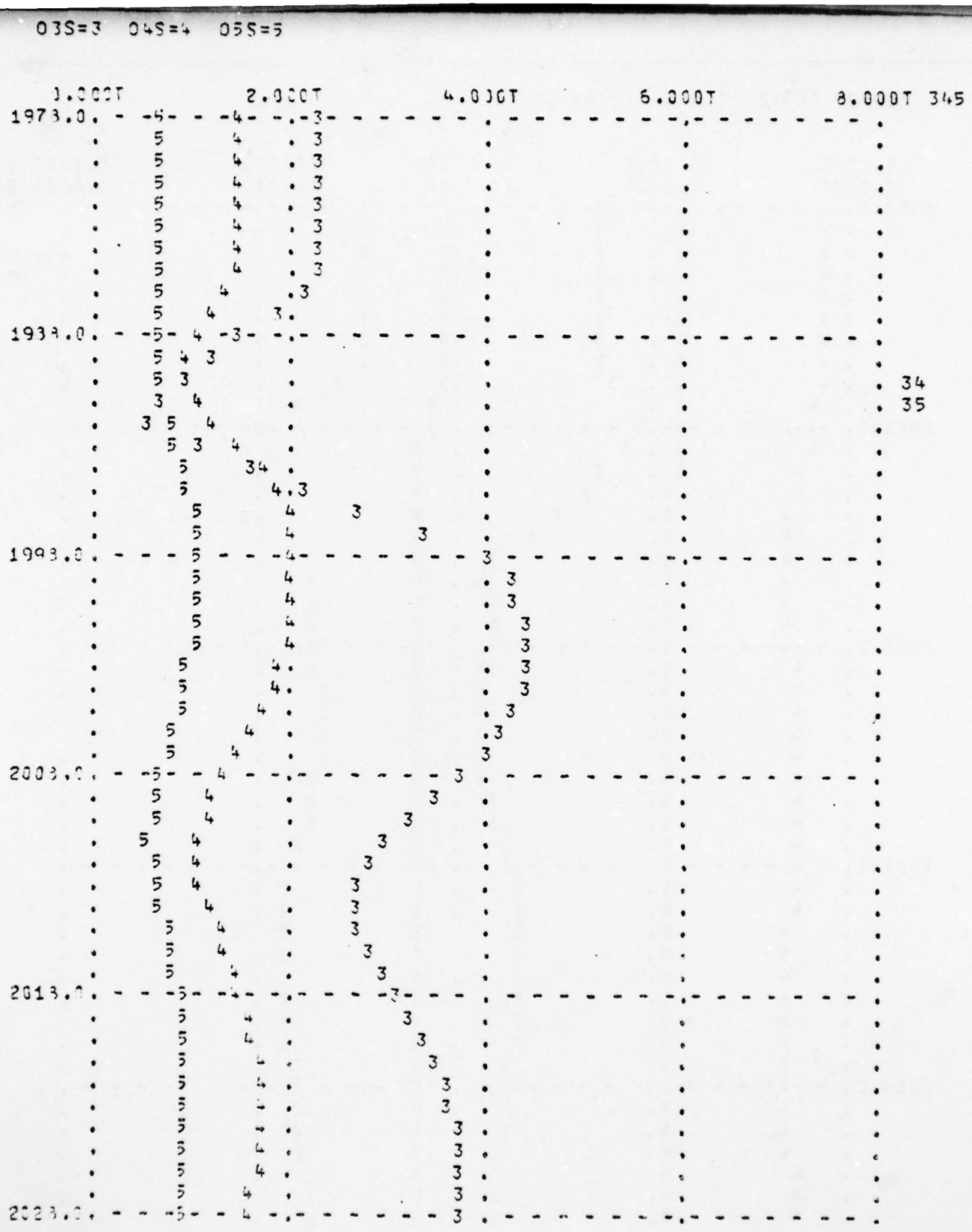


Figure C-10. Force Buildup (Hypothesis B), Inventories of Selected Officers

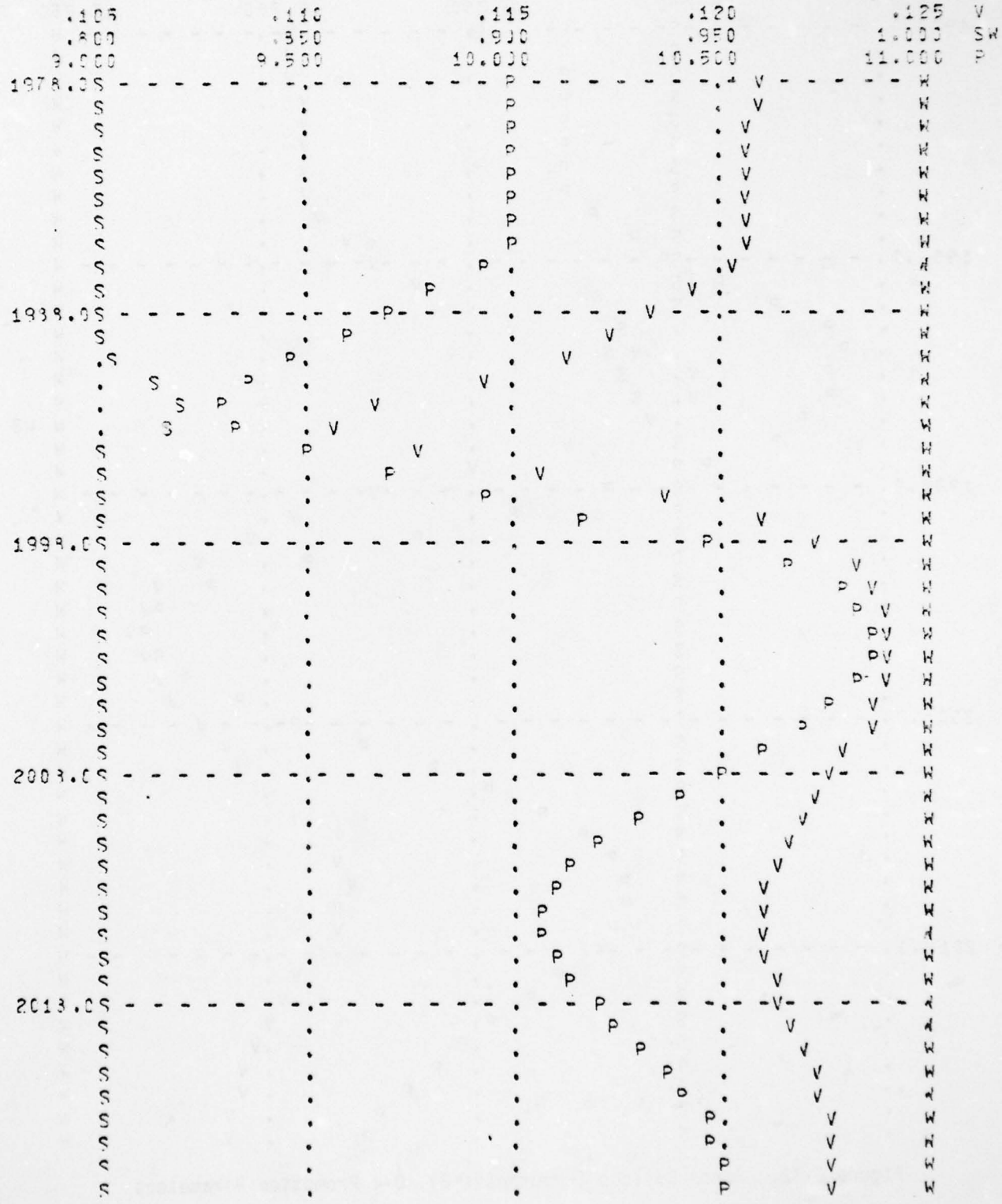
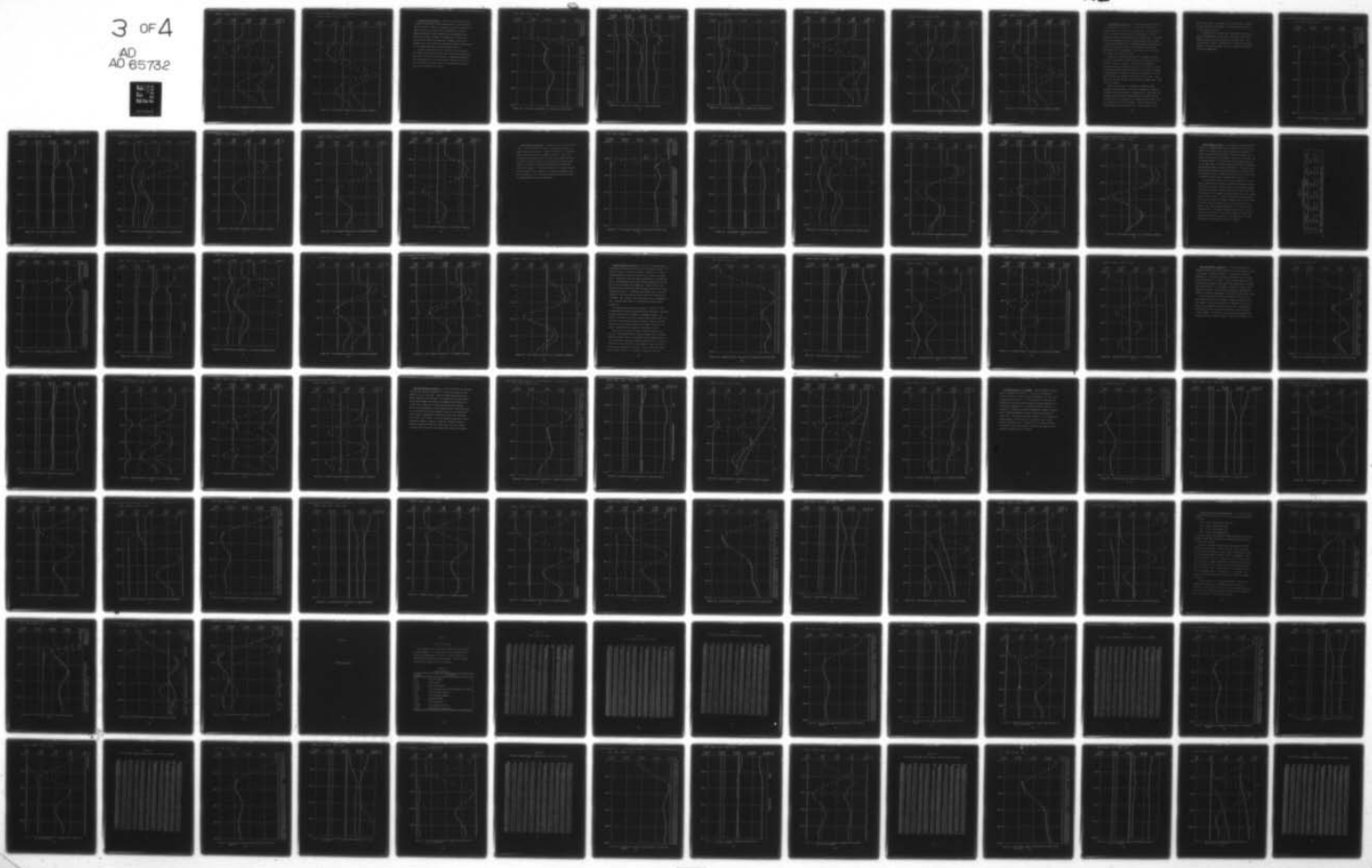


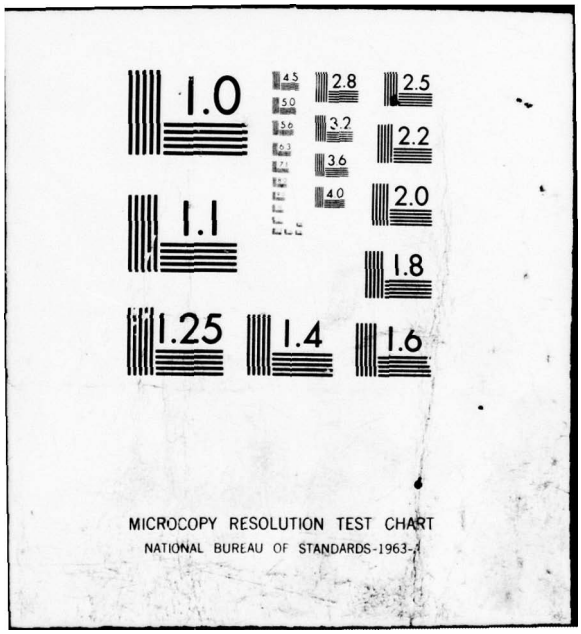
Figure C-11. Force Buildup (Hypothesis B), O-3 Promotion Parameters

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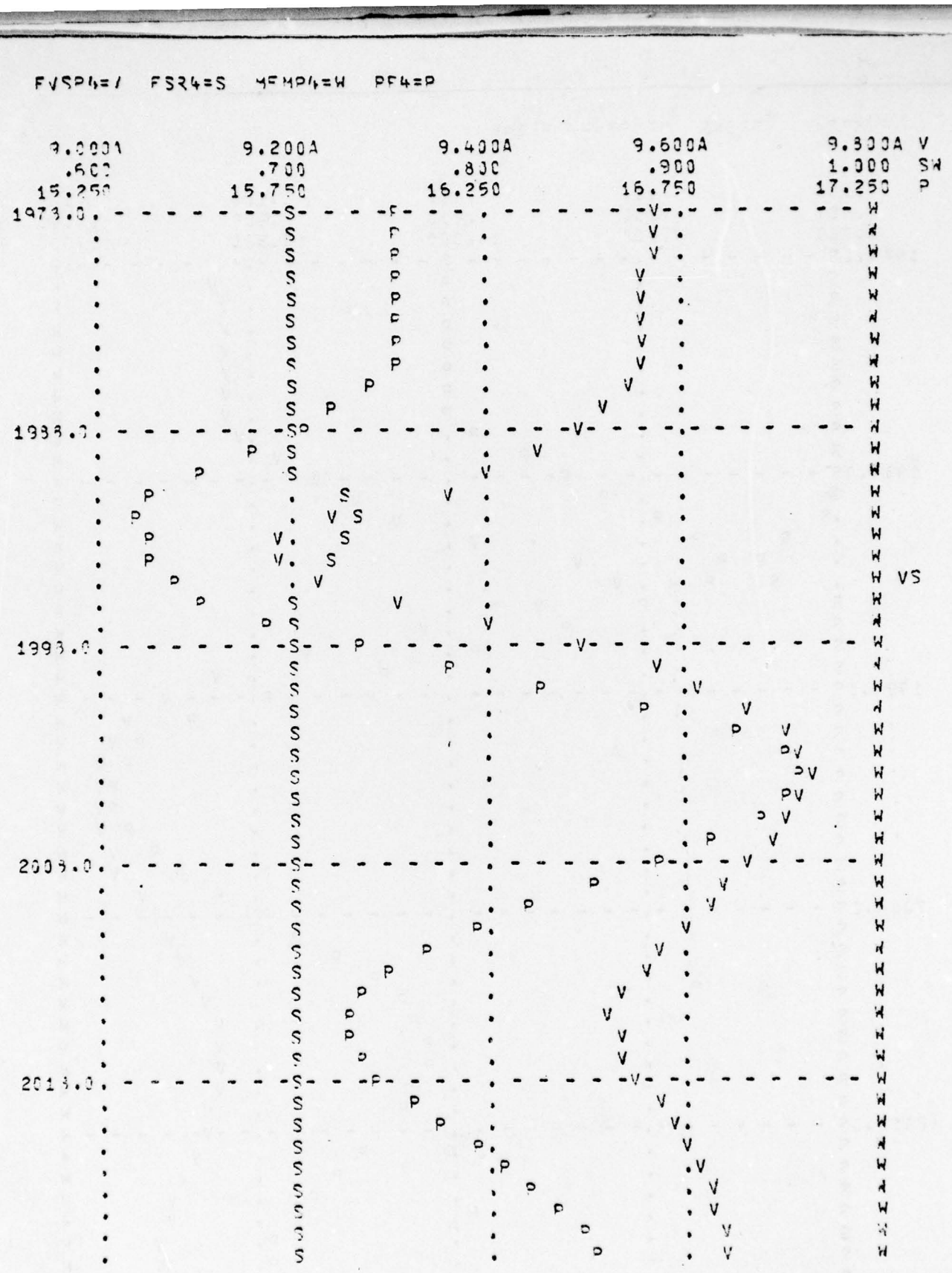


Figure C-12. Force Buildup (Hypothesis B), O-4 Promotion Parameters

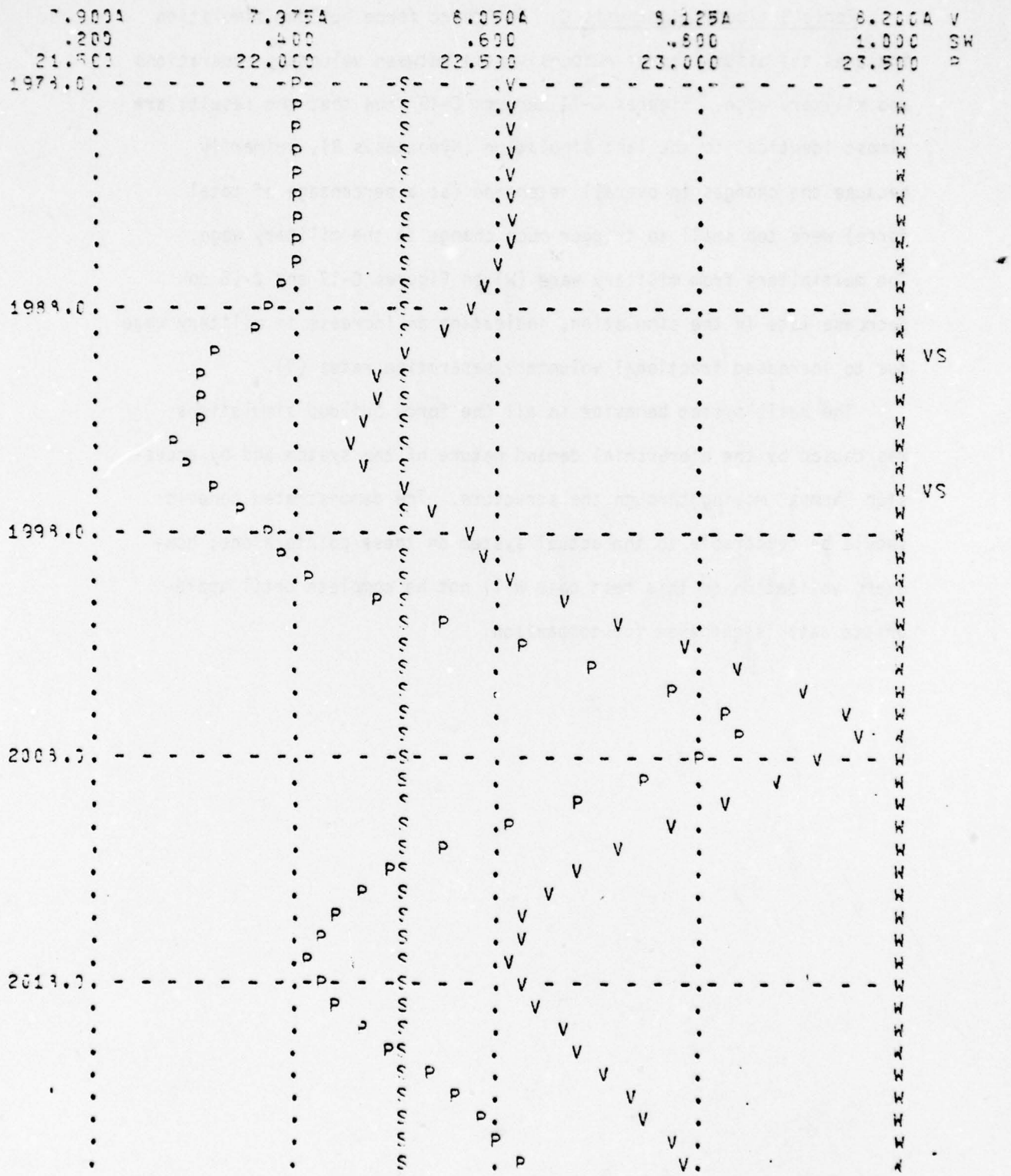


Figure C-13. Force Buildup (Hypothesis B), O-5 Promotion Parameters

Force Buildup, Hypothesis C. The third force buildup simulation includes the assumption of responsiveness between voluntary separations and military wage. Figures C-14 through C-19 show that the results are almost identical to the last simulation (Hypothesis B), primarily because the changes in overall retention (as a percentage of total force) were too small to trigger much change in the military wage. The multipliers from military wage (W) on Figures C-17 and C-18 do decrease late in the simulation, indicating an increase in military wage due to increased fractional voluntary separation rates (V).

The basic system behavior in all the force buildup simulations was caused by the hierarchial demand nature of the system and by accession "humps" moving through the structure. The demonstrated behavior should be comparable to the actual system on these points alone; however, validation on this test case will not be complete until appropriate data is gathered for comparison.

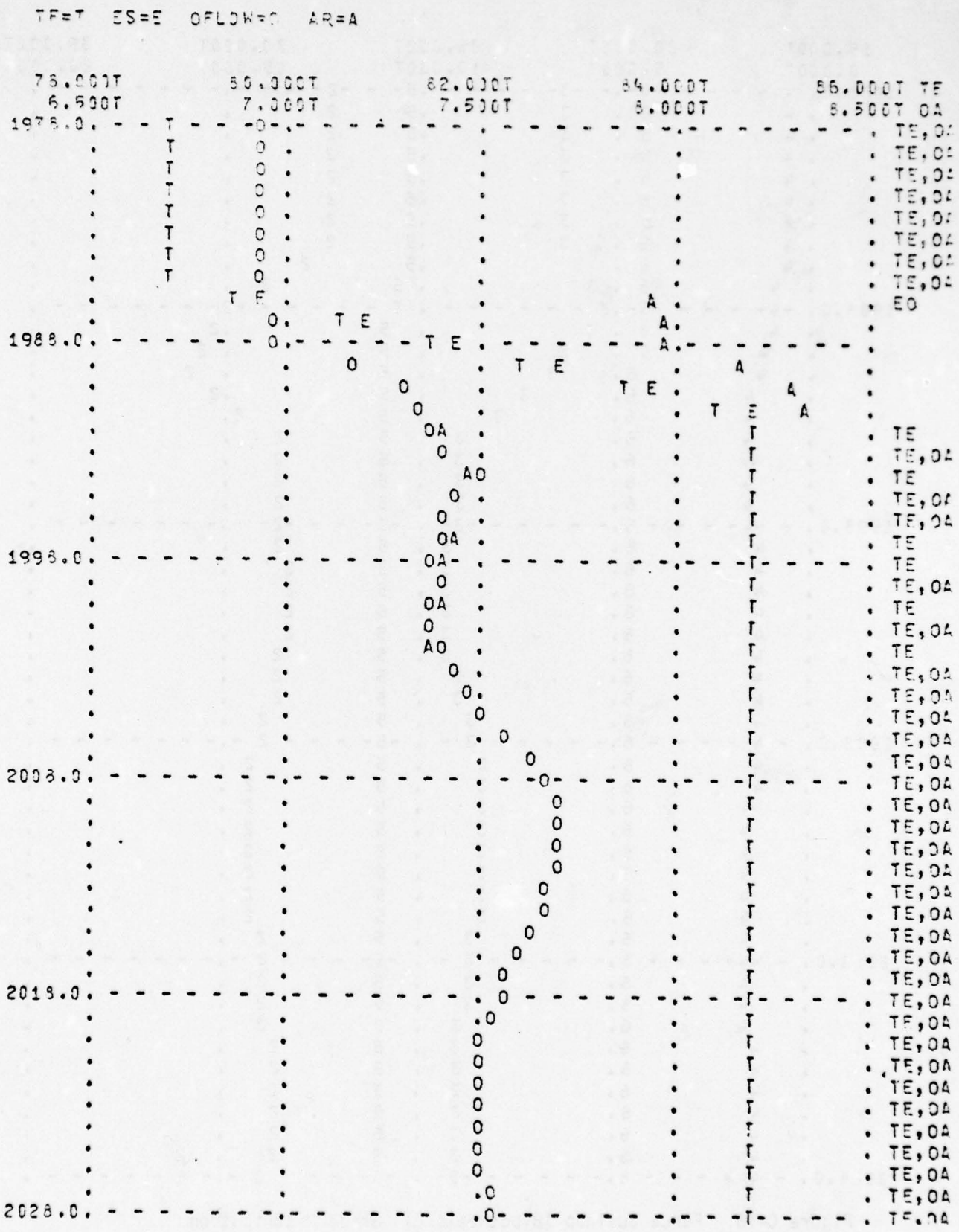


Figure C-14. Force Buildup (Hypothesis C), Accessions and Total Force

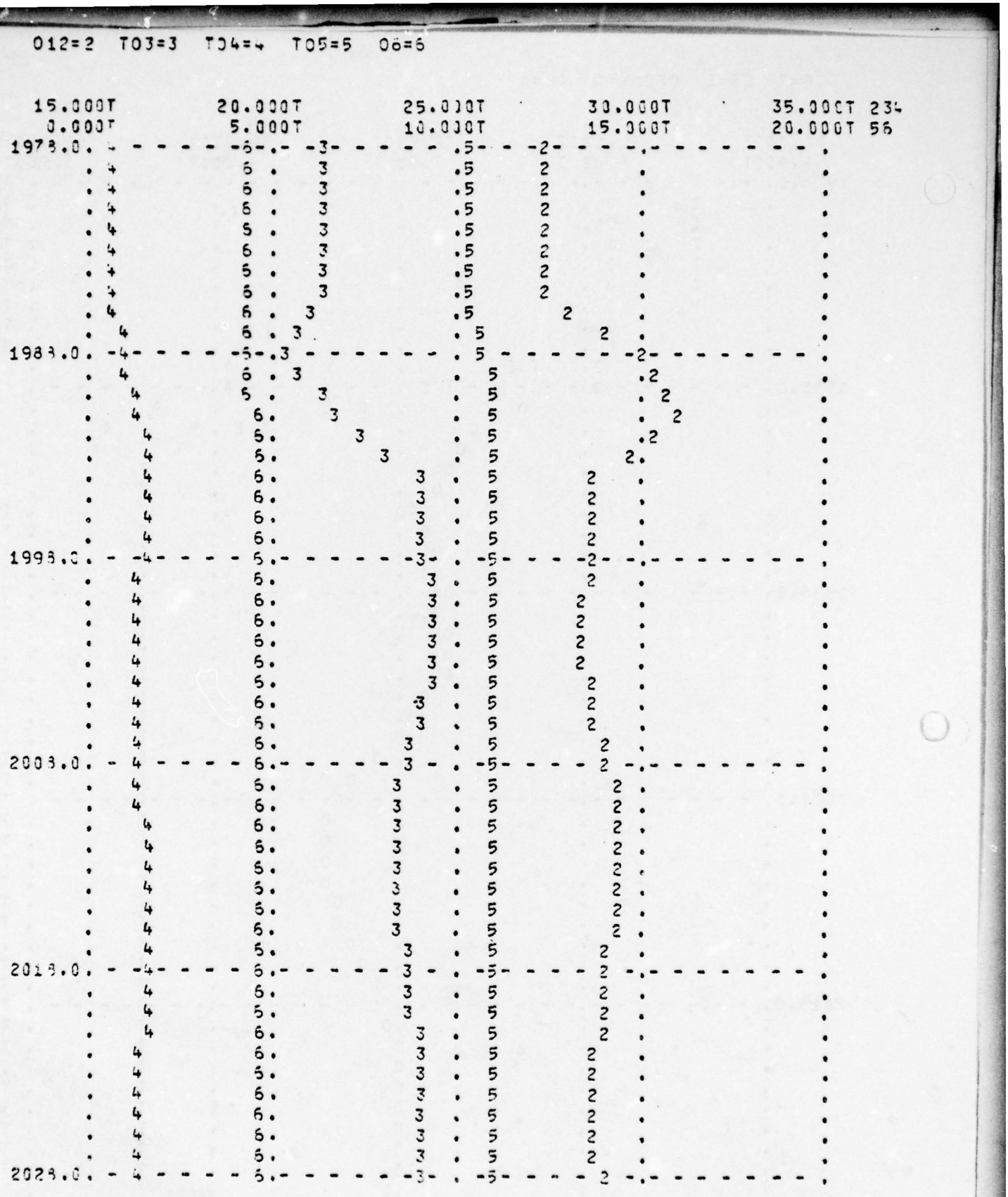


Figure C-15. Force Buildup (Hypothesis C), Grade Distribution

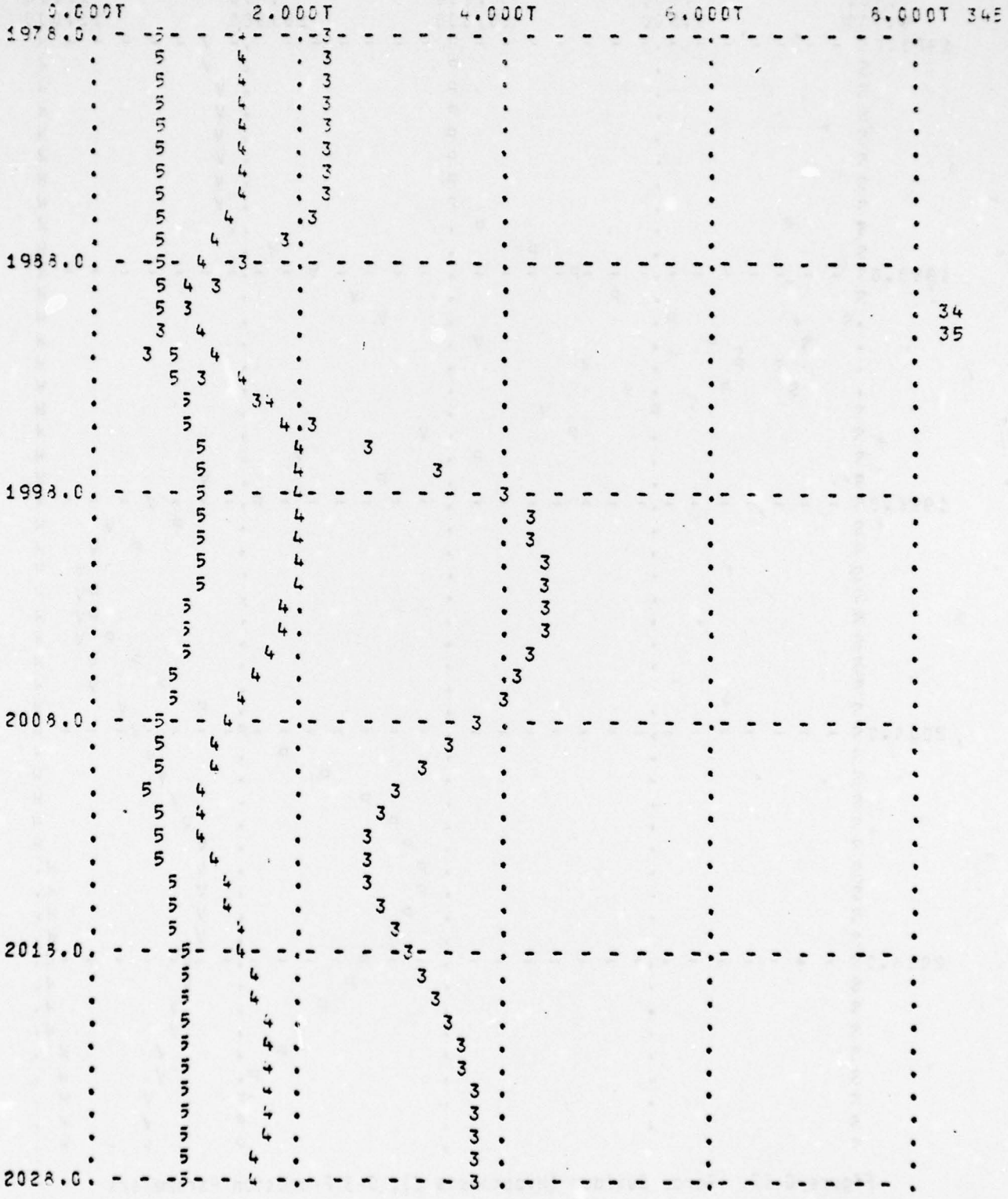


Figure C-16. Force Buildup (Hypothesis C), Inventories of Selected Officers

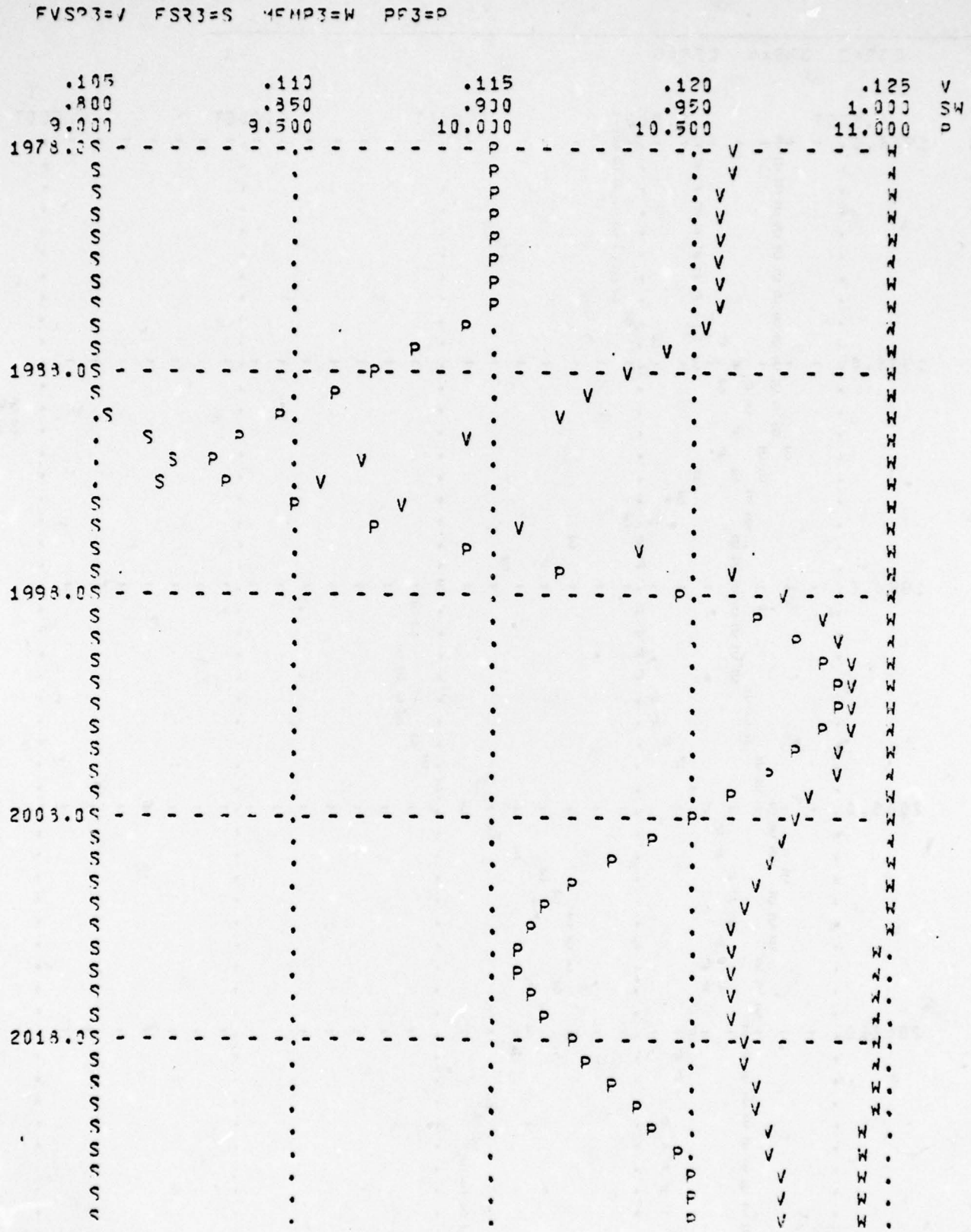


Figure C-17. Force Buildup (Hypothesis C), O-3 Promotion Parameters

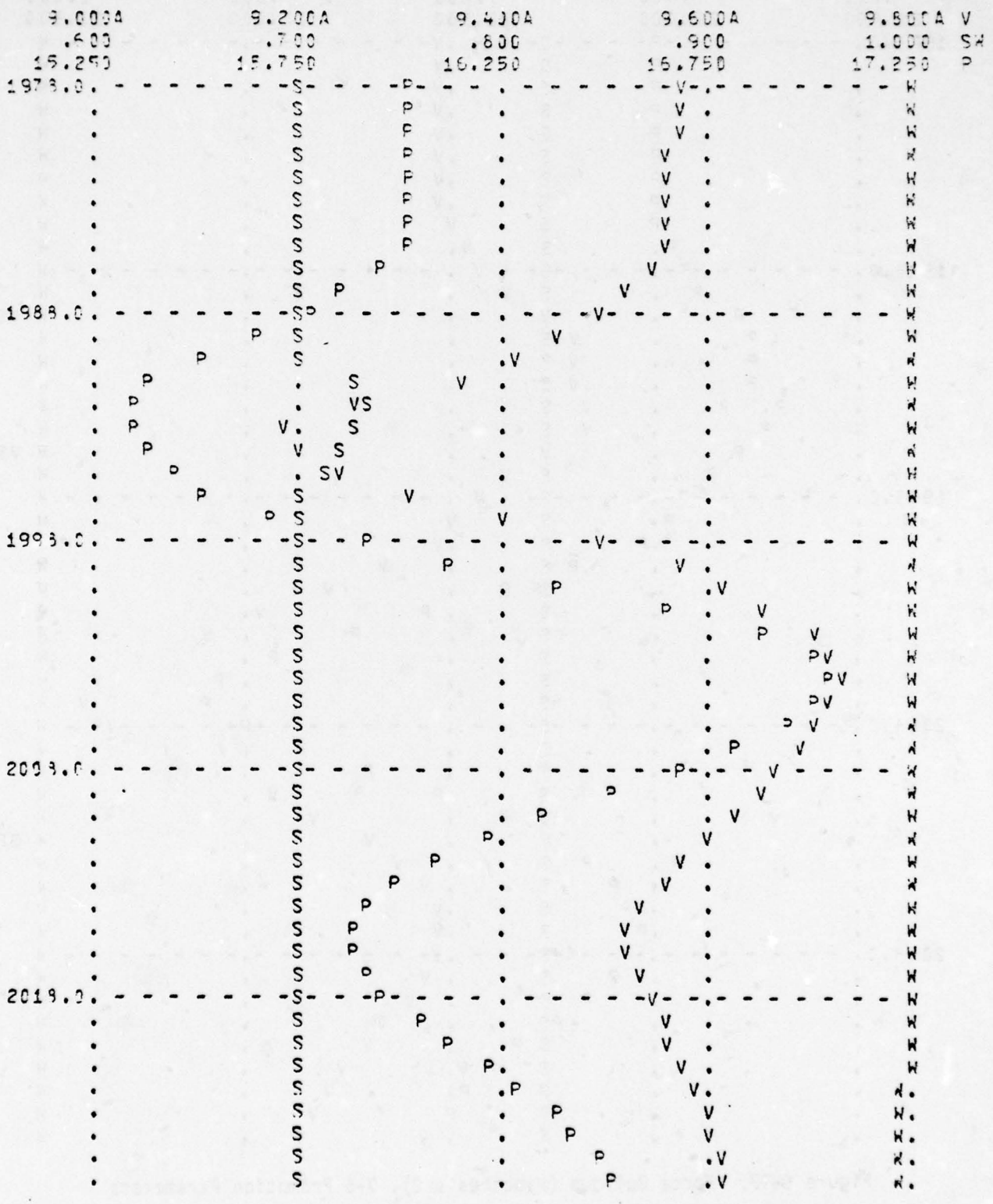


Figure C-18. Force Buildup (Hypothesis C), O-4 Promotion Parameters

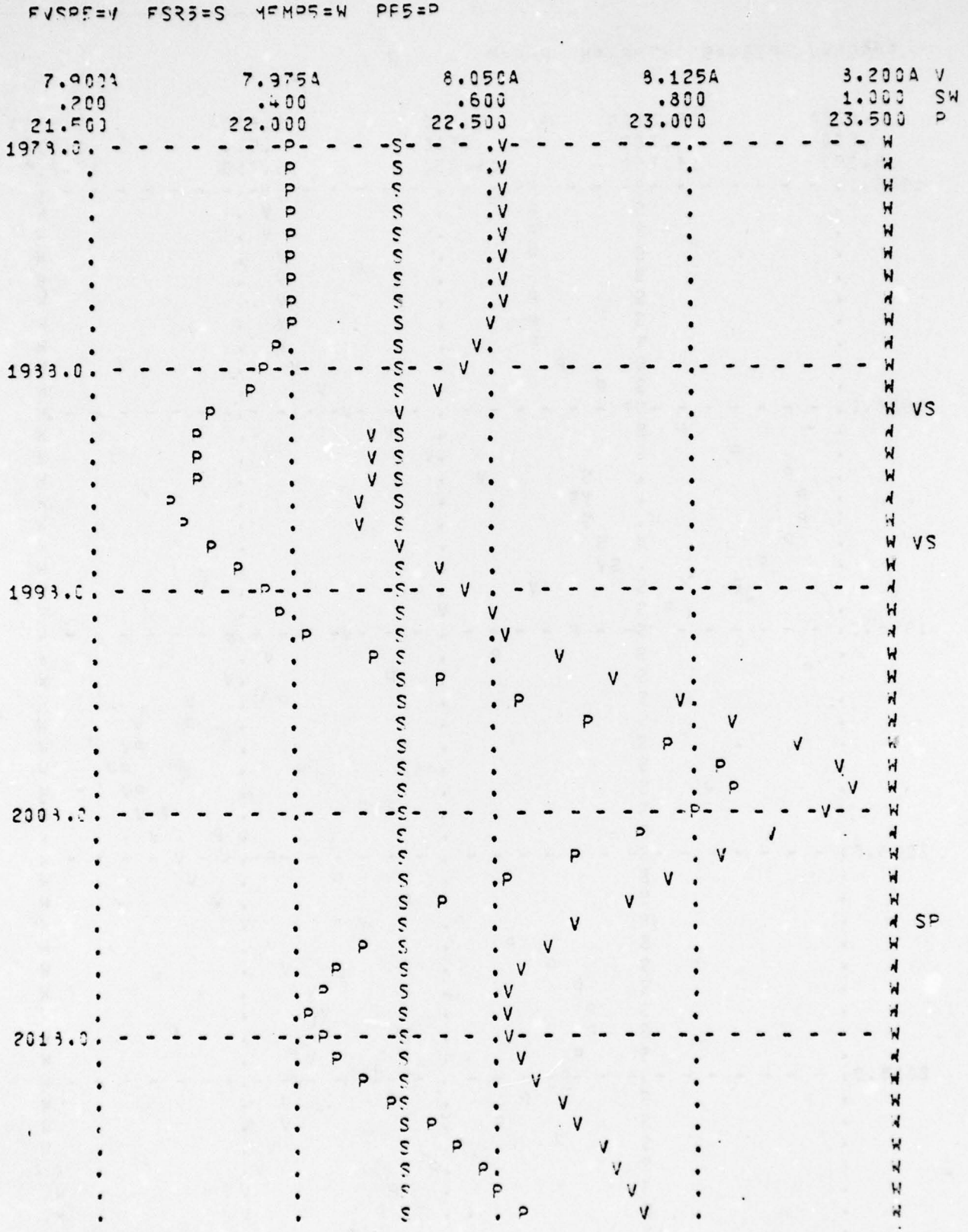


Figure C-19. Force Buildup (Hypothesis C), O-5 Promotion Parameters

Force Drawdown, Hypothesis A. The force drawdown was accomplished in a fashion similar to the buildup. The desired end strength (E) is gradually decreased by 3,800 over a five year span. The first simulation is run under the assumption of no responsiveness in voluntary separations to either career expectations or military wage. Figure C-20 shows that the accession rate (A) is reduced below attrition in order to reduce the total force size. The drawdown produces five reduced year groups which must pass the end-of-initial-obligation point before attrition (O) will stop decreasing. Total force size (T) and desired end strength finally meet at year 1993.

Figure C-21 illustrates the effects of the drawdown on grade distribution. The decrease in demand from the top three grades results in an initial buildup in captains. Lieutenants are simultaneously decreased through the decreased accession rate. Once demand from above stabilizes and reduced accessions reach the four year point, the number of captains begins to decrease. After a ten year transition, the numbers of captains and lieutenants are below the initial values. Therefore, as in the force buildup, the relative balance between these levels has been maintained.

Figure C-22 shows that all inventories of selected officers increase during the drawdown. The level of selected O-5s increases by an amount equal to the reduction in authorized O-6s. The selected O-4s increase by an amount equal to the reduction in authorized O-6s and O-5s, and finally, the selected O-3s increase by an amount equal to the total reduction in the top three grades. As the new demands after drawdown stabilize, the inventories fall to levels generally below

their initial values. This indicates that although demand is reduced for each grade during the drawdown, it eventually becomes greater at the new reduced force size.

All promotion points (Figures C-23 through C-25) rise during the period of reduced demand for each grade. The promotion points finally dampen to values which are less than under the larger force. The "sliding scale" principle is responsible for a less than proportionate decrease in the top three grades, resulting in better career progression for the reduced force.



Figure C-20. Force Drawdown (Hypothesis A), Accessions and Total Force

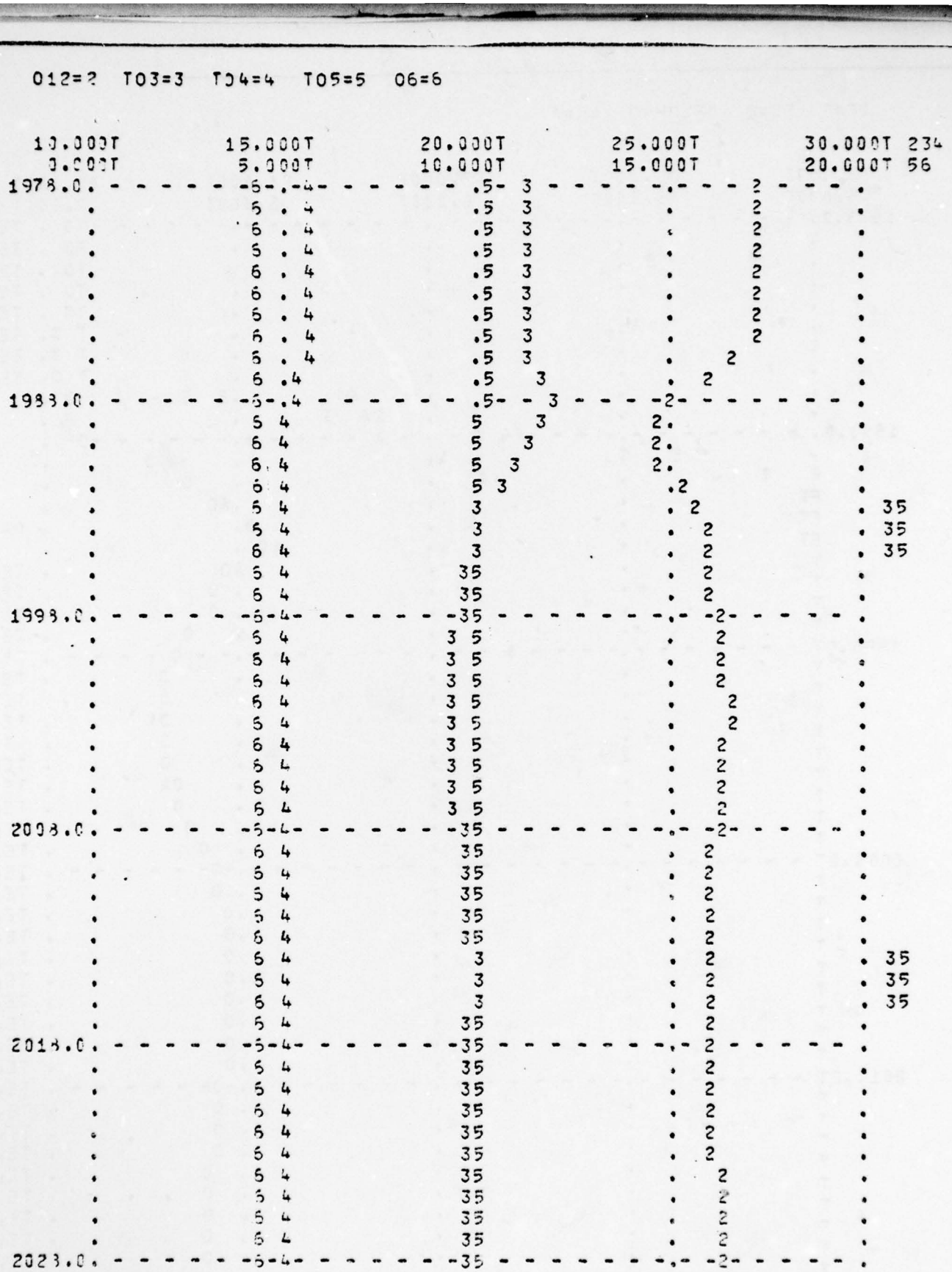


Figure C-21. Force Drawdown (Hypothesis A), Grade Distribution

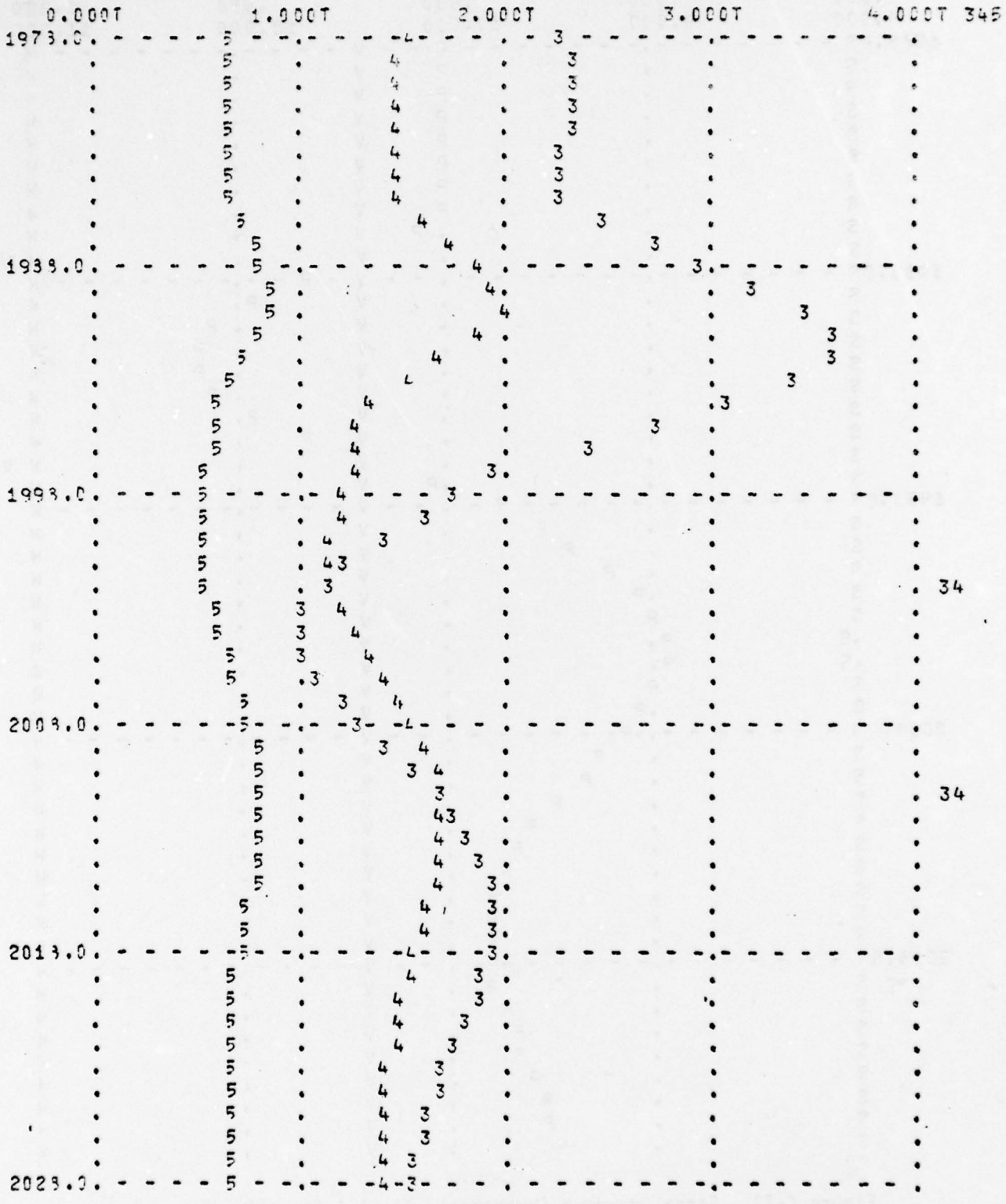


Figure C-22. Force Drawdown (Hypothesis A), Inventories of Selected Officers

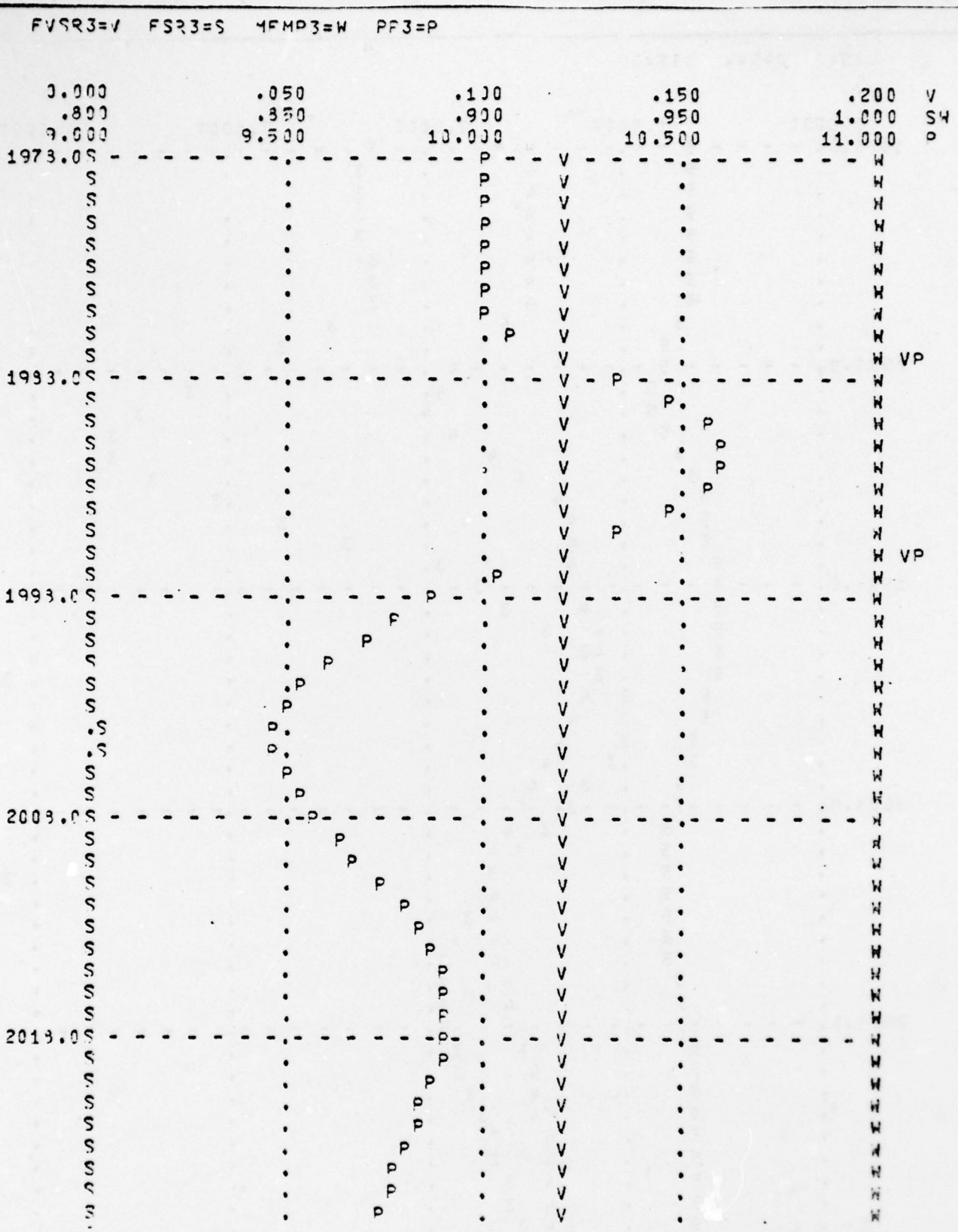


Figure C-23. Force Drawdown (Hypothesis A), O-3 Promotion Parameters

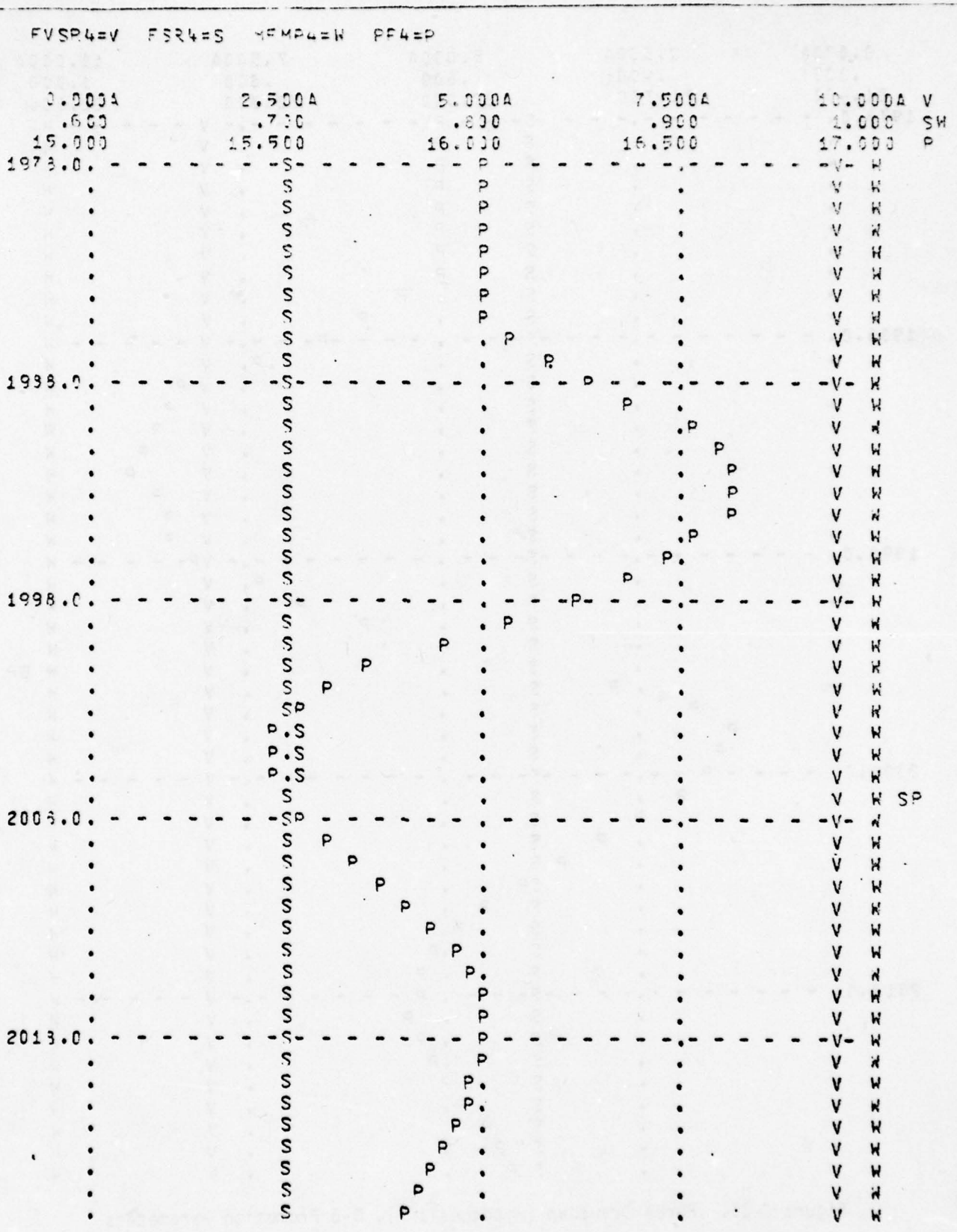


Figure C-24. Force Drawdown (Hypothesis A), O-4 Promotion Parameters

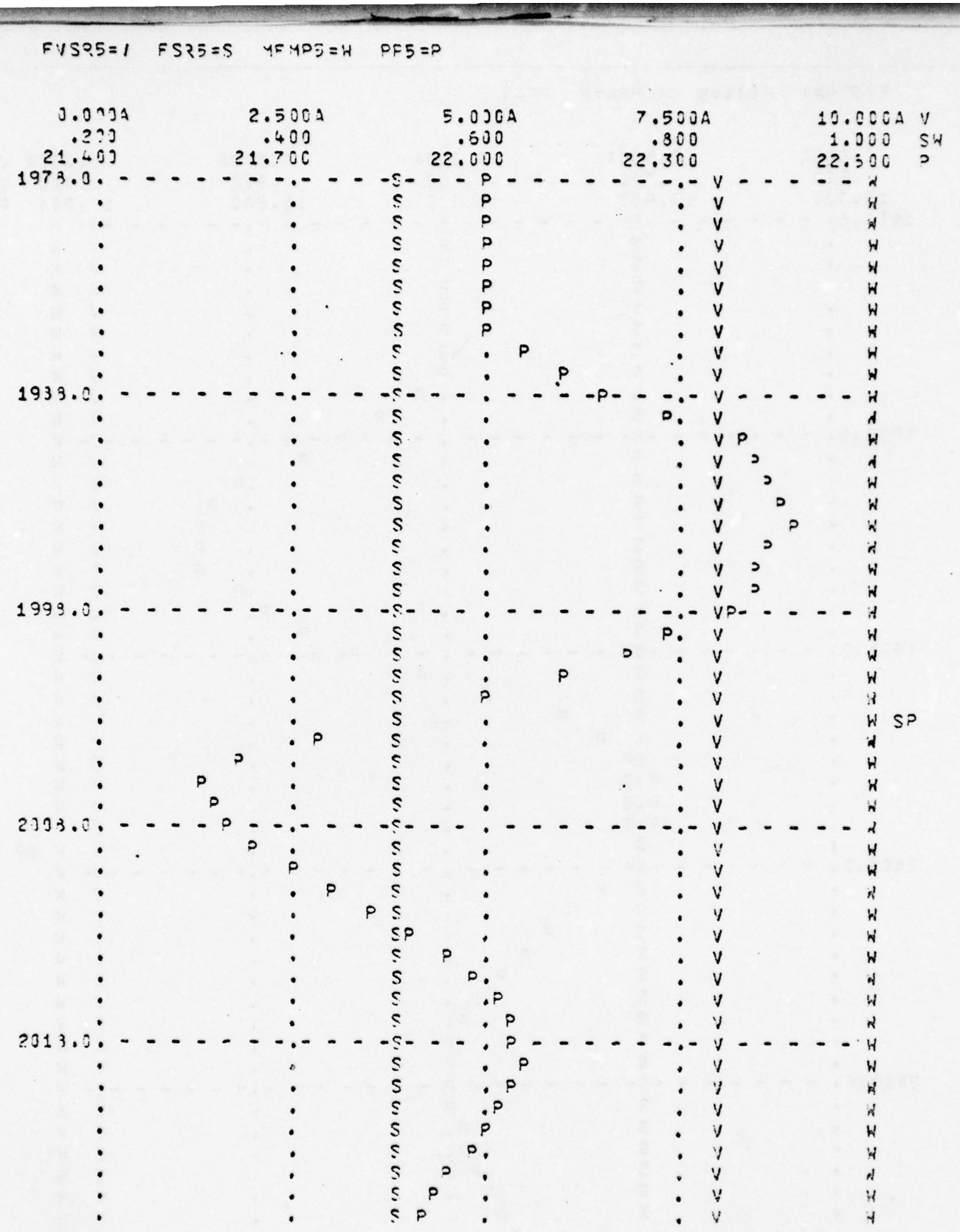


Figure C-25. Force Drawdown (Hypothesis A), O-5 Promotion Parameters

Force Drawdown, Hypothesis B. The results for the simulated force drawdown under the hypothesis of voluntary separations responding to career expectations are shown in Figures C-26 through C-31. The assumed responsiveness causes only minor changes in behavior. Figure C-26 indicates that the accession rate is slightly more dampened than before. The grade distribution (Figure C-27) is essentially the same, and the changes in inventories of selected officers are minor (Figure C-28). Figures C-29 through C-31 illustrate the changes in fractional voluntary separation rates (V) due to changes in the promotion parameters (P,S). The basic behavior in this simulation remained consistent over a range of responsiveness from voluntary separations.

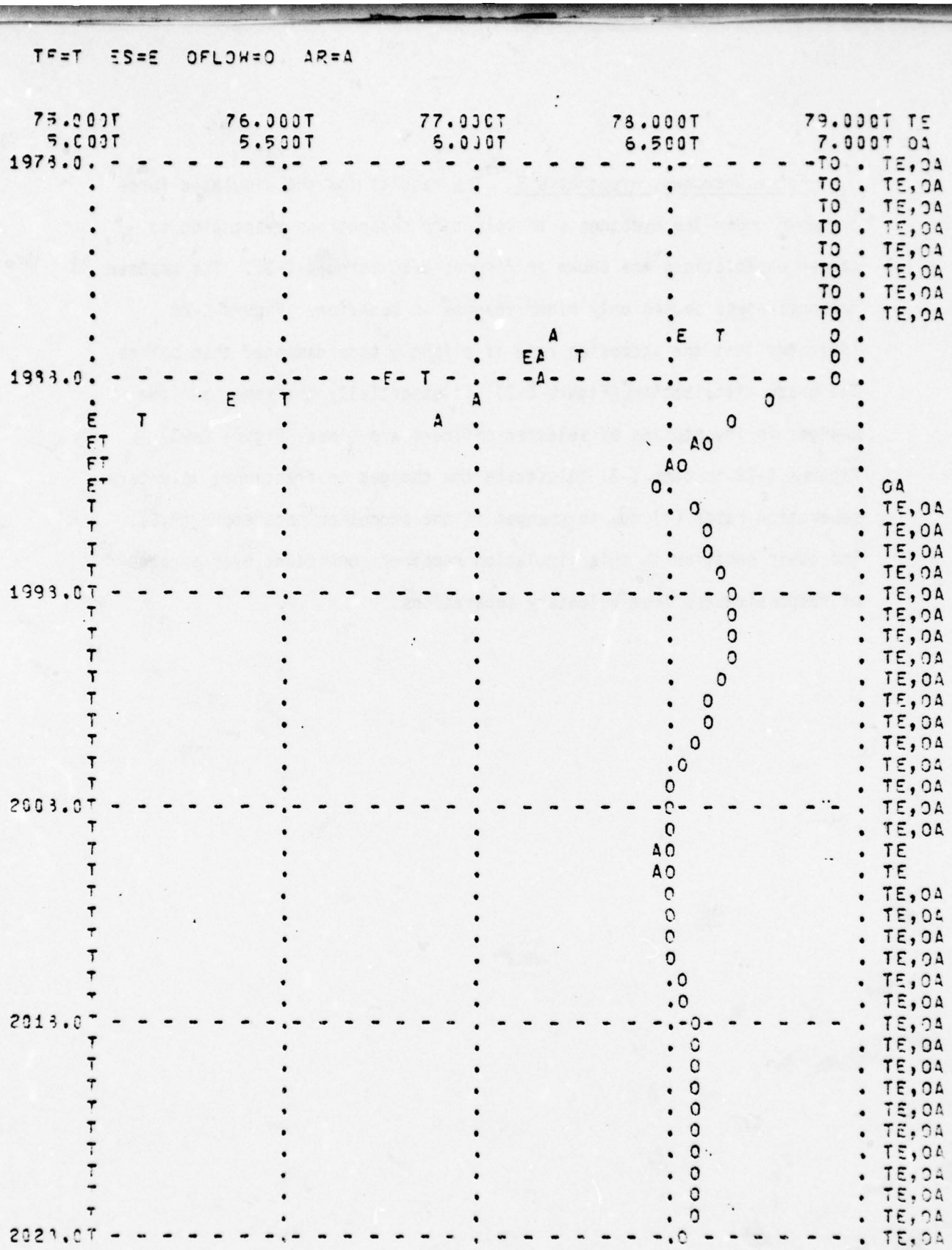


Figure C-26. Force Drawdown (Hypothesis B), Accessions and Total Force

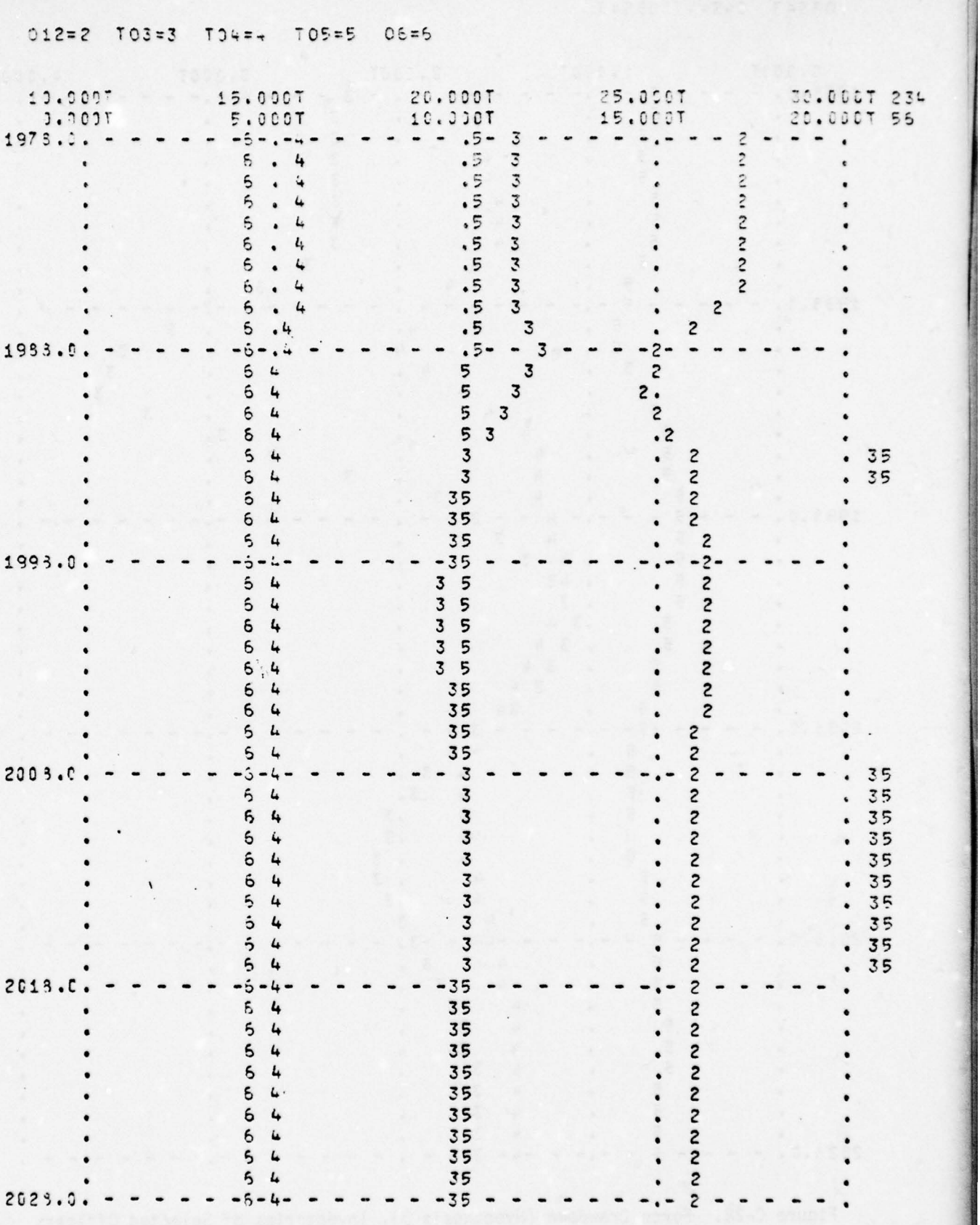


Figure C-27. Force Drawdown (Hypothesis B), Grade Distribution

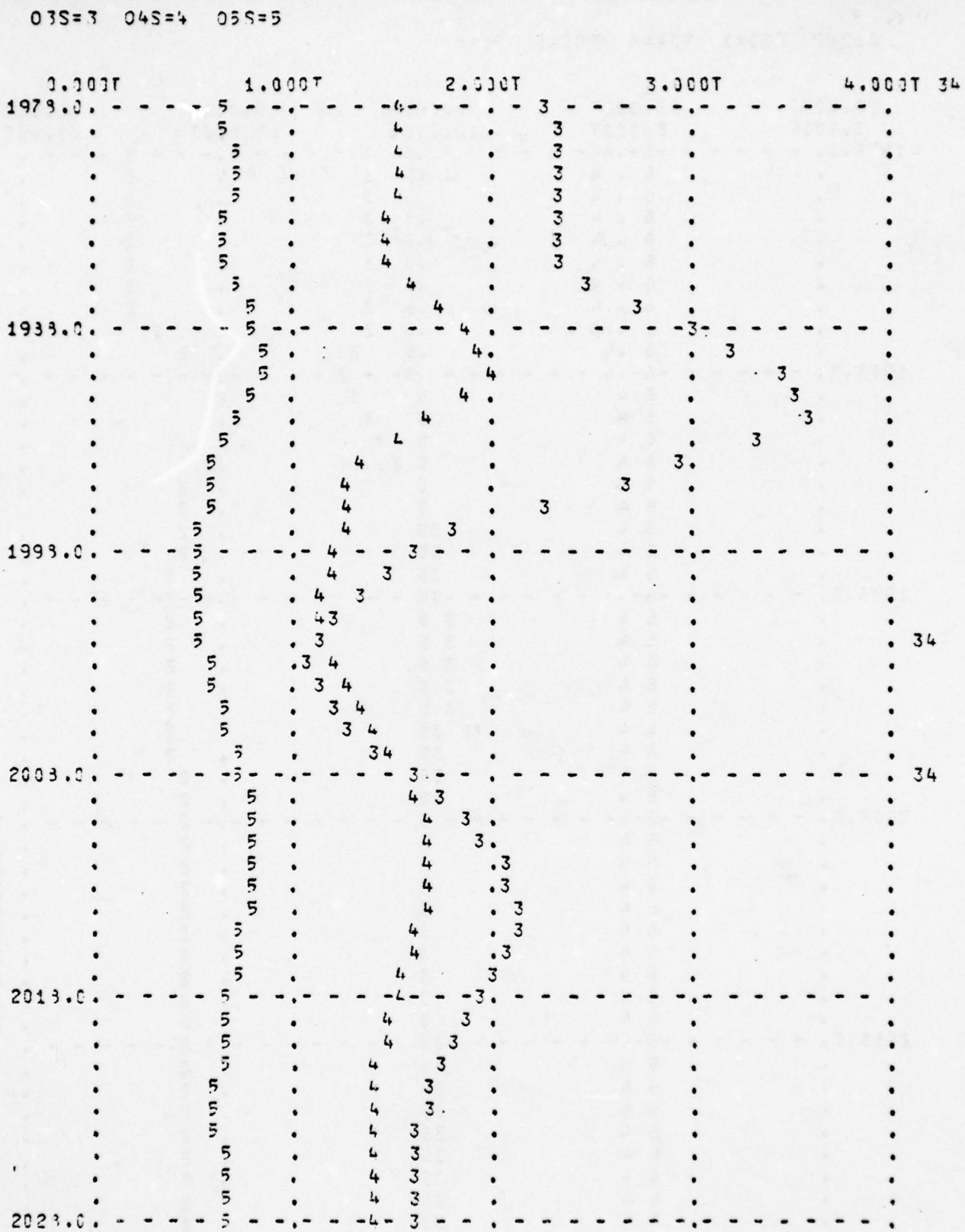


Figure C-28. Force Drawdown (Hypothesis B), Inventories of Selected Officers

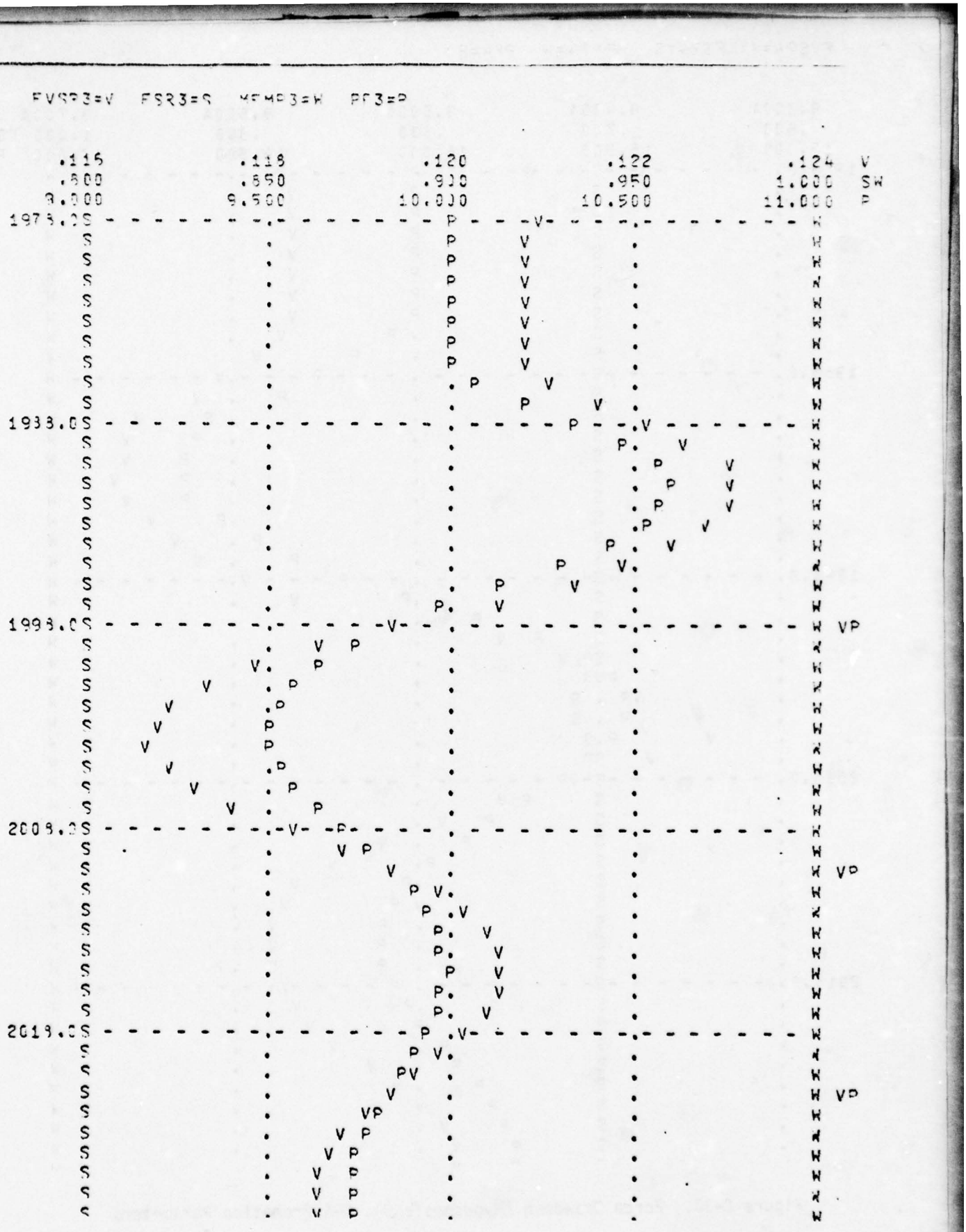


Figure C-29. Force Drawdown (Hypothesis B), O-3 Promotion Parameters

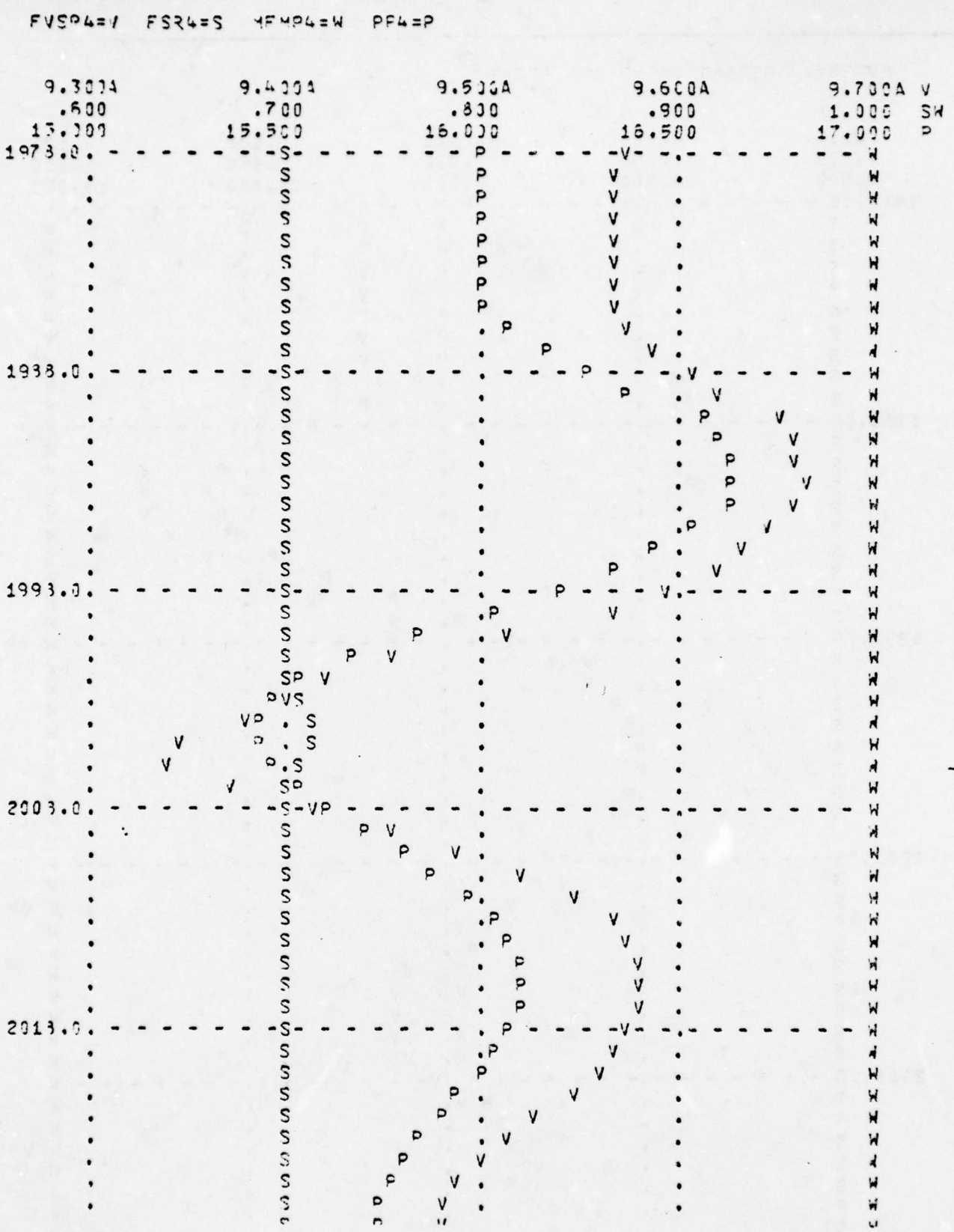


Figure C-30. Force Drawdown (Hypothesis B), O-4 Promotion Parameters

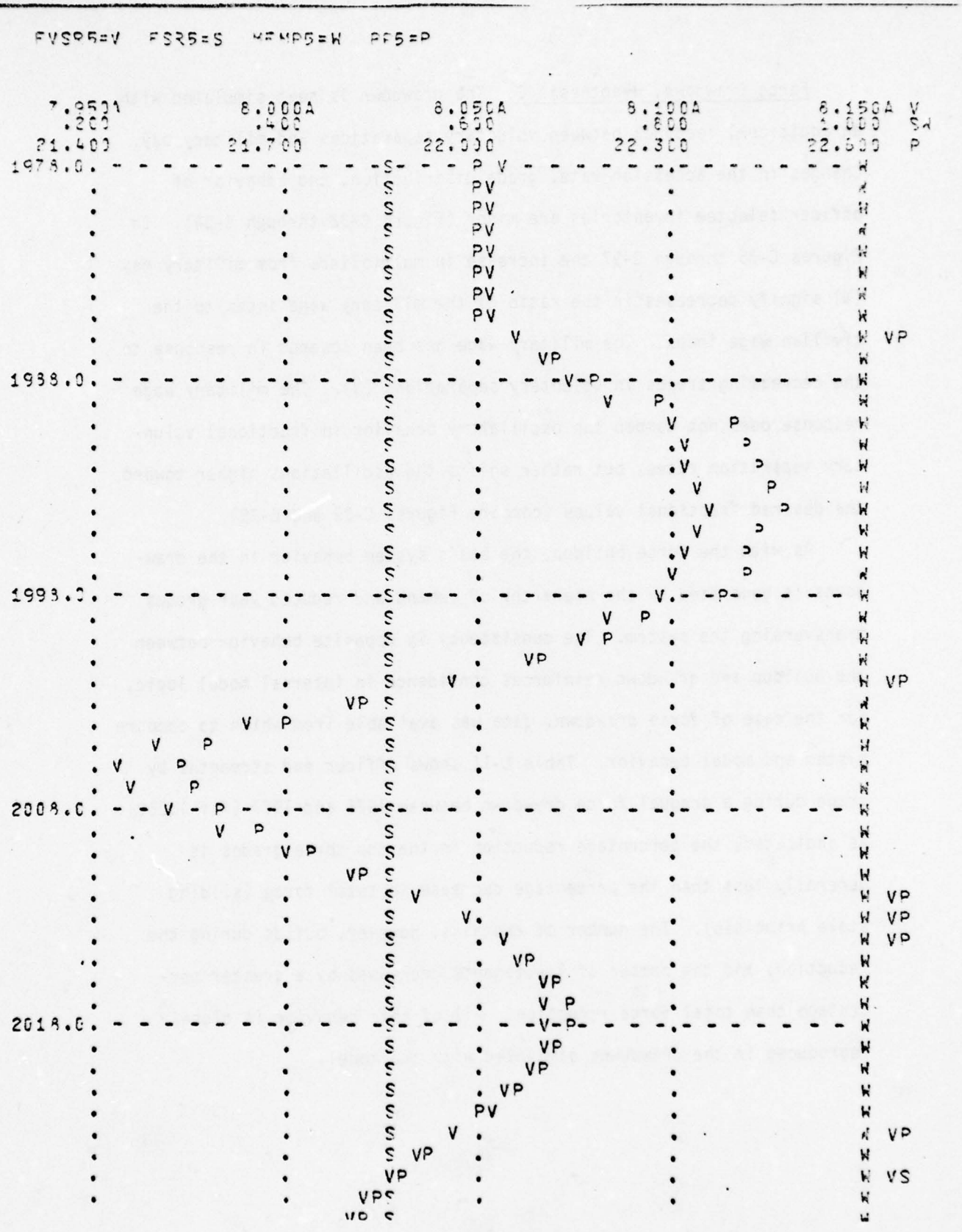


Figure C-31. Force Drawdown (Hypothesis B), O-5 Promotion Parameters

Force Drawdown, Hypothesis C. The drawdown is next simulated with an additional feedback between voluntary separations and military pay. Changes in the accession rate, grade distribution, and behavior of officer selectee inventories are minor (Figure C-32 through C-34). In Figures C-35 through C-37 the increase in multipliers from military pay (W) signify decreases in the ratio of the military wage index to the civilian wage index. The military wage has been lowered in response to the decreasing trends in voluntary separations (V). The military wage response does not dampen the oscillatory behavior in fractional voluntary separation rates, but rather shifts the oscillations higher toward the desired fractional values (compare Figures C-29 and C-35).

As with the force buildup, the basic system behavior in the drawdowns is generated by the hierarchy of demand and reduced year groups transversing the system. The consistency in opposite behavior between the buildup and drawdown reinforces confidence in internal model logic. For the case of force drawdown, data was available from which to compare system and model behavior. Table C-II shows officer end strengths by grade during a gradual force drawdown between 1975 and 1977 (Ref 1:250). As indicated, the percentage reduction in the top three grades is generally less than the percentage decrease in total force (sliding scale principle). The number of captains, however, builds during the reduction, and the number of lieutenants decreases by a greater percentage than total force reduction. All of this behavior is closely reproduced in the drawdowns simulated with the model.

TABLE C-II

Air Force Officer Force Reduction

Year	Lieutenant	Captain	Major	Lieutenant Colonel	Colonel	End Strength
1975	26238	39162	20605	13048	5488	104541
1976	22225(-.15)	39829(+.02)	19244(-.07)	12660(-.03)	5226(-.04)	99184(-.05)
1977	19281(-.13)	40333(+.01)	18594(-.03)	2299(-.03)	5167(-.01)	95674(-.04)

NOTE: Numbers in parentheses indicate percentage changes from the preceding year.

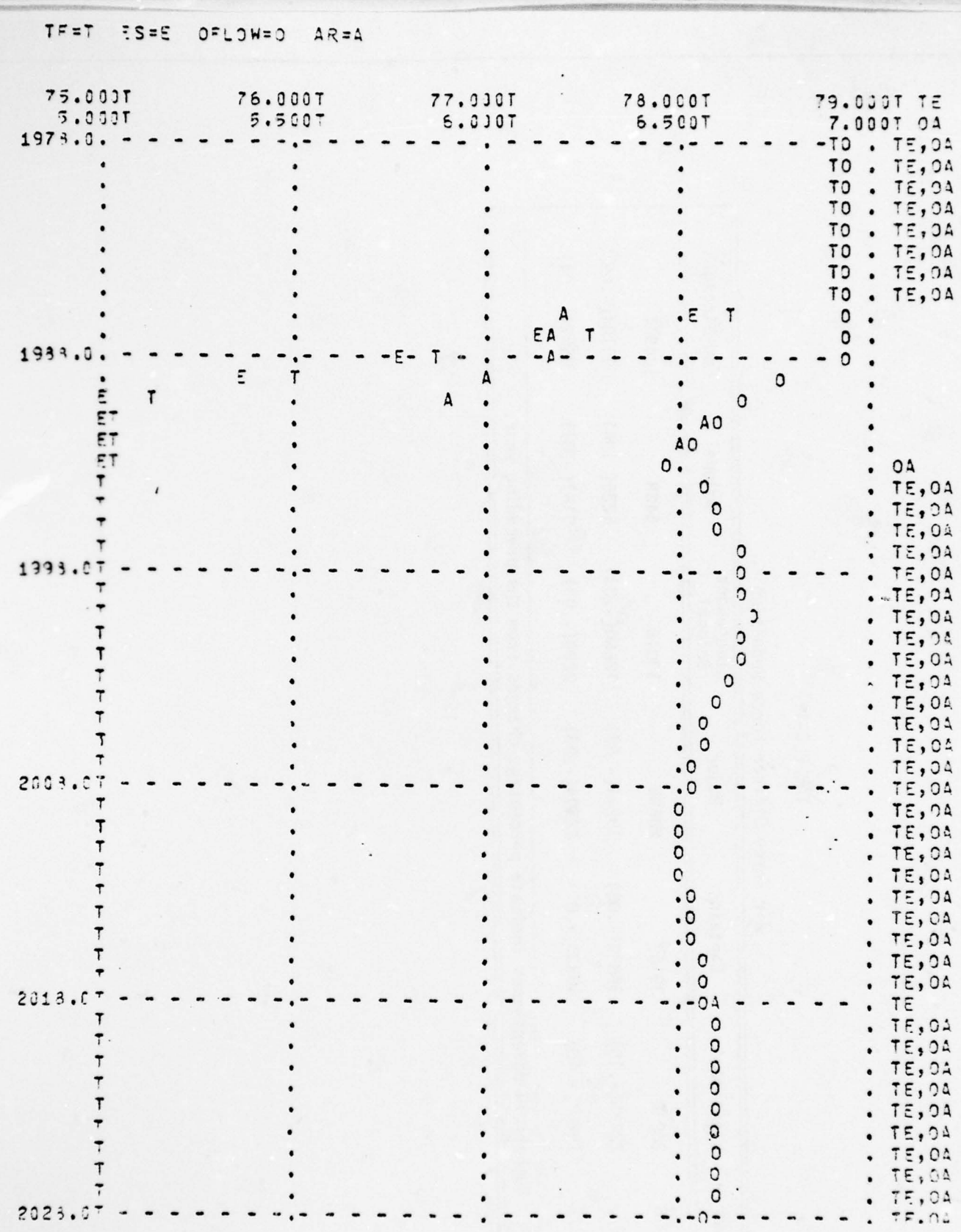


Figure C-32. Force Drawdown (Hypothesis C), Accessions and Total Force

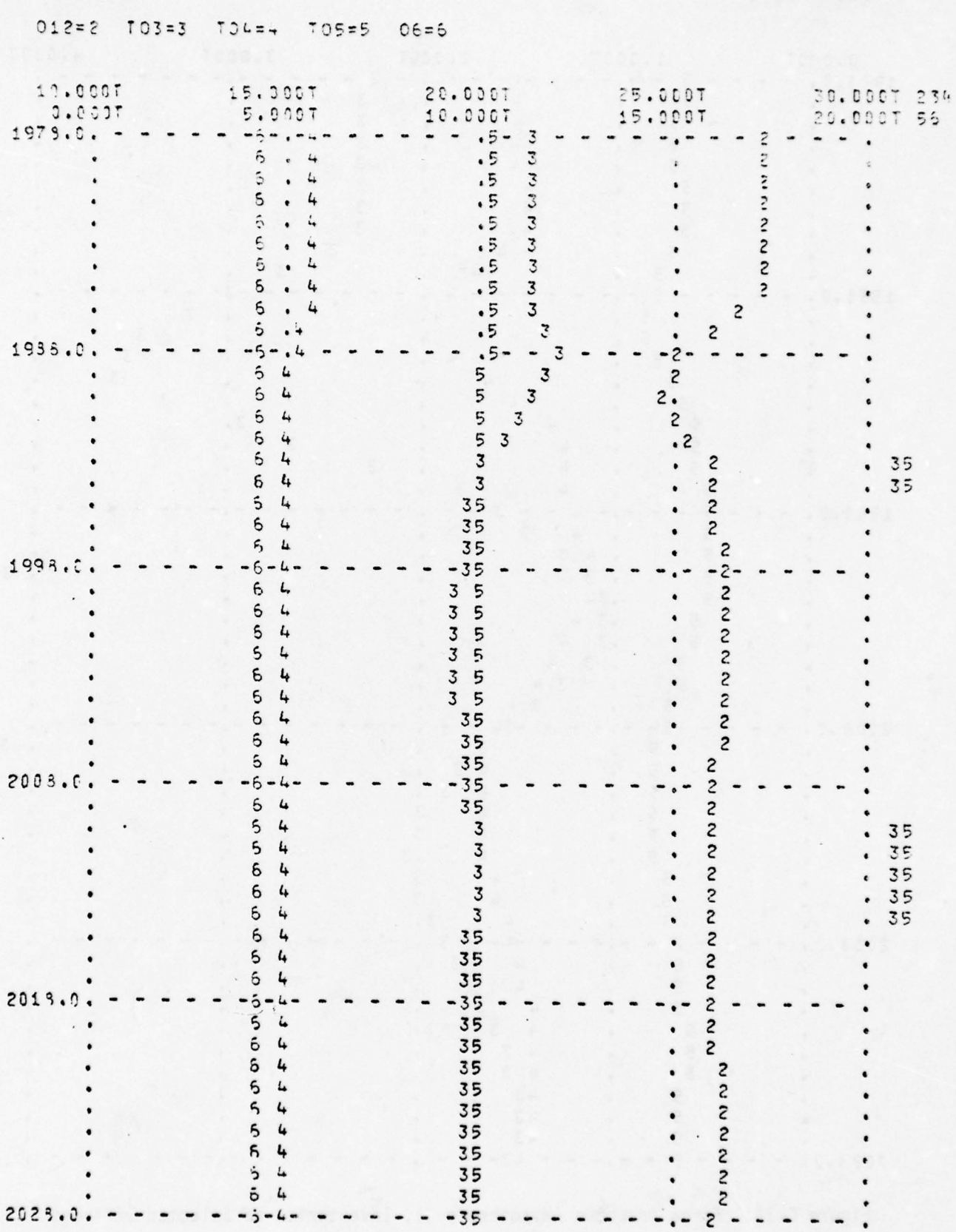


Figure C-33. Force Drawdown (Hypothesis C), Grade Distribution

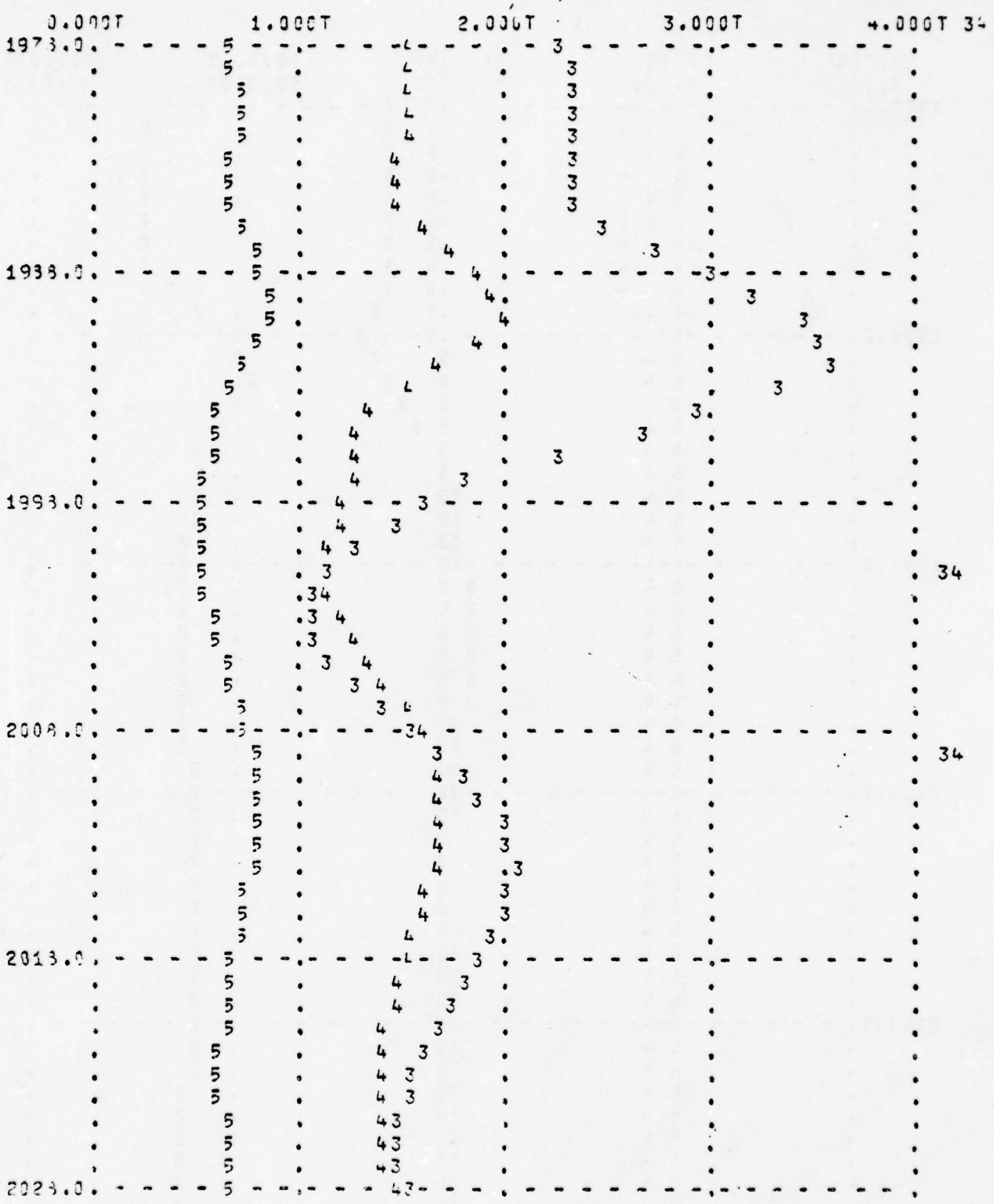


Figure C-34. Force Drawdown (Hypothesis C), Inventories of Selected Officers

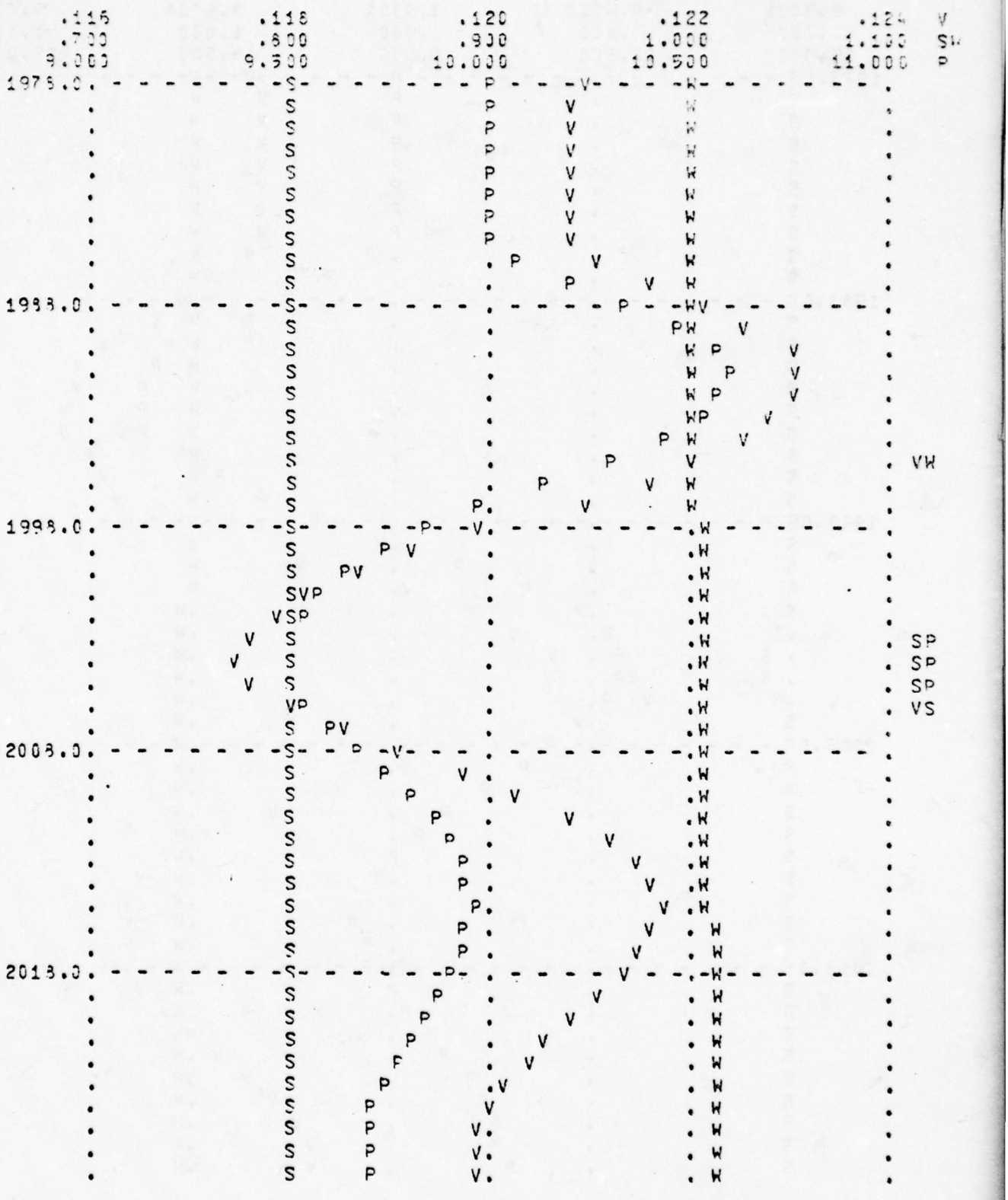


Figure C-35. Force Drawdown (Hypothesis C), O-3 Promotion Parameters

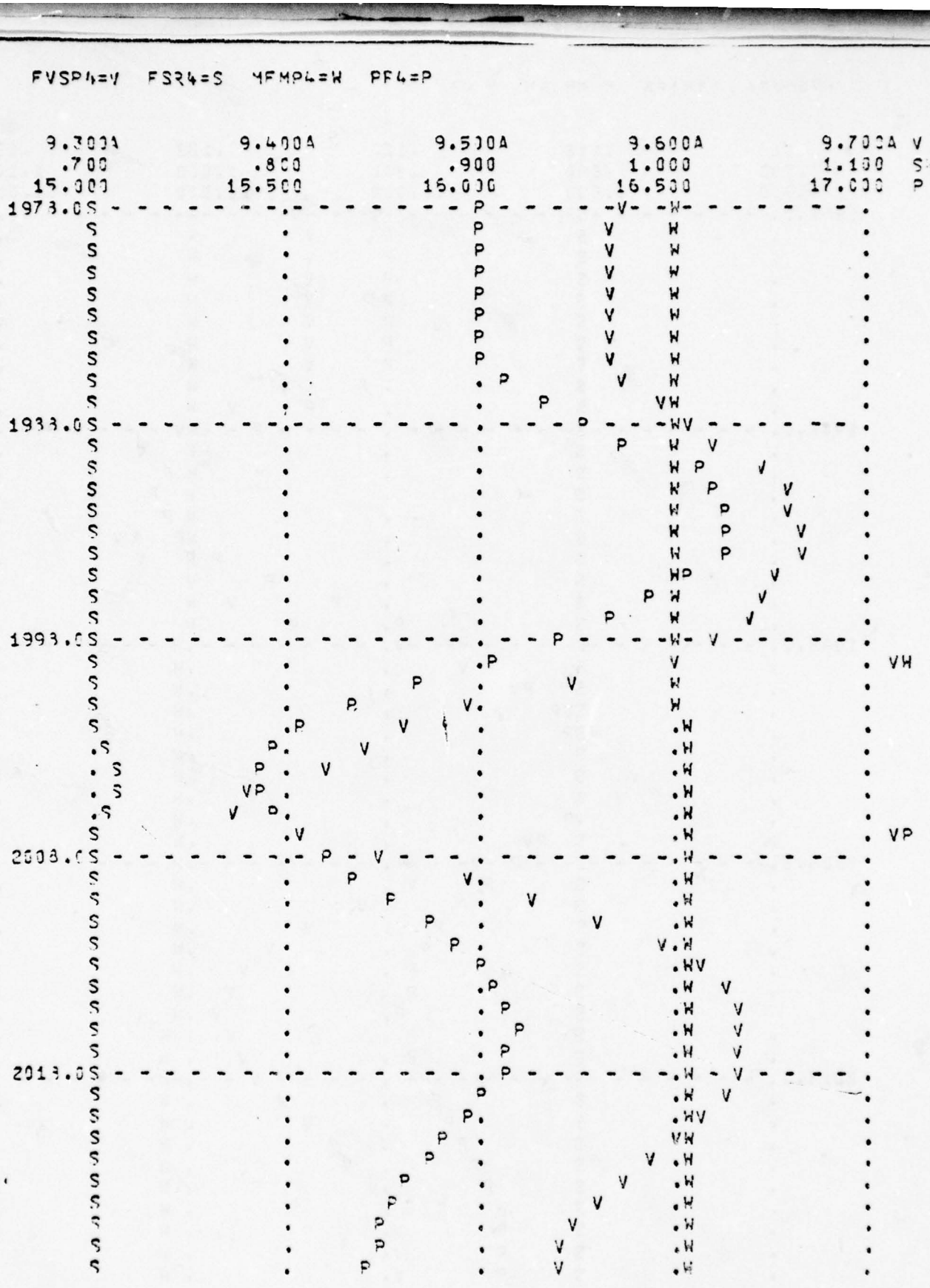


Figure C-36. Force Drawdown (Hypothesis C), O-4 Promotion Parameters

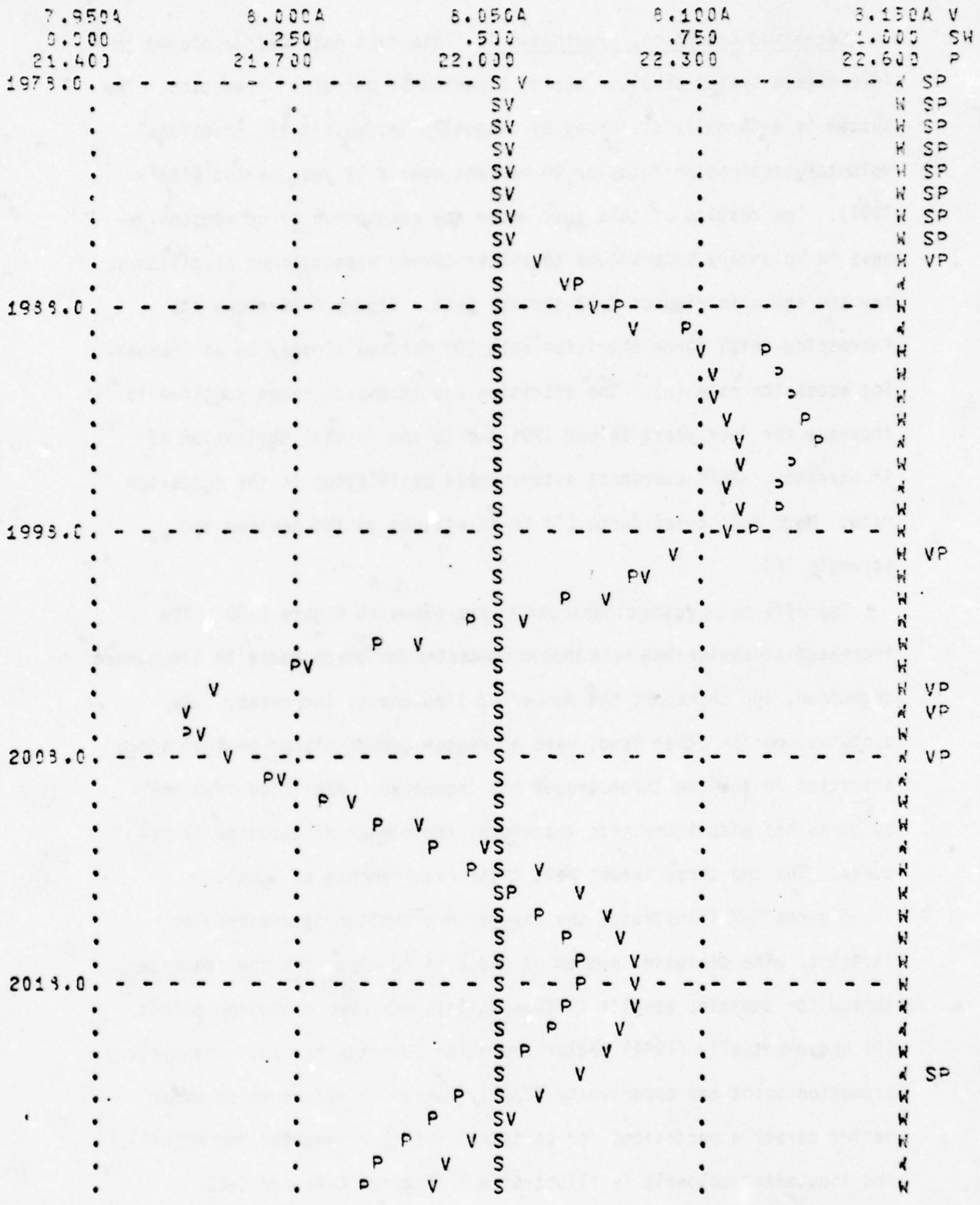


Figure C-37. Force Drawdown (Hypothesis C), O-5 Promotion Parameters

Decreased Retention, Hypothesis A. This test case was developed to investigate system behavior during a period of decreased retention. The system is externally disturbed by gradually increasing all fractional voluntary separation rates by 20 percent over a 10 year period (1981-1991). The results of this test under the assumption of no responsiveness in voluntary separations to either career expectations or military pay are shown in Figures C-38 through C-42. Figure C-38 shows the increasing total force attrition rate (O) matched closely by an increasing accession rate (A). The attrition and accession rates continue to increase for four years beyond 1991 due to the initial obligation of lieutenants. This overshoot sets up mild oscillation in the accession rate. Note that total force (T) is maintained on the desired end strength (E).

The effects on grade distribution are shown in Figure C-39. The increased accession rate more than compensates for the decrease in lieutenant retention, and therefore the number of lieutenants increases. The captains, on the other hand, have a greater demand placed on them since attrition in the top three grades has increased. Attrition from the captains has also increased; therefore, the number of captains is reduced. The top three grades meet their requirements as usual.

Figures C-40 illustrates the change in promotion parameters for captains. The decreased number of captains coupled with the increased demand for captains results in substantially earlier promotion points (P) and eventually (1994) better promotion opportunity (S). The cycling promotion point and opportunity finally dampen to values which offer better career expectations for captains. Similar behavior for majors and lieutenant colonels is illustrated in Figures C-41 and C-42.

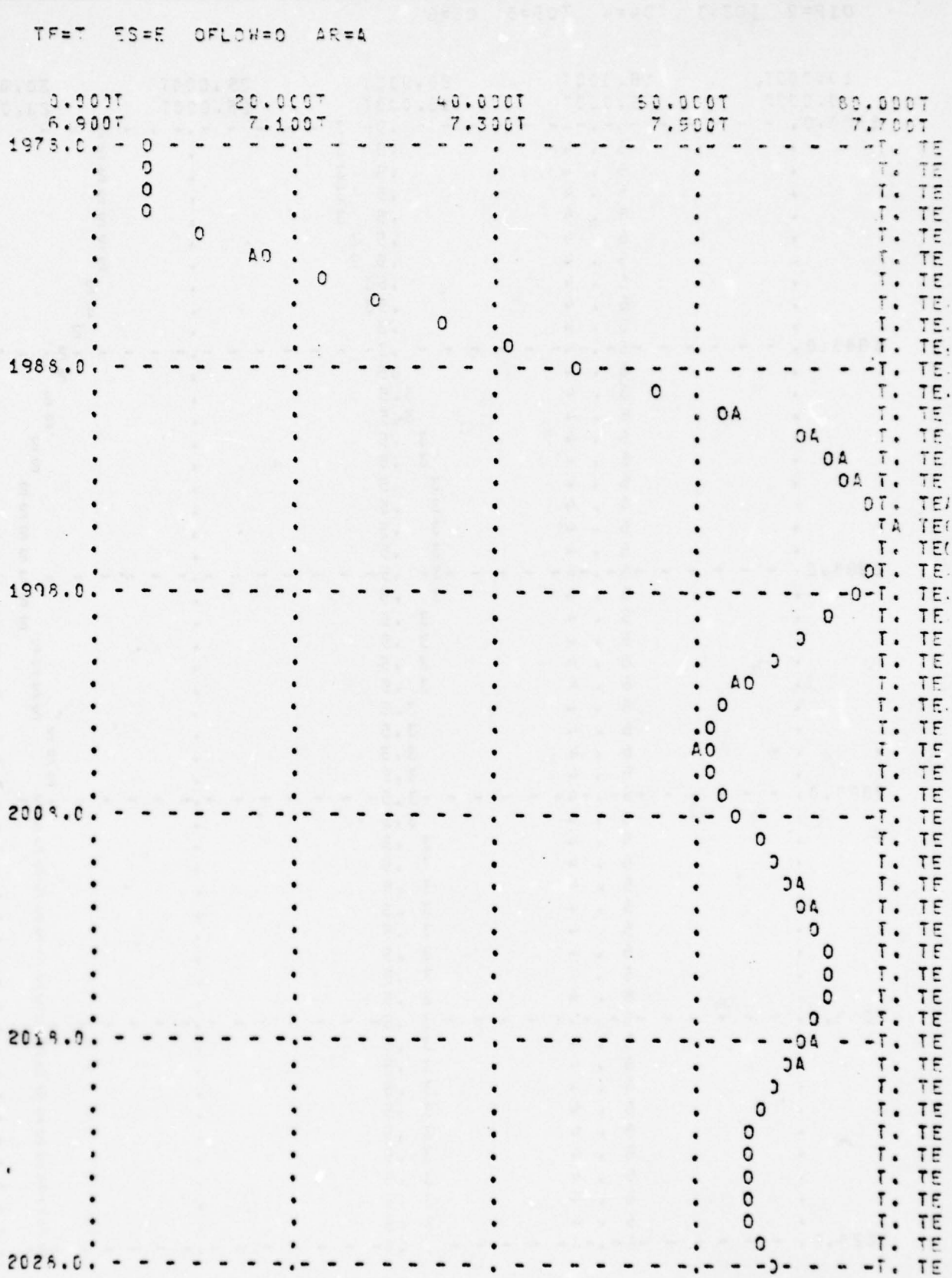


Figure C-38. Decreased Retention (Hypothesis A), Accession and Attrition Rates

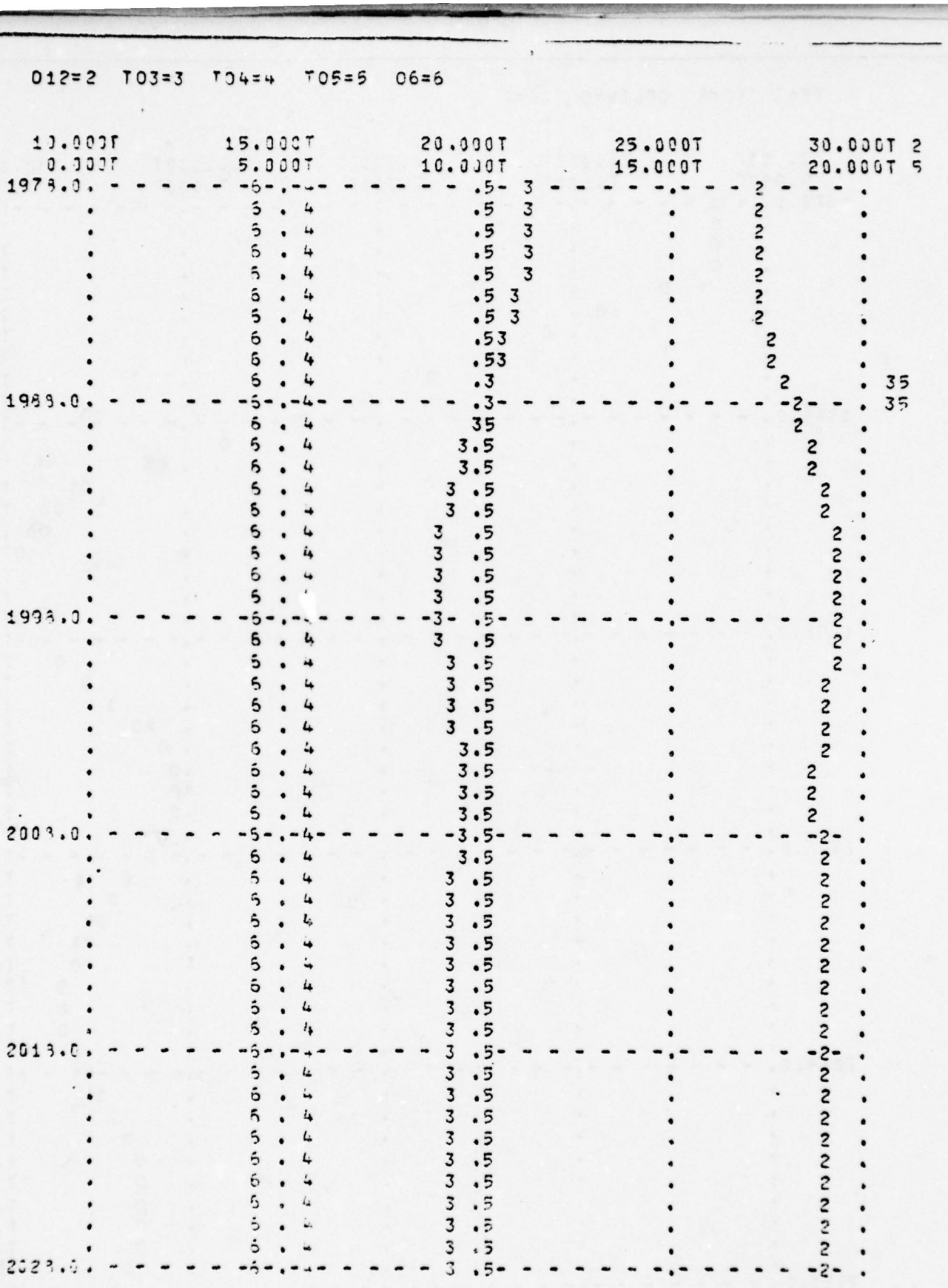


Figure C-39. Decreased Retention (Hypothesis A), Grade Distribution

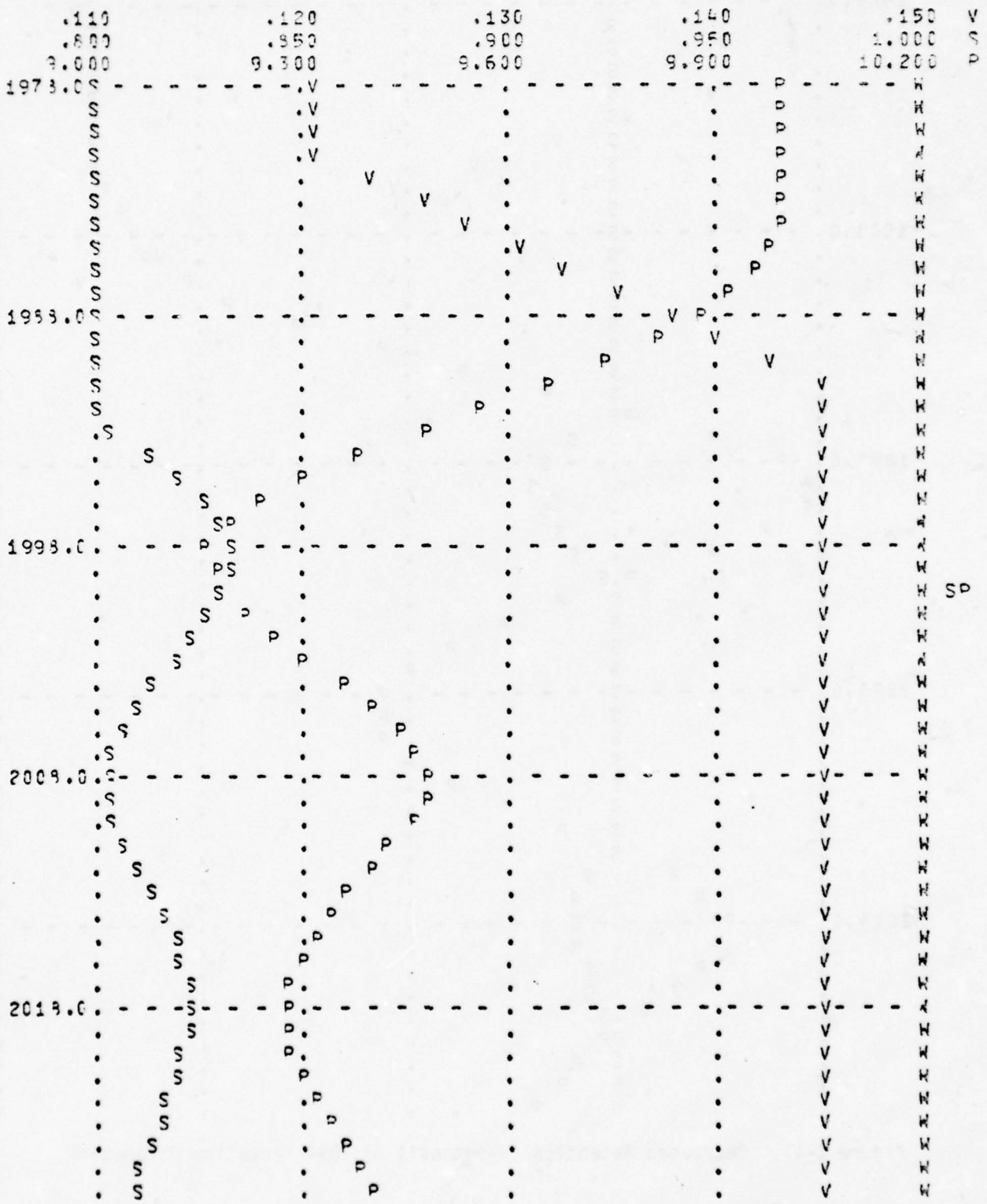


Figure C-40. Decreased Retention (Hypothesis A), O-3 Promotion Parameters

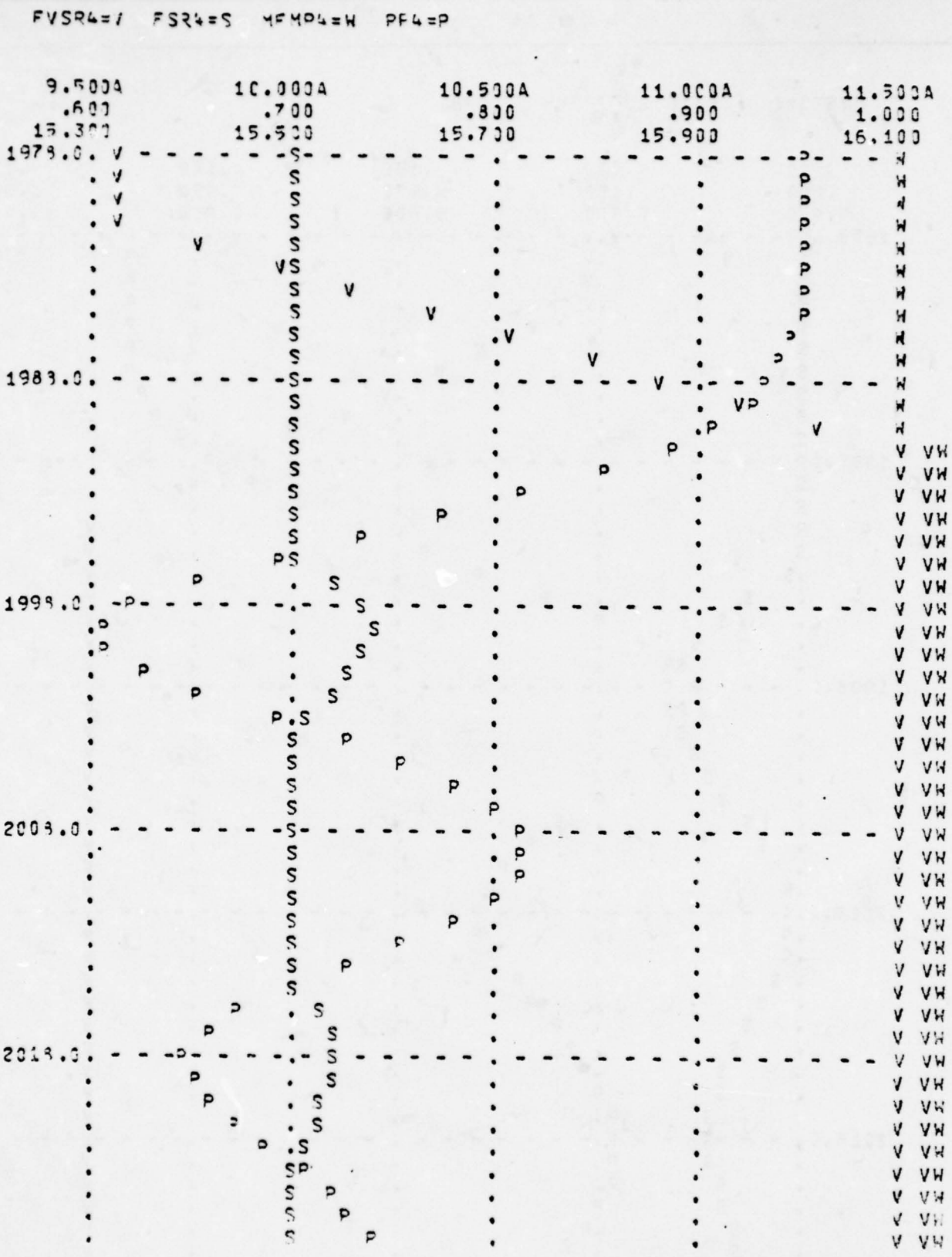


Figure C-41. Decreased Retention (Hypothesis A), O-4 Promotion Parameters

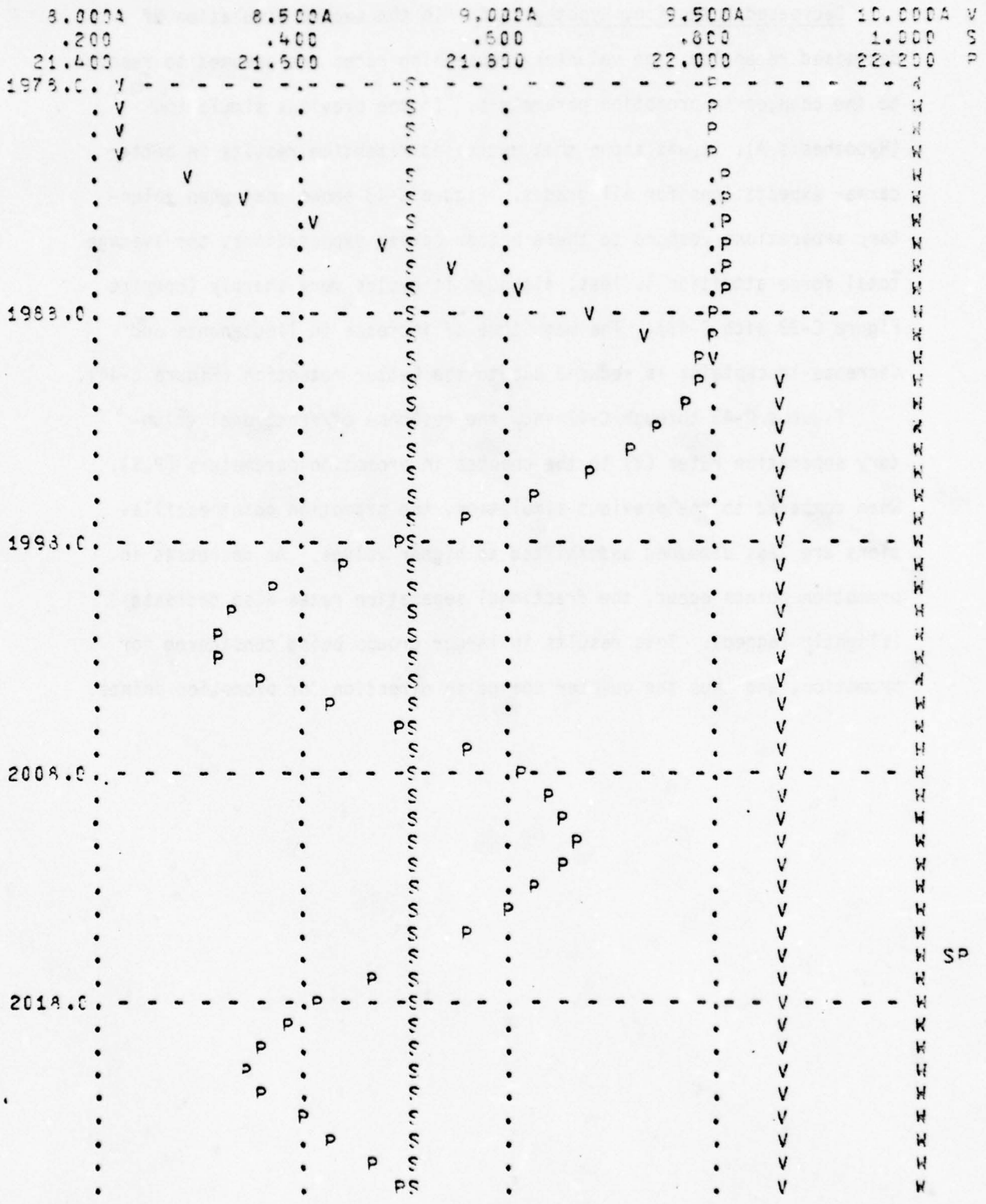


Figure C-42. Decreased Retention (Hypothesis A), O-5 Promotion Parameters

Decreased Retention, Hypothesis B. In the second simulation of decreased retention, the voluntary separation rates are assumed to respond to the changes in promotion parameters. In the previous simulation (Hypothesis A), it was shown that decreased retention results in better career expectations for all grades. Figure C-43 shows that when voluntary separations respond to these better career expectations, the average total force attrition is less, although it cycles more sharply (compare Figure C-38 with C-43). The magnitude of increase in lieutenants and decrease in captains is reduced due to the better retention (Figure C-44).

Figures C-45 through C-47 show the response of fractional voluntary separation rates (V) to the changes in promotion parameters (P,S). When compared to the previous simulation, the promotion point oscillations are less dampened and shifted to higher values. As decreases in promotion points occur, the fractional separation rates also decrease (slightly lagged). This results in larger groups being considered for promotion, and thus the quicker change in direction for promotion points.

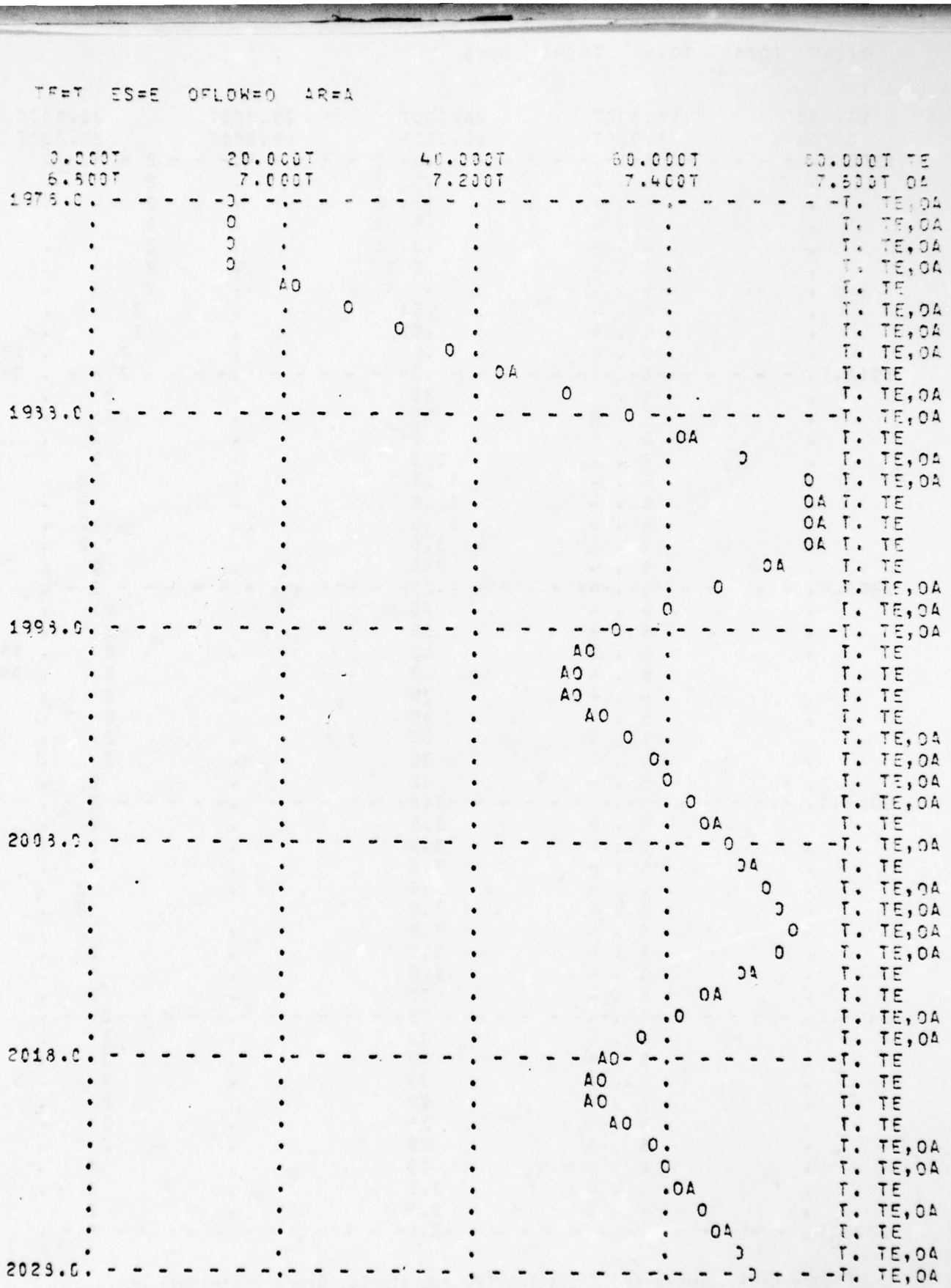


Figure C-43. Decreased Retention (Hypothesis B), Accession and Attrition Rates

```
012=2  TO3=3  TO4=4  TO5=5  O6=6

   10.000T          15.000T          20.000T          25.000T          30.000T 23
    0.000T           5.000T          10.000T          15.000T          20.000T 56
1978.0. - - - - - -6-.-4- - - - - - - .5- 3 - - - - - .- - - 2 - - - .
      .            5 . 4              .5  3           .      2        .
      .            5 . 4              .5  3           .      2        .
      .            6 . 4              .5  3           .      2        .
      .            6 . 4              .5  3           .      2        .
      .            6 . 4              .5 3            .      2        .
      .            6 . 4              .5 3            .      2        .
      .            6 . 4              .53             .       2       .
      .            5 . 4              .53             .       2       .
      .            5 . 4              .3              .        2      . 35
1988.0. - - - - - -6-.-4- - - - - - - .3- - - - - - - .- - - - 2 - - - . 35
      .            5 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4             3.5              .          2     .
      .            5 . 4             3.5              .          2     .
      .            6 . 4            3 .5              .           2    .
      .            6 . 4            3 .5              .           2    .
      .            6 . 4            3 .5              .           2    .
      .            6 . 4             3.5              .            2   .
      .            6 . 4             3.5              .          2     .
1998.0. - - - - - -6-.-4- - - - - - - 35- - - - - - - .- - - - - 2 - - .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              .3              .         2      . 35
      .            6 . 4              .3              .         2      . 35
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .          2     .
2008.0. - - - - - -6-.-4- - - - - - - -3.5- - - - - - - .- - - - - 2 - - .
      .            5 . 4             3.5              .         2      .
      .            6 . 4             3.5              .         2      .
      .            5 . 4             3.5              .         2      .
      .            6 . 4             3.5              .          2     .
      .            5 . 4             3.5              .          2     .
      .            6 . 4             3.5              .          2     .
      .            5 . 4             3.5              .         2      .
      .            6 . 4             3.5              .         2      .
      .            5 . 4              35              .         2      .
2018.0. - - - - - -6-.-4- - - - - - - 35- - - - - - - .- - - - -2- - - .
      .            5 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            6 . 4              35              .         2      .
      .            5 . 4              35              .          2     .
      .            6 . 4             3.5              .          2     .
      .            6 . 4             3.5              .          2     .
2028.0. - - - - - -6-.-4- - - - - - - -3.5- - - - - - - .- - - - - 2 - - .
```

Figure C-44. Decreased Retention (Hypothesis B), Grade Distribution

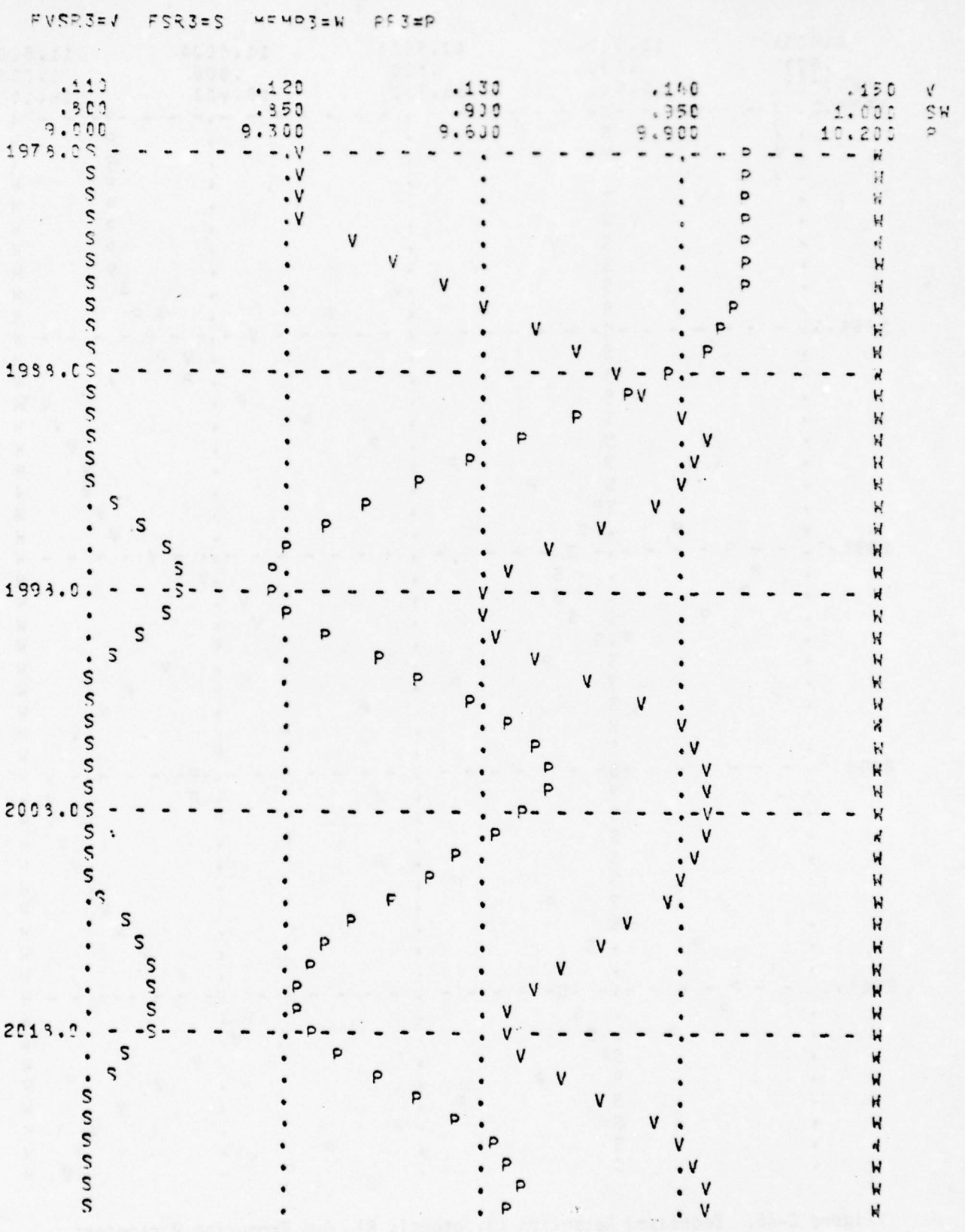


Figure C-45. Decreased Retention (Hypothesis B), O-3 Promotion Parameters

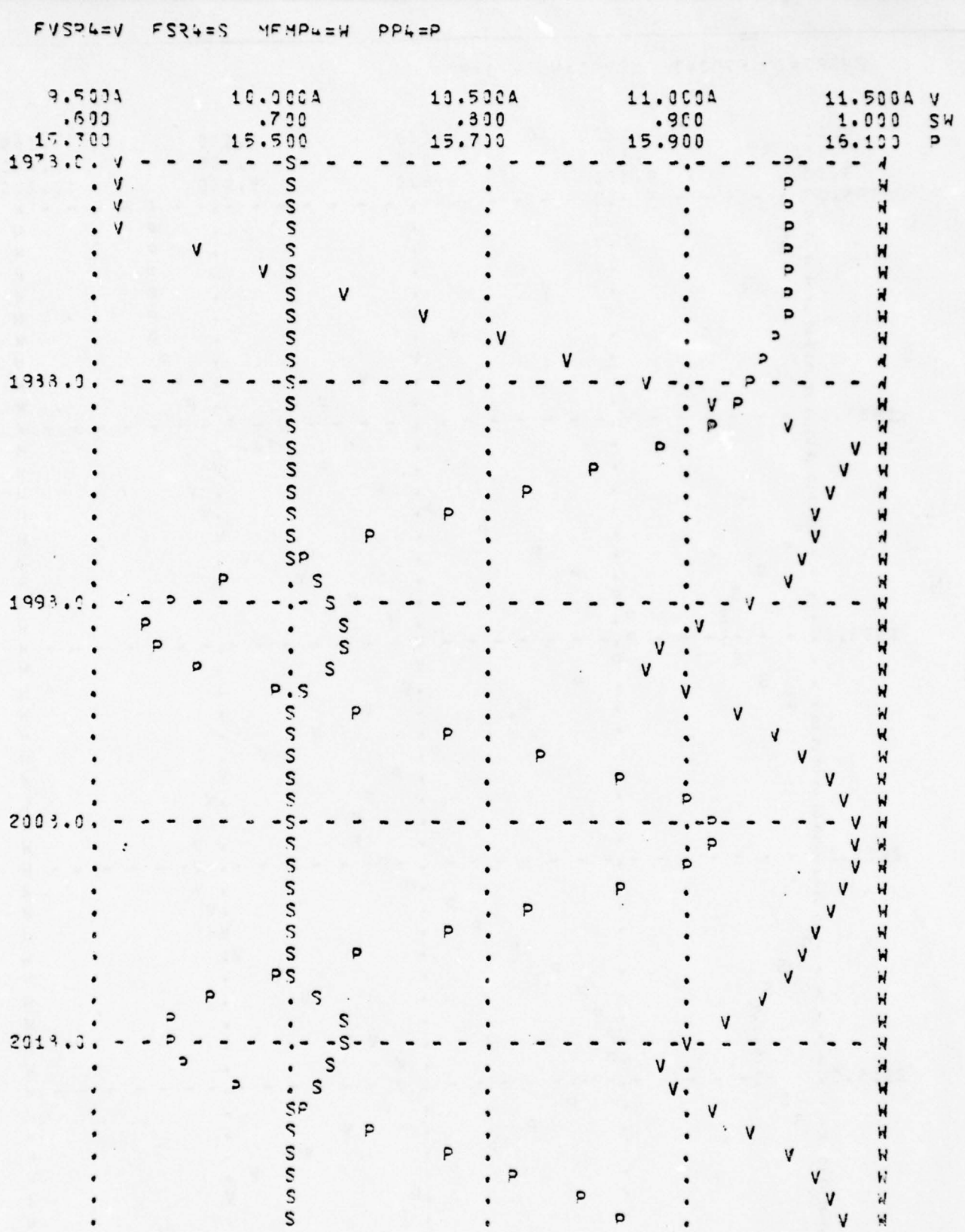


Figure C-46. Decreased Retention (Hypothesis B), O-4 Promotion Parameters

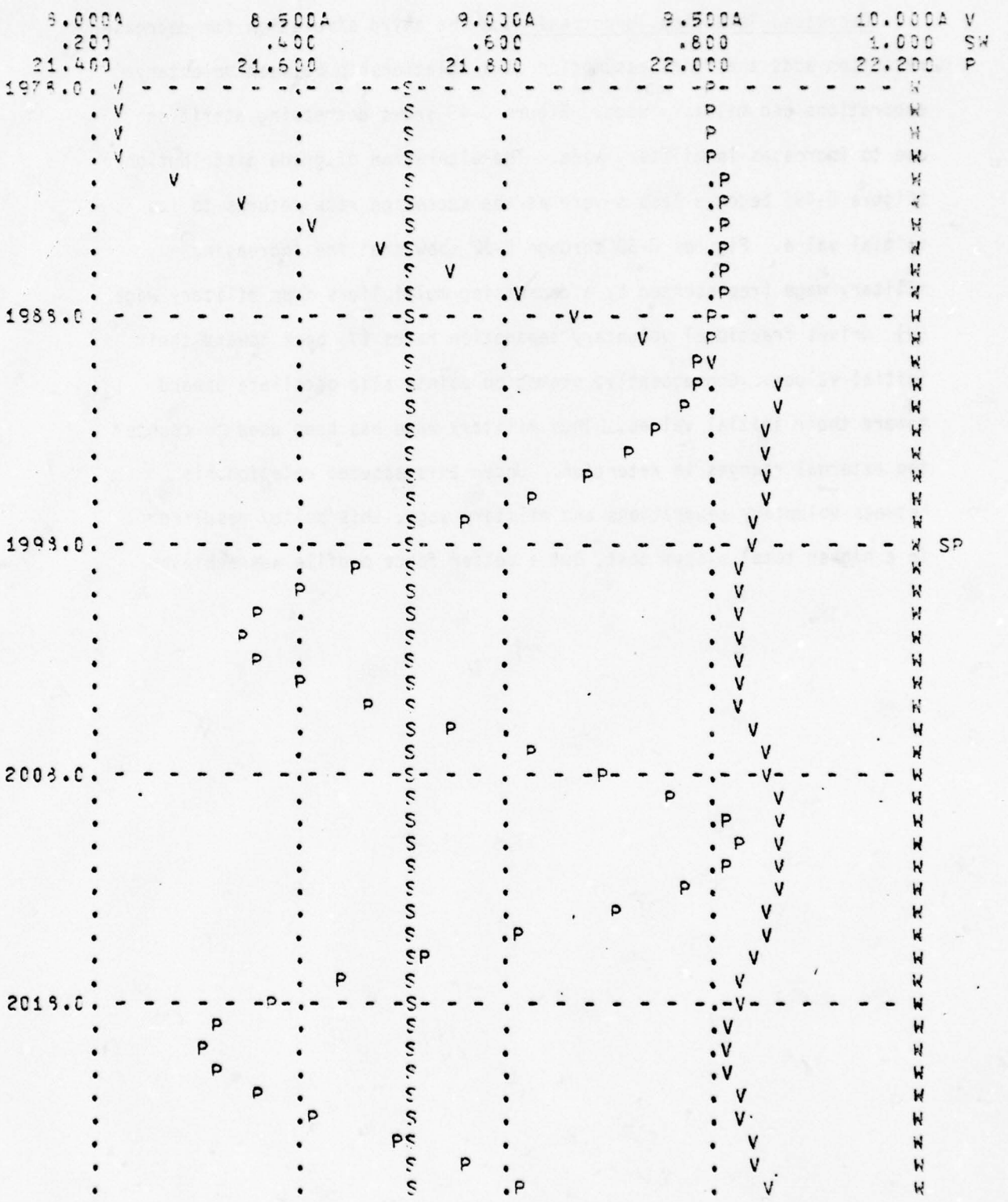


Figure C-47. Decreased Retention (Hypothesis B), O-5 Promotion Parameters

Decreased Retention, Hypothesis C. The third simulation for decreased retention adds the final assumption of a relationship between voluntary separations and military wage. Figure C-48 shows decreasing attrition due to increases in military wage. The alteration of grade distribution (Figure C-49) becomes less severe as the accession rate returns to its initial value. Figures C-50 through C-52 show that the increasing military wage (represented by a decreasing multipliers from military wage (W) drives fractional voluntary separation rates (V) back toward their initial values. Consequently, promotion points also oscillate upward toward their initial values. Thus military wage has been used to counter the external changes in retention. Under this assumed relationship between voluntary separations and military wage, this policy resulted in a higher total system cost, but a better force profile was achieved.

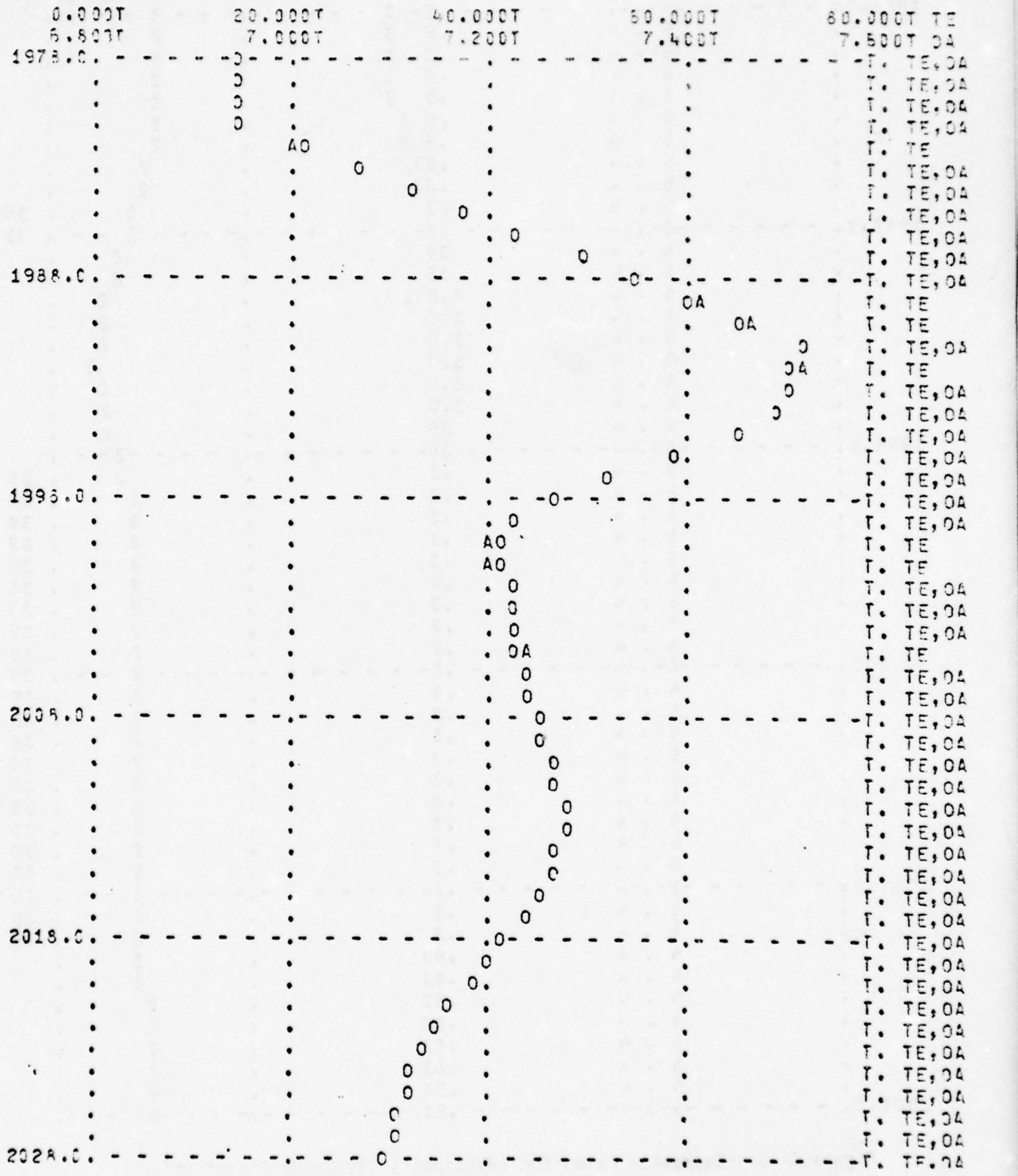


Figure C-48. Decreased Retention (Hypothesis C), Accession and Attrition Rates

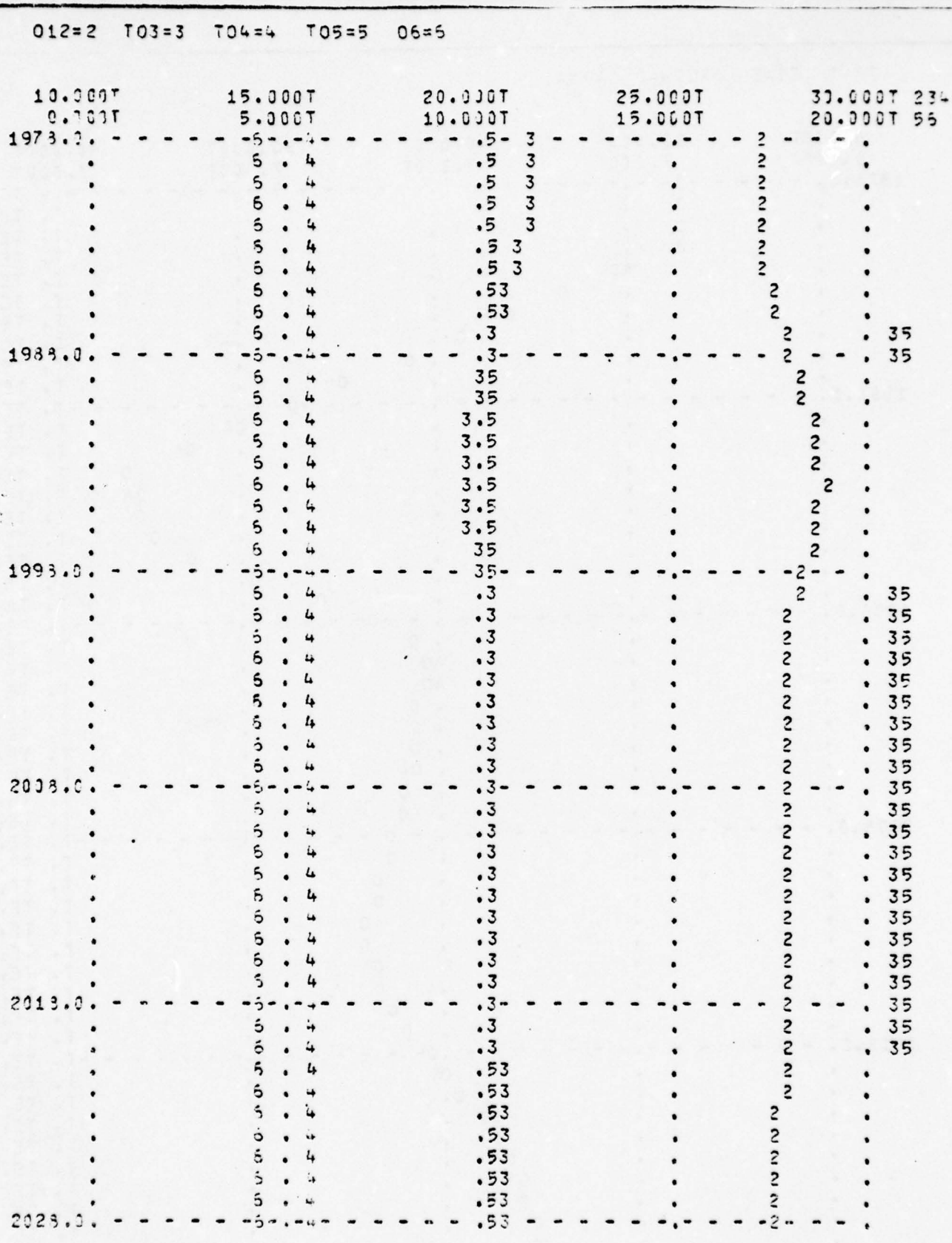


Figure C-49. Decreased Retention (Hypothesis C), Grade Distribution

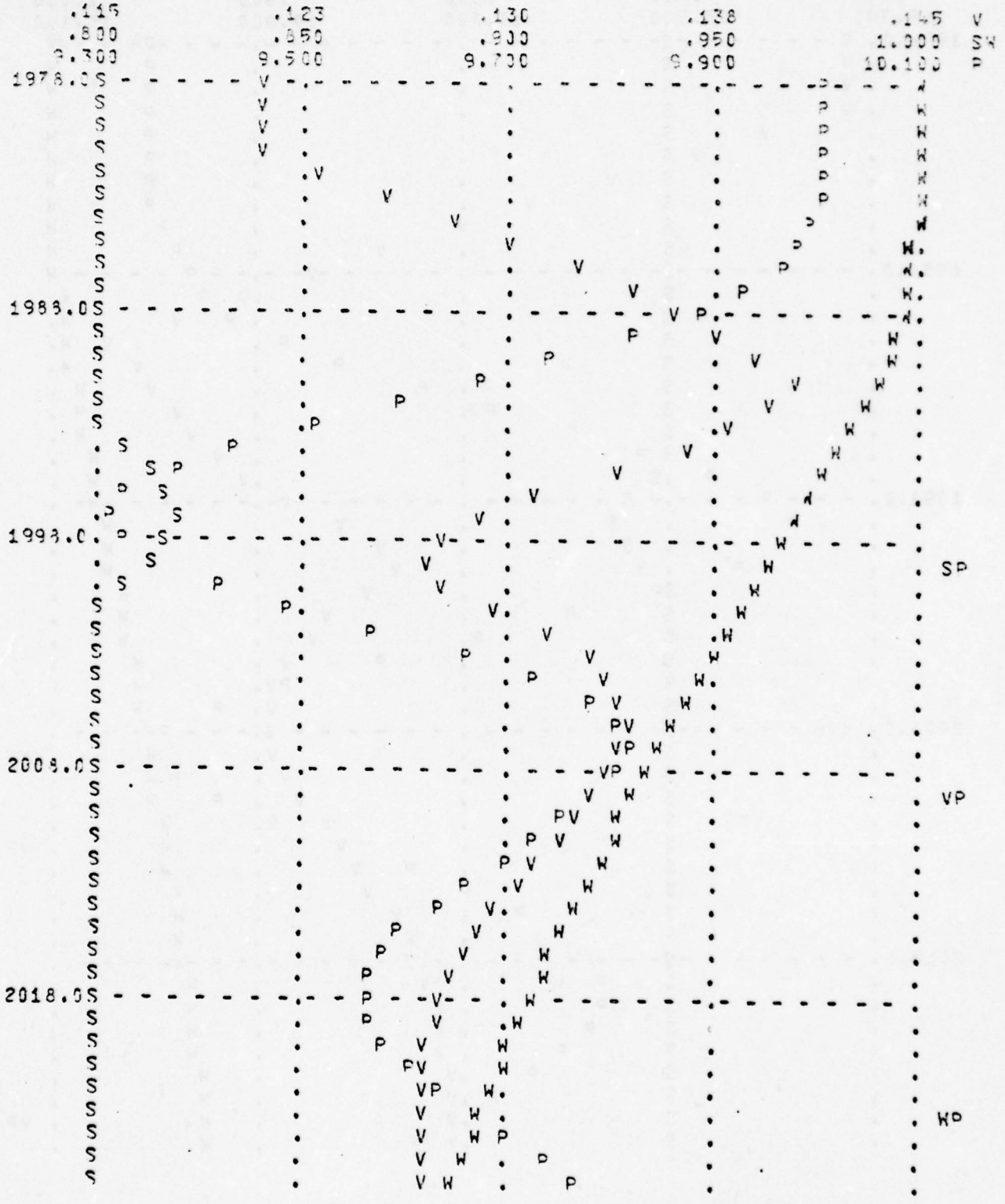


Figure C-50. Decreased Retention (Hypothesis C), 0-3 Promotion Parameters

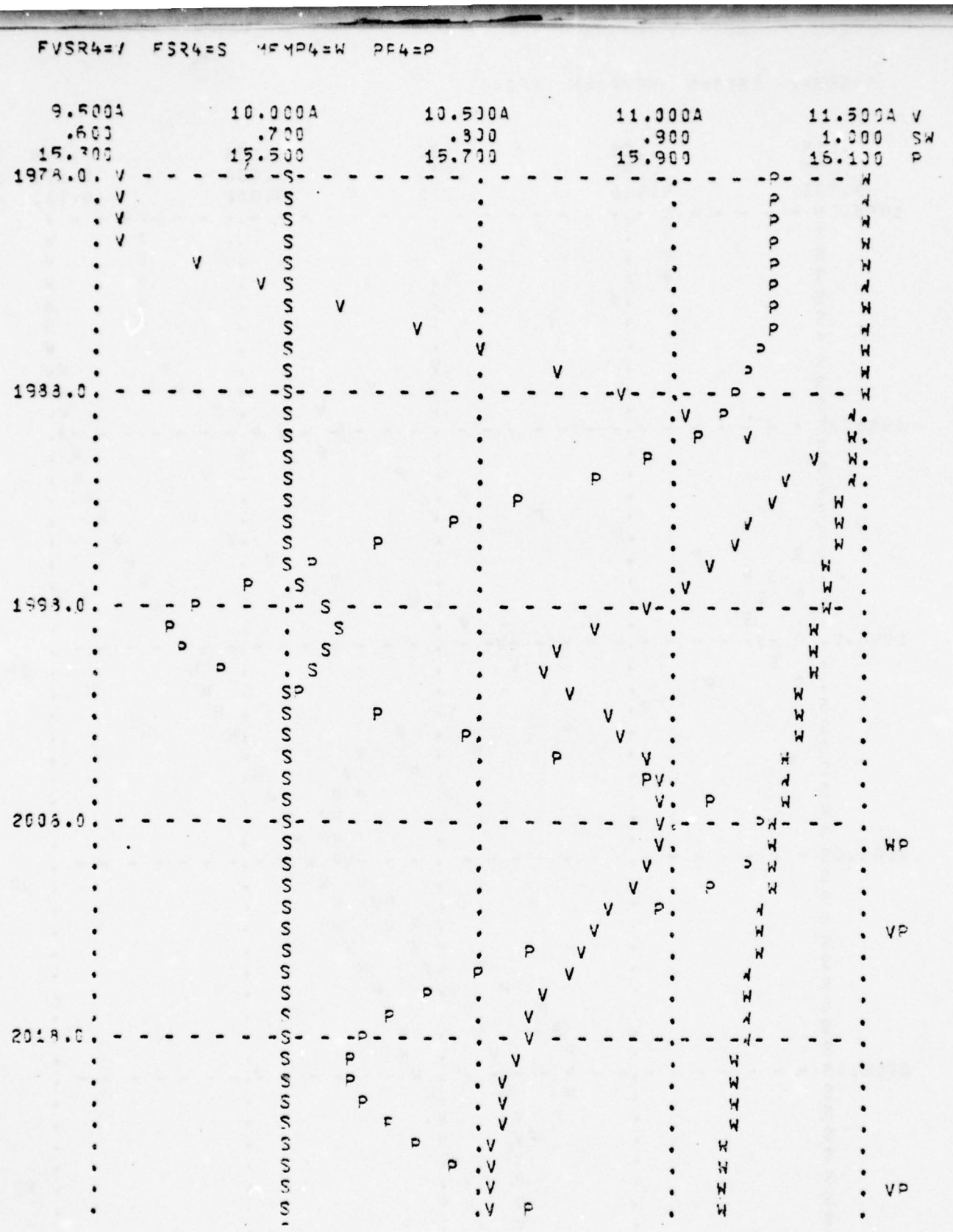


Figure C-51. Decreased Retention (Hypothesis C), O-4 Promotion Parameters

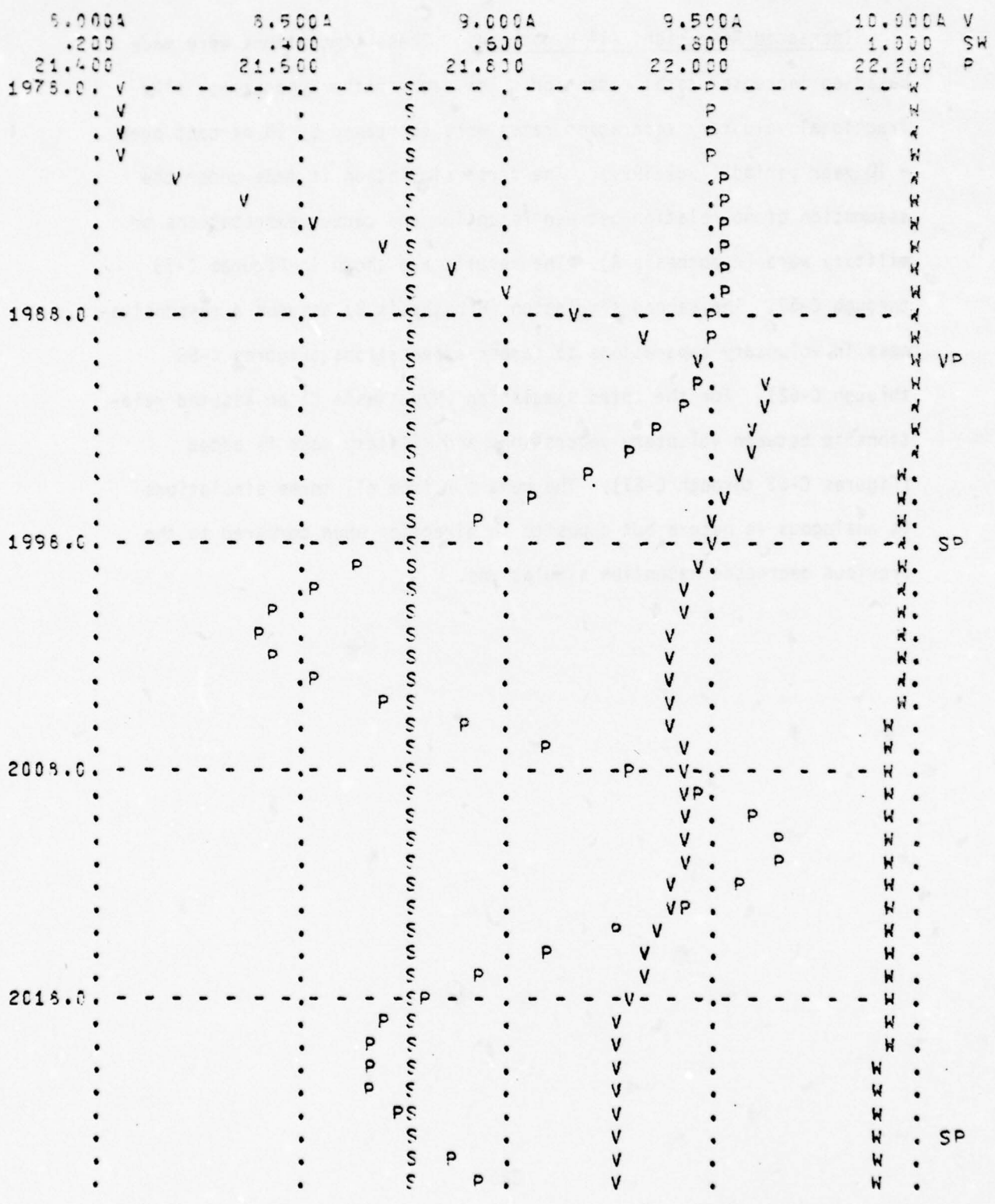


Figure C-52. Decreased Retention (Hypothesis C), O-5 Promotion Parameters

Increased Retention, All Hypotheses. These simulations were made based on increased total retention. For each of the hypotheses, all fractional voluntary separation rates were decreased by 20 percent over a 10 year period (1981-1991). The first simulation is made under the assumption of no relation between retention and career expectations or military wage (Hypothesis A). The results are shown in Figures C-53 through C-57. The second simulation (Hypothesis B) assumes a responsiveness in voluntary separations to career expectations (Figures C-58 through C-62). For the third simulation (Hypothesis C) an assumed relationship between voluntary separations and military wage is added (Figures C-63 through C-67). The behavior from all three simulations is analogous in nature but opposite in direction when compared to the previous decreased retention simulations.

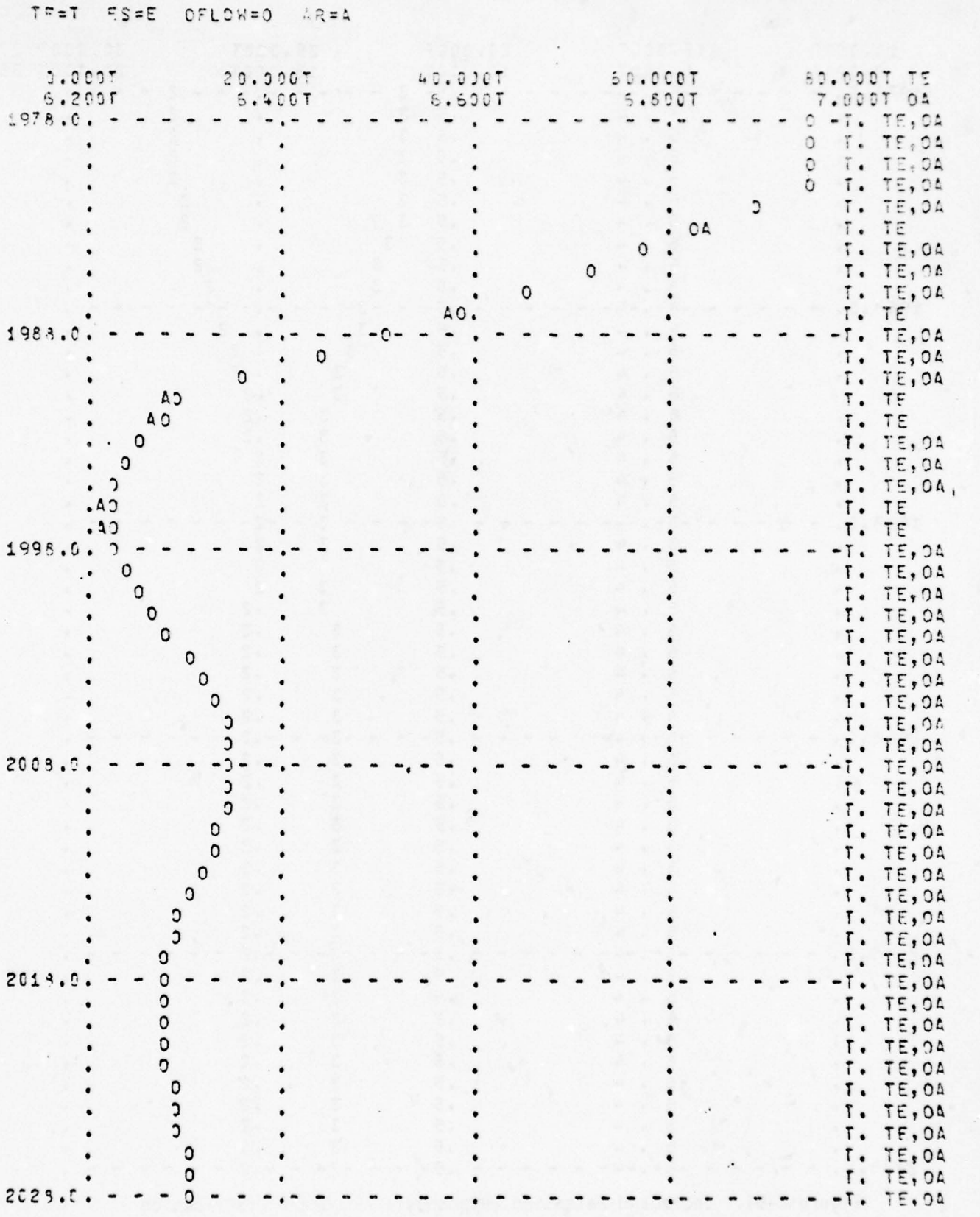


Figure C-53: Increased Retention (Hypothesis A), Accession and Attrition Rates

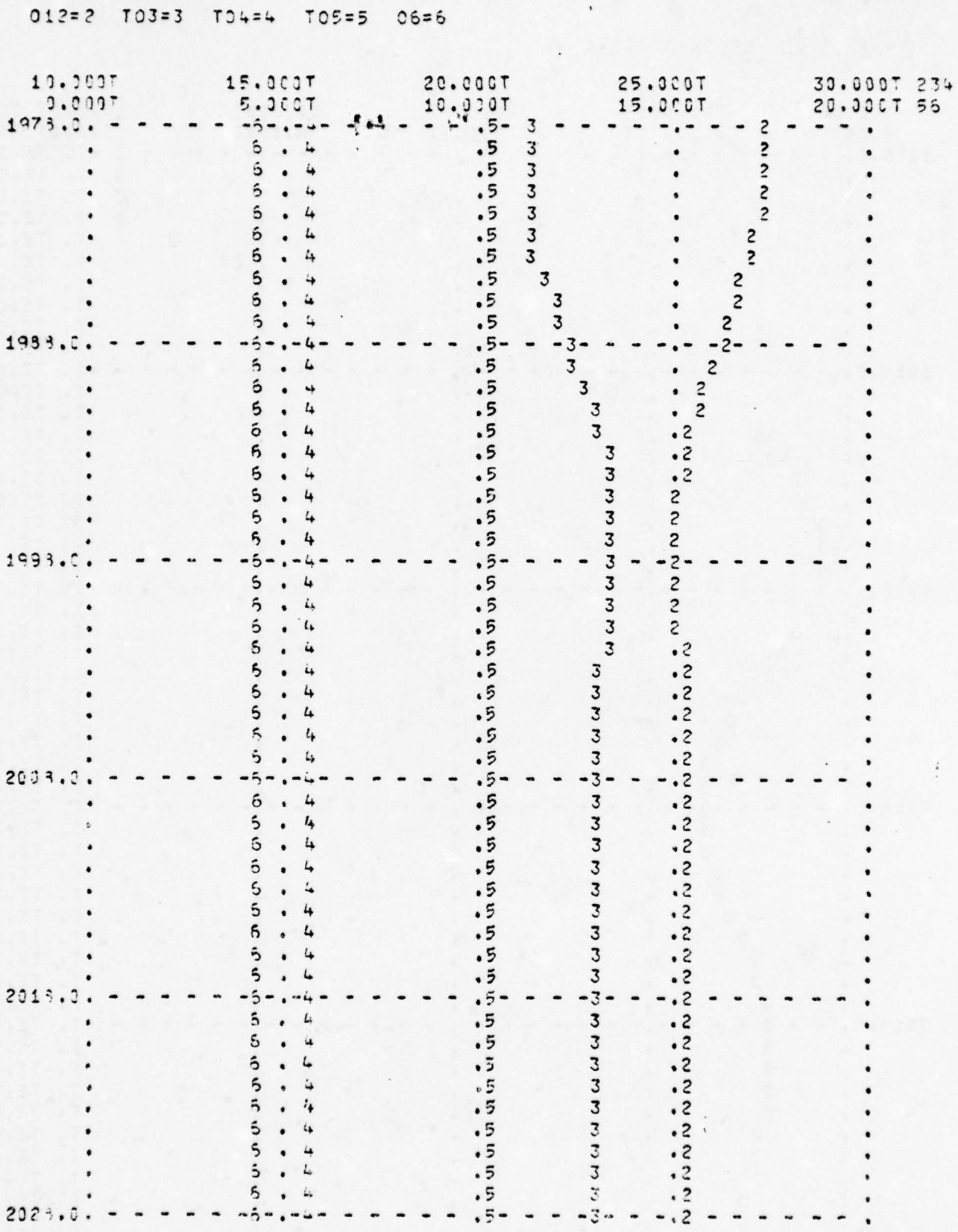


Figure C-54. Increased Retention (Hypothesis A), Grade Distribution

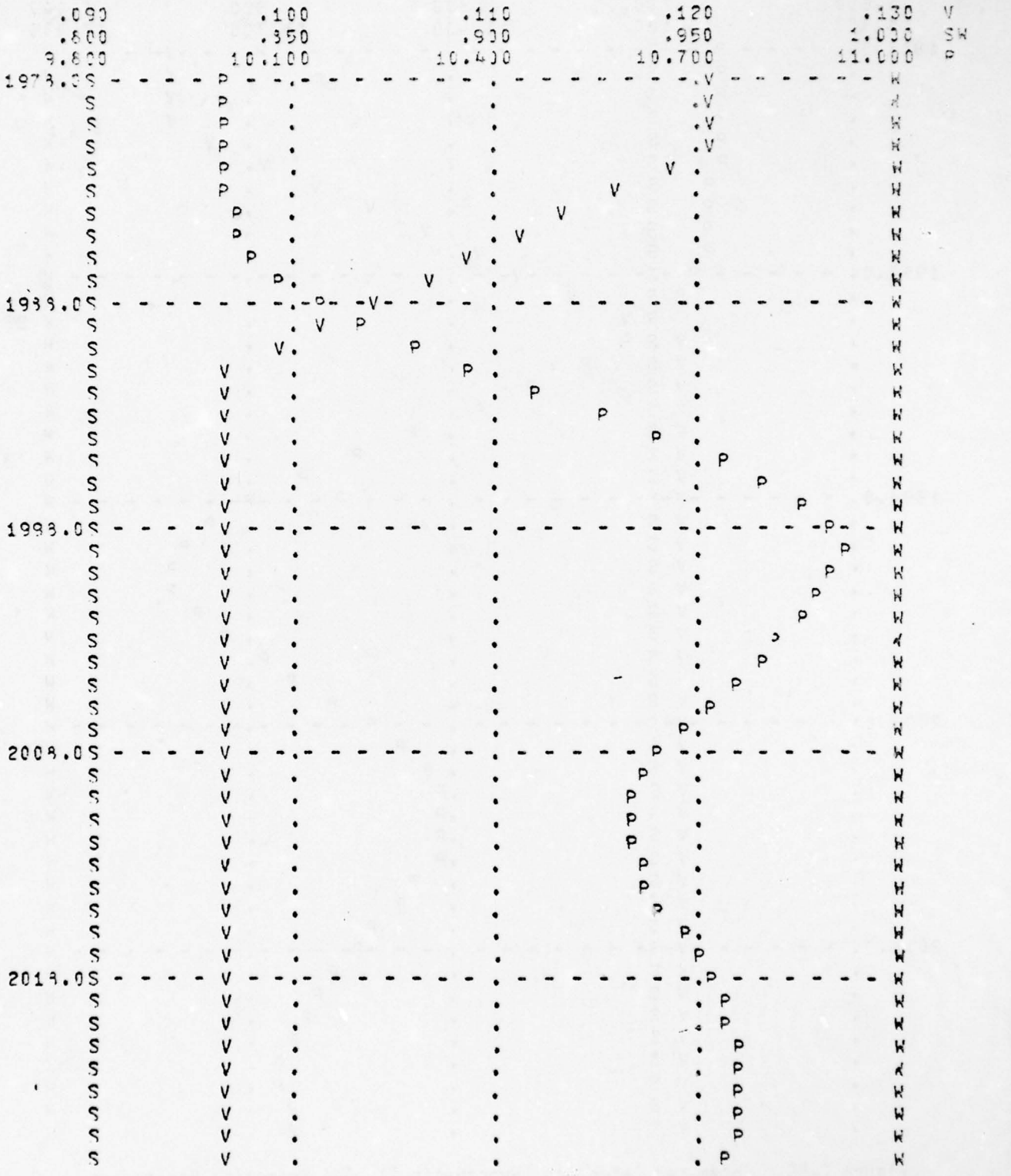


Figure C-55. Increased Retention (Hypothesis A), O-3 Promotion Parameters

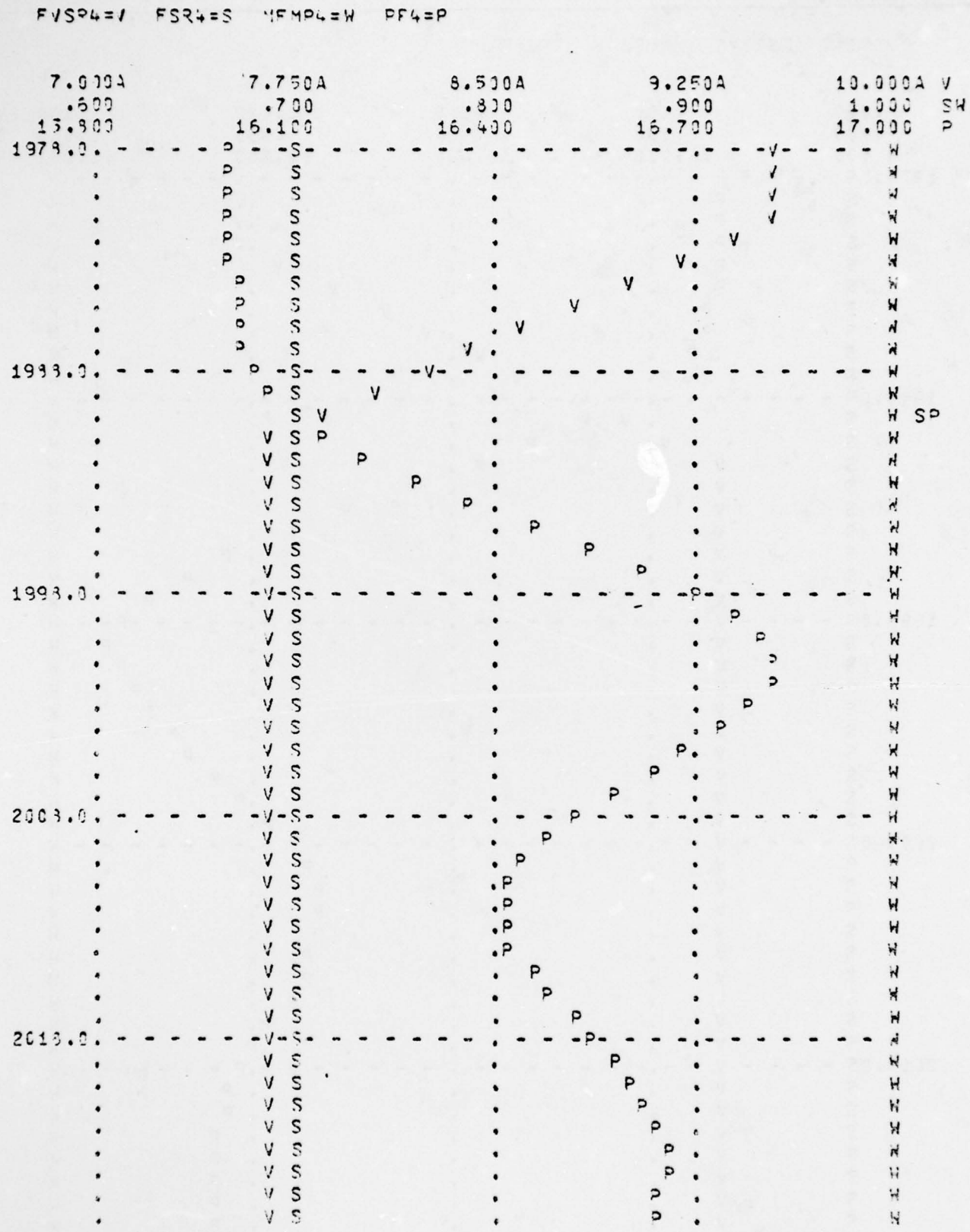


Figure C-56. Increased Retention (Hypothesis A), O-4 Promotion Parameters

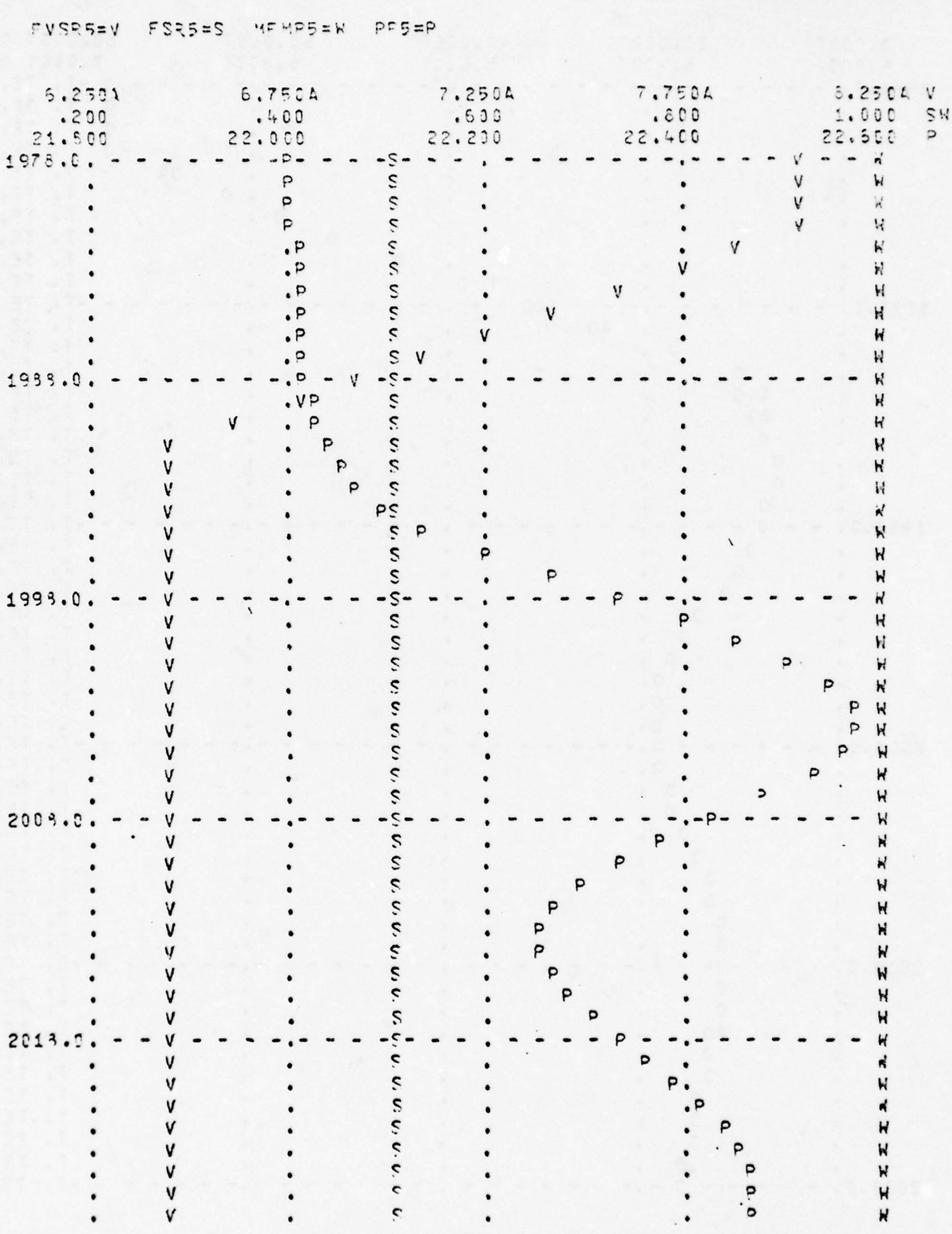


Figure C-57. Increased Retention (Hypothesis A), O-5 Promotion Parameters

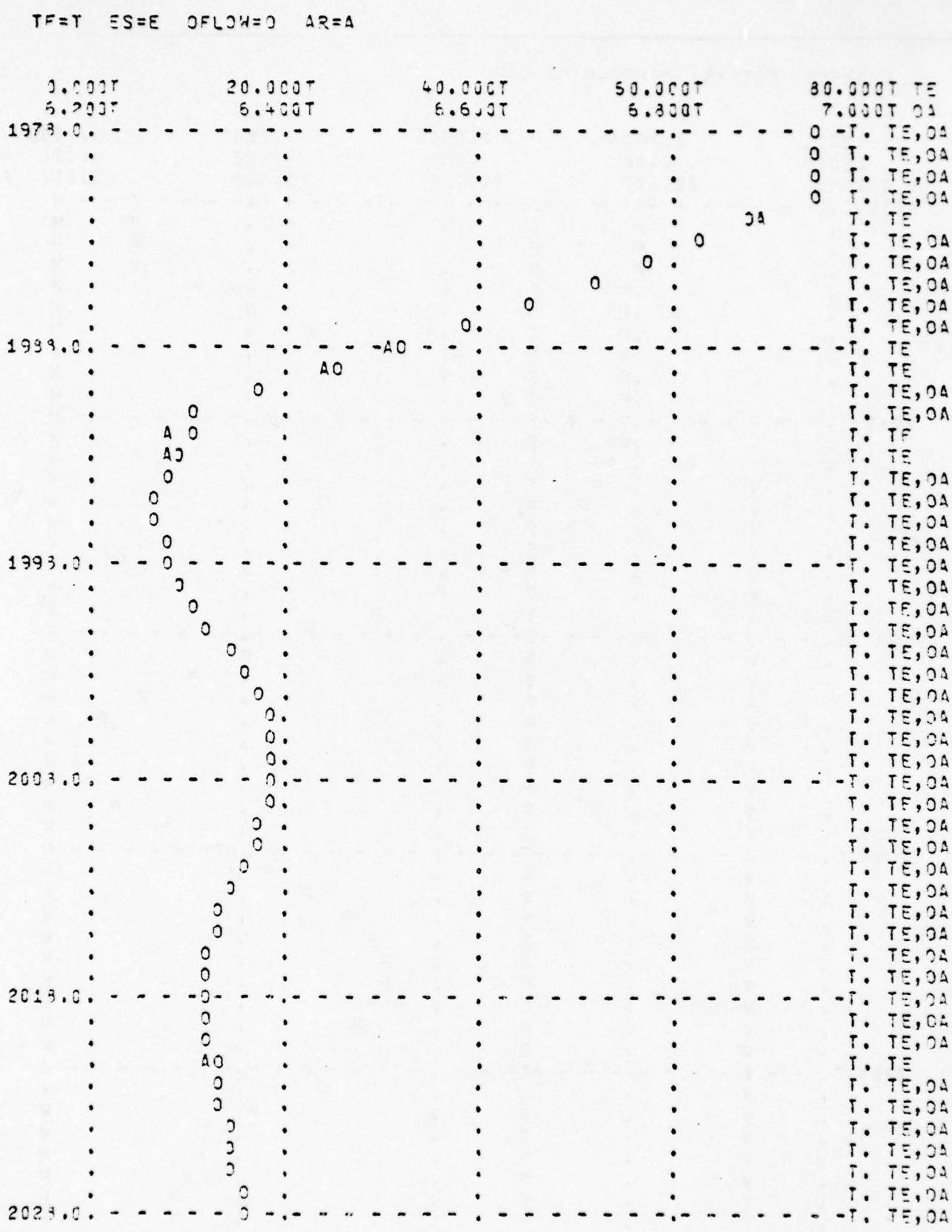


Figure C-58. Increased Retention (Hypothesis B), Accession and Attrition Rates

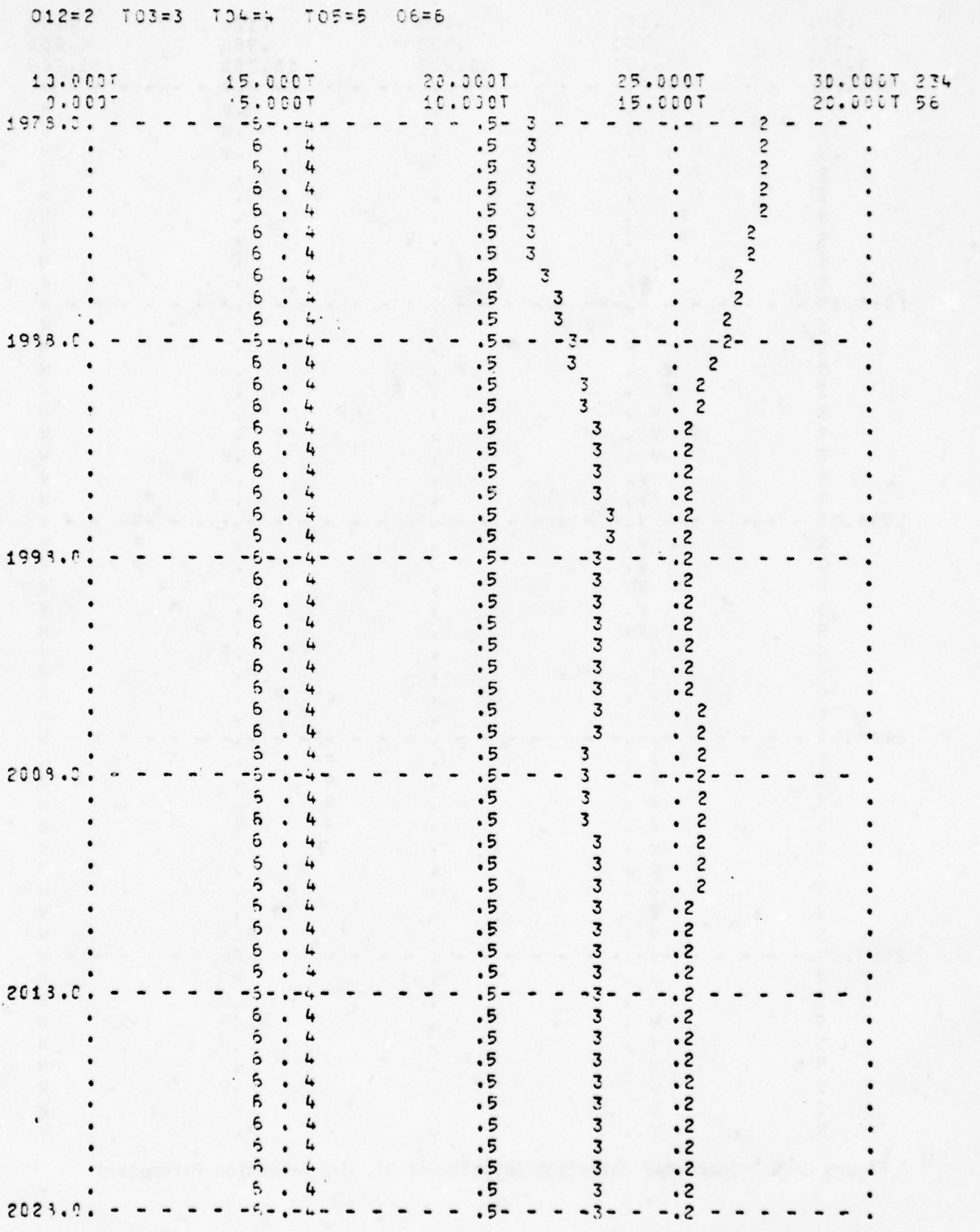


Figure C-59. Increased Retention (Hypothesis B), Grade Distribution

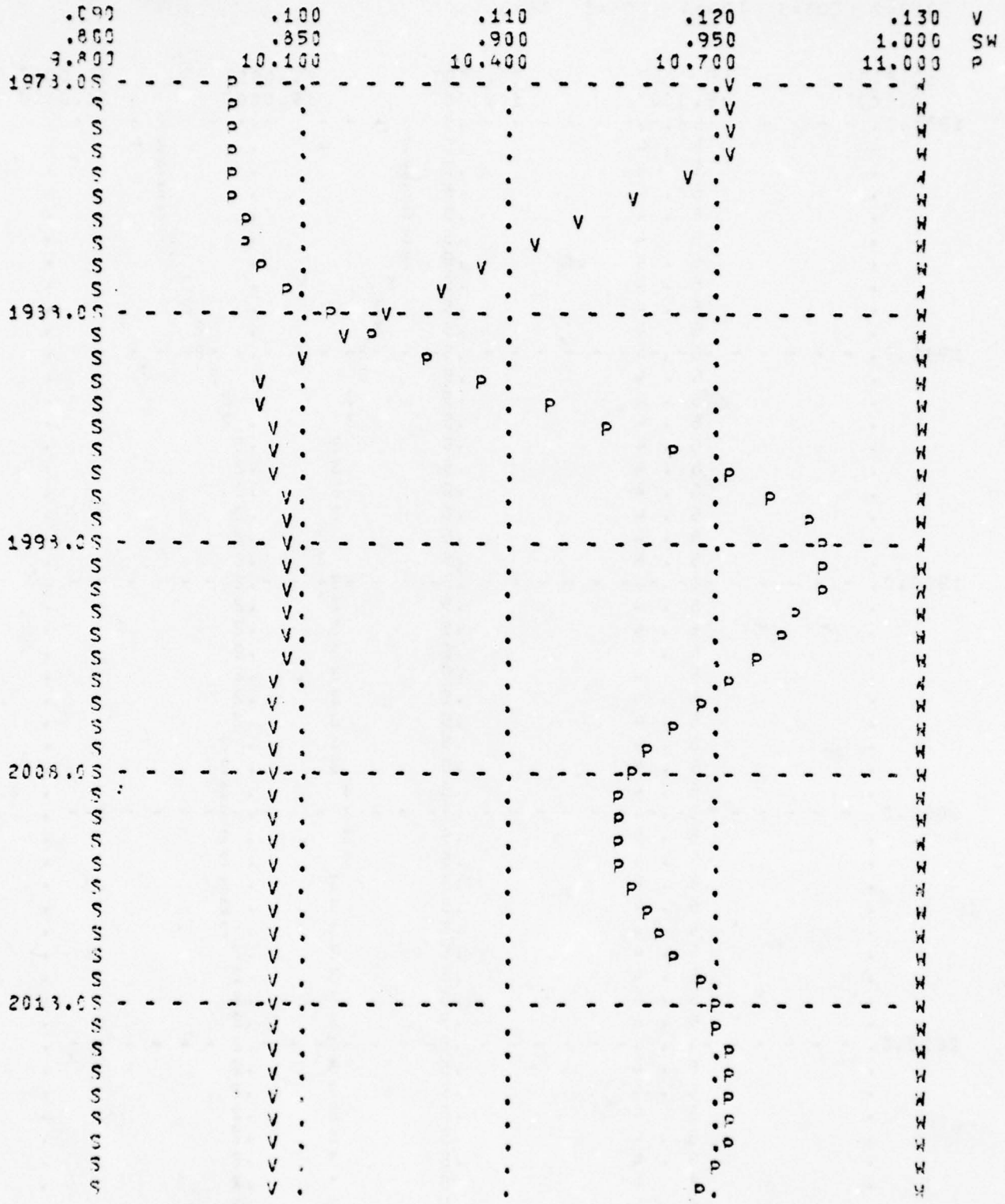


Figure C-60. Increased Retention (Hypothesis B), O-3 Promotion Parameters

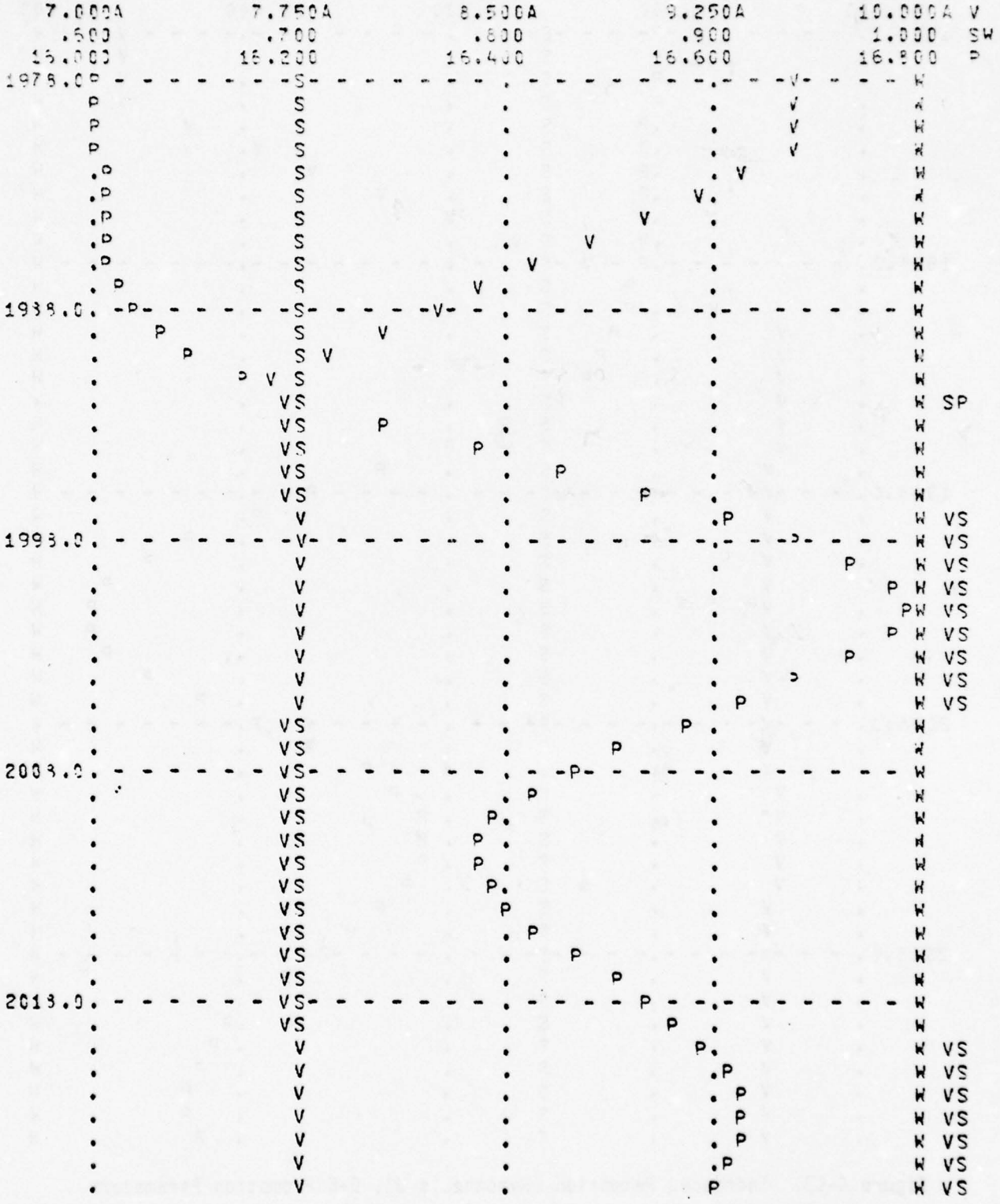


Figure C-61. Increased Retention (Hypothesis B), O-4 Promotion Parameters

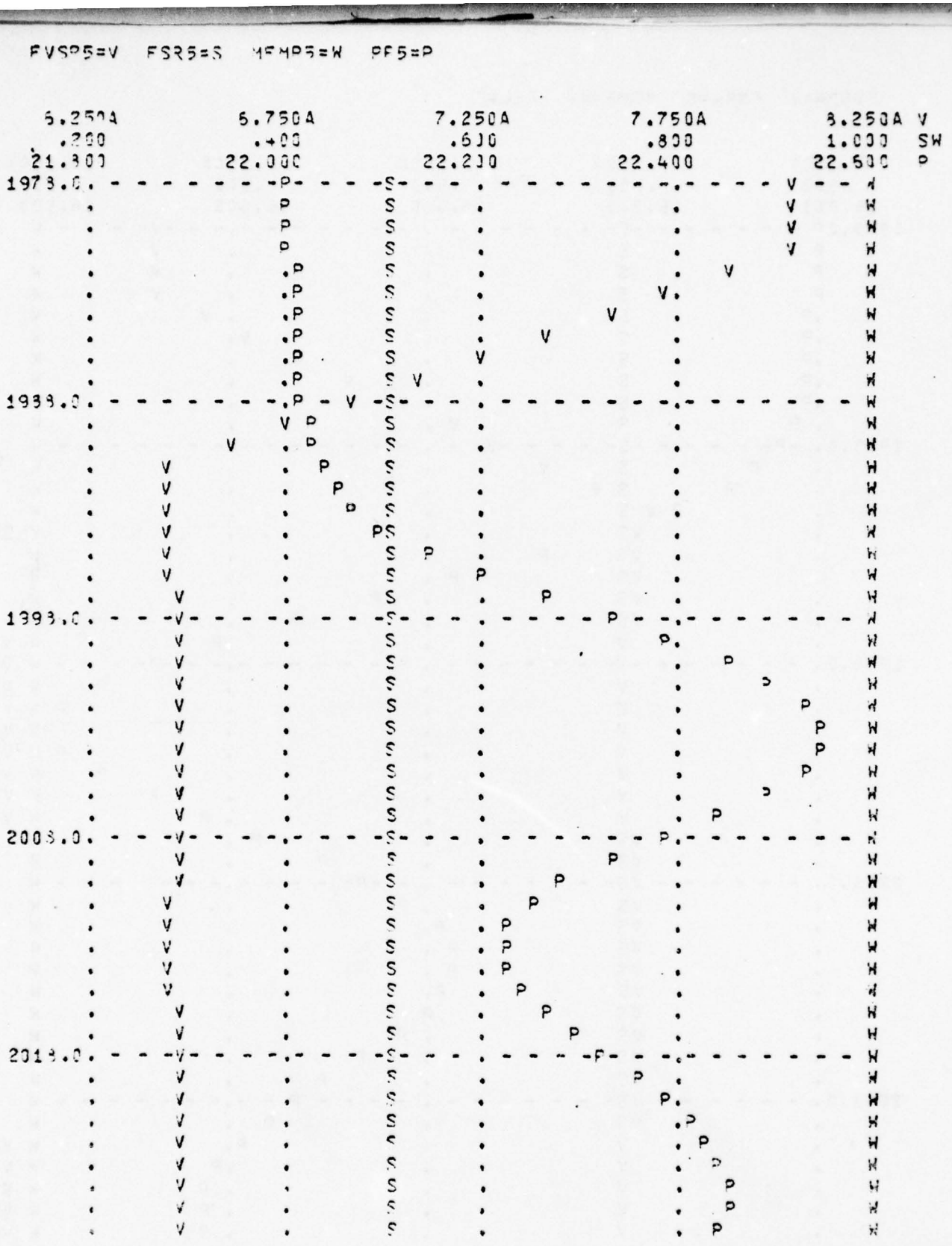


Figure C-62. Increased Retention (Hypothesis B), O-5 Promotion Parameters

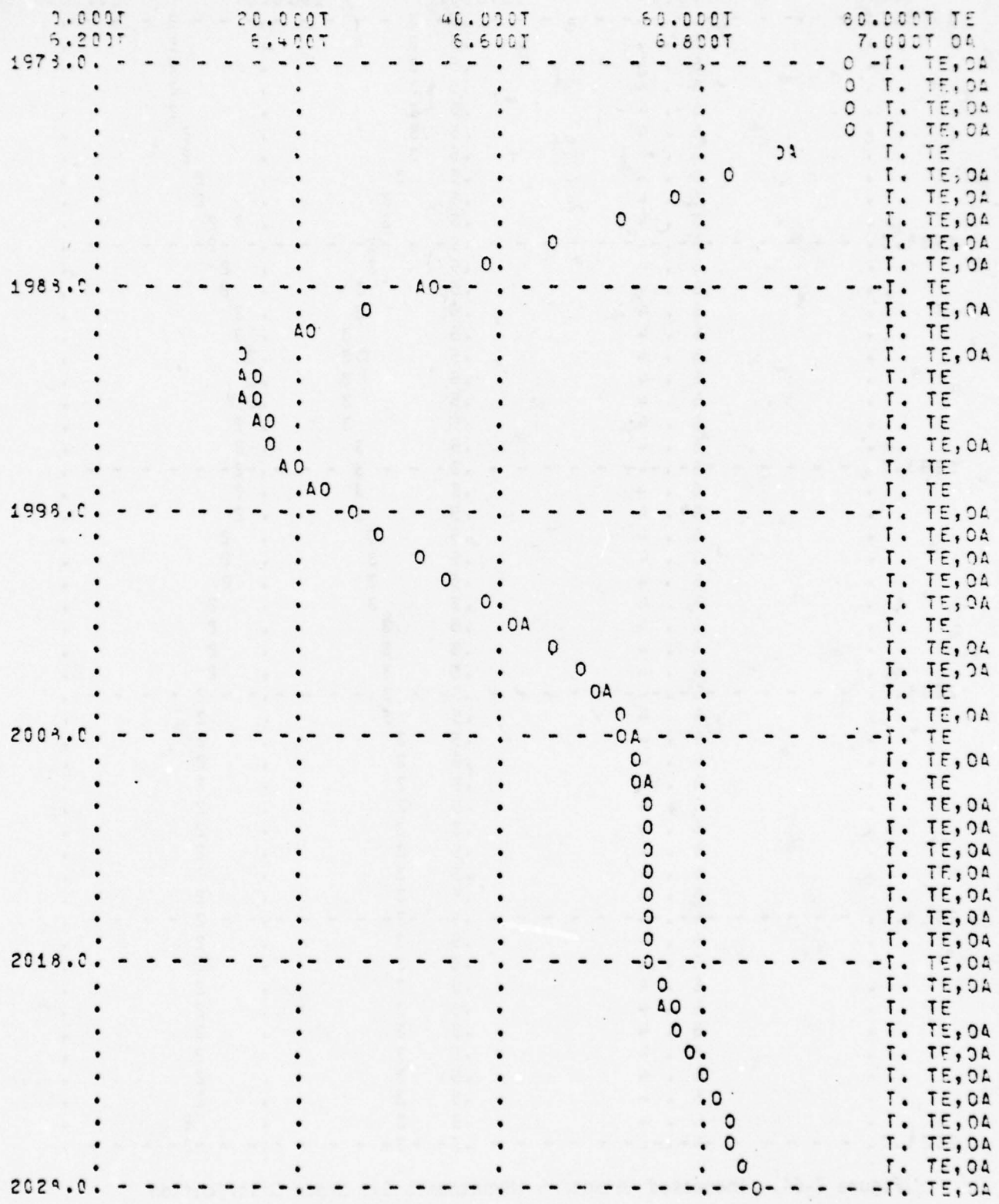


Figure C-63. Increased Retention (Hypothesis C), Accession and Attrition Rates

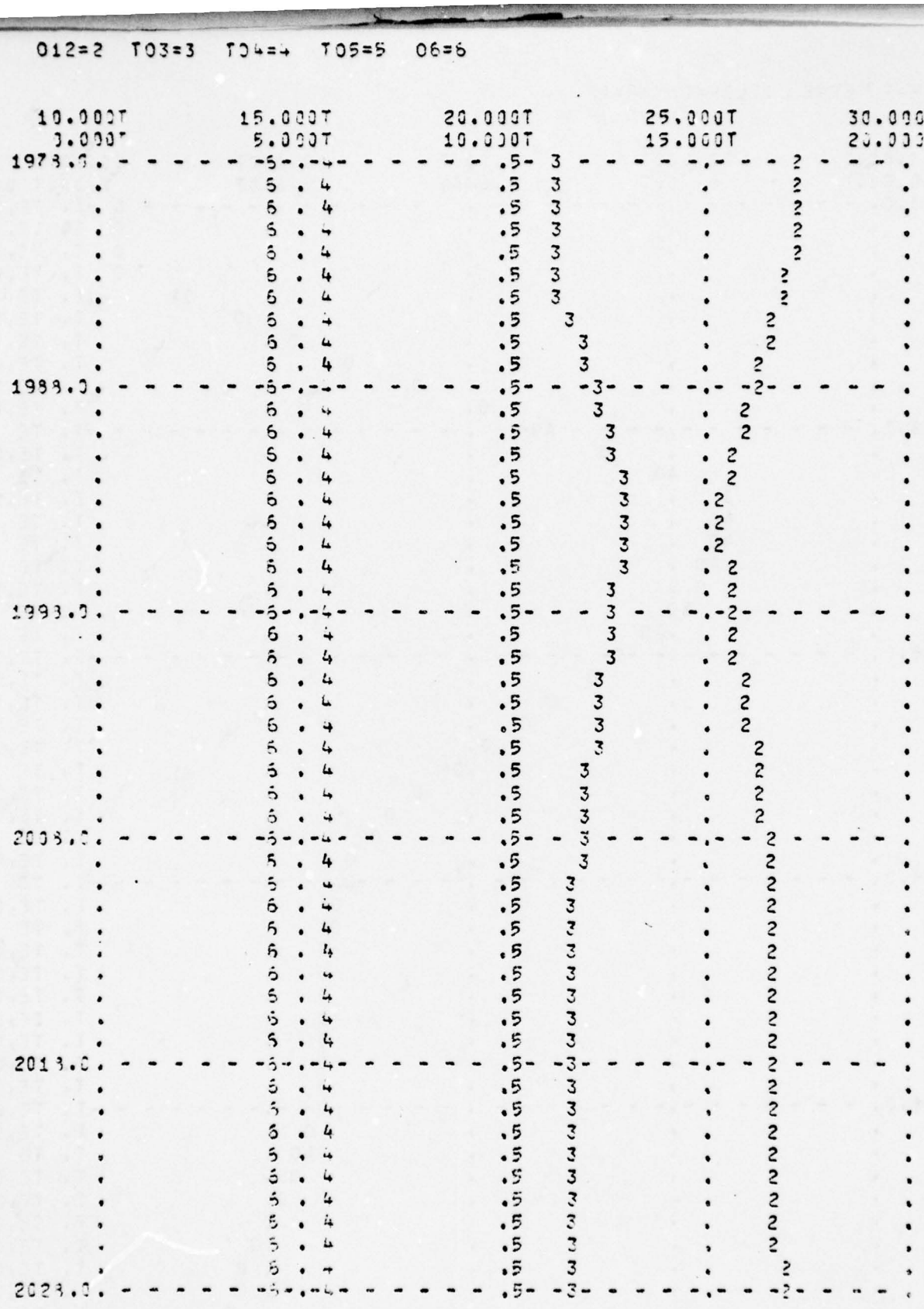


Figure C-64. Increased Retention (Hypothesis C), Grade Distribution

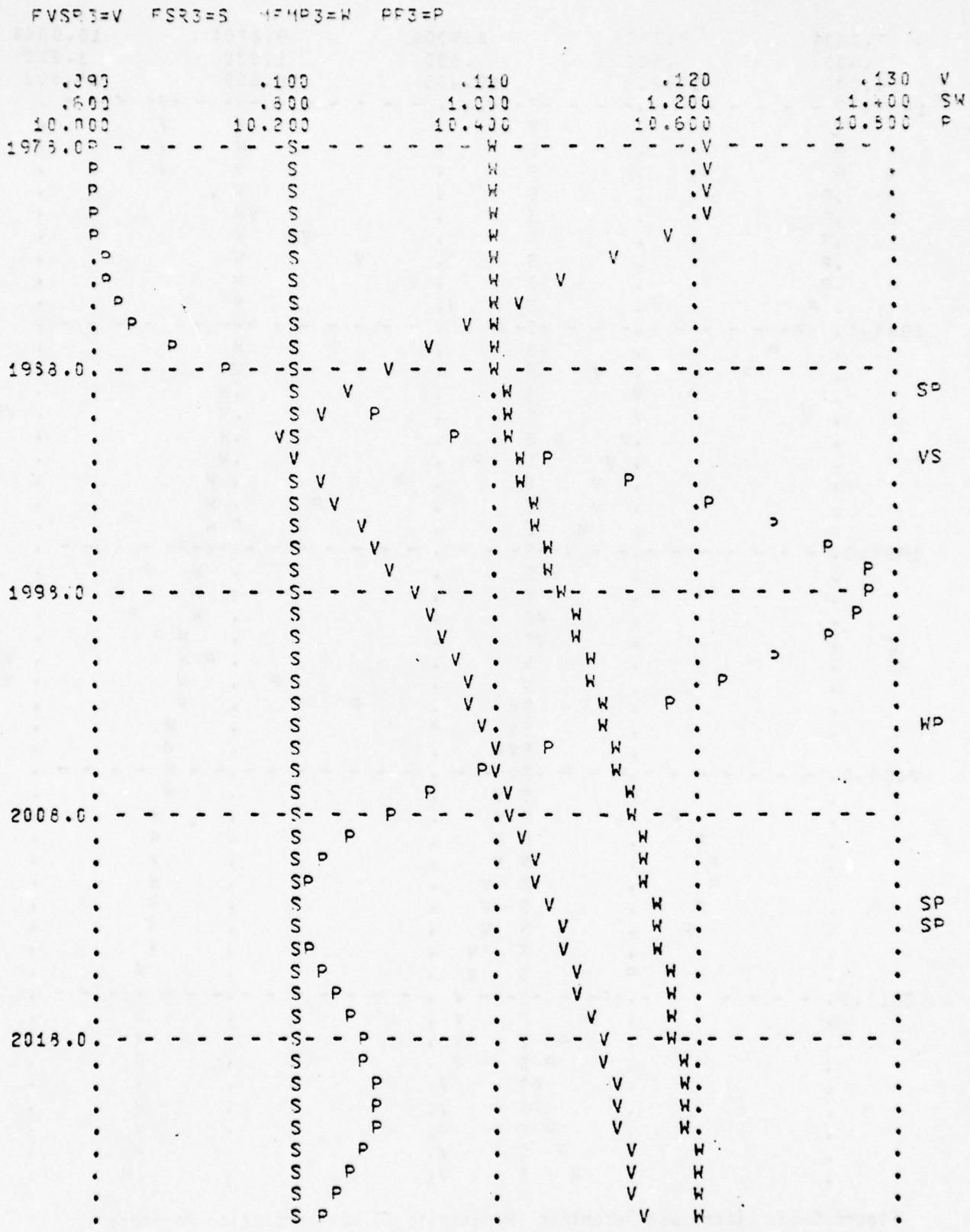


Figure C-65. Increased Retention (Hypothesis C), O-3 Promotion Parameters

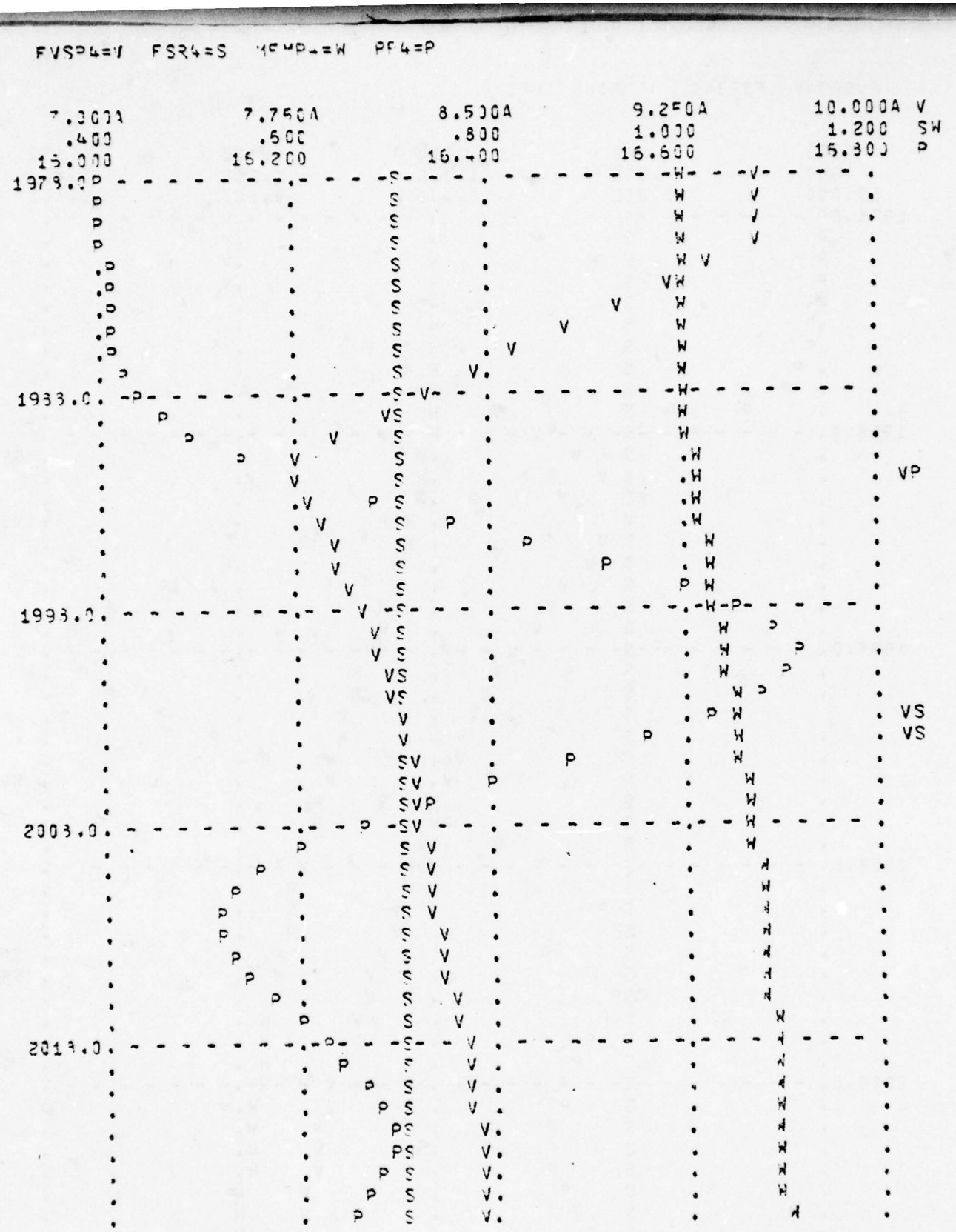


Figure C-66. Increased Retention (Hypothesis C), 0-4 Promotion Parameters

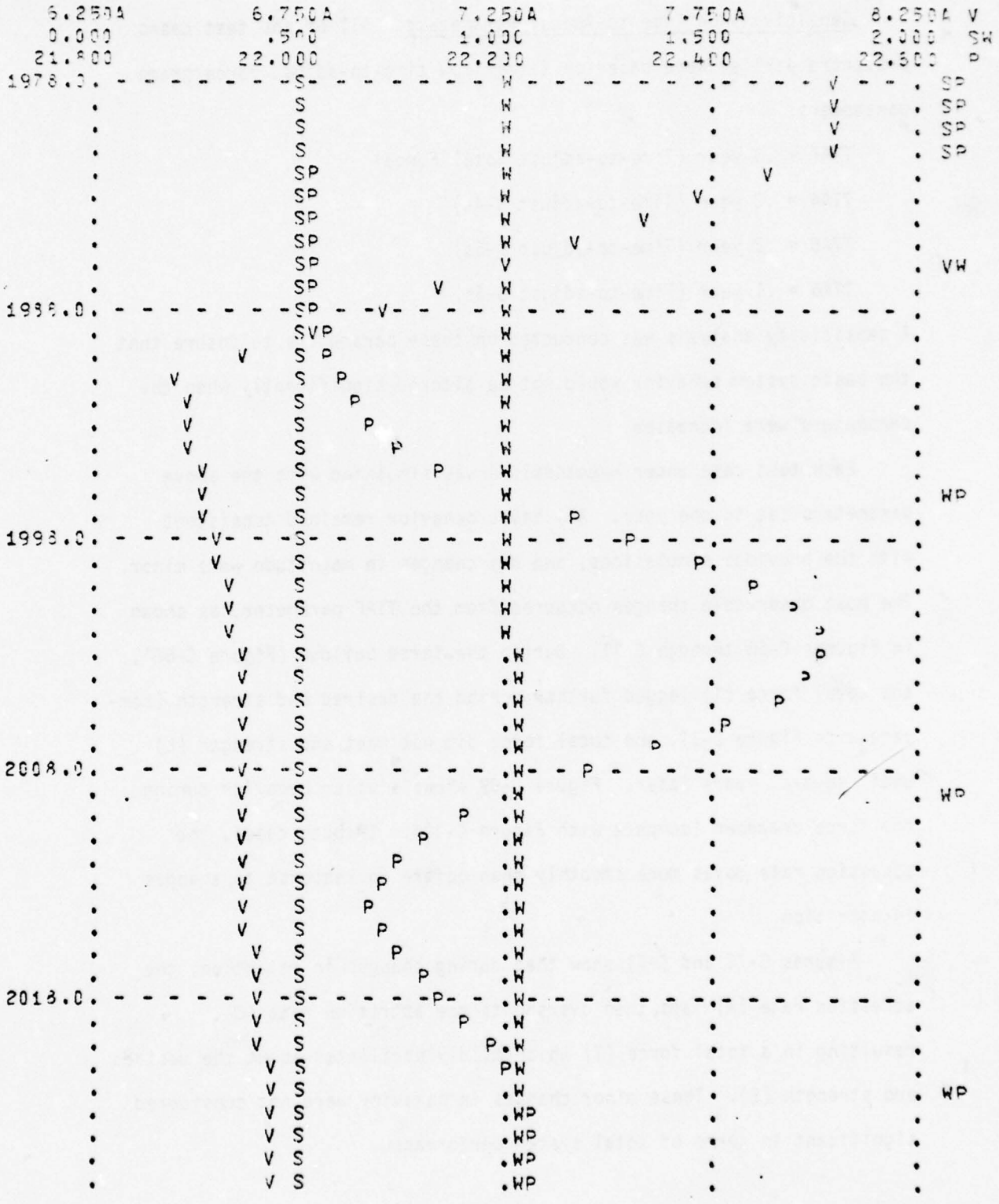


Figure C-67. Increased Retention (Hypothesis C), O-5 Promotion Parameters

Sensitivity on Time-to-Adjust Parameters. All of the test cases presented earlier were based on fairly low time-to-adjust force/grade parameters:

TTAF = .3 year (Time-to-adjust Total Force)

TTA4 = .3 year (Time-to-adjust 0-4s)

TTA5 = .2 year (Time-to-adjust 0-5s)

TTA6 = .1 year (Time-to-adjust 0-6s)

A sensitivity analysis was conducted on these parameters to insure that the basic system behavior would not be altered significantly when the parameters were increased.

Each test case under Hypothesis A was simulated with the above parameters set to one year. All basic behavior remained consistent with the previous simulations, and any changes in magnitude were minor. The most observable changes occurred from the TTAF parameter, as shown in Figures C-68 through C-71. During the force buildup (Figure C-68), the total force (T) lagged further behind the desired end strength (compare with Figure C-2), and total force did not meet end strength (E) until several years later. Figure C-69 shows similar behavior during the force drawdown (compare with Figure C-20). In both cases, the accession rate moves more smoothly than before in response to changes in attrition.

Figures C-70 and C-71 show that during changes in retention, the accession rate (A) lags, then overshoots the attrition rate (O), resulting in a total force (T) which mildly oscillates about the desired end strength (E). These minor changes in behavior were not considered significant in terms of total system performance.

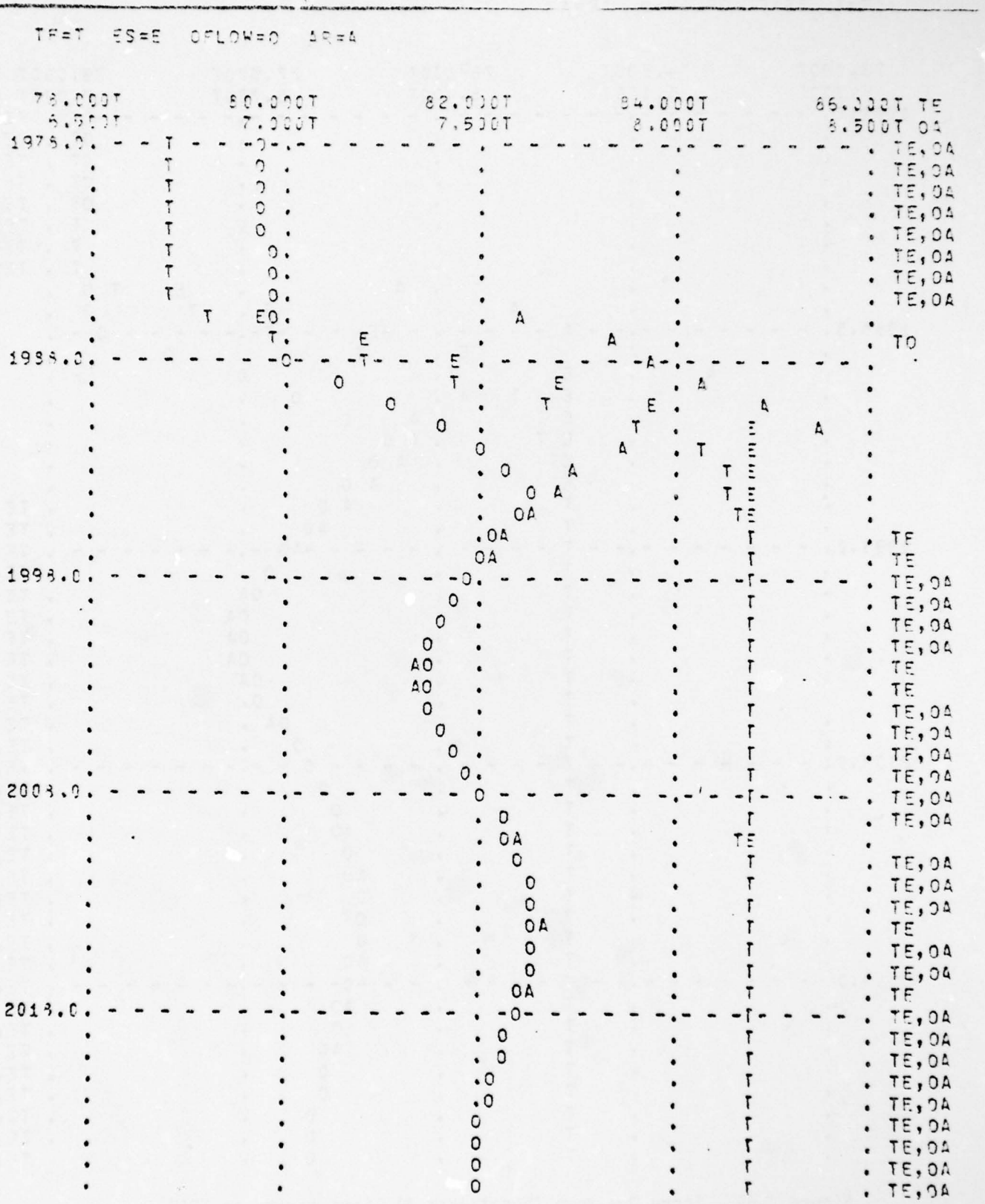


Figure C-68. Force Buildup (Hypothesis A), Sensitivity on TTAF

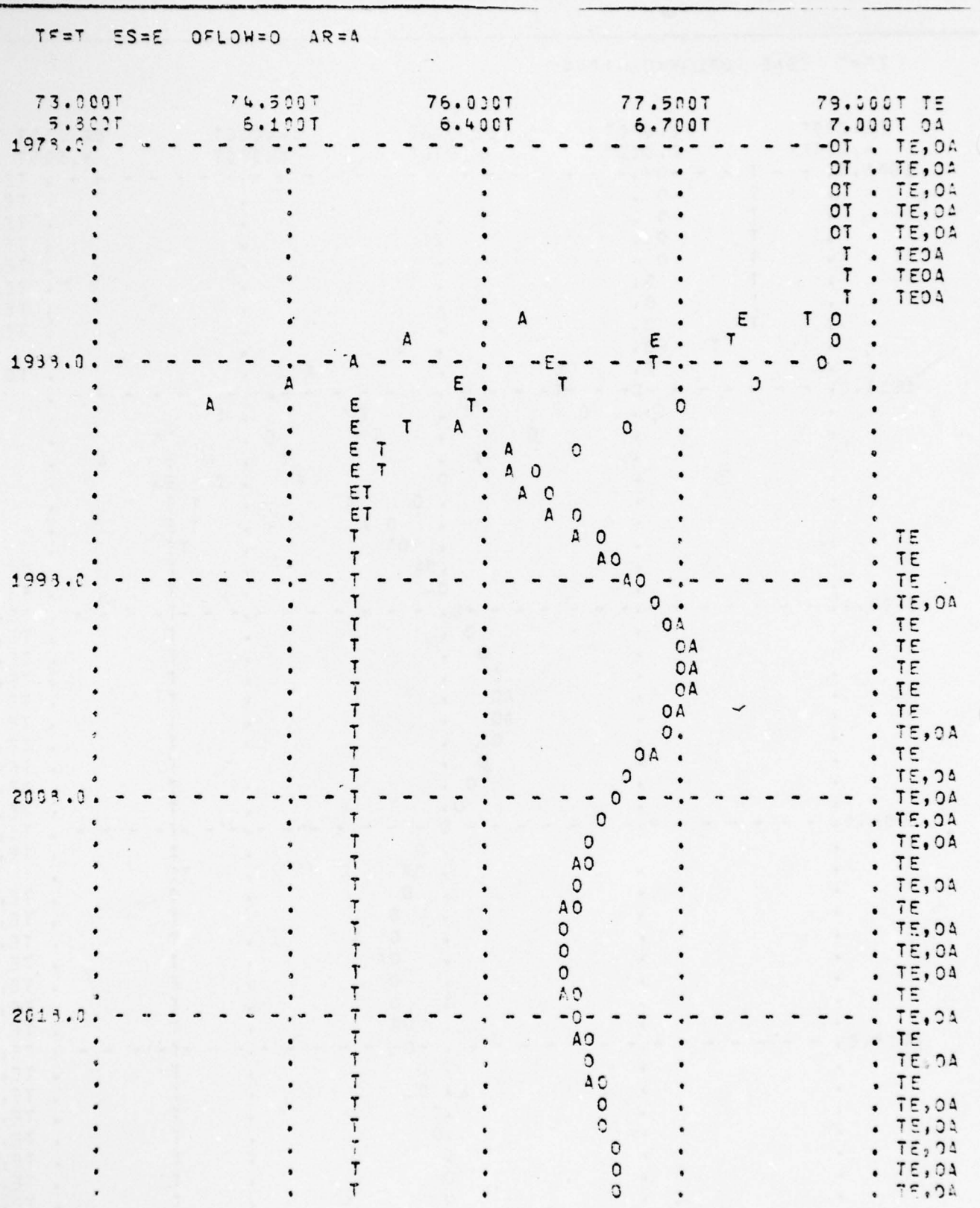


Figure C-69. Force Drawdown (Hypothesis A), Sensitivity on TTAF

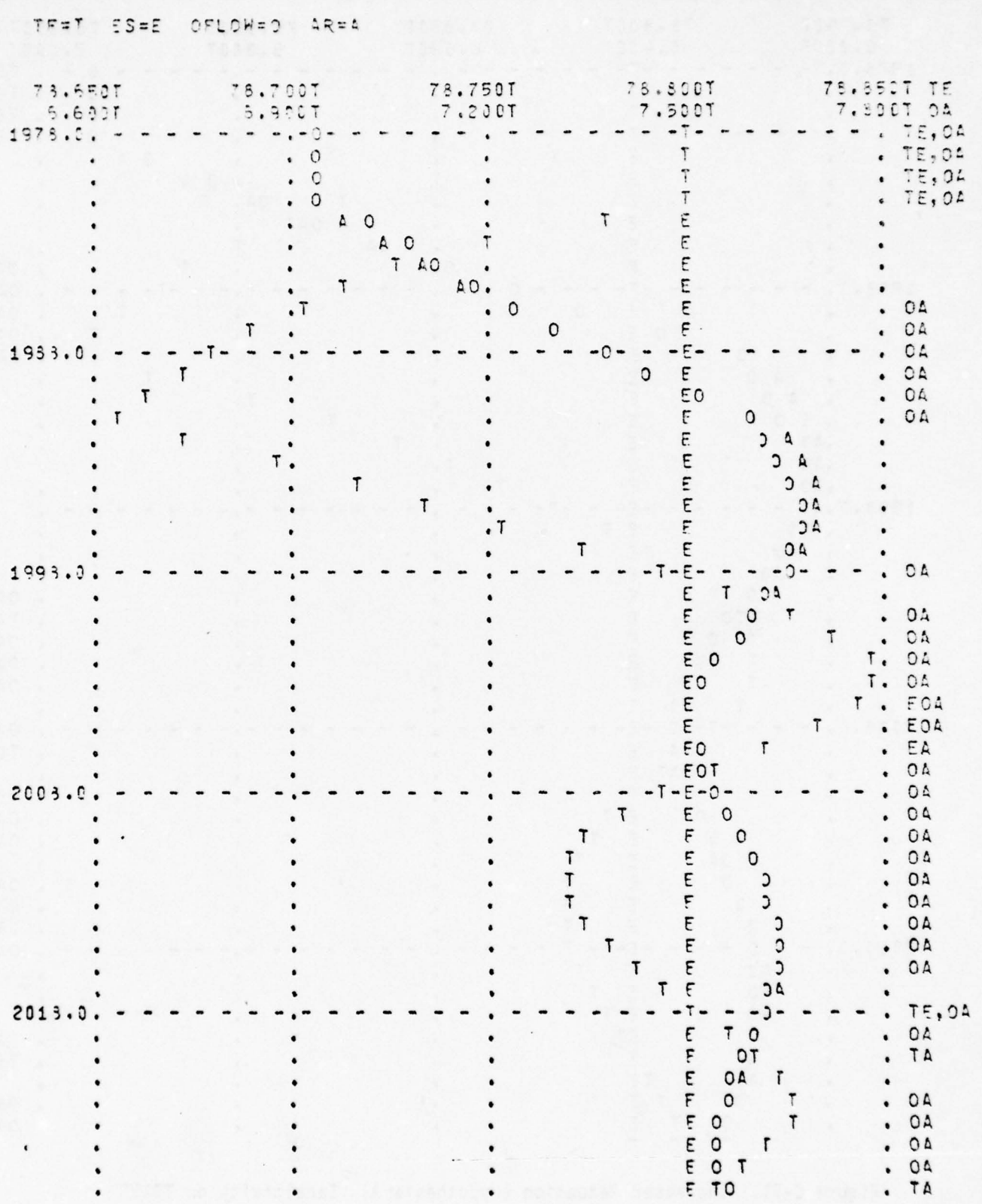


Figure C-70. Decreased Retention (Hypothesis A), Sensitivity on TTAF

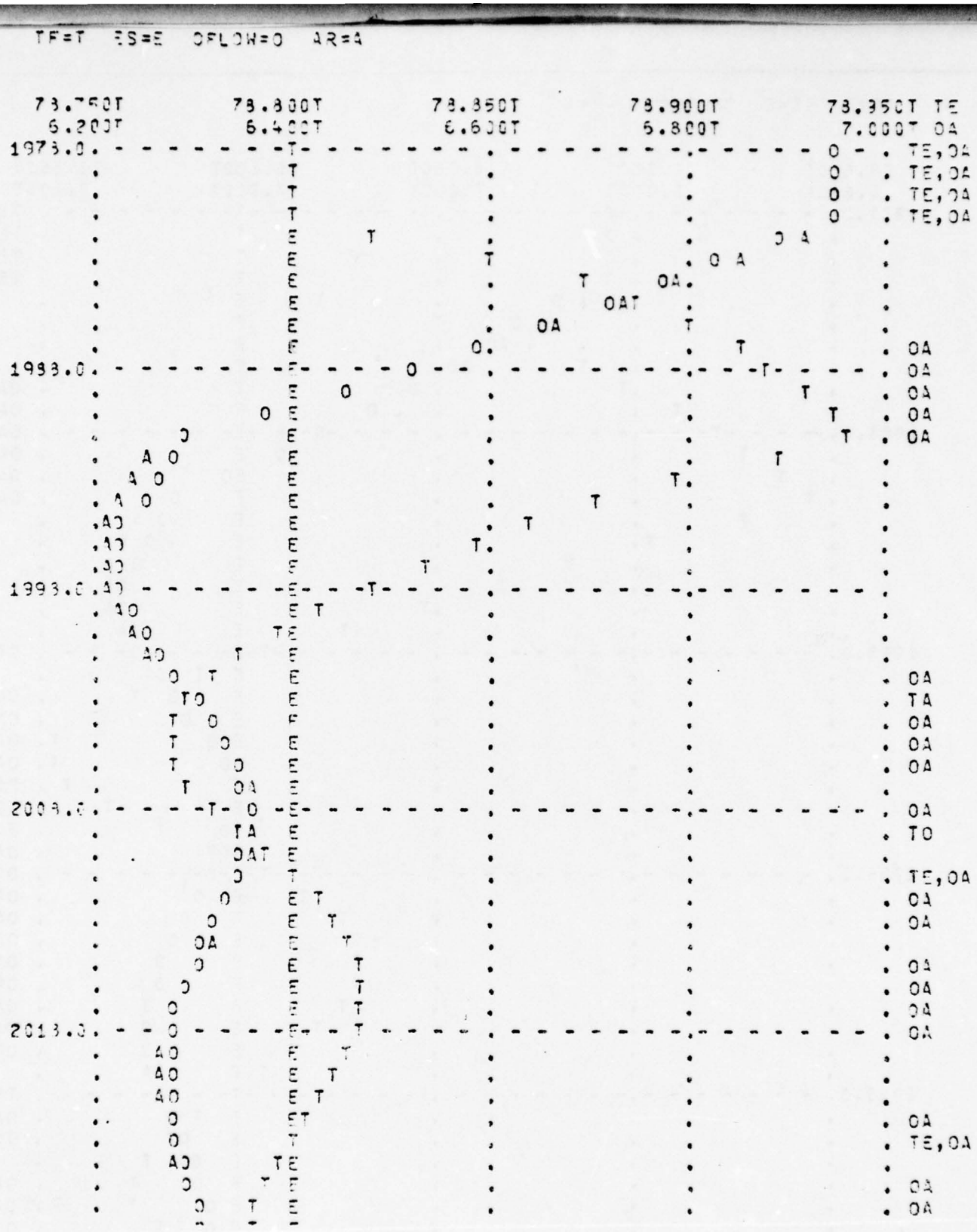


Figure C-71. Increased Retention (Hypothesis A), Sensitivity on TTAF

APPENDIX D

RMA Analysis Output

APPENDIX D

RMA Analysis Output

This chapter contains the complete DYNAMO output which was summarized in Chapter V. The order in which the output appears here parallels the presentation in Chapter V. Refer to Table C-I in Appendix C for an explanation of plot symbols. Table D-I below explains the print symbols used in this appendix.

TABLE D-I

Symbol Definitions

Symbol	Definition
RC	Recruitment Costs
TRNC	Training Costs
TADP	Total Active Duty Pay
TOTAL	Total Accession Costs (RC+TRNC+Precommissioning Costs
TRP	Total Retirement Payments
TSP	Total Separation Payments
DFDP	Deferred Annuities
TCS	Total System Costs
TOTRET	Total Number of Retirees
DTSC	Discounted Total System Costs

TABLE D-II

Present System Cost Streams

TIME	RC	TRNC	TACP	TOTAC	TPP	TSP	D*DP	TSC	TOTRET	DTSC
E-00	E 06	E 06	E 06	E 06	E 06	E 03	E-00	E 06	E-00	E 05
1978.0	15.03	563.6	1712.	638.0	9.	8556.	0.	2386.	0.	2354.6
1979.0	15.87	532.4	1800.	670.7	41.	8556.	0.	2539.	1307.	2357.2
1980.0	17.73	622.8	1992.	706.1	77.	8556.	0.	2701.	3751.	2349.5
1981.0	19.64	694.7	1989.	741.2	114.	8556.	0.	2873.	5534.	2328.6
1982.0	19.59	644.2	2091.	779.1	154.	8556.	0.	3053.	7257.	2307.3
1983.0	20.50	723.6	2198.	819.1	196.	8556.	0.	3244.	8922.	2285.9
1984.0	21.55	760.6	2311.	861.1	241.	8556.	0.	3445.	10533.	2263.3
1985.0	22.75	799.6	2429.	905.2	289.	8556.	0.	3656.	12091.	2239.9
1986.0	23.93	840.6	2554.	951.6	339.	8557.	0.	3879.	13597.	2215.8
1987.0	25.16	883.7	2685.	1000.4	393.	8557.	0.	4114.	15053.	2191.1
1988.0	26.45	929.0	2822.	1051.7	456.	13934.	0.	4372.	16461.	2171.2
1989.0	27.80	976.6	2967.	1105.6	517.	13934.	0.	4633.	17822.	2146.1
1990.0	29.23	1026.7	3119.	1162.3	581.	13934.	0.	4908.	19139.	2118.7
1991.0	30.72	1079.3	3279.	1221.9	650.	13934.	0.	5197.	20411.	2089.9
1992.0	32.30	1134.6	3447.	1284.5	722.	13934.	0.	5502.	21642.	2060.8
1993.0	33.95	1192.8	3622.	1350.3	799.	13934.	0.	5822.	22832.	2031.5
1994.0	35.69	1253.9	3809.	1419.5	880.	13934.	0.	6160.	23983.	2001.0
1995.0	37.52	1318.1	4004.	1492.2	966.	13940.	0.	6516.	25095.	1982.3
1996.0	39.44	1385.6	4209.	1568.6	1057.	13941.	0.	6891.	26171.	1964.6
1997.0	41.46	1456.6	4425.	1649.0	1153.	13941.	0.	7285.	27212.	1926.9
1998.0	43.59	1531.2	4652.	1733.5	1260.	19324.	0.	7711.	28218.	1901.6
1999.0	45.82	1609.6	4892.	1822.2	1368.	19325.	0.	8149.	29191.	1873.6
2000.0	48.17	1692.1	5141.	1915.6	1482.	19325.	0.	8609.	30132.	1845.6
2001.0	50.64	1778.7	5404.	2013.7	1602.	19325.	0.	9094.	31042.	1817.7
2002.0	53.23	1869.7	5681.	2116.9	1730.	19325.	0.	9604.	31923.	1789.9
2003.0	55.96	1965.7	5972.	2225.3	1864.	19325.	0.	10141.	32775.	1762.2
2004.0	58.82	2066.4	6278.	2339.3	2006.	19325.	0.	10706.	33599.	1734.6
2005.0	61.84	2172.2	6600.	2459.2	2157.	19324.	0.	11301.	34396.	1707.2
2006.0	65.01	2283.3	6938.	2585.2	2315.	19324.	0.	11927.	35167.	1680.0
2007.0	68.34	2400.0	7293.	2717.7	2483.	19324.	0.	12586.	35913.	1653.0
2008.0	71.84	2523.5	7667.	2856.8	2665.	24704.	0.	13281.	36635.	1627.5
2009.0	75.52	2653.9	8060.	3003.3	2852.	24705.	0.	14020.	37334.	1600.8
2010.0	79.39	2788.9	8473.	3157.3	3049.	24705.	0.	14788.	38010.	1574.3
2011.0	83.46	2931.8	8907.	3319.1	3257.	24704.	0.	15596.	38664.	1548.1
2012.0	87.74	3082.0	9363.	3489.1	3478.	24704.	0.	16447.	39297.	1522.2
2013.0	92.22	3240.0	9842.	3667.9	3708.	24704.	0.	17342.	39909.	1496.5
2014.0	96.96	3406.0	10347.	3856.9	3952.	24704.	0.	18293.	40502.	1471.1
2015.0	101.98	3580.5	10878.	4053.5	4209.	24704.	0.	19274.	41075.	1445.9
2016.0	107.15	3764.0	11435.	4261.2	4481.	24704.	0.	20316.	41630.	1421.1
2017.0	112.64	3956.9	12021.	4479.5	4768.	24704.	0.	21413.	42167.	1396.5
2018.0	118.41	4159.6	12637.	4709.0	5075.	30087.	0.	22577.	42687.	1372.9
2019.0	124.48	4372.7	13284.	4950.3	5394.	30087.	0.	23791.	43190.	1349.9
2020.0	130.86	4596.8	13966.	5204.0	5730.	30088.	0.	25068.	43676.	1325.2
2021.0	137.55	4832.3	14681.	5470.5	6084.	30088.	0.	26411.	44147.	1301.9
2022.0	144.61	5079.8	15433.	5750.9	6457.	30088.	0.	27825.	44603.	1278.8
2023.0	152.02	5341.1	16227.	6045.5	6850.	30088.	0.	29311.	45044.	1255.0
2024.0	159.81	5616.7	17065.	6356.2	7264.	30088.	0.	30875.	45471.	1233.6
2025.0	167.99	5907.3	17949.	6684.8	7701.	30088.	0.	32519.	45885.	1211.5
2026.0	176.60	6213.7	18883.	7023.1	8161.	30088.	0.	34250.	46285.	1189.7
2027.0	185.65	6537.6	19870.	7383.0	8645.	30088.	0.	36069.	46672.	1168.2
2028.0	195.15	6879.7	20913.	7761.3	9161.	36471.	0.	37994.	47047.	1147.3
2029.0	205.15	7237.0	21998.	8158.3	9699.	36470.	0.	40008.	47410.	1126.5
2030.0	215.67	7575.2	23017.	8577.0	10266.	36470.	0.	42126.	47762.	1105.9

TABLE D-III

RMA Cost Streams, No Personnel Response

TIME	RC	TRNC	TAOP	TOTAC	TRP	TSP	OPOP	TSC	TOTRET	OTSC
E-00	E 06	E 05	E 06	E 05	E 06	E 03	E 06	E 05	E-00	E 06
1978.0	16.05	563.6	1717.	638.0	9.	8556.	0.00	2785.	0.	2794.6
1979.0	16.87	592.4	1800.	670.7	41.	8556.	0.00	2539.	1907.	2367.2
1980.0	17.73	622.8	1892.	705.1	77.	8556.	0.00	2701.	3751.	2348.5
1981.0	18.64	654.7	1989.	741.2	114.	8556.	0.00	2873.	5534.	2328.6
1982.0	19.59	688.2	2091.	779.1	156.	8556.	1.60	3056.	7414.	2309.5
1983.0	20.60	723.5	2198.	819.1	200.	8556.	3.27	3248.	9229.	2289.0
1984.0	21.65	760.6	2311.	861.1	247.	8556.	5.01	3451.	10980.	2267.4
1985.0	22.76	799.6	2429.	905.2	297.	8556.	6.83	3664.	12670.	2244.7
1986.0	23.93	840.6	2554.	951.6	349.	8557.	8.72	3888.	14300.	2221.0
1987.0	25.16	883.7	2685.	1000.4	404.	8557.	10.70	4124.	15873.	2196.5
1988.0	26.45	929.0	2822.	1051.7	467.	13938.	12.77	4373.	17392.	2175.6
1989.0	27.80	976.6	2967.	1105.6	528.	13938.	14.92	4644.	18858.	2150.2
1990.0	29.23	1025.7	3119.	1162.3	592.	13938.	17.18	4918.	20277.	2127.3
1991.0	30.72	1078.3	3279.	1221.9	660.	13938.	19.54	5207.	21636.	2096.0
1992.0	32.30	1134.6	3447.	1284.5	733.	13938.	22.00	5513.	22957.	2069.0
1993.0	33.95	1192.8	3623.	1350.3	811.	13939.	24.58	5835.	24229.	2041.8
1994.0	35.68	1253.9	3809.	1419.5	893.	13939.	27.27	6174.	25457.	2014.4
1995.0	37.52	1318.1	4004.	1492.2	980.	13940.	30.09	6531.	26643.	1985.8
1996.0	39.44	1385.6	4209.	1568.6	1073.	13941.	33.05	5907.	27785.	1959.1
1997.0	41.46	1456.6	4425.	1649.0	1170.	13941.	35.14	7302.	28883.	1931.3
1998.0	43.59	1531.2	4652.	1733.5	1278.	19324.	38.37	7729.	29961.	1906.1
1999.0	45.82	1609.6	4890.	1822.2	1387.	19325.	42.77	8168.	30992.	1878.0
2000.0	48.17	1692.1	5141.	1915.6	1503.	19325.	46.32	8629.	31988.	1850.0
2001.0	50.64	1778.7	5404.	2013.7	1624.	19325.	50.04	9115.	32949.	1822.0
2002.0	53.23	1869.9	5681.	2116.9	1753.	19325.	53.94	9627.	33878.	1794.2
2003.0	55.96	1965.7	5972.	2225.3	1889.	19325.	58.03	10165.	34776.	1766.4
2004.0	58.82	2066.4	6278.	2339.3	2032.	19325.	62.31	10731.	35643.	1739.8
2005.0	61.84	2172.2	6600.	2459.2	2183.	19324.	66.81	11329.	36481.	1711.3
2006.0	65.01	2283.6	6938.	2585.2	2343.	19324.	71.52	11955.	37290.	1684.0
2007.0	68.34	2400.5	7293.	2717.7	2512.	19323.	76.46	12615.	38072.	1656.9
2008.0	71.84	2523.6	7667.	2856.9	2696.	24705.	81.64	13321.	38828.	1631.3
2009.0	75.52	2652.9	8060.	3003.3	2884.	24705.	87.08	14052.	39559.	1604.5
2010.0	79.39	2789.9	8473.	3157.3	3082.	24705.	92.79	14822.	40265.	1577.9
2011.0	83.46	2931.8	8907.	3319.1	3292.	24704.	98.77	15631.	40948.	1551.6
2012.0	87.74	3082.0	9363.	3489.1	3512.	24704.	105.05	16483.	41607.	1525.5
2013.0	92.23	3240.0	9843.	3667.9	3746.	24704.	111.65	17380.	42245.	1499.7
2014.0	96.96	3406.0	10347.	3855.9	3991.	24704.	118.56	18323.	42861.	1474.2
2015.0	101.93	3580.5	10878.	4053.5	4250.	24704.	125.83	19315.	43457.	1449.0
2016.0	107.15	3764.0	11435.	4261.2	4523.	24704.	133.45	20358.	44033.	1424.0
2017.0	112.64	3956.9	12021.	4479.5	4811.	24704.	141.45	21457.	44590.	1399.4
2018.0	118.41	4159.5	12637.	4709.0	5120.	30087.	149.86	22623.	45129.	1375.7
2019.0	124.48	4372.7	13284.	4950.3	5440.	30087.	158.68	23838.	45649.	1351.6
2020.0	130.86	4596.8	13965.	5204.0	5778.	30088.	167.95	25116.	46153.	1327.8
2021.0	137.56	4832.3	14681.	5470.6	6133.	30088.	177.68	26461.	46640.	1304.3
2022.0	144.61	5079.5	15433.	5750.9	6508.	30088.	187.90	27876.	47110.	1281.1
2023.0	152.02	5340.1	16223.	6045.5	6903.	30088.	198.63	29364.	47566.	1258.3
2024.0	159.81	5613.7	17055.	6355.2	7318.	30088.	209.90	30929.	48006.	1235.8
2025.0	167.99	5901.3	17929.	6680.8	7757.	30088.	221.74	32575.	48432.	1213.6
2026.0	176.60	6203.7	18847.	7023.1	8218.	30088.	234.17	34307.	48843.	1191.7
2027.0	185.65	6521.6	19813.	7383.0	8705.	30088.	247.24	36129.	49242.	1170.1
2028.0	195.15	6855.7	20828.	7761.3	9222.	35471.	260.96	38055.	49627.	1149.2
2029.0	205.16	7207.0	21895.	8158.9	9762.	35470.	275.36	40070.	50000.	1128.2
2030.0	215.67	7576.2	23017.	8577.0	10330.	35470.	290.53	42189.	50361.	1107.6

TABLE D-IV

RMA Cost Streams, Weak Intended Response, No Military Pay Feedback

TIME	RC	TRMC	TACP	TOTAC	TPP	TSP	DFOP	TSC	TOTRFT	DTSC
E-00	E 06	E 06	E 06	E 06	E 06	E 03	E 06	E 06	E-00	E 06
1978.0	15.05	557.6	1712.	638.0	9.	8556.	0.00	2385.	0.	2394.6
1979.0	15.37	532.4	1800.	673.7	41.	8556.	0.00	2539.	1907.	2367.2
1980.0	17.73	622.7	1897.	714.9	77.	8556.	0.00	2701.	3751.	2348.4
1981.0	18.33	654.6	1989.	741.0	114.	8556.	0.00	2873.	5534.	2328.5
1982.0	18.57	637.4	2092.	778.1	156.	8556.	1.60	3055.	7414.	2308.9
1983.0	20.51	720.6	2199.	815.7	200.	8557.	3.27	3245.	9226.	2287.1
1984.0	21.49	754.9	2312.	854.6	247.	8560.	5.01	3445.	10971.	2263.8
1985.0	22.51	791.7	2432.	895.1	296.	8569.	6.83	3655.	12550.	2239.4
1986.0	23.57	827.0	2557.	937.2	347.	8585.	8.72	3876.	14207.	2213.8
1987.0	24.67	866.5	2688.	981.0	402.	8613.	10.70	4107.	15824.	2187.3
1988.0	25.82	907.1	2825.	1026.9	464.	14096.	12.77	4351.	17323.	2165.5
1989.0	27.03	949.4	2974.	1074.7	524.	14178.	14.93	4616.	18758.	2137.2
1990.0	28.29	993.6	3128.	1124.5	587.	14260.	17.19	4884.	20160.	2108.4
1991.0	29.60	1039.7	3288.	1177.0	663.	14325.	19.55	5165.	21601.	2078.1
1992.0	31.00	1088.9	3456.	1232.7	725.	14371.	22.03	5464.	22995.	2046.5
1993.0	32.52	1142.5	3631.	1293.4	811.	14403.	24.62	5780.	24345.	2012.6
1994.0	34.15	1199.8	3827.	1356.2	881.	14425.	27.33	6114.	25655.	1976.7
1995.0	35.88	1260.7	4010.	1426.7	967.	14434.	30.16	6465.	26928.	1938.9
1996.0	37.71	1324.6	4225.	1499.4	1057.	14425.	33.15	6837.	27567.	1899.2
1997.0	39.64	1392.6	4442.	1576.4	1154.	14395.	36.29	7229.	28675.	1857.7
1998.0	41.68	1464.6	4664.	1657.9	1261.	19877.	39.57	7643.	29752.	1814.1
1999.0	43.86	1540.7	4900.	1744.1	1370.	19776.	43.02	8088.	30802.	1768.7
2000.0	46.16	1621.1	5159.	1835.1	1485.	19672.	46.64	8548.	31824.	1722.5
2001.0	48.56	1705.9	5422.	1931.1	1607.	19562.	50.44	9132.	32821.	1675.5
2002.0	51.11	1795.5	5700.	2032.5	1737.	19541.	54.43	9544.	33791.	1778.7
2003.0	53.80	1889.8	5992.	2139.3	1874.	19510.	58.63	10282.	34734.	1752.0
2004.0	56.62	1988.9	6298.	2251.4	2020.	19493.	63.04	10643.	35651.	1725.4
2005.0	59.57	2092.8	6620.	2369.1	2174.	19489.	67.68	11246.	36539.	1699.0
2006.0	62.67	2201.6	6959.	2492.3	2337.	19494.	72.55	11874.	37399.	1672.6
2007.0	65.91	2315.5	7315.	2621.2	2508.	19509.	77.68	12535.	38228.	1646.3
2008.0	69.30	2434.6	7690.	2756.0	2695.	24973.	83.08	13240.	39027.	1621.3
2009.0	72.85	2559.0	8084.	2896.9	2886.	25005.	88.75	13970.	39795.	1595.0
2010.0	76.55	2689.7	8498.	3044.3	3087.	25046.	94.74	14737.	40532.	1568.9
2011.0	80.44	2827.7	8934.	3198.8	3299.	25088.	101.07	15543.	41240.	1542.9
2012.0	84.51	2969.9	9390.	3360.7	3522.	25130.	107.66	16391.	41920.	1517.0
2013.0	88.79	3119.9	9871.	3530.6	3757.	25168.	114.63	17282.	42574.	1491.4
2014.0	93.28	3278.5	10380.	3709.0	4005.	25200.	121.97	18220.	43202.	1466.9
2015.0	98.00	3443.9	10916.	3896.9	4269.	25222.	129.70	19206.	43803.	1443.8
2016.0	102.97	3617.0	11479.	4094.8	4549.	25235.	137.83	20243.	44382.	1421.9
2017.0	108.20	3799.3	12068.	4302.5	4829.	25238.	146.39	21334.	44936.	1401.4
2018.0	113.71	3990.4	12686.	4521.7	5140.	30729.	155.40	22494.	45502.	1357.8
2019.0	119.52	4191.5	13335.	4752.7	5482.	30713.	164.88	23703.	46021.	1343.9
2020.0	125.64	4403.5	14017.	4995.1	5832.	30691.	174.86	24975.	46545.	1329.3
2021.0	132.09	4626.9	14730.	5252.7	6190.	30664.	185.35	26315.	47044.	1307.1
2022.0	138.89	4863.9	15485.	5522.9	6568.	30637.	196.39	27725.	47529.	1274.2
2023.0	146.04	5113.3	16279.	5807.5	6937.	30610.	208.00	29209.	48001.	1251.7
2024.0	153.58	5374.9	17112.	6107.1	7357.	30585.	220.20	30770.	48460.	1229.4
2025.0	161.50	5650.3	17988.	6422.2	7801.	30564.	233.04	32414.	48906.	1207.5
2026.0	169.83	5939.0	18909.	6753.5	8268.	30548.	246.54	34143.	49339.	1186.0
2027.0	178.59	6243.5	19877.	7101.6	8761.	30533.	260.73	35961.	49759.	1164.7
2028.0	187.78	6563.5	20895.	7467.3	9286.	35995.	276.65	37885.	50165.	1144.0
2029.0	197.44	6899.9	21968.	7851.4	9822.	35997.	291.34	39907.	50559.	1122.3
2030.0	207.58	7253.0	23091.	8254.5	10419.	36004.	307.84	42012.	50939.	1102.0

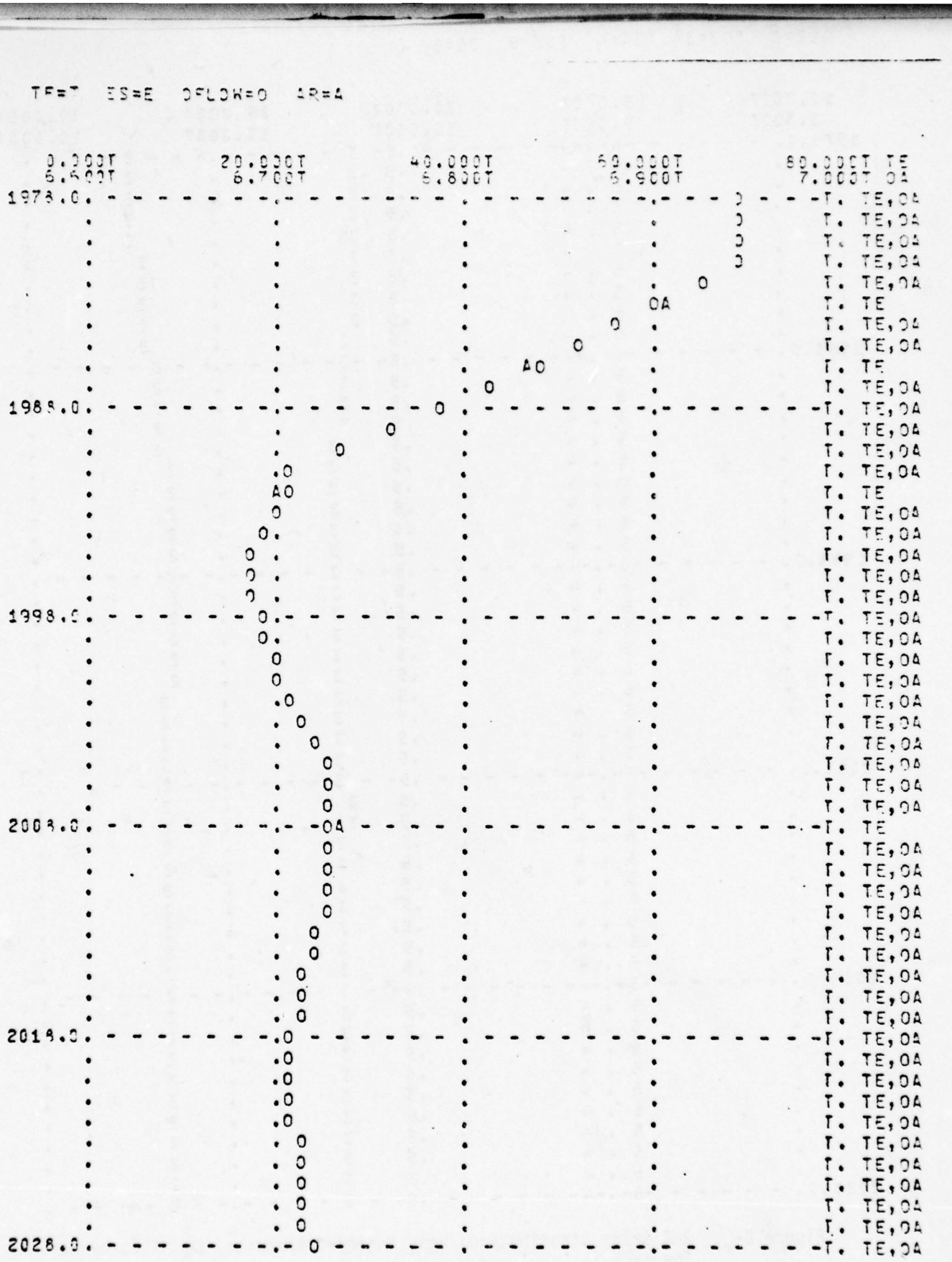


Figure D-1. RMA Accessions, Weak Intended Response, No Military Pay Feedback

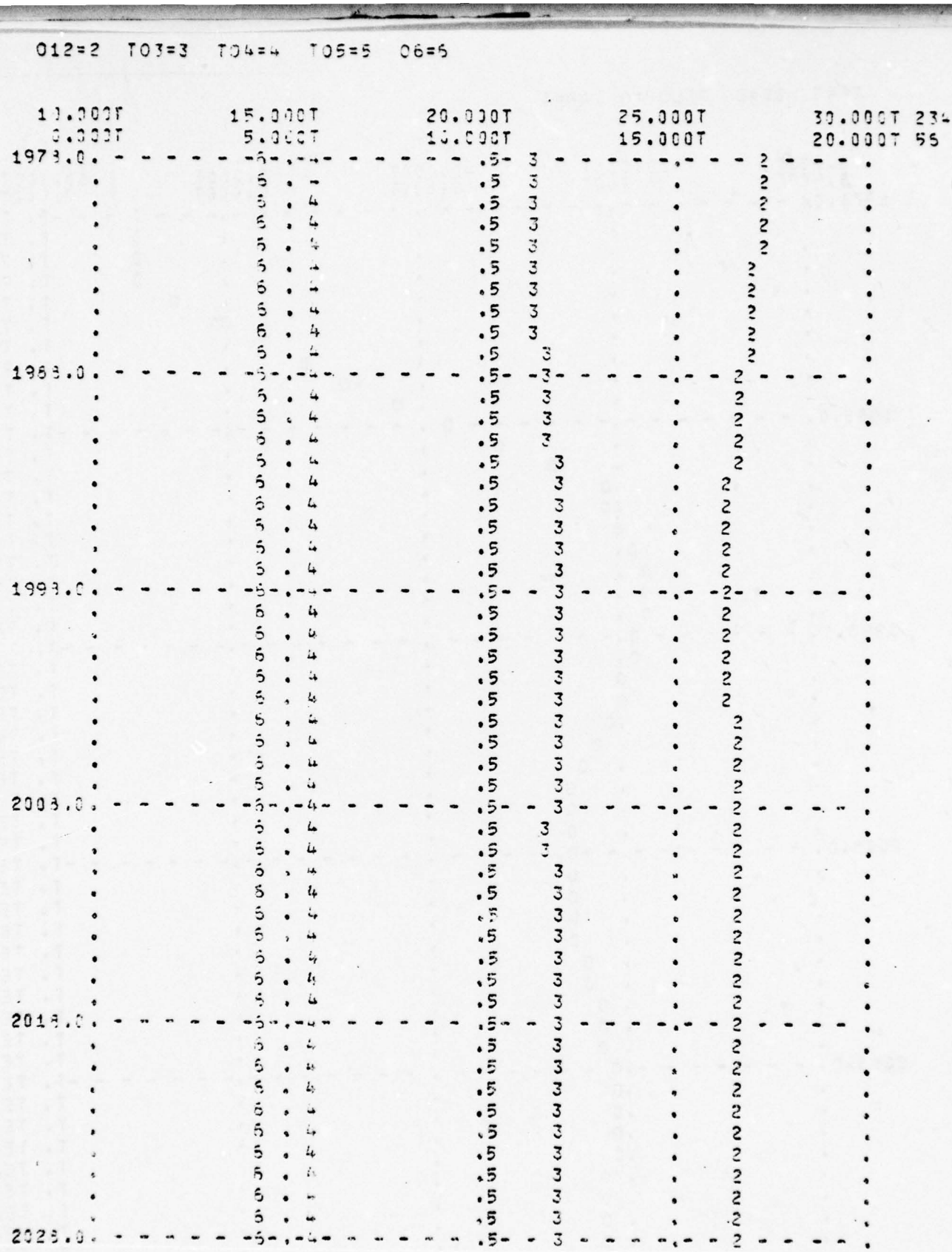


Figure D-2. RMA Grade Distribution, Weak Intended Response, No Military Pay Feedback

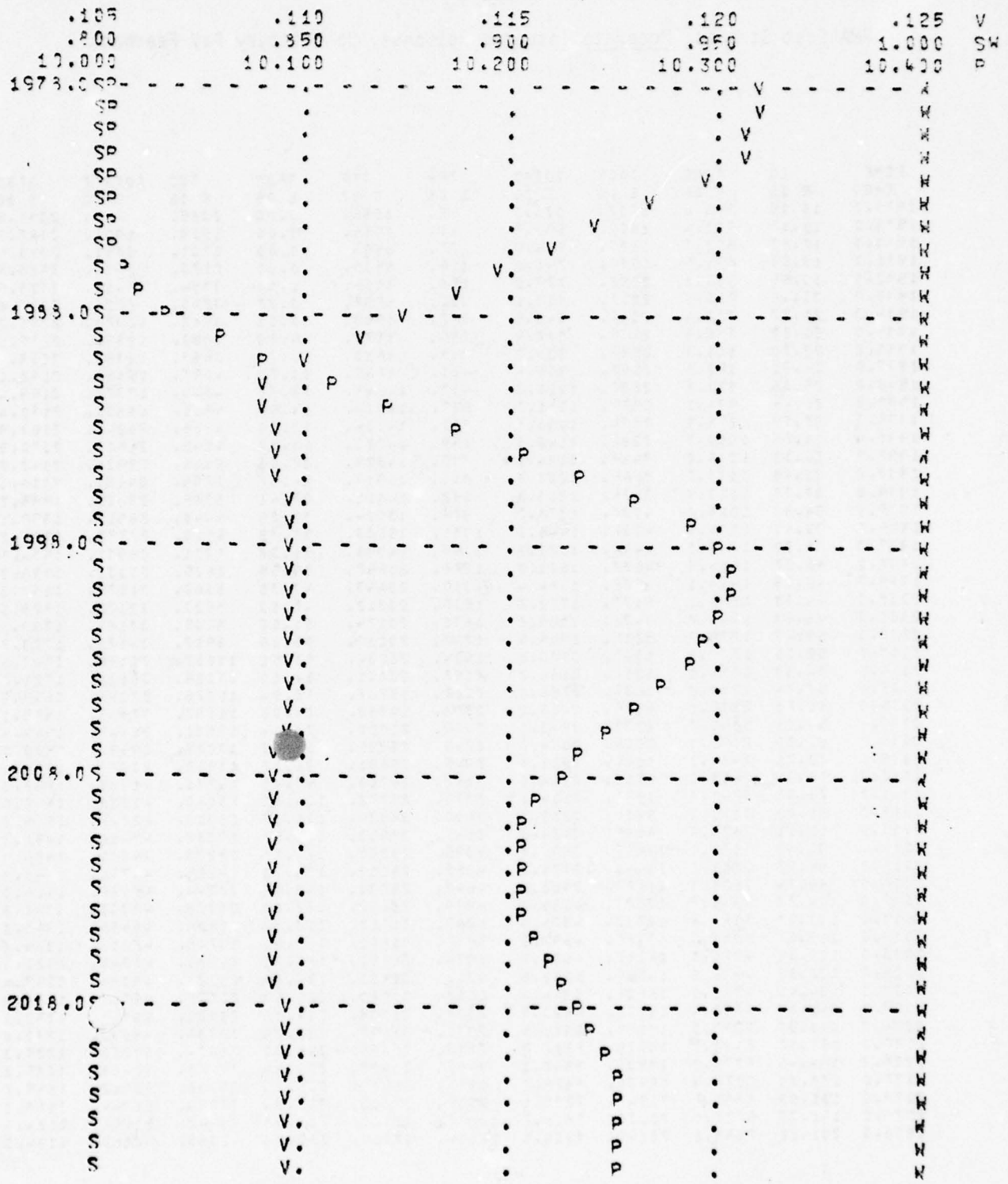


Figure D-3. RMA O-3 Promotion Parameters, Weak Intended Response, No Military Pay Feedback

TABLE D-V

RMA Cost Streams, Moderate Intended Response, No Military Pay Feedback

TIME	RC	TRMC	TACP	TOTAC	TRP	TSP	TFDP	TSC	TOTRET	OTSC
E+00	E 06	E 06	E 06	E 06	E 06	E 06	E 06	E 06	E+00	E 06
1978.0	16.05	643.6	1710.	638.0	9.	8556.	0.00	2385.	0.	2384.6
1979.0	16.37	532.4	1609.	670.7	41.	8556.	0.00	2639.	1907.	2357.2
1980.0	17.73	602.7	1897.	704.9	77.	8556.	0.00	2701.	3751.	2348.4
1981.0	18.53	634.5	1985.	741.0	114.	8556.	0.00	2873.	5534.	2323.5
1982.0	19.55	636.4	2092.	777.5	156.	8556.	1.60	3054.	7414.	2303.5
1983.0	20.45	718.2	2200.	813.1	200.	8557.	3.27	3243.	9228.	2295.6
1984.0	21.37	750.4	2311.	849.6	247.	8563.	5.01	3442.	10978.	2261.2
1985.0	22.32	783.9	2426.	887.4	296.	8578.	6.83	3650.	12666.	2275.9
1986.0	23.30	818.7	2546.	926.3	348.	8610.	8.72	3868.	14293.	2209.4
1987.0	24.31	853.8	2669.	966.5	403.	8665.	10.70	4097.	15863.	2182.0
1988.0	25.35	890.7	2797.	1008.3	461.	14244.	12.77	4349.	17377.	2159.4
1989.0	26.46	923.1	2929.	1051.7	527.	14414.	14.94	4601.	18833.	2130.4
1990.0	27.59	963.9	3174.	1096.8	592.	14584.	17.20	4866.	20243.	2100.9
1991.0	28.75	1010.2	3297.	1143.6	659.	14723.	19.57	5145.	21608.	2070.9
1992.0	30.03	1063.0	3466.	1194.1	732.	14829.	22.06	5441.	22921.	2042.0
1993.0	31.48	1116.7	3640.	1251.6	810.	14914.	24.67	5756.	24191.	2014.3
1994.0	33.03	1170.3	3834.	1313.3	892.	14981.	27.41	6089.	25421.	1986.7
1995.0	34.67	1218.0	4038.	1378.7	979.	15034.	30.29	6440.	26613.	1959.1
1996.0	36.43	1278.5	4237.	1448.3	1071.	15083.	33.32	6813.	27772.	1931.7
1997.0	38.29	1350.0	4494.	1522.5	1169.	14998.	36.50	7201.	28901.	1904.5
1998.0	40.27	1414.5	4682.	1601.0	1278.	20667.	39.85	7625.	30002.	1880.3
1999.0	42.35	1483.1	4922.	1684.4	1389.	20493.	43.38	8060.	31079.	1857.3
2000.0	44.58	1556.1	5173.	1772.7	1506.	20312.	47.10	8520.	32132.	1836.5
2001.0	46.93	1643.7	5436.	1866.2	1631.	20174.	51.02	9005.	33164.	1739.9
2002.0	49.43	1735.3	5711.	1965.4	1763.	20087.	55.15	9517.	34177.	1773.7
2003.0	52.06	1828.8	6007.	2070.1	1904.	20034.	59.51	10057.	35169.	1757.5
2004.0	54.83	1935.1	6311.	2184.2	2053.	20001.	64.10	10626.	36121.	1721.7
2005.0	57.74	2024.2	6637.	2295.3	2212.	19987.	68.94	11229.	37053.	1695.9
2006.0	60.78	2135.1	6971.	2416.8	2379.	19988.	74.06	11857.	37966.	1670.1
2007.0	63.95	2246.7	7339.	2543.1	2556.	20002.	79.44	12521.	38845.	1644.4
2008.0	67.25	2362.0	7709.	2674.7	2749.	25609.	85.12	13229.	39691.	1620.0
2009.0	70.71	2484.0	8104.	2811.6	2945.	25651.	91.12	13962.	40503.	1594.1
2010.0	74.31	2611.3	8519.	2954.8	3152.	25708.	97.45	14731.	41282.	1568.3
2011.0	78.06	2743.3	8955.	3104.1	3370.	25772.	104.13	15540.	42028.	1542.6
2012.0	81.99	2880.3	9417.	3260.3	3600.	25839.	111.17	16389.	42742.	1515.8
2013.0	86.11	3024.9	9896.	3424.0	3841.	25902.	118.61	17282.	43426.	1491.3
2014.0	90.43	3175.9	10407.	3595.7	4095.	25953.	126.46	18220.	44081.	1466.0
2015.0	94.97	3336.0	10944.	3776.2	4362.	26002.	134.72	19206.	44711.	1440.8
2016.0	99.74	3507.3	11507.	3966.0	4643.	26033.	143.45	20244.	45317.	1416.0
2017.0	104.77	3690.5	12097.	4166.0	4939.	26042.	152.65	21336.	45901.	1391.5
2018.0	110.09	3886.8	12717.	4376.9	5257.	31712.	162.34	22496.	46466.	1368.0
2019.0	115.67	4093.4	13368.	4599.5	5597.	31692.	172.56	23706.	47014.	1344.1
2020.0	121.53	4311.0	14050.	4834.5	5934.	31651.	183.32	24980.	47545.	1320.6
2021.0	127.82	4540.2	14766.	5082.6	6331.	31622.	194.66	26321.	48056.	1297.4
2022.0	134.41	4781.3	15520.	5344.4	6688.	31579.	206.60	27737.	48554.	1274.6
2023.0	141.35	5035.4	16312.	5620.6	7097.	31535.	219.16	29230.	49042.	1252.1
2024.0	148.67	5302.5	17145.	5911.6	7528.	31493.	232.39	30786.	49523.	1230.0
2025.0	156.37	5583.2	18024.	6217.9	7983.	31455.	246.30	32424.	50012.	1208.3
2026.0	164.48	5878.0	18951.	6540.2	8462.	31425.	261.04	34168.	50488.	1186.8
2027.0	173.01	6187.4	19929.	6879.2	8970.	31400.	276.64	35993.	50912.	1165.7
2028.0	181.95	6511.1	20964.	7235.1	9509.	37000.	293.54	37924.	51344.	1145.2
2029.0	191.35	6851.0	22061.	7610.7	10079.	37382.	311.58	39942.	51781.	1124.6
2030.0	201.20	7208.1	23140.	8000.6	10684.	37300.	327.50	42065.	52160.	1104.3



Figure D-4. RMA Accessions, Moderate Intended Response, No Military Pay Feedback

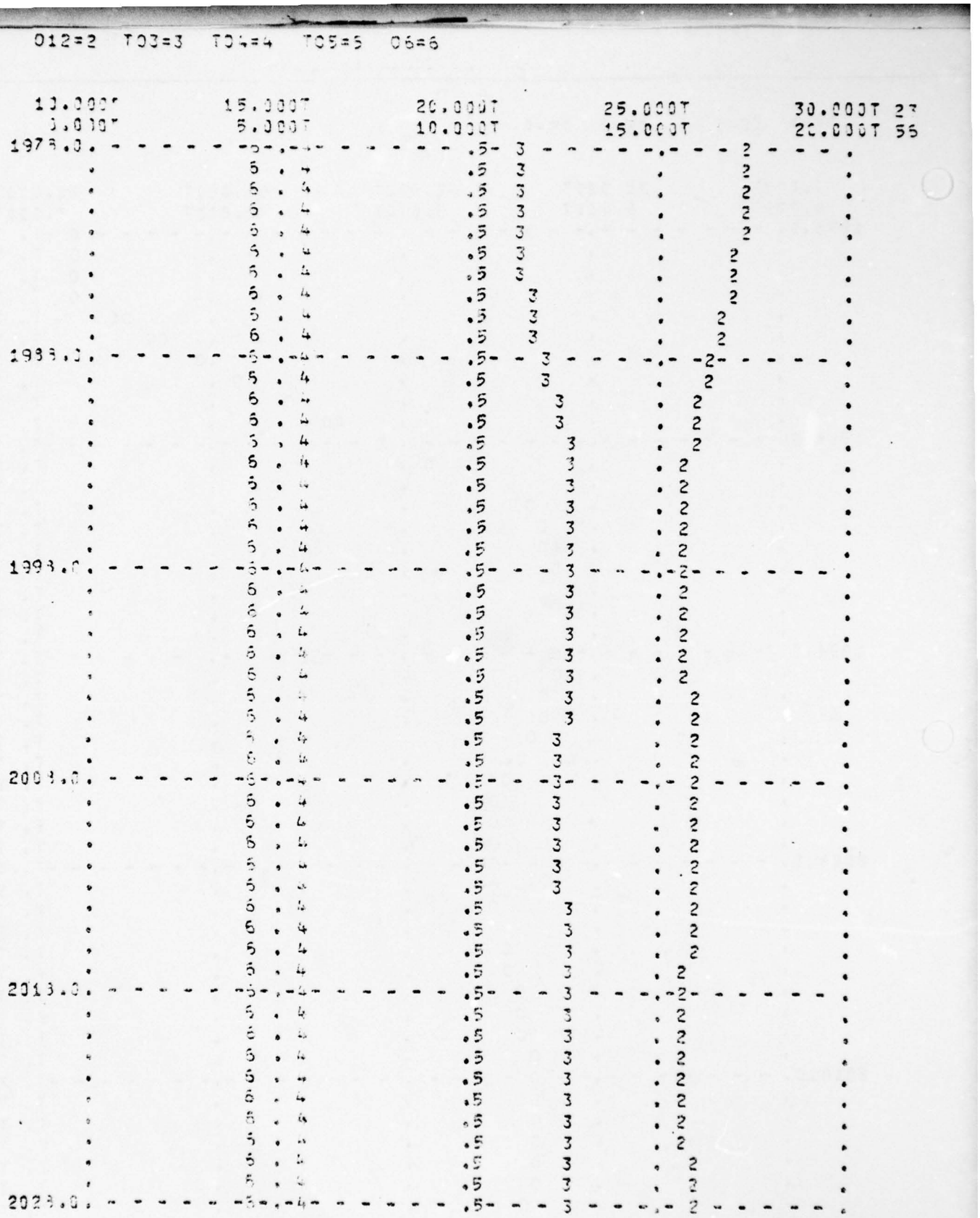


Figure D-5. RMA Grade Distribution, Moderate Intended Response, No Military Pay Feedback

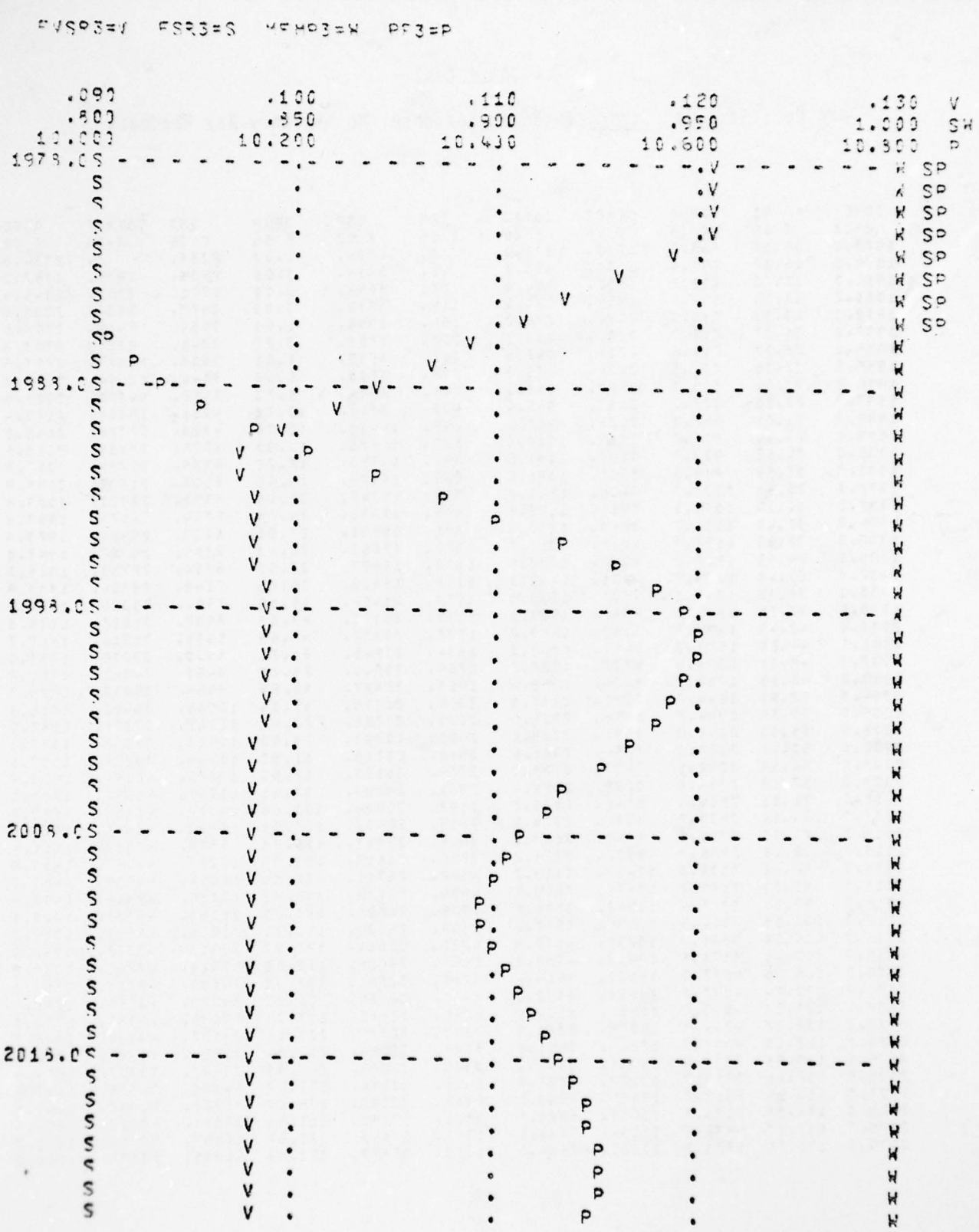


Figure D-6. RMA O-3 Promotion Parameters, Moderate Intended Response, No Military Pay Feedback

TABLE D-VI

RMA Cost Streams, Strong Intended Response, No Military Pay Feedback

TIME	RD	TRNP	TAPP	TOTAC	TRP	TSP	DEOP	TSO	TOTPFT	OTSC
E-00	E 06	E 05	E 06	E 05	E 05	E 03	E 06	E 06	E-00	E 06
1979.0	16.15	503.6	1712.	538.0	9.	8556.	0.00	2785.	0.	2384.6
1980.0	16.37	532.4	1800.	570.7	41.	8555.	0.00	2539.	1907.	2367.2
1981.0	17.73	622.7	1892.	704.8	77.	8556.	0.00	2701.	3751.	2343.4
1982.0	18.53	654.0	1989.	741.0	114.	8556.	0.00	2871.	5534.	2324.5
1983.0	19.53	686.0	2092.	776.7	156.	8556.	1.60	3054.	7414.	2308.0
1984.0	20.37	715.3	2200.	809.8	200.	8558.	3.27	3241.	9223.	2293.6
1985.0	21.20	744.6	2313.	842.9	247.	8565.	5.01	3436.	10977.	2281.6
1986.0	22.05	774.6	2432.	875.9	296.	8583.	6.83	3641.	12664.	2270.8
1987.0	22.92	805.0	2557.	911.3	348.	8634.	8.73	3856.	14290.	2262.6
1988.0	23.80	835.0	2689.	946.4	403.	8718.	10.71	4081.	15858.	2253.4
1989.0	24.71	867.9	2828.	982.4	466.	14410.	12.78	4329.	17370.	2249.2
1990.0	25.64	900.7	2973.	1019.5	527.	14675.	14.95	4576.	18828.	2244.6
1991.0	26.60	934.3	3127.	1057.6	591.	14950.	17.22	4835.	20234.	2237.5
1992.0	27.59	968.8	3288.	1098.6	659.	15235.	19.60	5108.	21592.	2235.9
1993.0	28.59	1003.7	3456.	1140.2	732.	15545.	22.11	5398.	22903.	2227.8
1994.0	29.60	1038.8	3630.	1182.7	809.	15882.	24.74	5709.	24171.	1997.9
1995.0	30.65	1075.7	3812.	1226.4	891.	15891.	27.51	6039.	25401.	1970.4
1996.0	31.75	1114.7	4004.	1271.7	978.	15883.	30.43	6386.	26597.	1942.8
1997.0	32.88	1154.9	4204.	1317.6	1070.	15877.	33.51	6754.	27763.	1915.7
1998.0	34.05	1217.2	4415.	1377.6	1168.	15620.	36.76	7142.	28904.	1888.9
1999.0	35.43	1279.7	4471.	1448.3	1268.	21454.	40.19	7564.	30024.	1955.2
2000.0	36.82	1345.2	4700.	1523.6	1378.	21454.	43.82	7997.	31127.	1938.5
2001.0	38.34	1417.0	4940.	1603.8	1339.	21170.	47.82	8455.	32214.	1913.7
2002.0	42.49	1492.5	5192.	1689.2	1508.	20872.	47.65	8455.	32214.	1913.7
2003.0	44.78	1572.9	5457.	1780.3	1634.	20645.	51.71	8940.	33286.	1787.0
2004.0	47.21	1658.5	5735.	1877.2	1769.	20506.	56.00	9452.	34342.	1761.7
2005.0	49.80	1749.2	6028.	1979.9	1913.	20423.	60.54	9994.	35382.	1736.7
2006.0	52.51	1844.7	6335.	2087.9	2069.	20376.	65.34	10565.	36401.	1711.8
2007.0	55.35	1944.7	6656.	2201.1	2238.	20354.	70.42	11167.	37396.	1687.0
2008.0	58.33	2049.0	6990.	2319.1	2400.	20363.	75.80	11800.	38363.	1662.1
2009.0	61.41	2157.2	7336.	2441.6	2582.	20380.	81.50	12465.	39297.	1637.1
2010.0	64.60	2269.1	7727.	2568.3	2779.	25123.	87.53	13175.	40194.	1613.4
2011.0	67.89	2384.9	8129.	2699.4	2981.	25199.	93.91	13908.	41052.	1589.0
2012.0	71.31	2504.9	8546.	2835.2	3197.	25234.	100.66	14677.	41869.	1562.5
2013.0	74.86	2629.7	8984.	2976.5	3415.	25402.	107.81	15483.	42648.	1536.9
2014.0	78.57	2759.0	9447.	3123.8	3649.	25517.	115.38	16330.	43389.	1511.4
2015.0	82.45	2896.2	9932.	3278.0	3895.	25619.	123.39	17220.	44095.	1485.9
2014.0	86.51	3039.0	10447.	3439.7	4152.	25710.	131.86	18154.	44769.	1460.7
2015.0	90.79	3189.2	10979.	3609.5	4424.	25779.	140.82	19136.	45414.	1435.6
2016.0	95.29	3347.4	11543.	3788.7	4709.	25821.	150.29	20169.	46033.	1410.8
2017.0	100.05	3514.5	12139.	3977.8	5009.	25834.	160.30	21256.	46629.	1386.3
2018.0	105.08	3691.2	12758.	4177.9	5332.	32664.	170.87	22413.	47207.	1362.9
2019.0	110.41	3878.6	13410.	4389.9	5668.	32822.	182.02	23619.	47769.	1339.2
2020.0	116.06	4077.0	14100.	4614.4	6019.	32861.	193.80	24890.	48316.	1316.8
2021.0	122.04	4287.2	14822.	4852.3	6392.	32889.	206.22	26229.	48855.	1292.9
2022.0	128.37	4510.5	15580.	5104.1	6786.	32912.	219.31	27640.	49382.	1270.3
2023.0	135.07	4746.3	16379.	5370.2	7203.	32936.	233.11	29127.	49899.	1248.2
2024.0	142.13	4997.0	17215.	5651.2	7643.	32964.	247.64	30694.	50406.	1226.4
2025.0	149.58	5254.6	18096.	5947.3	8109.	32902.	262.95	32343.	50903.	1204.9
2026.0	157.41	5529.7	19.22.	6255.7	8600.	32154.	279.07	34080.	51389.	1183.8
2027.0	165.64	5819.7	19989.	6585.8	9118.	32122.	296.03	35907.	51863.	1162.9
2028.0	174.27	6121.8	21018.	6929.8	9671.	37851.	313.83	37841.	52323.	1142.7
2029.0	183.33	6439.2	22094.	7288.1	10243.	37853.	332.67	39862.	52768.	1122.3
2030.0	192.76	6771.5	23221.	7664.2	10853.	37872.	352.44	41986.	53198.	1102.2

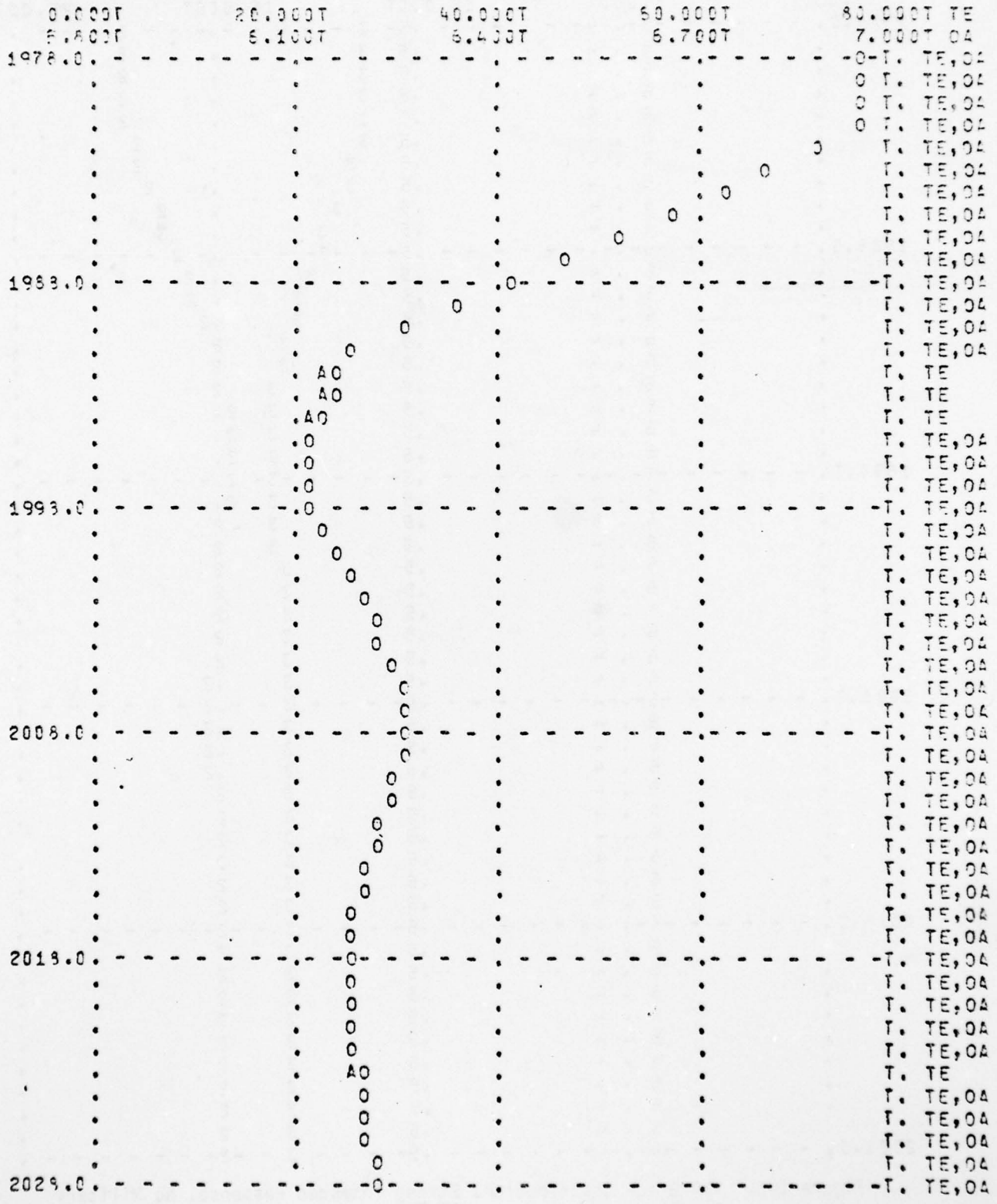


Figure D-7. RMA Accessions, Strong Intended Response, No Military Pay Feedback

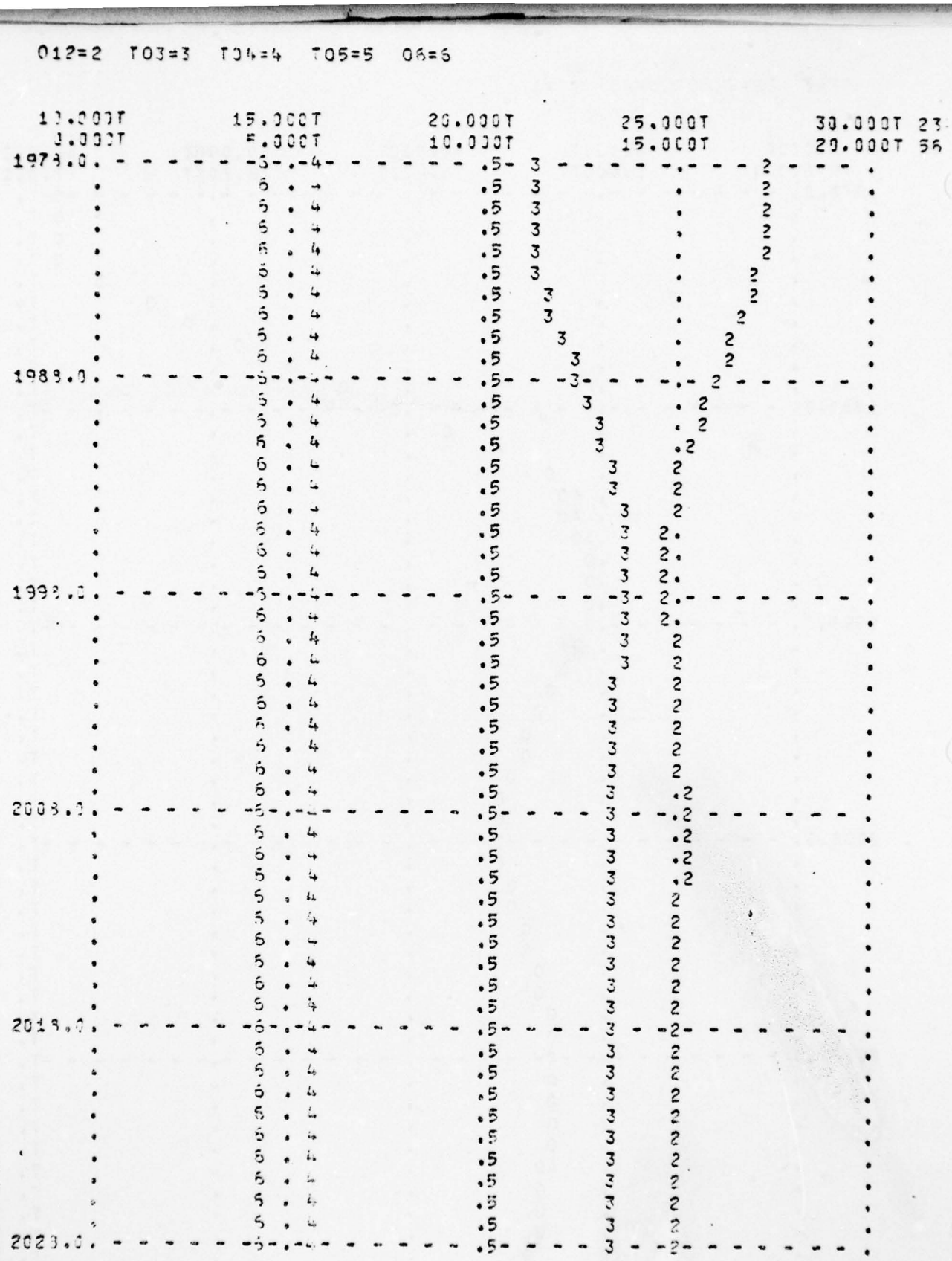


Figure D-8. RMA Grade Distribution, Strong Intended Response, No Military Pay Feedback

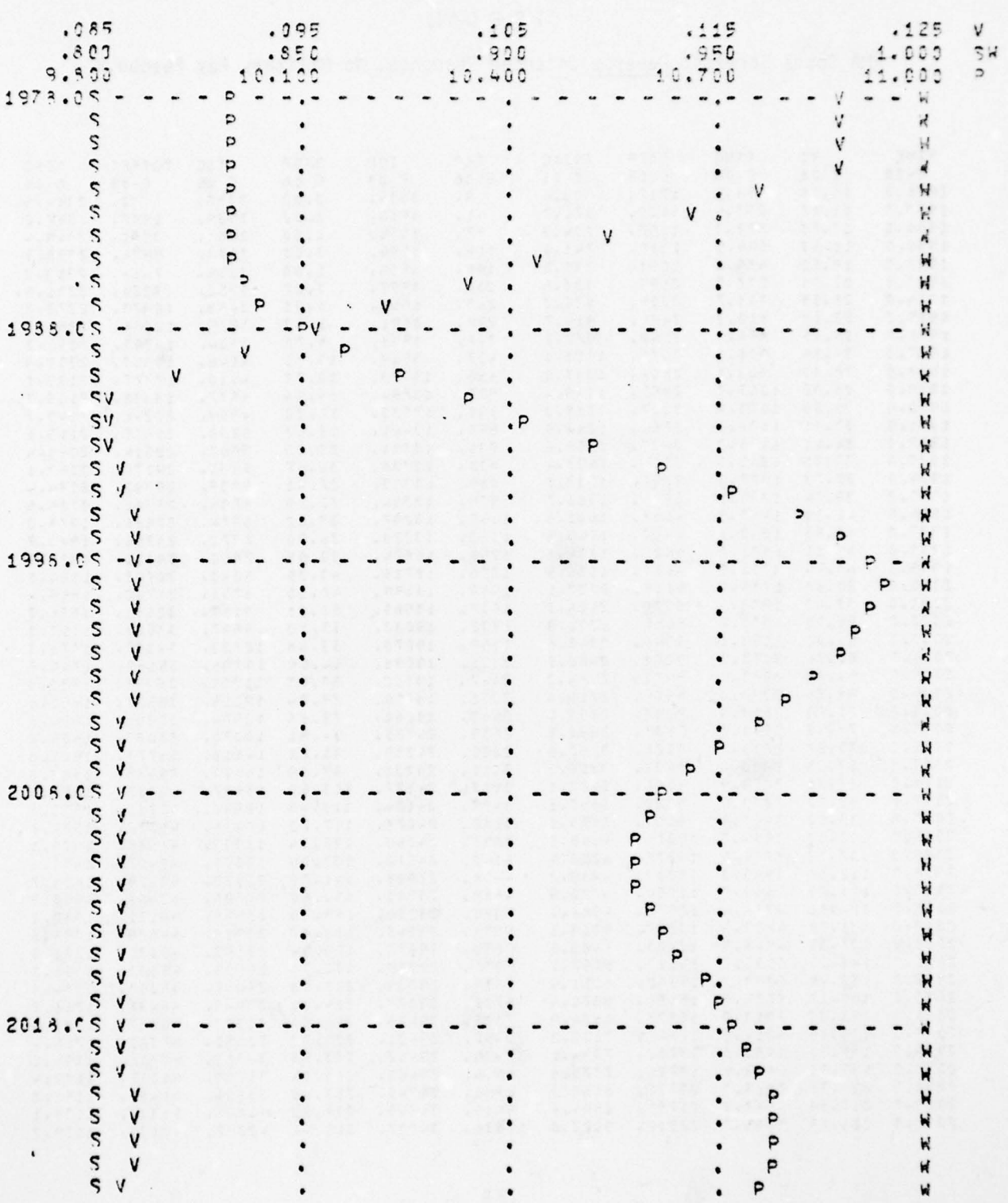


Figure D-9. RMA O-3 Promotion Parameters, Strong Intended Response, No Military Pay Feedback

TABLE D-VII

RMA Costs Streams, Reverse Intended Response, No Military Pay Feedback

TIME	RC	TRNC	TAPP	TOTAC	TPP	TSP	DFDP	TSC	TOTPFT	DTSC
E-00	E 05	E 06	E 06	E 05	E 06	E 03	E 06	E 05	E-00	E 06
1978.0	16.05	363.5	1717.	636.0	9.	8556.	0.00	2385.	0.	2384.6
1979.0	16.87	373.4	1802.	674.2	41.	8556.	0.00	2539.	1907.	2357.2
1980.0	17.73	622.7	1892.	704.9	77.	8556.	0.00	2701.	3751.	2749.4
1981.0	18.63	656.9	1985.	741.0	114.	8556.	0.00	2871.	5534.	2329.5
1982.0	19.52	689.0	2081.	780.0	156.	8556.	1.60	3056.	7414.	2310.0
1983.0	20.71	727.5	2197.	823.6	200.	8557.	3.27	3252.	9228.	2291.6
1984.0	21.84	764.7	2306.	870.3	247.	8556.	5.01	3458.	10978.	2272.3
1985.0	23.12	812.3	2426.	919.7	296.	8551.	6.83	3675.	12666.	2251.7
1986.0	24.45	854.7	2549.	972.2	348.	8538.	8.72	3904.	14293.	2230.2
1987.0	25.85	908.0	2679.	1028.0	403.	8509.	10.70	4146.	15863.	2207.9
1988.0	27.33	960.1	2814.	1087.0	466.	13773.	12.77	4410.	17377.	2183.0
1989.0	28.98	1018.2	2957.	1149.4	537.	13654.	14.94	4677.	18838.	2156.7
1990.0	30.66	1073.4	3107.	1215.3	630.	17633.	17.20	4959.	20246.	2128.7
1991.0	32.31	1134.9	3264.	1284.8	658.	13441.	19.57	5255.	21605.	2115.1
1992.0	34.11	1198.2	3431.	1356.6	731.	13381.	22.06	5567.	22914.	2089.4
1993.0	35.91	1261.8	3606.	1428.4	809.	13738.	24.67	5893.	24176.	2063.1
1994.0	37.73	1327.3	3790.	1502.8	889.	13309.	27.41	6235.	25392.	2034.4
1995.0	39.74	1396.1	3984.	1580.7	976.	13294.	30.29	6596.	26561.	2004.6
1996.0	41.78	1467.6	4187.	1661.6	1067.	13297.	33.32	6974.	27686.	1973.3
1997.0	43.90	1542.1	4403.	1745.9	1163.	13329.	36.50	7373.	28766.	1941.7
1998.0	46.11	1620.0	4629.	1834.1	1269.	13574.	39.85	7800.	29801.	1907.5
1999.0	48.44	1701.8	4866.	1926.5	1376.	13715.	43.38	8240.	30793.	1894.5
2000.0	50.87	1786.9	5116.	2023.1	1499.	13959.	47.10	8701.	31742.	1865.4
2001.0	53.42	1875.4	5370.	2124.5	1637.	13965.	51.01	9187.	32651.	1836.3
2002.0	56.09	1970.4	5645.	2230.9	1732.	19033.	55.13	9697.	33522.	1807.3
2003.0	58.90	2068.1	5944.	2342.6	1883.	19075.	59.48	10233.	34357.	1778.3
2004.0	61.86	2173.0	6251.	2460.3	2001.	19098.	64.05	10799.	35159.	1749.5
2005.0	64.98	2282.7	6571.	2584.3	2147.	19102.	68.87	11401.	35932.	1720.9
2006.0	68.25	2398.0	6909.	2715.0	2301.	19090.	73.94	12015.	36677.	1692.6
2007.0	71.73	2519.9	7262.	2853.0	2463.	19065.	79.28	12674.	37396.	1664.6
2008.0	75.40	2648.7	7630.	2998.9	2639.	24735.	84.91	13378.	38097.	1638.2
2009.0	79.27	2784.3	8020.	3152.9	2820.	24285.	90.82	14108.	38777.	1610.8
2010.0	83.35	2928.4	8437.	3315.6	3011.	24231.	97.05	14877.	39438.	1582.8
2011.0	87.66	3079.9	8866.	3487.1	3217.	24177.	103.60	15687.	40083.	1557.1
2012.0	92.22	3239.6	9323.	3667.8	3427.	24124.	110.48	16540.	40711.	1530.3
2013.0	97.00	3407.6	9802.	3858.1	3652.	24074.	117.72	17438.	41323.	1504.8
2014.0	102.03	3584.3	10321.	4058.1	3891.	24040.	125.34	18387.	41918.	1479.1
2015.0	107.32	3770.0	10829.	4268.4	4143.	24012.	133.34	19375.	42497.	1453.6
2016.0	112.87	3965.0	11387.	4489.2	4408.	23995.	141.75	20425.	43059.	1429.7
2017.0	118.73	4169.7	11980.	4720.9	4689.	23991.	150.60	21526.	43604.	1403.9
2018.0	124.91	4385.4	12579.	4964.0	4990.	23226.	159.90	22695.	44131.	1380.1
2019.0	131.22	4603.6	13227.	5219.1	5301.	23245.	169.67	23913.	44679.	1355.8
2020.0	137.95	4843.8	13901.	5486.5	5630.	23273.	179.94	25193.	45134.	1331.9
2021.0	145.00	5093.7	14617.	5767.1	5975.	23305.	190.73	26539.	45603.	1308.2
2022.0	152.40	5353.7	15360.	6061.5	6339.	23339.	202.08	27955.	46058.	1284.8
2023.0	160.17	5625.5	16150.	6370.4	6722.	20373.	214.01	29443.	46496.	1261.7
2024.0	168.33	5913.2	16974.	6694.9	7125.	29405.	226.54	31007.	46917.	1238.9
2025.0	176.90	6211.3	17840.	7035.8	7550.	29431.	239.72	32652.	47322.	1216.4
2026.0	185.91	6530.8	18763.	7394.1	7996.	29452.	253.58	34381.	47711.	1194.2
2027.0	195.38	6863.5	19721.	7770.9	8466.	29466.	268.14	36200.	48087.	1172.4
2028.0	205.35	7213.7	20736.	8167.3	8966.	34745.	283.45	38124.	48450.	1151.2
2029.0	215.84	7582.1	21798.	8584.4	9488.	34745.	299.52	40136.	48800.	1130.1
2030.0	226.87	7969.7	22918.	9023.3	10038.	34737.	316.44	42252.	49139.	1110.2



Figure D-10. RMA Accessions, Reverse Intended Response, No Military Pay Feedback

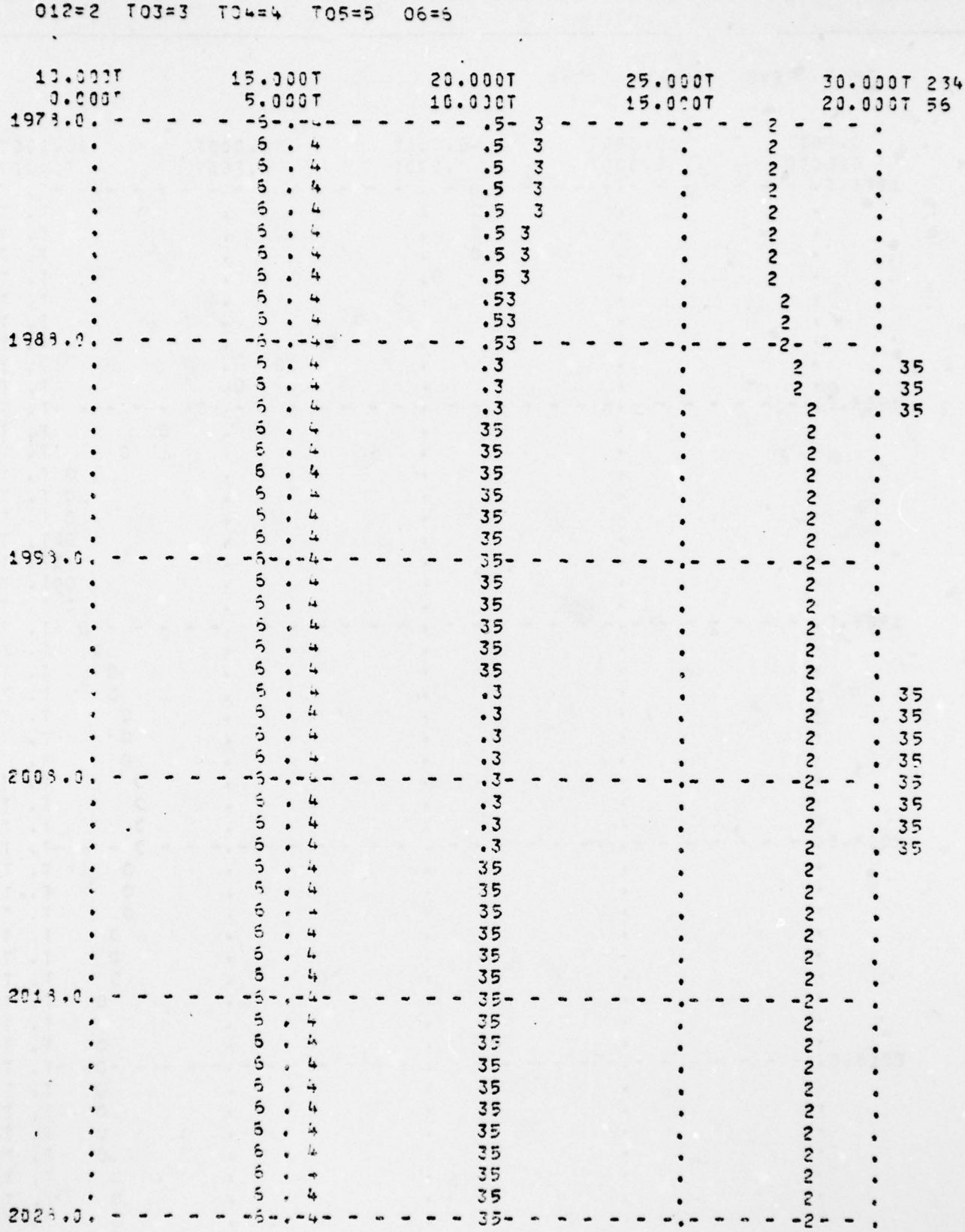


Figure 11. RMA Grade Distribution, Reverse Intended Response, No Military Pay Feedback

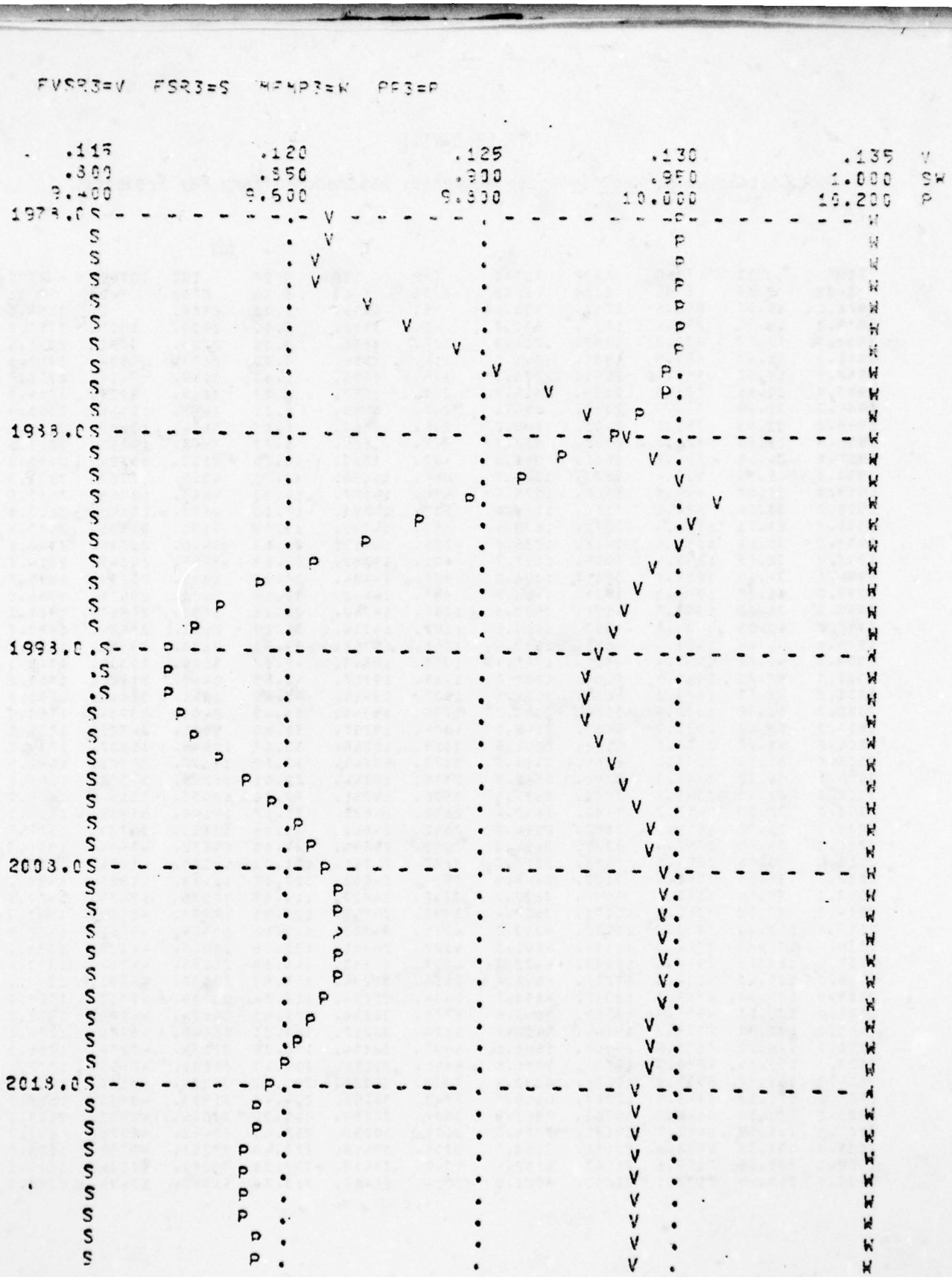


Figure D-12. RMA O-3 Promotion Parameters, Reverse Intended Response, No Military Pay Feedback

TABLE D-VIII

RMA Cost Streams, Weak Intended Response, Assumed Military Pay Feedback

TIME	RC	TRNC	TADP	TOTAC	TRP	TSP	DFOP	TSC	TOTRET	DTSC
E+00	E 06	E 06	E 06	E 06	E 06	E 03	E 06	E 06	E+00	E 06
1978.0	16.05	563.6	1712.	638.0	9.	8556.	0.00	2385.	0.	2384.6
1979.0	16.37	592.4	1800.	670.7	41.	8556.	0.00	2539.	1907.	2367.2
1980.0	17.73	622.7	1892.	704.9	77.	8556.	0.00	2701.	3751.	2348.4
1981.0	18.53	654.5	1988.	741.0	114.	8556.	0.00	2873.	5534.	2328.5
1982.0	19.57	687.4	2091.	779.1	156.	8556.	1.60	3055.	7414.	2308.9
1983.0	20.61	723.6	2199.	819.8	200.	8557.	3.27	3243.	9225.	2286.9
1984.0	21.69	764.0	2312.	864.6	247.	8560.	5.01	3445.	10971.	2263.4
1985.0	22.51	790.7	2431.	895.2	296.	8563.	6.83	3654.	12650.	2239.6
1986.0	23.58	828.0	2556.	937.3	347.	8565.	8.72	3873.	14267.	2212.5
1987.0	24.69	866.8	2688.	981.3	402.	8613.	10.70	4103.	15824.	2185.4
1988.0	25.85	907.4	2827.	1027.3	464.	14096.	12.77	4356.	17323.	2162.8
1989.0	27.07	949.9	2969.	1075.4	524.	14177.	14.93	4608.	18769.	2137.6
1990.0	28.36	994.6	3118.	1126.0	587.	14258.	17.19	4873.	20160.	2103.8
1991.0	29.71	1041.4	3273.	1179.0	653.	14321.	19.55	5151.	21501.	2073.4
1992.0	31.16	1091.6	3438.	1235.8	725.	14363.	22.03	5446.	22795.	2043.8
1993.0	32.75	1145.4	3609.	1297.9	801.	14390.	24.62	5757.	24045.	2014.7
1994.0	34.46	1205.1	3789.	1364.3	881.	14404.	27.33	6086.	25255.	1985.7
1995.0	35.27	1257.3	3974.	1434.8	957.	14402.	30.18	6432.	26423.	1956.8
1996.0	38.20	1333.5	4178.	1509.8	1057.	14380.	33.16	6793.	27567.	1929.1
1997.0	40.25	1403.8	4383.	1589.5	1153.	14334.	35.29	7133.	28674.	1899.7
1998.0	42.44	1478.4	4601.	1673.9	1251.	19768.	38.54	7600.	29751.	1874.2
1999.0	44.75	1557.4	4829.	1763.4	1370.	19643.	43.03	8029.	30800.	1846.1
2000.0	47.20	1640.9	5069.	1858.0	1485.	19517.	46.65	8481.	31822.	1815.2
2001.0	49.79	1728.2	5321.	1958.1	1607.	19416.	50.45	8958.	32816.	1780.6
2002.0	52.53	1822.4	5586.	2063.7	1736.	19345.	54.45	9461.	33784.	1743.7
2003.0	55.40	1922.6	5865.	2175.0	1874.	19297.	58.65	9991.	34725.	1705.2
2004.0	58.42	2028.8	6158.	2291.3	2019.	19266.	63.07	10549.	35637.	1664.2
2005.0	61.60	2142.0	6466.	2414.5	2173.	19249.	67.72	11137.	36520.	1642.5
2006.0	64.92	2260.3	6790.	2542.9	2335.	19244.	72.61	11755.	37373.	1555.8
2007.0	68.40	2383.8	7131.	2677.1	2506.	19251.	77.76	12405.	38194.	1620.2
2008.0	72.03	2512.7	7490.	2817.4	2692.	24633.	83.17	13089.	38983.	1604.1
2009.0	75.82	2647.1	7867.	2964.0	2882.	24662.	88.88	13813.	39739.	1577.7
2010.0	79.79	2786.4	8265.	3117.3	3082.	24699.	94.88	14572.	40464.	1551.3
2011.0	83.94	2931.8	8687.	3277.7	3293.	24740.	101.21	15365.	41158.	1525.2
2012.0	88.28	3082.4	9122.	3445.9	3514.	24780.	107.87	16199.	41823.	1499.2
2013.0	92.84	3238.1	9581.	3622.2	3747.	24817.	114.89	17075.	42463.	1473.5
2014.0	97.63	3401.5	10071.	3807.4	3992.	24848.	122.28	17997.	43070.	1448.0
2015.0	102.66	3573.3	10582.	4002.0	4251.	24873.	130.06	18966.	43657.	1422.8
2016.0	107.96	3754.0	11119.	4206.8	4522.	24881.	138.26	19985.	44222.	1398.0
2017.0	113.53	3944.3	11683.	4422.3	4809.	24883.	146.89	21058.	44767.	1373.4
2018.0	119.40	4144.4	12277.	4649.4	5118.	30294.	155.98	22197.	45293.	1349.8
2019.0	125.58	4355.0	12900.	4888.7	5434.	30274.	165.54	23384.	45802.	1325.9
2020.0	132.10	4578.6	13555.	5140.9	5770.	30248.	175.61	24634.	46295.	1302.3
2021.0	138.97	4773.2	14244.	5406.7	6124.	30217.	186.21	25949.	46774.	1279.1
2022.0	146.21	5020.5	14968.	5686.8	6497.	30184.	197.36	27334.	47239.	1256.2
2023.0	153.84	5280.9	15728.	5981.8	6890.	30151.	209.09	28791.	47691.	1233.8
2024.0	161.87	5555.0	16528.	6292.4	7305.	30120.	221.42	30324.	48130.	1211.6
2025.0	170.32	5843.5	17368.	6619.2	7743.	30092.	234.40	31936.	48556.	1189.8
2026.0	179.20	6146.9	18251.	6962.9	8204.	30069.	248.05	33635.	48970.	1168.3
2027.0	188.54	6465.7	19180.	7324.2	8693.	30052.	262.40	35421.	49371.	1147.2
2028.0	198.35	6800.8	20156.	7703.7	9208.	35415.	277.49	37310.	49760.	1125.7
2029.0	208.65	7152.6	21187.	8102.4	9747.	35409.	293.36	39285.	50134.	1106.1
2030.0	219.48	7522.1	22268.	8520.9	10314.	35410.	310.04	41352.	50496.	1085.3

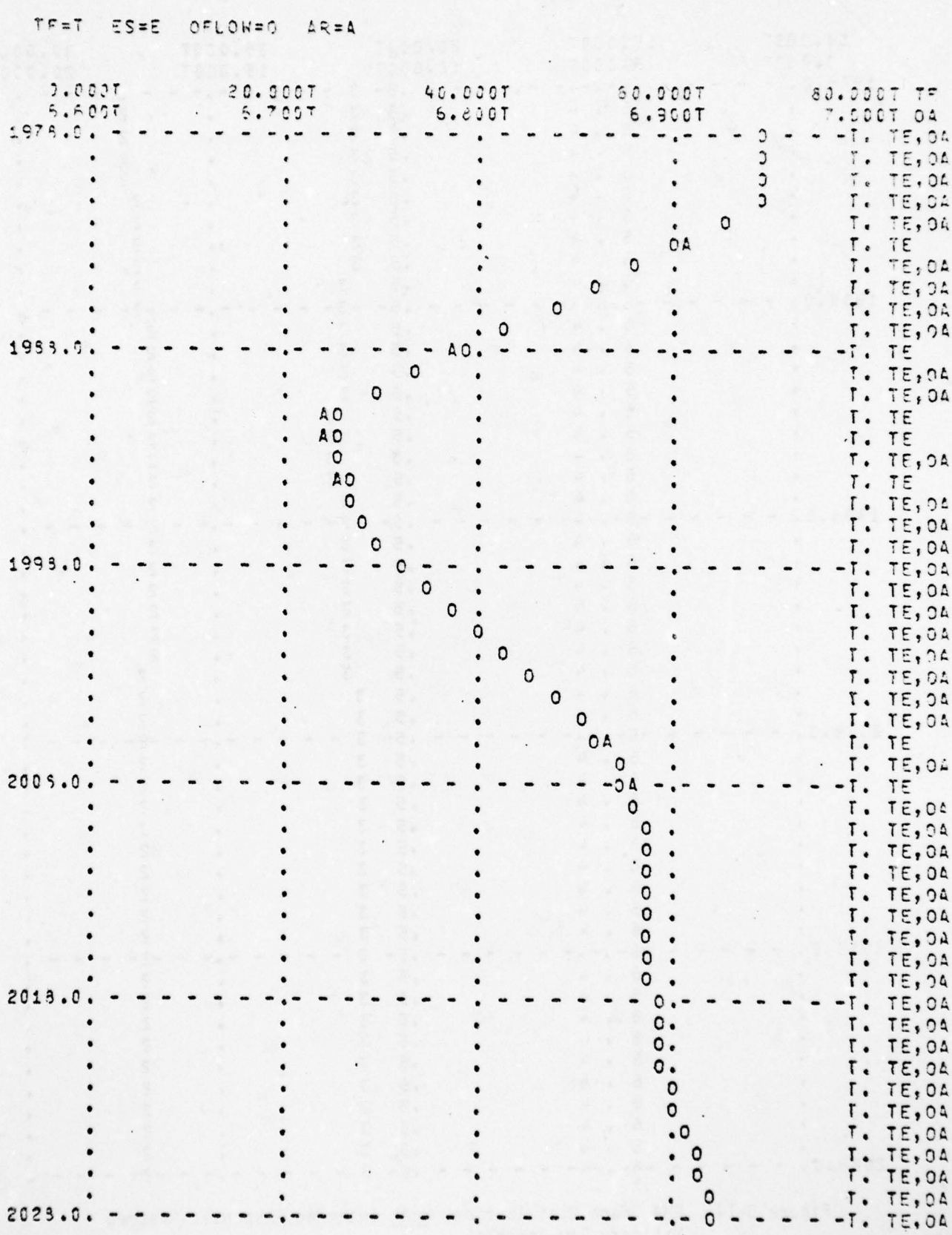


Figure D-13. RMA Accessions, Weak Intended Response, Assumed Military Pay Feedback

O12=2 TO3=3 TO4=4 TO5=5 O6=6

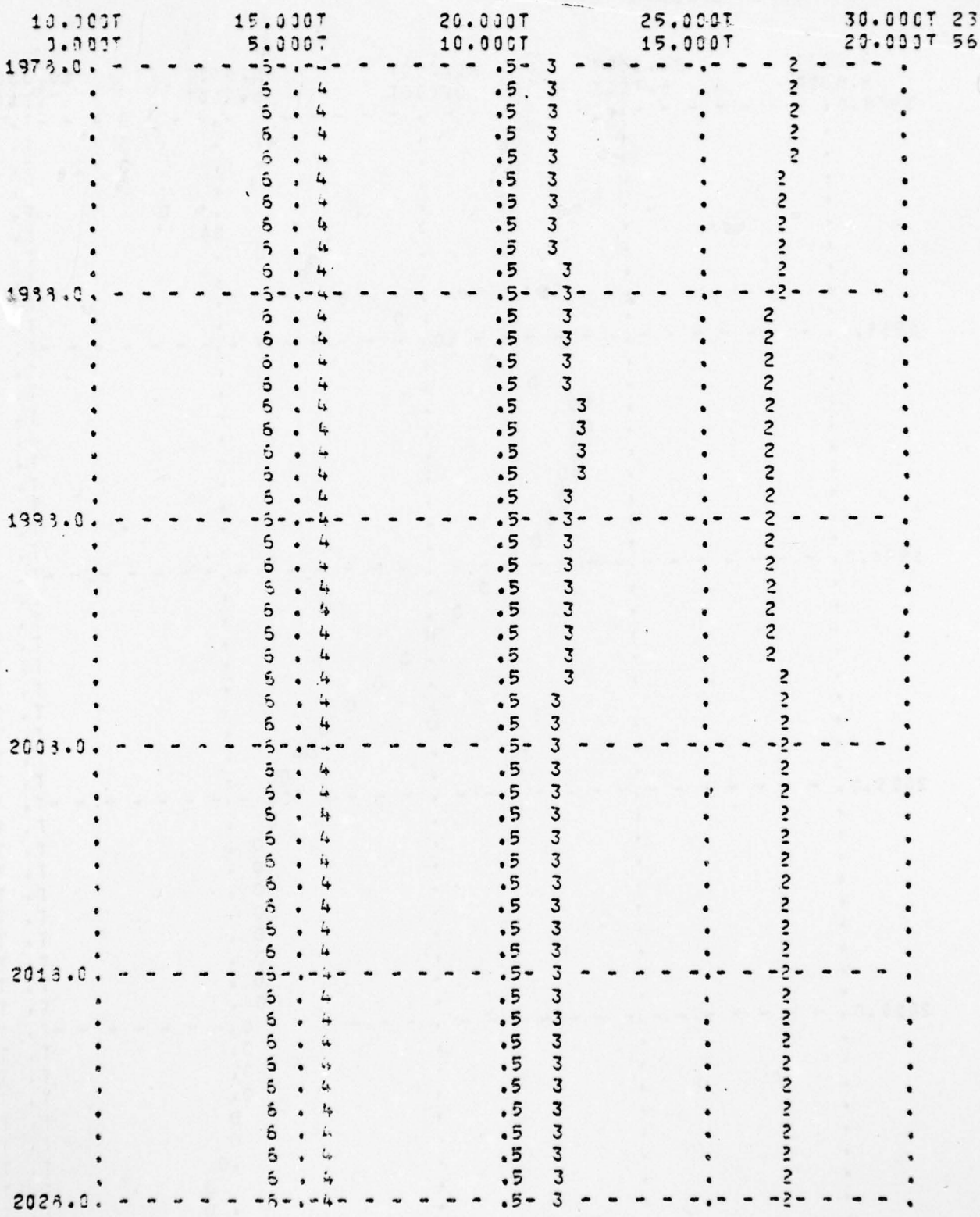


Figure D-14. RMA Grade Distribution, Weak Intended Response, Assumed Military Pay Feedback

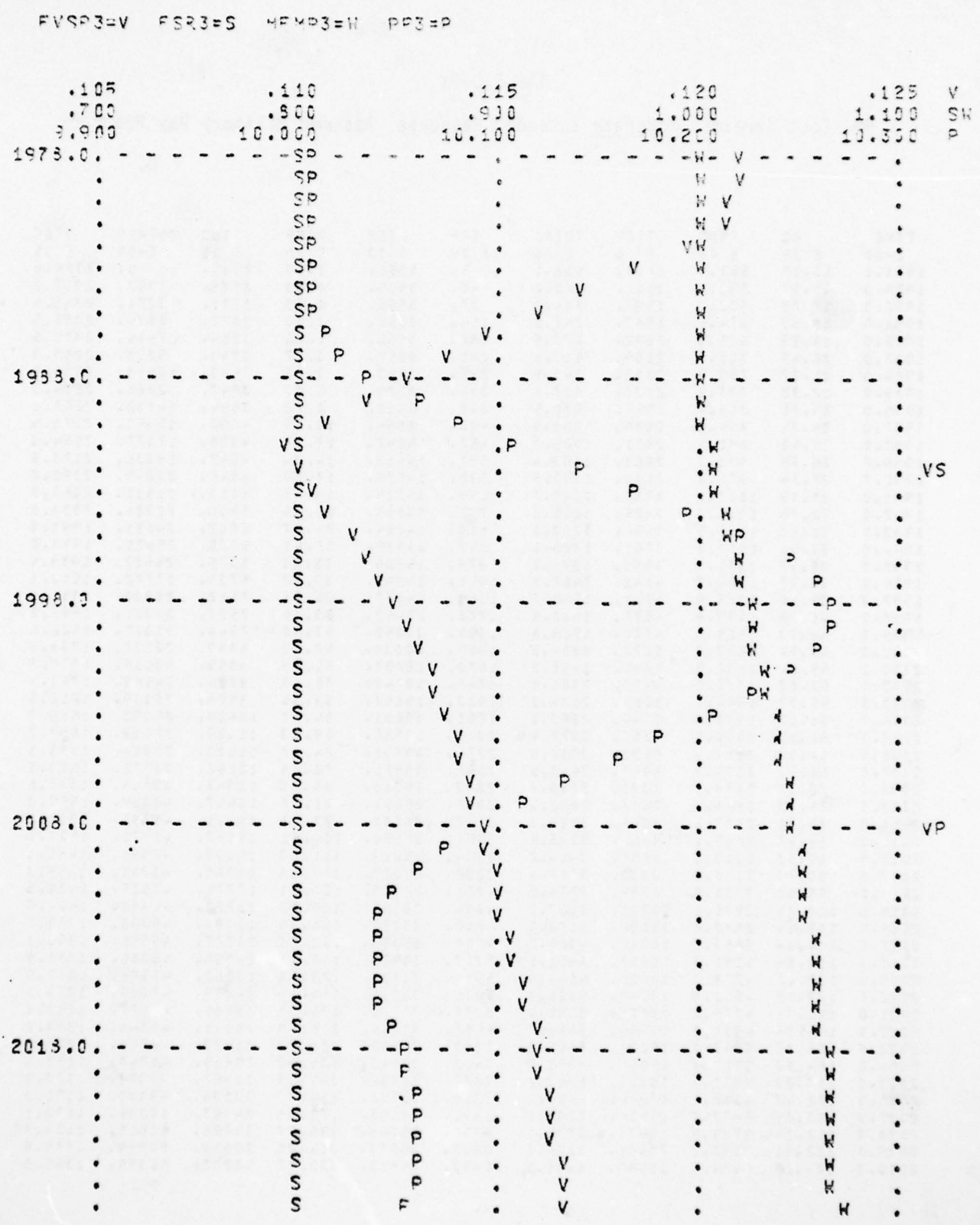


Figure D-16. RMA O-3 Promotion Parameters, Weak Intended Response, Assumed Military Pay Feedback

TABLE D-IX

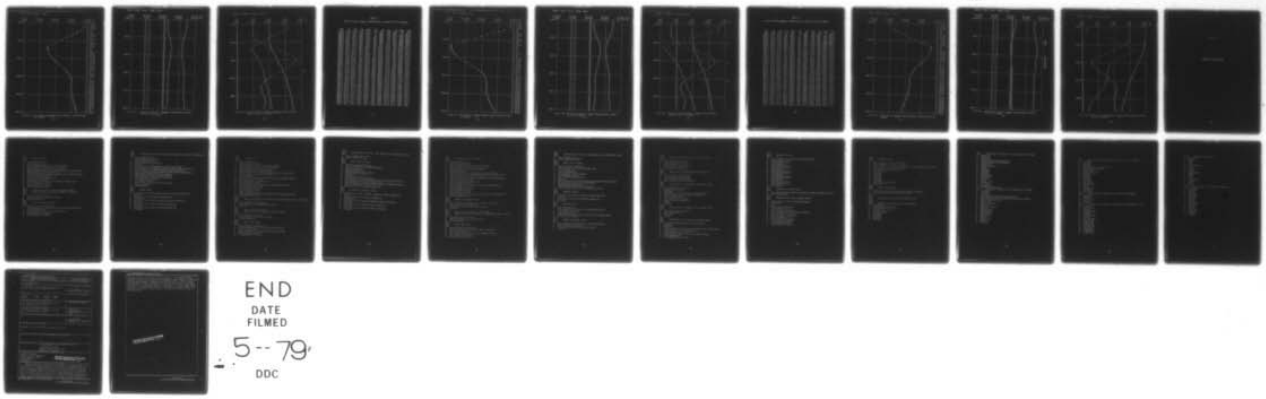
RMA Cost Streams, Moderate Intended Response, Assumed Military Pay Feedback

TIME	RC	TRMC	TACP	TOTAC	TRP	TSP	DFDP	TSC	TOTRET	DTSC
E-00	E 06	E 06	E 06	E 06	E 06	E 03	E 06	E 06	E-00	E 06
1978.0	16.05	563.6	1712.	638.0	9.	8556.	0.00	2385.	0.	2394.6
1979.0	16.87	592.4	1800.	670.7	41.	8556.	0.00	2539.	1907.	2367.2
1980.0	17.73	622.7	1892.	704.9	77.	8556.	0.00	2701.	3751.	2344.6
1981.0	18.63	654.5	1989.	741.0	114.	8556.	0.00	2873.	5534.	2328.5
1982.0	19.55	686.8	2092.	777.5	156.	8556.	1.60	3054.	7414.	2318.5
1983.0	20.45	718.3	2199.	813.1	200.	8557.	3.27	3243.	9228.	2285.3
1984.0	21.37	751.5	2312.	849.6	247.	8563.	5.01	3440.	10978.	2260.5
1985.0	22.32	785.9	2431.	887.5	296.	8578.	6.83	3647.	12666.	2234.5
1986.0	23.31	818.4	2555.	926.5	348.	8610.	8.72	3864.	14293.	2207.1
1987.0	24.34	854.1	2685.	966.9	403.	8664.	10.70	4090.	15863.	2179.4
1988.0	25.42	891.9	2821.	1009.2	467.	14247.	12.77	4338.	17377.	2154.3
1989.0	26.55	930.6	2963.	1053.4	527.	14412.	14.94	4587.	18838.	2123.6
1990.0	27.74	971.3	3111.	1099.5	592.	14579.	17.20	4846.	20248.	2092.2
1991.0	28.99	1013.8	3266.	1147.7	659.	14714.	19.58	5113.	21608.	2060.0
1992.0	30.35	1063.3	3426.	1200.3	732.	14811.	22.06	5406.	22921.	2028.9
1993.0	31.92	1118.1	3594.	1260.3	810.	14884.	24.67	5712.	24191.	1999.9
1994.0	33.51	1170.3	3768.	1325.0	892.	14935.	27.41	6035.	25421.	1969.2
1995.0	35.42	1231.2	3950.	1394.0	979.	14956.	30.29	6375.	26613.	1939.4
1996.0	37.37	1296.7	4141.	1467.8	1071.	14940.	33.32	6734.	27772.	1910.1
1997.0	39.45	1365.9	4341.	1546.7	1169.	14877.	36.51	7112.	28900.	1881.1
1998.0	41.66	1439.9	4550.	1630.6	1278.	20462.	39.86	7523.	30000.	1855.2
1999.0	44.03	1518.6	4770.	1719.8	1388.	20250.	43.40	7944.	31075.	1826.6
2000.0	46.54	1602.2	5000.	1814.6	1505.	20031.	47.12	8389.	32127.	1798.5
2001.0	49.20	1690.9	5242.	1915.2	1630.	19859.	51.05	8859.	33155.	1770.7
2002.0	52.03	1785.0	5497.	2021.8	1762.	19740.	55.19	9354.	34159.	1743.4
2003.0	55.02	1884.3	5764.	2134.5	1903.	19658.	59.56	9878.	35139.	1716.5
2004.0	58.17	1988.8	6044.	2253.0	2051.	19601.	64.17	10429.	36093.	1689.7
2005.0	61.47	2098.5	6340.	2377.4	2209.	19566.	69.03	11009.	37019.	1663.2
2006.0	64.93	2213.4	6650.	2507.6	2376.	19550.	74.17	11620.	37914.	1636.8
2007.0	68.54	2333.3	6977.	2643.5	2552.	19551.	79.59	12262.	38778.	1610.5
2008.0	72.31	2458.1	7321.	2785.0	2742.	25015.	85.32	12948.	39604.	1585.6
2009.0	76.23	2588.1	7683.	2932.4	2937.	25051.	91.37	13657.	40395.	1559.3
2010.0	80.31	2723.6	8065.	3086.0	3142.	25100.	97.76	14401.	41150.	1533.1
2011.0	84.57	2865.1	8468.	3246.4	3358.	25158.	104.51	15182.	41870.	1507.0
2012.0	89.03	3013.1	8888.	3414.2	3584.	25213.	111.63	16003.	42556.	1481.1
2013.0	93.70	3168.0	9332.	3589.8	3822.	25277.	119.15	16865.	43211.	1455.3
2014.0	98.60	3330.6	9799.	3774.0	4071.	25329.	127.11	17771.	43835.	1429.8
2015.0	103.74	3501.1	10290.	3967.5	4334.	25366.	135.50	18723.	44433.	1404.5
2016.0	109.14	3680.6	10806.	4170.9	4610.	25390.	144.36	19724.	45005.	1379.7
2017.0	114.84	3869.3	11348.	4385.2	4901.	25396.	153.71	20777.	45556.	1355.1
2018.0	120.84	4068.3	11918.	4611.1	5217.	30915.	163.58	21996.	46086.	1331.5
2019.0	127.17	4278.3	12516.	4849.4	5536.	30890.	173.98	23062.	46598.	1307.6
2020.0	133.86	4500.9	13145.	5100.3	5876.	30851.	184.95	24289.	47095.	1284.1
2021.0	140.91	4735.1	13809.	5366.4	6235.	30803.	196.51	25581.	47577.	1260.9
2022.0	148.36	4982.2	14509.	5646.7	6613.	30750.	208.69	26941.	48046.	1238.2
2023.0	156.22	5243.0	15248.	5942.3	7012.	30696.	221.52	28373.	48502.	1215.8
2024.0	164.50	5517.8	15990.	6253.9	7433.	30643.	235.03	29880.	48947.	1193.9
2025.0	173.23	5807.4	16800.	6582.2	7877.	30594.	249.25	31467.	49379.	1172.2
2026.0	182.42	6112.1	17648.	6927.7	8346.	30552.	264.23	33136.	49800.	1151.0
2027.0	192.09	6432.7	18536.	7291.1	8840.	30518.	279.98	34893.	50209.	1130.1
2028.0	202.24	6769.6	19471.	7673.0	9365.	35943.	296.57	36751.	50605.	1109.8
2029.0	212.91	7123.2	20451.	8074.0	9913.	35970.	314.01	38694.	50949.	1089.5
2030.0	224.10	7494.4	21486.	8495.0	10490.	35923.	332.37	40733.	51359.	1069.5

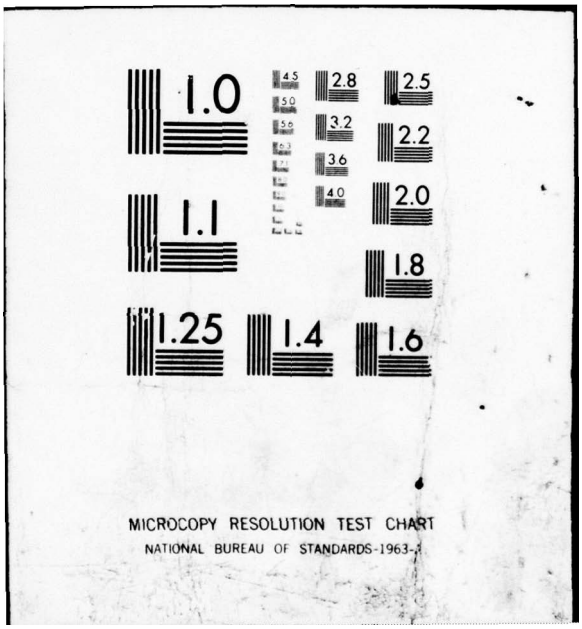
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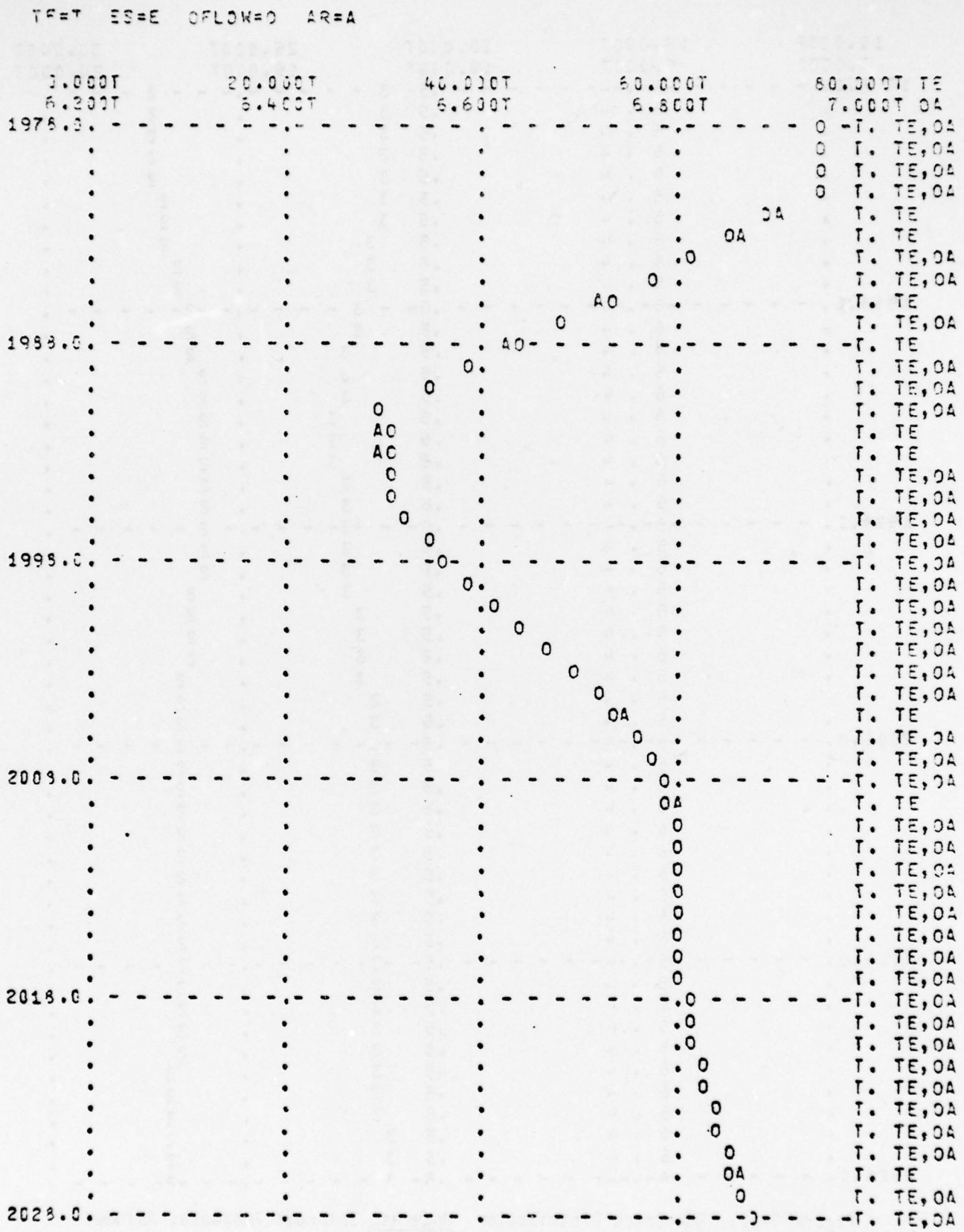


Figure D-16. RMA Accessions, Moderate Intended Response, Assumed Military Pay Feedback

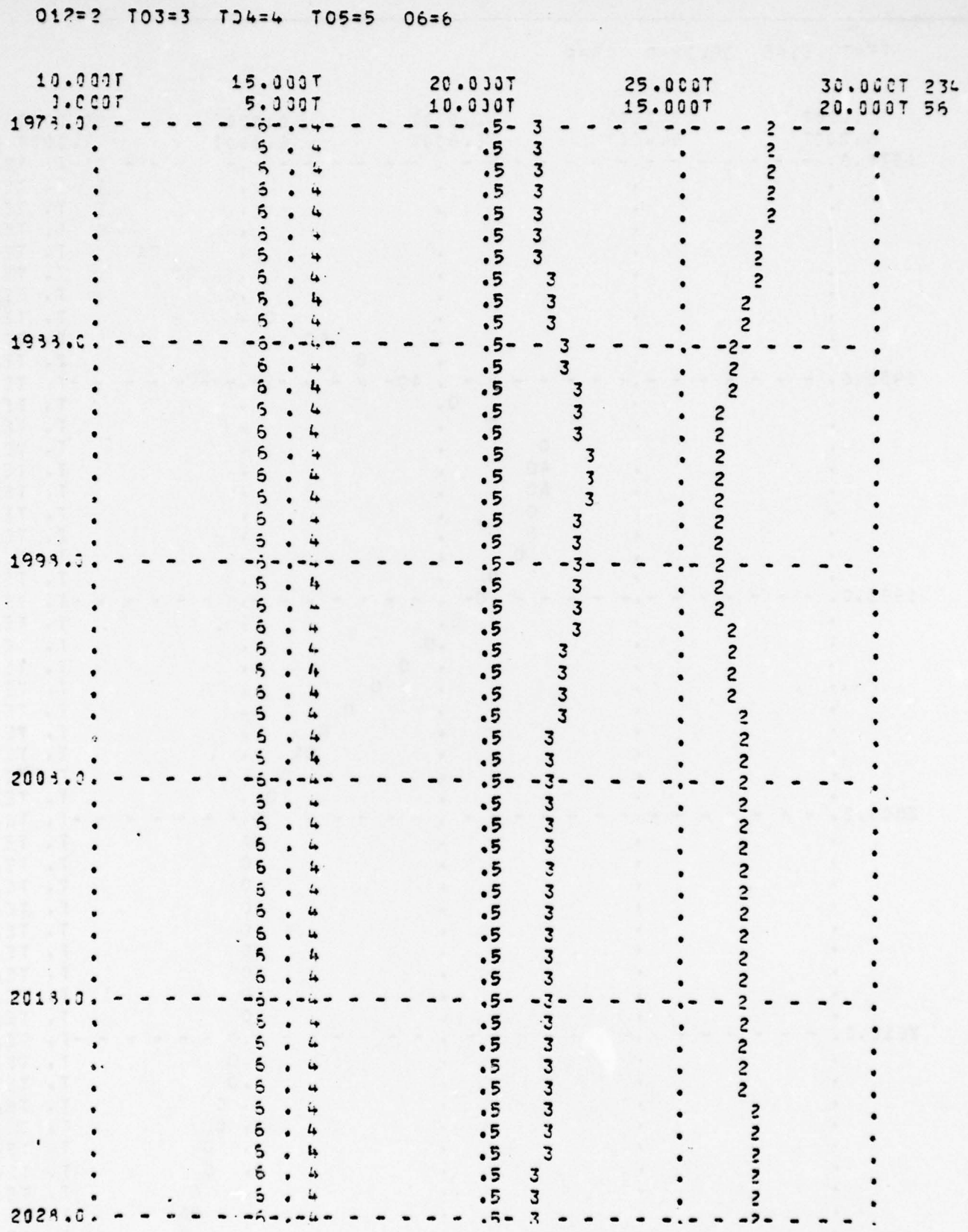


Figure D-17. RMA Grade Distribution, Moderate Intended Response, Assumed Military Pay Feedback

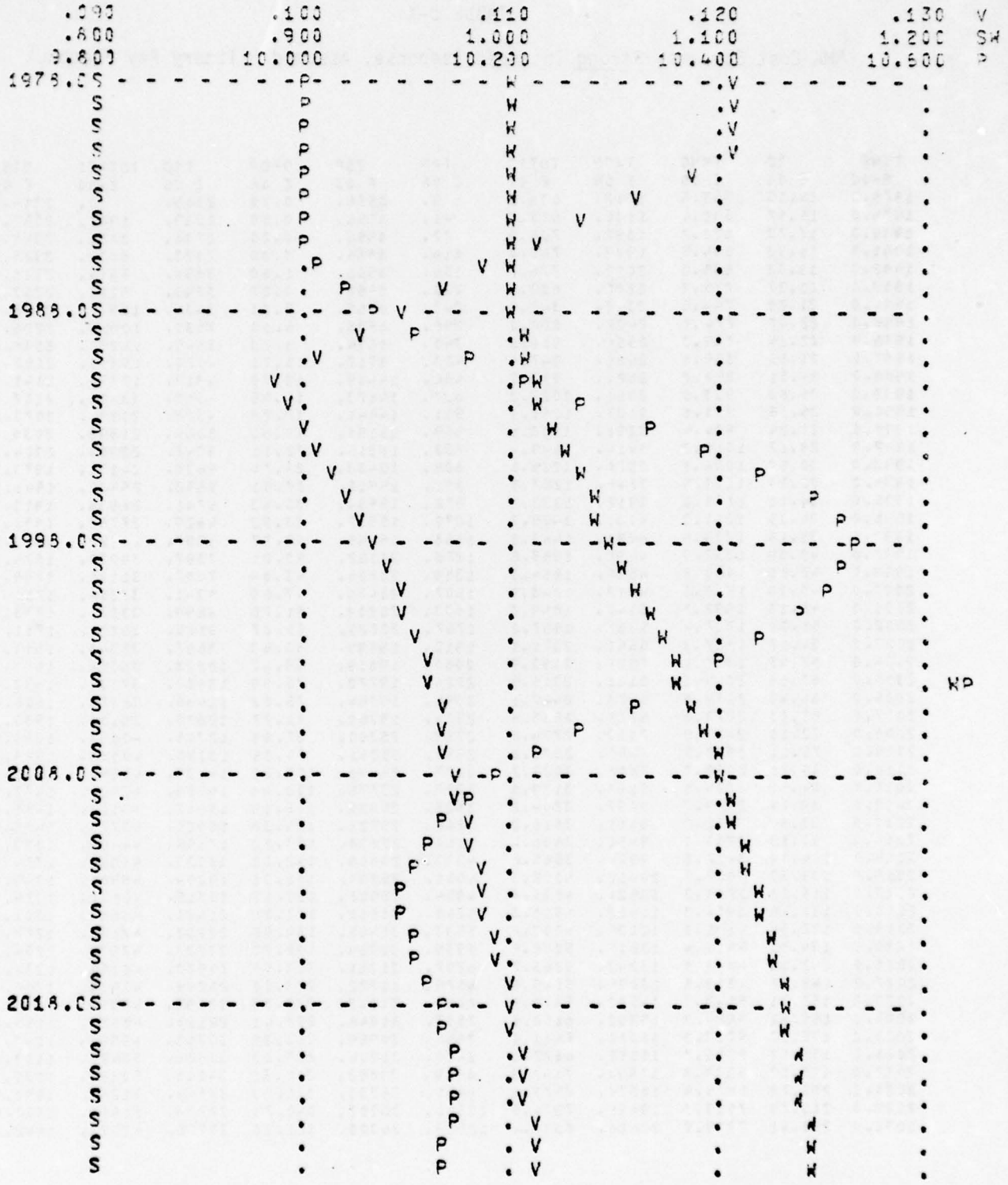


Figure D-18. RMA O-3 Promotion Parameters, Moderate Intended Response, Assumed Military Pay Feedback

TABLE D-X

RMA Cost Streams, Strong Intended Response, Assumed Military Pay Feedback

TIME	RC	TRNC	TATP	TOTAC	TRP	TSP	OFOP	TSC	TOTRET	OTSC
E-00	E 06	E 06	E 06	E 06	E 06	E 03	E 06	E 06	E-00	E 06
1978.0	16.05	563.6	1712.	638.0	9.	8556.	0.00	2385.	0.	2394.6
1979.0	15.87	592.4	1800.	670.7	41.	8556.	0.00	2539.	1907.	2357.2
1980.0	17.73	622.7	1892.	704.9	77.	8556.	0.00	2701.	3751.	2349.4
1981.0	18.53	654.5	1989.	741.0	114.	8556.	0.00	2873.	5534.	2324.5
1982.0	19.53	688.0	2092.	778.7	156.	8556.	1.50	3054.	7414.	2314.0
1983.0	20.37	719.3	2200.	809.8	200.	8558.	3.27	3240.	9228.	2283.2
1984.0	21.20	744.6	2313.	842.9	247.	8565.	5.01	3434.	10977.	2256.5
1985.0	22.07	774.7	2432.	877.0	296.	8588.	5.93	3639.	12654.	2228.5
1986.0	22.94	805.3	2556.	911.6	348.	8634.	8.73	3849.	14290.	2198.8
1987.0	23.85	836.6	2686.	947.1	403.	8717.	10.71	4070.	15858.	2167.7
1988.0	24.81	869.2	2821.	983.9	466.	14409.	12.79	4312.	17370.	2141.1
1989.0	25.80	903.0	2961.	1022.2	527.	14673.	14.95	4552.	18828.	2107.8
1990.0	26.86	938.1	3107.	1061.9	591.	14941.	17.22	4803.	20274.	2073.6
1991.0	27.94	974.4	3258.	1103.1	659.	15158.	19.60	5064.	21592.	2038.5
1992.0	29.17	1015.3	3414.	1149.4	732.	15316.	22.11	5342.	22903.	2004.7
1993.0	30.67	1064.8	3576.	1205.6	809.	15433.	24.74	5638.	24171.	1973.1
1994.0	32.33	1119.5	3746.	1267.5	891.	15516.	27.51	5952.	25401.	1941.9
1995.0	34.11	1178.0	3918.	1333.9	978.	15565.	30.43	6281.	26596.	1910.9
1996.0	36.05	1241.3	4100.	1405.7	1070.	15537.	33.52	6629.	27762.	1880.4
1997.0	38.15	1309.5	4291.	1483.0	1168.	15445.	36.77	6997.	28902.	1850.5
1998.0	40.39	1382.5	4490.	1565.8	1278.	21162.	40.21	7397.	30020.	1824.1
1999.0	42.80	1460.5	4699.	1654.3	1399.	20826.	43.84	7807.	31121.	1795.1
2000.0	45.38	1543.8	4918.	1748.9	1507.	20476.	47.69	8241.	32204.	1766.7
2001.0	48.13	1632.7	5147.	1849.7	1633.	20202.	51.76	8699.	33271.	1738.9
2002.0	51.05	1727.4	5388.	1957.2	1767.	20020.	56.07	9185.	34320.	1711.8
2003.0	54.17	1827.8	5640.	2071.1	1910.	19899.	60.63	9697.	35348.	1685.1
2004.0	57.45	1933.6	5908.	2190.9	2067.	19819.	65.47	10238.	36354.	1658.7
2005.0	60.89	2044.1	6185.	2316.5	2224.	19772.	70.59	10807.	37332.	1632.6
2006.0	64.49	2159.6	6478.	2447.6	2394.	19754.	76.02	11406.	38278.	1606.6
2007.0	68.23	2279.6	6788.	2583.8	2574.	19760.	81.77	12035.	39189.	1580.6
2008.0	72.10	2403.9	7113.	2724.8	2769.	25300.	87.88	12706.	40057.	1555.9
2009.0	76.11	2532.5	7456.	2870.8	2958.	25361.	94.35	13398.	40883.	1529.7
2010.0	80.28	2666.0	7818.	3022.2	3177.	25441.	101.21	14123.	41667.	1503.5
2011.0	84.61	2804.8	8198.	3179.5	3396.	25536.	108.46	14884.	42408.	1477.4
2012.0	89.14	2949.7	8597.	3344.2	3625.	25635.	116.13	15682.	43110.	1451.4
2013.0	93.87	3101.2	9018.	3516.2	3866.	25728.	124.36	16520.	43775.	1425.5
2014.0	98.83	3260.1	9460.	3696.4	4118.	25808.	133.02	17399.	44406.	1399.9
2015.0	104.04	3427.0	9924.	3885.8	4383.	25866.	142.20	18323.	45007.	1374.6
2016.0	109.53	3602.8	10412.	4085.3	4661.	25899.	151.91	19294.	45581.	1349.6
2017.0	115.33	3788.3	10924.	4295.8	4954.	25902.	162.19	20315.	46131.	1324.9
2018.0	121.46	3984.3	11462.	4518.3	5268.	31518.	173.06	21401.	46662.	1301.4
2019.0	127.94	4191.8	12027.	4753.7	5603.	31465.	184.55	22532.	47176.	1277.5
2020.0	134.81	4411.4	12619.	5002.9	5935.	31394.	196.70	23723.	47674.	1254.1
2021.0	142.08	4643.8	13242.	5266.7	6297.	31311.	209.53	24978.	48160.	1231.2
2022.0	149.77	4889.8	13895.	5545.9	6679.	31222.	223.06	26299.	48634.	1208.7
2023.0	157.91	5150.8	14582.	5840.9	7082.	31132.	237.35	27692.	49099.	1186.6
2024.0	166.50	5424.7	15302.	6152.5	7507.	31046.	252.41	29158.	49553.	1165.0
2025.0	175.57	5713.8	16060.	6481.1	7956.	30969.	268.29	30701.	49997.	1143.7
2026.0	185.12	6018.7	16855.	6827.1	8430.	30904.	285.02	32326.	50429.	1122.9
2027.0	195.17	6339.3	17691.	7190.9	8929.	30853.	302.65	34035.	50850.	1102.3
2028.0	205.72	6675.9	18570.	7573.1	9461.	36230.	321.23	35844.	51258.	1082.4
2029.0	216.79	7029.2	19495.	7974.0	10026.	36207.	340.78	37734.	51653.	1062.4
2030.0	228.41	7399.5	20466.	8394.4	10589.	36300.	361.38	39721.	52033.	1042.3

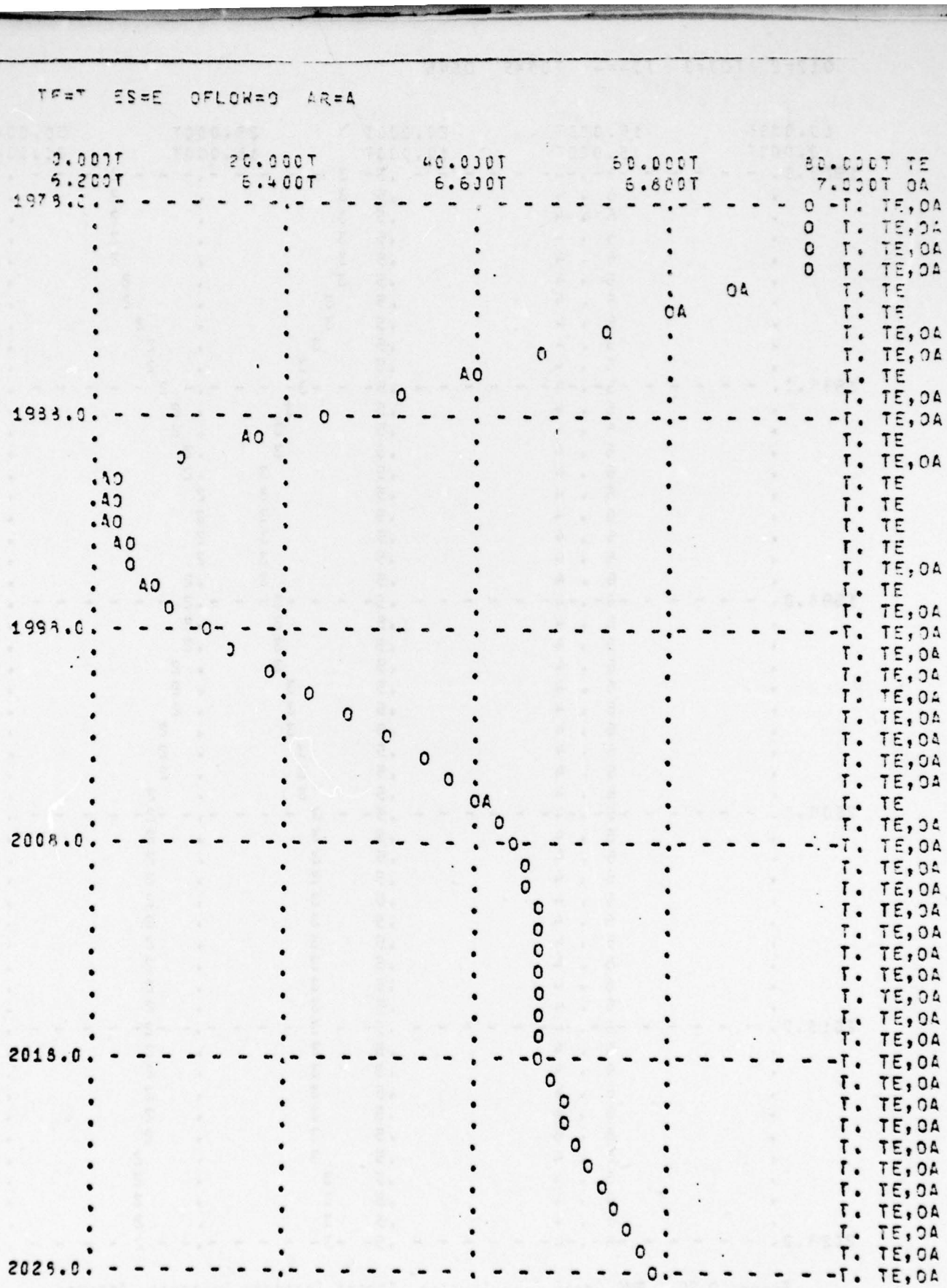


Figure D-19. RMA Accessions, Strong Intended Response, Assumed Military Pay Feedback

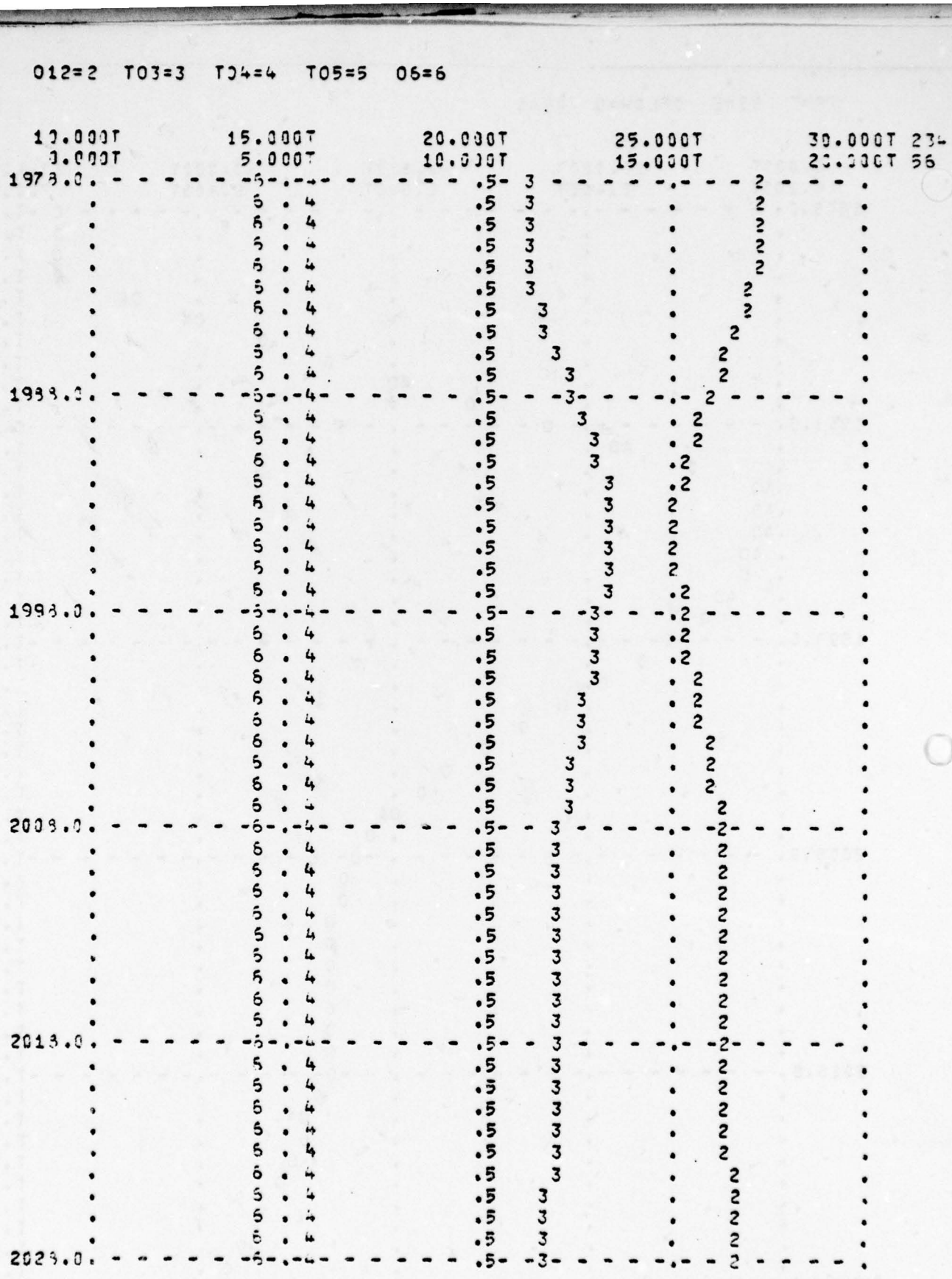


Figure D-20. RMA Grade Distribution, Strong Intended Response, Assumed Military Pay Feedback

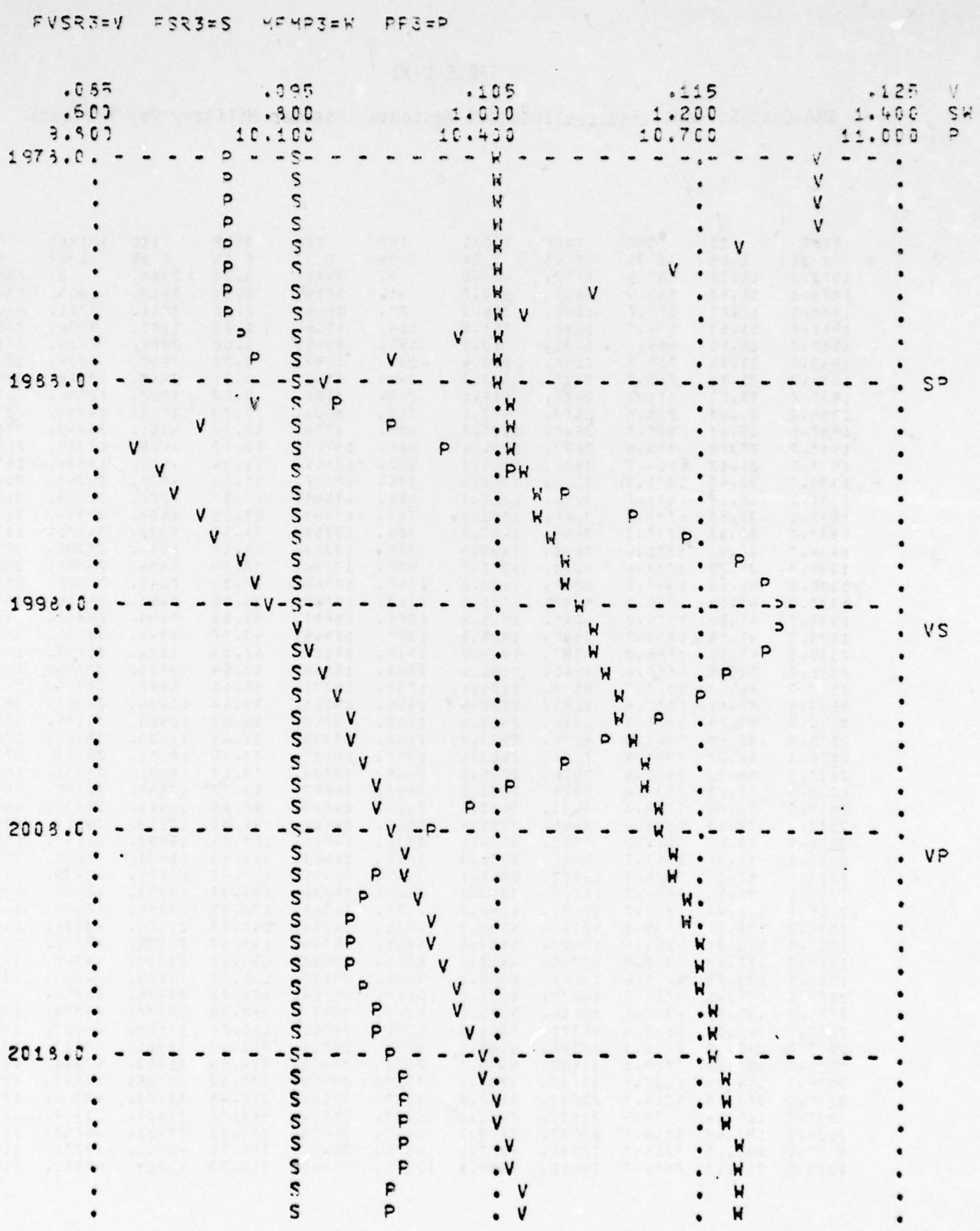


Figure D-21. RMA O-3 Promotion Parameters, Strong Intended Response, Assumed Military Pay Feedback

TABLE D-XI

RMA Cost Streams, Reverse Intended Response, Assumed Military Pay Feedback

TIME E-00	RC E 06	TRNC E 06	TACP E 06	TOTAC E 06	TRP E 06	TSP E 03	DFDP E 06	TSC E 06	TOTRET E-00	DTSC E 06
1978.0	15.25	563.5	1712.	638.0	9.	8556.	0.00	2385.	0.	2384.6
1979.0	16.37	592.4	1800.	670.7	41.	8556.	0.00	2539.	1907.	2367.2
1980.0	17.73	622.7	1892.	704.9	77.	8556.	0.00	2701.	3751.	2348.4
1981.0	19.33	654.5	1984.	741.0	114.	8556.	0.00	2873.	5534.	2328.5
1982.0	19.52	649.0	2091.	780.0	156.	8556.	1.60	3056.	7414.	2310.0
1983.0	20.71	727.5	2198.	823.6	200.	8557.	3.27	3252.	9228.	2291.8
1984.0	21.93	768.7	2310.	870.3	247.	8556.	5.01	3459.	10978.	2272.6
1985.0	23.12	812.3	2426.	919.6	296.	8551.	6.83	3677.	12666.	2252.7
1986.0	24.43	858.6	2553.	972.1	348.	8538.	8.72	3909.	14293.	2232.1
1987.0	25.83	907.7	2680.	1027.7	403.	8509.	10.70	4151.	15863.	2210.9
1988.0	27.29	958.6	2827.	1086.4	466.	13773.	12.77	4419.	17377.	2196.3
1989.0	28.83	1014.3	2978.	1148.3	527.	13656.	14.94	4690.	18838.	2171.4
1990.0	30.45	1071.9	3126.	1213.5	590.	13537.	17.20	4976.	20247.	2149.1
1991.0	32.15	1132.7	3290.	1282.3	658.	13449.	19.57	5278.	21605.	2129.5
1992.0	33.89	1195.0	3465.	1352.9	731.	13393.	22.06	5598.	22914.	2110.8
1993.0	35.62	1257.2	3646.	1423.2	808.	13358.	24.67	5932.	24176.	2095.7
1994.0	37.40	1321.4	3845.	1495.9	889.	13333.	27.41	6293.	25392.	2080.1
1995.0	39.25	1388.4	4051.	1571.7	976.	13334.	30.29	6654.	26562.	2064.3
1996.0	41.16	1457.3	4260.	1650.2	1067.	13349.	33.31	7043.	27685.	1997.9
1997.0	43.14	1529.9	4498.	1731.8	1163.	13395.	36.50	7453.	28766.	1971.1
1998.0	45.20	1605.2	4747.	1816.9	1270.	13487.	39.85	7894.	29802.	1946.7
1999.0	47.36	1683.3	4995.	1905.9	1377.	18849.	43.37	8347.	30795.	1919.3
2000.0	49.61	1766.2	5267.	1999.0	1489.	19017.	47.08	8824.	31745.	1891.7
2001.0	51.96	1852.4	5545.	2096.5	1608.	19146.	50.99	9325.	32659.	1864.0
2002.0	54.43	1942.7	5843.	2198.6	1733.	19231.	55.11	9852.	33529.	1835.2
2003.0	57.01	2037.6	6156.	2305.9	1864.	19286.	59.44	10406.	34367.	1808.3
2004.0	59.73	2137.4	6484.	2418.8	2002.	19319.	64.00	10989.	35174.	1780.6
2005.0	62.60	2242.5	6830.	2537.7	2148.	19332.	68.81	11603.	35951.	1752.9
2006.0	65.62	2353.9	7194.	2663.1	2302.	19327.	73.86	12250.	36703.	1725.5
2007.0	68.81	2470.6	7578.	2795.6	2465.	19309.	79.18	12931.	37431.	1698.3
2008.0	72.18	2593.4	7981.	2935.6	2642.	24653.	84.78	13659.	38140.	1672.7
2009.0	75.74	2725.3	8401.	3083.6	2824.	24610.	90.66	14416.	38830.	1646.0
2010.0	79.50	2863.4	8846.	3239.8	3016.	24561.	96.85	15213.	39504.	1619.6
2011.0	83.46	3008.2	9313.	3404.6	3220.	24510.	103.35	16053.	40167.	1593.5
2012.0	87.64	3162.7	9805.	3578.3	3435.	24463.	110.19	16938.	40805.	1567.7
2013.0	92.03	3324.3	10322.	3761.1	3663.	24421.	117.37	17871.	41435.	1542.1
2014.0	96.64	3494.3	10866.	3953.2	3907.	24386.	124.92	18853.	42048.	1516.9
2015.0	101.49	3672.7	11438.	4155.0	4158.	24367.	132.85	19886.	42646.	1491.9
2016.0	106.58	3860.1	12040.	4366.9	4426.	24359.	141.17	20975.	43228.	1467.1
2017.0	111.91	4055.5	12672.	4589.0	4710.	24364.	149.92	22120.	43792.	1442.6
2018.0	117.49	4262.5	13340.	4822.0	5014.	29692.	159.11	23335.	44340.	1419.0
2019.0	123.35	4479.4	14041.	5066.1	5330.	29725.	168.76	24602.	44869.	1394.9
2020.0	129.48	4704.7	14778.	5321.9	5662.	29766.	178.90	25935.	45391.	1371.1
2021.0	135.90	4941.8	15554.	5590.0	6012.	29812.	189.55	27337.	45874.	1347.5
2022.0	142.63	5190.4	16371.	5871.2	6381.	29861.	200.74	28811.	46350.	1324.1
2023.0	149.69	5451.3	17229.	6166.1	6770.	29908.	212.49	30361.	46807.	1301.0
2024.0	157.10	5725.1	18133.	6475.7	7178.	29952.	224.84	31990.	47248.	1278.2
2025.0	164.88	6012.5	19083.	6800.8	7609.	29990.	237.82	33705.	47673.	1255.6
2026.0	173.05	6314.8	20082.	7142.5	8062.	30021.	251.45	35508.	48082.	1233.4
2027.0	181.64	6632.5	21132.	7501.8	8539.	30044.	265.77	37404.	48478.	1211.4
2028.0	190.64	6966.3	22237.	7879.7	9047.	35436.	280.81	39411.	48850.	1190.1
2029.0	200.16	7318.5	23396.	8277.4	9576.	35444.	296.52	41510.	49231.	1168.7
2030.0	210.18	7688.7	24620.	8695.9	10134.	35443.	313.23	43719.	49590.	1147.7

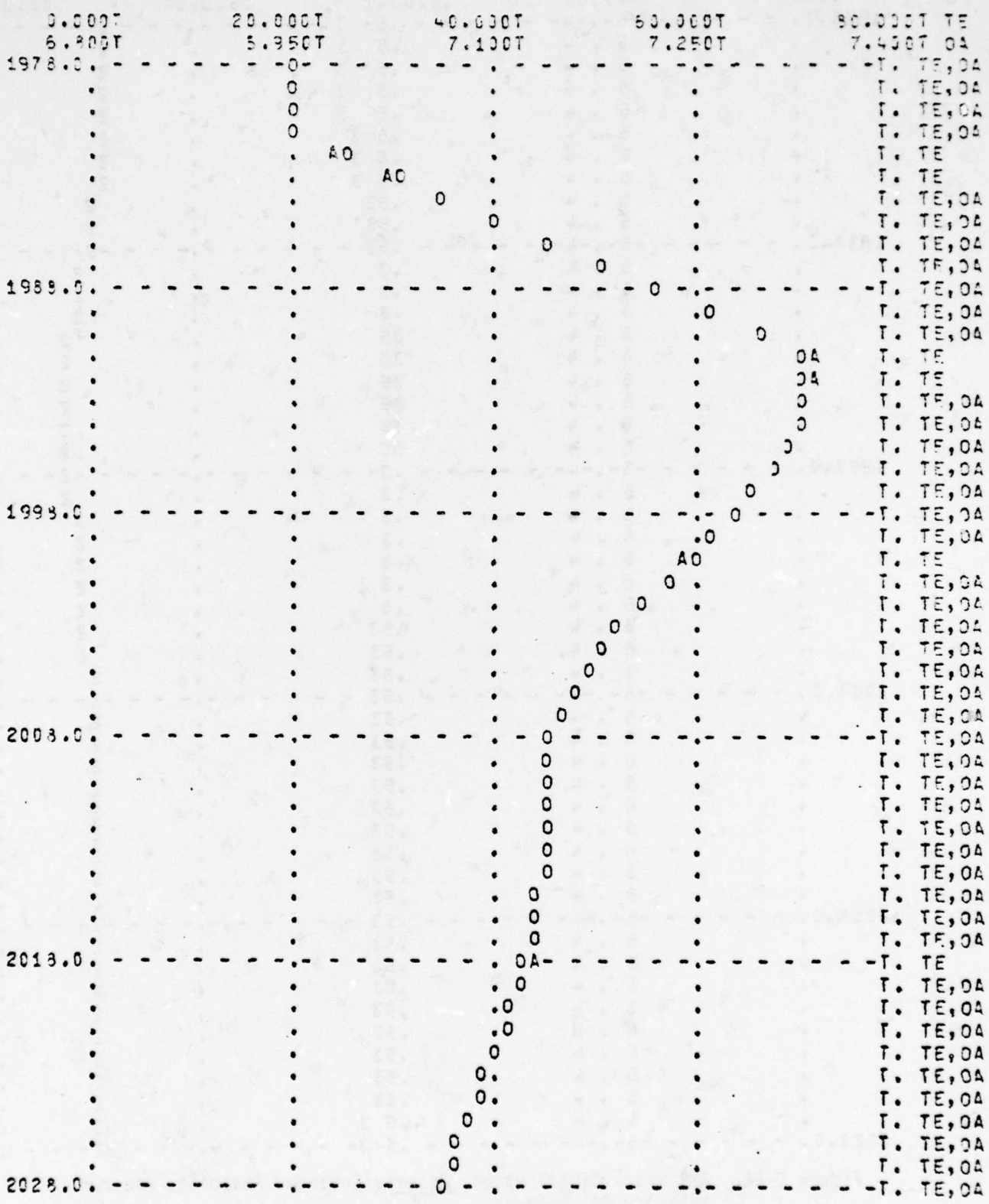


Figure D-22. RMA Accessions, Reverse Intended Response, Assumed Military Pay Feedback

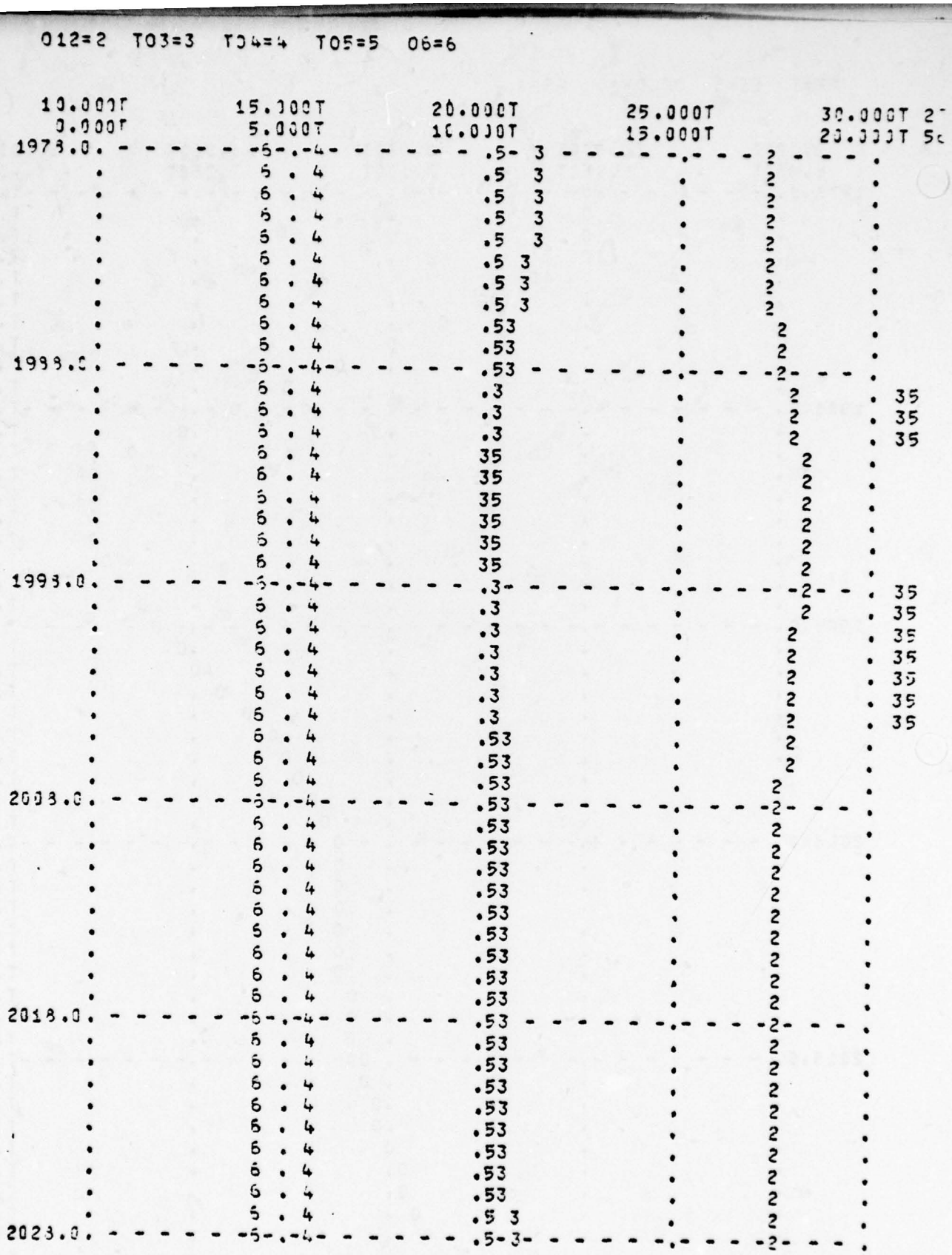


Figure D-23. RMA Grade Distribution, Reverse Intended Response, Assumed Military Pay Feedback

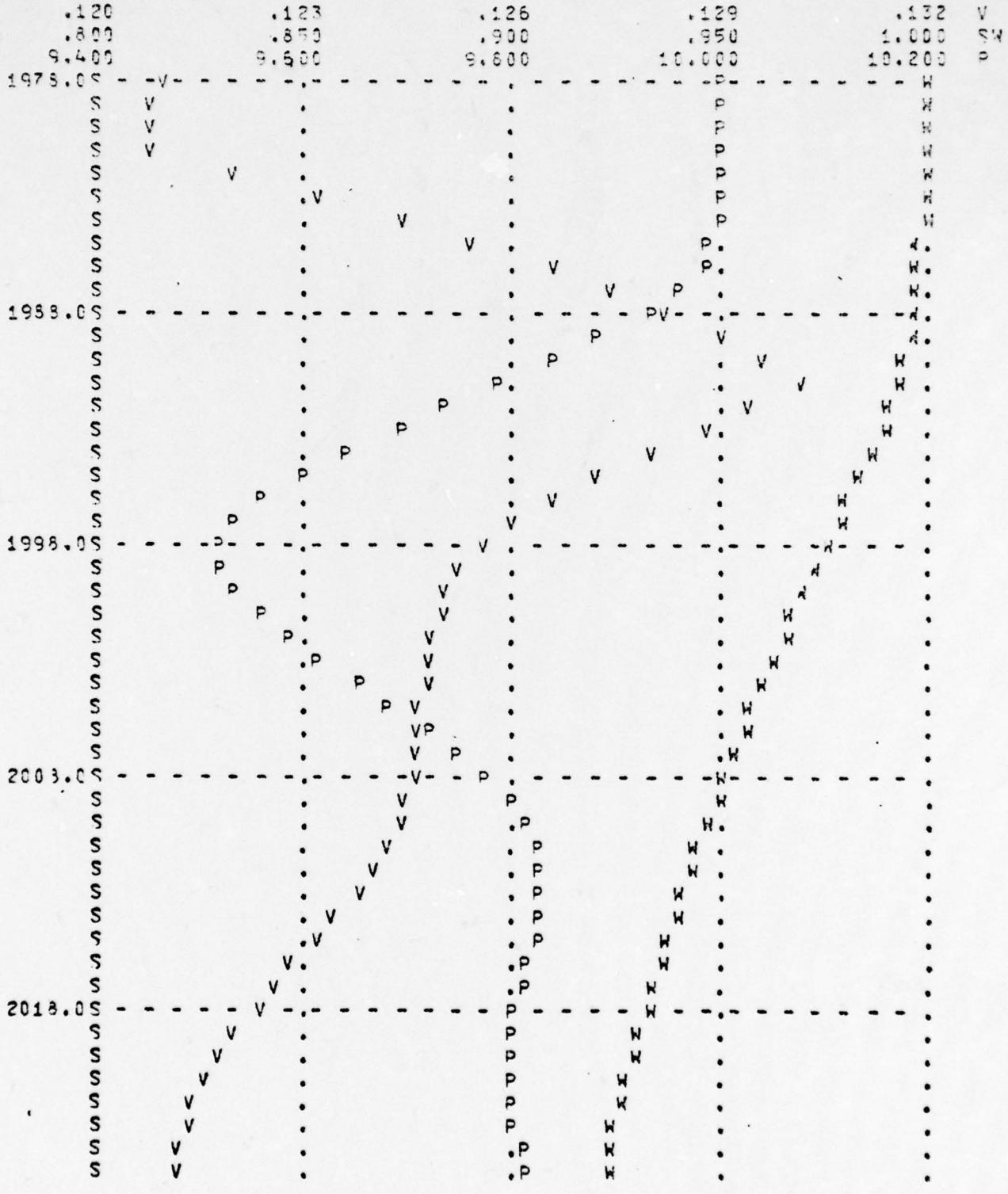


Figure D-24. RMA O-3 Promotion Parameters, Reverse Intended Response, Assumed Military Pay Feedback

APPENDIX E

Computer Program Listing

APPENDIX E

Computer Program Listing

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MFC,CM770000,T200,IO60,STCSR.    T770010,CARPENTER/LACEY
ATTACH,PROFIL,BIGD,ID=AFIT.
BEGIN,DYNAMO,CM=77000,W=575,M=15.
*            MPS   MODEL
NOTE
NOTE       ACCESSIONS
NOTE
R    AR.KL=SMOOTH(OFLOW.K,2)+TFD.K/TTAF
A    TFD.K=ES.K-TF.K
A    TF.K=012.K+T03.K+T04.K+T05.K+06.K
A    T03.K=03.K+03P.K+03S.K
A    T04.K=04.K+04P.K+04S.K
A    T05.K=05.K+05P.K+05S.K
A    ES.K=ESN+RAMP(SLPE,SF1)+RAMP(-SLPE,SF2)
C    TTAF=.3
A    OFLOW.K=RSR2.JK+VSR2.JK+NPR2.JK
X    +RSR3.JK+VSR3.JK+RSR3P.JK+RR3I.JK+RSR3S.JK
X    +RSR4.JK+VSR4.JK+RSR4S.JK+RSR4P.JK+RR4.JK
X    +RSR5.JK+VSR5.JK+RSR5P.JK+RR5.JK+RSR5S.JK
X    +RSR6.JK+RR6.JK
NOTE
NOTE       FIRST AND SECOND LTS
NOTE
L    012.K=012.J+(DT)(AR.JK-RSR2.JK-NPR2.JK-VSR2.JK-PR2.JK)
N    012=012N
NOTE
NOTE       SHIFT 012 TO SELECTION POINT FOR CAPTAIN
NOTE
C    MTIG4=5
C    MTIG5=5
FOR  W=1,4
FOR  X=1,5
FOR  Y=1,MTIG4
FOR  Z=1,MTIG5
A    OUT2.K=SHIFTL(PIP2,K,1)
L    PIP2.K(1)=PIP2.J(1)+(DT)(AR.JK)
N    PIP2(W)=PIP2I(W)
```

```
NOTE
NOTE      SHIFT RSR FOR FOUR YEARS
NOTE
A     OUTR2.K=SHIFT_(PIPR2.K,1)
L     PIPR2.K(1)=PIPR2.J(1)+(DT)(PSR2.JK)
N     PIPR2(W)=PIPR2I(W)
A     AVR2.K=(SJMV(PIPR2.K,2,4)+OUTR2.K)/4
A     FL2.K=OUT2.K-AVR2.K
A     NETFL2.K=(1-FVSR2.K)(FL2.K)
R     PR2.KL=FPR2*(NETEL2.K)
C     FPR2=.95
R     NPR2.KL=(1-FPR2)(NETEL2.K)/1
R     VSR2.KL=FVSR2.K*FL2.K
R     PSR2.KL=FRSR2*OUT2.K
A     FVSR2.K=FVSR2N*MFCE2.K*MFMP2.K*MFR32.K
A     XSR3.K=1-FSR3.K
A     MFCE2.K=TABHL(TCE2,PR3TPO.K,1.4,5.0,.6)
A     PR3TPO.K=SMOOTH(XSR3.K,2)(PR3.K)
T     TCE2=.96/1.0/1.04/1.07/1.1/1.2/1.25
A     MFMP2.K=TABHL(TMP2,SMOOTH(IMW.K/CWI.K,2),.5,2.0,.25)
T     TMP2=1.25/1.1/1.0/.96/.9/.85/.75
A      CWI.K=CPI.K*(1+AMP*SIN(6.283*TIME.K/PER))
C     AMP=1
C     PER=1
A     MFR32.K=MFR32N+RAMP(SLPR32,SR321)+RAMP(-SLPR32,SR322)
NOTE
NOTE      CAPTAIN LEVELS
NOTE
L     O3.K=O3.J+(DT)(PR2.JK-RSR3.JK-VSR3.JK-NSR3.JK-RIFR.JK-SR3.JK)
N     O3=O3N
L     RO3V.K=RO3V.J+(DT)(VSR3.JK-DRR3V.JK)
N     RO3V=RO3VN
L     O3P.K=O3P.J+(DT)(NSR3.JK-PR3I.JK-RSR3P.JK)
N     O3P=O3PN
L     RO3I.K=RO3I.J+(DT)(PR3I.JK-DRR3I.JK)
N     RO3I=RO3IN
L     RO3R.K=RO3R.J+(DT)(RIFR.JK-DRR3R.JK)
N     RO3R=RO3RN
L     O3S.K=O3S.J+(DT)(SR3.JK-RSR3S.JK-PR3.JK)
N     O3S=O3SN
```

```
NOTE
NOTE      CAPTAIN RATES
NOTE
R    PSR3.KL=FRSR3*O3.K
R    VSR3.KL=FVSR3.K*O3.K
A    FVSR3.K=FVSR3N+MFCE3.K*MFAR3.K*MFRB3.K
A    MFCE3.K=TABHL(TCE3,PR3TRO.K,1.4,5.0,.6)
T    TCE3=.95/1.0/1.02/1.04/1.06/1.15/1.2
A    MFAR3.K=TABHL(TMR3,SMOOTH(IMW.K/CWI.K,2),.5,2.0,.25)
T    TMR3=1.2/1.05/1.0/.96/.9/.85/.8
A    MFR3.K=MFR3N+RAMP(SLPR3,SRB31)+RAMP(-SLPR33,SRB32)
R    OPR3V.KL=FOPR3V*RO3V.K
R    NSR3.KL=(1-FSR3.K)(NETEL3.K)
R    RSR3P.KL=FRSR3P*O3P.K
R    PR3T.KL=DELAY3(NSR3.JK,AT3P)-SMOOTH(RSR3P.JK,1)
R    OPR3I.KL=FOPR3I*RO3I.K
R    OPR3R.KL=FOPR3R*RO3R.K
R    RSR3S.KL=FRSR3S*O3S.K
NOTE
NOTE      DETERMINATION OF CAPTAIN SELECTION RATE
NOTE      SHIFT CAPTAIN TO SELECTION POINT (9 YEARS)
NOTE
A    OUT3.K=SHIFTL(PIP3,K,1)
L    PIP3.K(1)=PIP3.J(1)+(DT)(FP2.JK)
N    PIP3(X)=PIP3I(X)
NOTE
NOTE      SHIFT RSR,VSR AND RIFR
NOTE
A    OUTR3.K=SHIFTL(PIPR3.K,1)
L    PIPR3.K(1)=PIPR3.J(1)+(DT)(RSR3.JK+VSR3.JK+RIFR.JK)
N    PIPR3(X)=PIPR3I(X)
A    AVR3.K=(SUMV(PIPR3,K,2,5)+OUTR3.K)/5
A    NETEL3.K=OUT3.K-AVP3.K
R    SR3.KL=FSR3.K*NETEL3.K
```

```
NOTE
NOTE      DETERMINATION OF PR3, FSR3, RIFR BASED ON AVERAGE PROMOTION DE
NOTE
A    XPD3.K=D3S.K/PR3.JK
A    APD3.K=SMOOTH(XPD3.K,1)
A    MD04.K=AUTH4.K-TO4.K
A    DO4.K=(DEA4*AUTH4.K)-TO4.K
C    DEA4=1.0
A    AUTH4.K=AUTH4N+RAMP(SLP4,S41)+RAMP(-SLP4,S42)
A    PR3.KL=CLIP(A4.K,SMOOTH(OFLOW4.K,1)+DO4.K/TTA4,APD3.K,2)
A    A4.K=MIN(D3S.K/2,SMOOTH(OFLOW4.K,1)+MDO4.K/TTA4)
A    OFLOW4.K=RSR4.JK+VSR4.JK+FSR4P.JK+RR4.JK+RSR4S.JK+PR4.JK
A    FSR3.K=TABHL(FSR3T,APD3.K,0,4.0,.5)
T    FSR3T=.85/.8/.9/.8/.9/.8/.75/.70/.65
A    RIFR.KL=CLIP(TFE.K,RIF.K,TFE.K,1000)
A    TFE.K=MAX(TF.K-ES.K,0)
A    RIF.K=FRIF.K*D3.K
A    FRIF.K=TABHL(TRIF,APD3.K,3.5,4.5,.5)
T    TRIF=.03/.04/.03
A    PR3.K=APD3.K+0
NOTE
NOTE      MAJOR LEVELS
NOTE
L    O4.K=O4.J+(DT)(PR3.JK-VSR4.JK-SR4.JK-FSR4.JK-NSR4.JK)
N    O4=O4N
L    RO4V.K=RO4V.J+(DT)(VSR4.JK-DRR4V.JK)
N    RO4V=RO4VN
L    O4P.K=O4P.J+(DT)(NSR4.JK-FSR4P.JK-RR4.JK-FRR4.JK)
N    O4P=O4PN
L    RO4.K=RO4.J+(DT)(RR4.JK+FRR4.JK-DRR4.JK)
N    RO4=RO4N
L    O4S.K=O4S.J+(DT)(SR4.JK-RSR4S.JK-PR4.JK)
N    O4S=O4SN
```

```
NOTE
NOTE      MAJOR RATES
NOTE
R    RSR4.KL=FRSR4*O4.K
R    VSR4.KL=FVSR4.K*O4.K
A    FVSR4.K=FVSR4N*MFOR4.K*MFMR4.K*MFRR4.K
A    MFOR4.K=TABHL(TOR4,RR4TRO.K,3,8.4,.9)
T    TOR4=.9/.97/1.0/1.02/1.03/1.05/1.1
A    RR4TRO.K=SMOOTH(YSR4.K,2)*RR4.K
A    MFMR4.K=TABHL(TMR4,SMOOTH(IMW.K/OWI.K,2),.5,2.0,.25)
T    TMR4=1.05/1.04/1.0/.96/.92/.87/.8
A    YSR4.K=1-FSR4.K
A    MFRR4.K=MFRR4N+RAMP(SLPRR4,SR341)+RAMP(-SLPRR4,SR342)
R    ORR4W.KL=FORR4.V*RO4V.K
R    NSR4.KL=(1-FSR4.K)(NETEL4.K)
R    RSR4P.KL=FRSR4P*O4P.K
R    RR4.KL=DELAY3(NSR4.JK,AT4P.K)-SMOOTH(RSR4P.JK,1)
A    AT4P.K=SMOOTH(XT4P.K,3)
R    RSR4S.KL=FRSR4S*O4S.K
A    XT4P.K=AYS4P.K-SR4.K
A    SR4.K=OUTR3.K+MTIG4
A    AYS4P.K=AYS4PN+RAMP(SLPYS4,SYS41)+RAMP(-SLPYS4,SYS42)
R    ORR4.KL=FORR4*RO4.K
NOTE
NOTE      FORCED RETIREMENT RATE FOR USE DURING TOTAL FORCE REDUCTIONS
NOTE
A    O4F.K=MAX(TO4.K-AUTH4.K,0)
R    FRR4.KL=CLIP(O4F.K/TTR4,0,O4E.K,300)
C    TTR4=.5
NOTE
NOTE      MAJOR SELECTION RATE
NOTE      SHIFT MAJORS TO SELECTION POINT (MTIG4)
NOTE
A    OUT4.K=SHIFTL(PIR4.K,1)
L    PIR4.K(1)=PIR4.J(1)+(DT)(FRI.JK)
N    PIR4(Y)=PIR4I(Y)
NOTE
NOTE      SHIFT RSR, VSR
NOTE
A    OUTR4.K=SHIFTL(PIRR4.K,1)
L    PIRR4.K(1)=PIRR4.J(1)+(DT)(RSR4.JK+VSR4.JK)
N    PIRR4(Y)=PIRR4I(Y)
A    AVR4.K=(SUMV(PIRR4.K,2,MTIG4)+OUTR4.K)/MTIG4
A    NETE.4.K=OUT4.K-AVR4.K
R    SR4.KL=FSR4.K*NETEL4.K
```

```
NOTE
NOTE      DETERMINATION OF PR4, FSR4 BASED ON AVG PROMOTION DELAY
NOTE
A    APD4.K=SMOOTH(XPD4.K,1)
A    XPD4.K=D4S.K/PP4.JK
NOTE
NOTE      SHIFT PP3 BY MTIG4
NOTE
A    OUTPP3.K=SHIFTL(PIPP3.K,1)
L    PIPP3.K(1)=PIPP3.J(1)+(DT)(INPP3.JK)
R    INPP3.KL=PP3.K/1
N    PIPP3(Y)=PIPP3I(Y)
A    PP4.K=OUTPP3.K+MTIG4+APD4.K
A    MDD5.K=AUTH5.K-T05.K
C    DFA5=1.0
A    D05.K=(DFA5*AJTH5.K)-T05.K
R    PP4.KL=CLIP(A5.K,SMOOTH(OFLOW5.K,1)+D05.K/TTA5,PP4.K,17)
A    A5.K=SMOOTH(OFLOW5.K,1)+MDD5.K/TTA5
A    OFLOW5.K=RSP5.JK+VSP5.JK+FSR5F.JK+RR5.JK+RSR5S.JK+PR5.JK
A    FSR4.K=TABHL(FSR4T,PP4.K,15,19,.5)
T    FSR4T=.8/.7/.7/.7/.7/.7/.65/.6/.55
NOTE
NOTE      LIEUTENANT COLONEL LEVELS
NOTE
L    05.K=05.J+(DT)(PR4.JK-VSR5.JK-SR5.JK-PSR5.JK-NSR5.JK)
N    05=05N
L    R05V.K=R05V.J+(DT)(VSP5.JK-DRR5V.JK)
N    R05V=R05VN
L    05P.K=05P.J+(DT)(NSP5.JK-PSR5P.JK-RR5.JK-FRR5.JK)
N    05P=05PN
L    R05.K=R05.J+(DT)(RR5.JK+FRR5.JK-DRR5.JK)
N    R05=R05N
L    05S.K=05S.J+(DT)(SP5.JK-PSR5S.JK-PR5.JK)
N    05S=05SN
```

```
NOTE
NOTE      LIEUTENANT COLONEL RATES
NOTE
R    RSR5.KL=FRSR5*OS.K
R    VSR5.KL=FVSR5.K*OS.K
A    FVSR5.K=FVSRN*MFOR5.K*MFMR5.K*MFRR5.K
A    MFOR5.K=TABHL(TOR5,PR5TRO.K,6,16,1.0)
A    PR5TRO.K=SMOOTH(XSR5.K,2)(PR5.K)
A    XSR5.K=1-FSR5.K
T    TOR5=.9/.95/.97/1.0/1.01/1.02/1.04/1.07/1.11
A    MFMR5.K=TABHL(TMR5,SMOOTH(IMW.K/CWI.K,2),.5,2.0,.25)
T    TMR5=1.04/1.02/1.0/.95/.9/.87/.85
A    MFRR5.K=MFRRN+RAMP(SLPR51,SR551)+RAMP(-SLPR55,SR552)
R    RSR5.KL=FRSR5V*OS5V.K
R    NSR5.KL=(1-FSR5.K)(NETEL5.K)
R    RSR5P.KL=FRSR5P*OSP.K
R    PR5.KL=DELAY3(NSR5.JK,AT5P.K)-SMOOTH(RSR5P.JK,1)
A    AT5P.K=SMOOTH(XT5P.K,3)
R    RSR5S.KL=FRSR5S*OSS.K
A    XT5P.K=AYS5P.K-SR5.K
A    SR5.K=OUTR4.K+MTIG5
A    AYS5P.K=AYS5PN+RAMP(SLPYS1,SYS51)+RAMP(-SLPYS5,SYS52)
R    OR5.KL=FORR5*RO5.K
NOTE
NOTE      FORCED RETIREMENT RATE
NOTE
A    AUTH5.K=AUTHEN+RAMP(SLP5,S51)+RAMP(-SLP5,S52)
A    OSE.K=MAX(TOE.K-AUTH5.K,0)
R    FRR5.KL=CLIP(OSE.K/TTR5,0,OSE.K,200)
C    TTR5=.5
NOTE
NOTE      LIEUTENANT COLONEL SELECTION RATE
NOTE      SHIFT LIEUTENANT COLONELS TO SELECTION POINT (MTIG5)
NOTE
A    OUT5.K=SHIFTL(PIPR5.K,1)
L    PIPR5.K(1)=PIPR5.J(1)+(DT)(FR4.JK)
N    PIPR5(Z)=PIPR5I(Z)
NOTE
NOTE      SHIFT RSR, VSR
NOTE
A    OUTR5.K=SHIFTL(PIPR5.K,1)
L    PIPR5.K(1)=PIPR5.J(1)+(DT)(RSR5.JK+VSR5.JK)
N    PIPR5(7)=PIPR5I(7)
A    AVR5.K=(SUMV(PIPR5.K,2,MTIG5)+OUTR5.K)/MTIG5
A    NETEL5.K=OUT5.K-AVR5.K
R    SR5.KL=FSR5.K*NETEL5.K
```

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NOTE
NOTE      DETERMINATION OF PR5, FSR5 BASED ON AVG PROMOTION DELAY
NOTE
A    APP5.K=SMOOTH(XPP5.K,1)
A    XPP5.K=O5S.K/PR5.JK
NOTE
NOTE      SHIFT PP4 BY MTIG5
NOTE
A    OUTPP4.K=SHIFTL(PIPP4.K,1)
L    PIPP4.K(1)=PTPP4.J(1)+(DT)(INPP4.JK)
R    INPP4.KL=PP4.K/1
N    PTPP4(Z)=PIPP4I(Z)
A    PP5.K=OUTPP4.K+MTIG5+APP5.K
A    MOO5.K=AUTH5.K-O5.K
A    OO6.K=(OFA5*AUTH5.K)-O5.K
C    OFA5=1.0
R    PP5.KL=CLIP(A5.K,SMOOTH(OFLOW5.K,1)+OO6.K/TTA5,PP5.K,23)
A    A5.K=SMOOTH(OFLOW5.K,1)+MOO6.K/TTA5
A    OFLOW5.K=RSP5.JK+PP5.JK
A    FSR5.K=TABHL(FSR5T,PP5.K,21,26,.5)
T    FSR5T=.6/.5/.5/.5/.5/.5/.48/.46/.44/.42/.4
NOTE
NOTE      COLONEL LEVELS
NOTE
L    O6.K=O6.J+(DT)(PR5.JK-RSR6.JK-RR5.JK-FRR6.JK)
N    O6=O6N
L    P06.K=P06.J+(DT)(PP6.JK+FPR6.JK-DRR6.JK)
N    P06=P06N
NOTE
NOTE      COLONEL RATES
NOTE
R    RSP6.KL=FRSP6*O6.K
R    RR6.KL=DELAY3(PR5.JK,AT6.K)-SMOOTH(RSP6.JK,1)
A    AT6.K=SMOOTH(XT6.K,3)
A    XT6.K=AYS6.K-PP5.K
A    AYS6.K=AYS6N+RAMP(SLPYS6,SYS61)+RAMP(-SLPYS6,SYS62)
R    DRR6.KL=FDRR6*P06.K
NOTE
NOTE      FORCED RETIREMENT RATE
NOTE
A    AUTH6.K=AUTH6N+RAMP(SLP6,S61)+RAMP(-SLP6,S62)
A    O6E.K=MAX(O6.K-AUTH6.K,0)
R    FRR6.KL=CLIP(O6E.K/TTR6,0,O6E.K,100)
C    TTR6=.5
```

```
NOTE
NOTE      NUMBER OF ACCESSIONS FROM EACH SOURCE
NOTE
A    ACCA.K=MIN(900,TOTA.K)
A    MACR.K=MAX(TOTA.K-900,0)
A    ACCR.K=MIN(4500,MACR.K)
A    ACCO.K=MAX(TOTA.K-5400,0)
A    TOTA.K=SMOOTH(AR.JK,1)
NOTE
NOTE      COSTS FOR PRE-COMMISSIONING TRAINING
NOTE
A    CACCA.K=ACCA.K*CPI.K*15221
A    CACCR.K=ACCR.K*CPI.K*6411
A    CACCO.K=ACCO.K*CPI.K*8083
A    PCC.K=CACCA.K+CACCR.K+CACCO.K
NOTE
NOTE      CALCULATION OF MILITARY WAGE INDEX (IMW)
NOTE
L    IMW.K=IMW.J+(DT)(MWI.JK)
R    MWI.KL=FMWI.K*IMW.K
N    IMW=IMWN
A    FMWI.K=TABHL(TMWI,TVS.K,0,.08666,.021715)
A    TVSR.K=VSR2.JK+VSR3.JK+VSR4.JK+VSR5.JK
A    FTVSR.K=TVSR.K/TF.K
A    TVS.K=SMOOTH(FTVSR.K,2)
T    TMWI=.02/.04/.05/.06/.08
C    IMWN=1
C    INF=.05
NOTE
NOTE      CALCULATION OF CONSUMER PRICE INDEX (CPI)
NOTE
L    CPI.K=CPI.J+(DT)(IINF.JK)
R    IINF.KL=INF*CPI.K
N    CPI=CPIN
C    CPIN=1
NOTE
NOTE      RECRUITMENT AND INITIAL TRAINING COSTS
NOTE
A    PC.K=(RCN*MEMPI.K+PCS)*(TOTA.K)*(CPI.K)
C    RCN=1105
C    PCS=1205
A    MEMPI.K=TABHL(TMPI,SMOOTH(IMW.K/CWI.K,2),.5,2.0,.25)
T    TMPI=1.2/1.05/1.0/.98/.96/.94/.9
A    TRNC.K=TOTA.K*CPI.K*ACPT.K
A    ACPT.K=TABHL(TACPT,TF.K,76800,106718,27918)
T    TACPT=81089/71073
A    TOTAC.K=PCC.K+PC.K+TRNC.K
```

```
NOTE
NOTE      ACTIVE DUTY PAY
NOTE
A    TADP.K=ADP2.K+ADP3.K+ADP4.K+ADP5.K+ADP6.K
A    ADP2.K=012.K*STP2.K
A    STP2.K=STP2I*IMW.K
C    STP2I=14216.5
A    ADP3.K=T03.K*STP3.K
A    STP3.K=STP3I*IMW.K
C    STP3I=21481
A    ADP4.K=T04.K*STP4.K
A    STP4.K=STP4I*IMW.K
C    STP4I=25242
A    ADP5.K=T05.K*STP5.K
A    STP5.K=STP5I*IMW.K
C    STP5I=30521
A    ADP6.K=06.K*STP6.K
A    STP6.K=STP6I*IMW.K
C    STP6I=36152
NOTE
NOTE      SEPARATION TRAVEL COSTS
NOTE
A    STC.K=SMOOTH(OFLOW.K+RIFR.JK+FRR4.JK+FRR5.JK+FRP6.JK,1)*STP.K
A    STP.K=CPI.K*2462
NOTE
NOTE      RETIREMENT PAY FOR PRESENT SYSTEM
NOTE
A    TRP.K=TRP03.K+TRP04.K+TRP05.K+TRP06.K
A    TRP03.K=A
C    A=0
A    TRP04.K=R04.K*ARP04.K
A    ARP04.K=RP04.K*0.5
A    RP04.K=1821.5*CPI.K*12
A    TRP05.K=R05V.K*ARP05V.K+R05.K*ARP05.K
A    ARP05V.K=RP05V.K*0.737
A    RP05V.K=2154.02*CPI.K*12
A    ARP05.K=RP05.K*.606
A    RP05.K=2178.6*CPI.K*12
A    TRP06.K=R06.K*ARP06.K
A    ARP06.K=RP06.K*.598
A    RP06.K=2670*CPI.K*12
```

```
NOTE
NOTE      SEPARATION PAY
NOTE
A    SP03I.K=SMOOTH(3P3I.JK,1)*SPI.K
A    SP03R.K=SMOOTH(PIRR.JK,1)*SPR.K
A    SPI.K=(SPIN)*(1+STEP(H1.K,ST1)+STEP(H1.K,ST2)+STEP(H1.K,ST3)
X    +STEP(H1.K,ST4)+STEP(H1.K,ST5))
A    H1.K=EXP(10*LOGN(1+INF))-1
C    SPIN=15000
C    ST1=1988
C    ST2=1998
C    ST3=2003
C    ST4=2018
C    ST5=2028
A    SPR.K=SPI.K*SPRN/SPIN
C    SPRN=14000
NOTE
NOTE      TOTAL SYSTEM COST
NOTE
A    TSC.K=TOTAC.K+TAXR.K+STC.K+TRR.K+SP03I.K+SP03R.K
A    DTSC.K=TSC.K/(EXP(.07*(TIME.K-1978)))
NOTE
NOTE
NOTE      CONSTANTS AND TABLES FOR INITIAL RUN
NOTE
NOTE
NOTE    EQUILIBRIUM CONSTANTS FOR LIEUTENANTS
C    O12N=27200
T    PIR2I=0/6950/6950/6950
T    PIRR2I=0/-76/476/476
C    FRSR2=.0175
C    FVSR2N=.1720729
N    RR2=5092
N    NPR2=263
N    VSR2=1114
N    RSR2=476
```

```
NOTE      EQUILIBRIUM CONSTANTS FOR ACTIVE DUTY CAPTAINS
C    03N=17750
C    03PN=1150
C    03SN=2300
T    PIP3I=0/5092/5092/5092/5092
T    PIPR3I=0/2217/2217/2217/2217
C    FRSP3=.004
C    FVSP3N=.1209014
N    PSP3=71
N    VSP3=2146
N    SP3=2300
N    NSP3=575
N    RP3I=570.4
C    FRSP3P=.004
N    PSP3P=4.6
N    RIFP=0
C    FRSP3S=.004
N    PSP3S=9.2
N    PP3=2290.8
T    PIPP3I=0/10/10/10/10
NOTE      EQUILIBRIUM CONSTANTS FOR ACTIVE DUTY MAJORS
C    04N=10900
C    04PN=3200
C    04SN=1500
T    PIP4I=0/2290.8/2290.8/2290.8/2290.8
T    PIPR4I=0/147.94286/147.94286/147.94286/147.94286
T    PIPP4I=0/15/15/15/15
C    FRSP4=.004
C    FVSP4N=.0096727
N    PSP4=43.6
N    VSP4=104.3428572
N    SP4=1500
N    NSP4=642.857
N    RP4=630.057
C    FRSP4P=.004
N    RSP4P=12.8
N    FPP4=0
C    FRSP4S=.004
N    PSP4S=6
N    PP4=1494
```

```
NOTE      EQUILIBRIUM CONSTANTS FOR ACTIVE DUTY LT COLONELS
C    05N=7200
C    05PN=2500
C    05SN=700
T    PIP5I=0/1494/1494/1494/1494
T    PIPR5I=0/94/94/94/94
C    FPSP5=.005
C    FVSR5N=.0080556
N    PSP5=36
N    VSP5=58
N    SP5=700
N    NSP5=700
N    PP5=587.5
C    FPSR5P=.005
N    PSPR5=12.5
N    FPP5=0
C    FPSP5S=.005
N    PSP5S=3.5
N    PPF=596.5
NOTE      EQUILIBRIUM CONSTANTS FOR ACTIVE DUTY COLONELS
C    06N=4400
C    FPSR6=.017
N    PSP6=74.8
N    PP6=521.7
N    FPP6=0
NOTE      CONSTANTS AND INITIAL CONDITIONS FOR RETIREMENT POOLS
C    R03IN=0
C    FOR33I=.025
C    R03VN=0
C    FOR33V=.0227
C    R03PN=0
C    FOR33R=.0227
C    R04VN=0
C    FOR34V=.0256
C    R04IN=25420
C    FOR34=.027
C    R05VN=5000
C    FOR35V=.030
C    R05N=34015
C    FOR35=.034
C    R06N=15925
C    FOR35=.041
```

```
NOTE      FORCE AUTHORIZATIONS
C    ESN=78800
C    SLP7=0
C    S71=0
C    S72=0
C    AUTH4N=15500
C    SLP4=0
C    S41=0
C    S42=0
C    AUTH5N=10400
C    SLP5=0
C    S51=0
C    S52=0
C    AUTH6N=4400
C    SLP6=0
C    S61=0
C    S62=0
NOTE      MULTIPLIERS FOR RETIREMENT BENEFITS
C    MFR32N=1.0
C    SLPR32=0
C    SPR321=0
C    SPR322=0
C    MFR33N=1.0
C    SLPR33=0
C    SPR331=0
C    SPR332=0
C    MFR34N=1.0
C    SLPR34=0
C    SPR341=0
C    SPR342=0
C    MFR35N=1.0
C    SLPR35=0
C    SPR351=0
C    SPR352=0
```

```
NOTE   AVERAGE YEAR OF RETIREMENT
C    AT33=2
C    AYSAPN=19.878
C    SLPYS4=0
C    SYS41=0
C    SYS42=0
C    AYSTPN=24.5714?3
C    SLPYS5=0
C    SYS71=0
C    SYS72=0
C    AYSSIN=24.3177
C    SLPYS6=0
C    SYS61=0
C    SYS62=0
NOTE      TIME CONSTANTS
N    TIME=1978
C    TTAA=.3
C    TTAB=.2
C    TTAC=.1
PRINT    IRP,TADP,TOTAC,TSC,SPO3I,SPO3R,DTSC
PLOT     TP=T,ES=E/OFLOW=0,AR=A
PLOT     O12=2,TO3=3,TO4=4/TO5=5,O6=6
PLOT     O7S=3,O4S=4,O5S=5
PLOT     F/SR3=V/FSR3=S,MEMP3=W/PP3=P
PLOT     F/SR4=V/FSR4=S,MEMP4=W/PP4=P
PLOT     F/SR5=V/FSR5=S,MEMP5=W/PP5=P
SPEC     DT=.025/LENGTH=2030/PLTPER=1/PRTPER=1
RUN   BASE
```

Vitae

Michael Raymond Lacey was born 3 July 1947 in San Francisco, California. After graduating from Serra High School in San Mateo, he entered the United States Air Force Academy, graduating in 1969. He completed pilot training at Reese Air Force Base, Texas and was assigned to the 9th Special Operations Squadron at DaNang Air Base, South Viet Nam. In 1972 he returned to Reese Air Force Base as an instructor pilot in the T-37 aircraft. In 1976 he entered the Air Force Institute of Technology as a candidate for Master of Science in Operations Research.

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

Numerous proposals for restructuring the military retirement system have been prompted by increasing concern over the growth of personnel costs. In particular, the Retirement Modernization Act, now before Congress, has generated a considerable amount of controversy over its provisions for reducing the size of benefits for 20 year retirees. When future costs are used as a measure of effectiveness for alternative retirement programs, a problem arises because of the interactions between the retirement system and the personnel system. Changes in retirement benefits can induce significant changes in

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retention patterns, with serious cost implications. This report develops a dynamic model of the Air Force officer personnel system suitable for analyzing the long range effects of alternative retirement programs. The cost impacts of hypothesized changes in retention indicate that any savings in retirement costs may not be large enough to effect a net reduction in total system costs. Furthermore, if unanticipated changes in retention in the lower grades should develop, the increased turnover costs could completely swamp any savings in retirement costs.

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