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July 1972

Trading off Airmunition Stockpiles and Industrial Mobilization Production Capability: Discussion, Conclusions, and Computer Program Instructions

Fred Morgan and Mary Freeman

A Report prepared for

UNITED STATES AIR FORCE PROJECT RAND

Rand
SANTA MONICA, CA. 90406

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10. ABSTRACT

The report describes the problems involved in achieving a balance between stockpiles of airmunitions and their respective mobilization production capability. The report examines the elements needed by logistics planners to balance the demand (wartime consumption anticipated) and supply (WRM and production anticipated) of airmunitions. It describes the computerized planning tool (SWIPE) that makes visible the by-item airmunitions position for each year of a five-year program; and evaluates the supply and demand for munitions occurring in any interim year. The report concludes with observations regarding munitions management; the appendixes contain the SWIPE computer program, and instructions for users.

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PREFACE

In the fall of 1970, Hq USAF asked Rand to provide assistance in an area of considerable OSD and Air Force interest: the procurement of War Readiness Materiel (WRM). The fundamental issue involved the uncertainty regarding the appropriate size of WRM stockpiles needed to achieve a balance between materiel support and force size; early estimates of the price tag ranged from less than one billion dollars to nearly three billion dollars in munitions procurement over the next five years.

Rand's response was to initiate two concurrent and complementary studies, one addressing munitions demand and the other munitions supply. This report deals with supply.

Although the Air Force initially asked that the study address the problem of tradeoffs between WRM stockpiling and the enhancement of munitions mobilization production capability, more far-reaching issues came to light. The study evolved into the development of a computerized planning tool "SWIPE" designed not only to accomplish these tradeoffs but also to provide an improved planning capability with respect to force structuring and support costs. Every effort was made to enhance the usefulness of the product by arranging the outputs in a self-explanatory, non-technical format suitable for presentation to any decisionmaking level directly from the printed hard copy. The report includes user instructions for the SWIPE computer program.

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SUMMARY

The FY 72-76 OSD Logistic Guidance created the need for changes in the planning of materiel support for U.S. and allied forces. In part, this was the result of modification of the Planning-Programming-Budgeting-System. One significant change was the adoption of five-year fiscal guidelines for Service spending; another was the imposition of a requirement that the Services identify, explain, and document the materiel support levels that they intend to apply to forces in their Program Objective Memoranda (POM) for FY 72-76. The Air Force complied with this request and submitted their estimates in June 1970. OSD also estimated what the Air Force POM should be over the five-year program. In August, OASD (SA) circulated an Air Force Munitions Issue Paper for Air Force comment, the thrust being that the Air Force munitions buy for WRM was too low.

ESTIMATES OF PRODUCTION CAPABILITY

There were various reasons for the discrepancy between OSD estimates and Air Force estimates; but clearly OSD had spotlighted an area in which the total costs were to be unexpectedly large irrespective of the estimating differences. There was some disagreement between the Air Force and OSD methods of estimating the industrial mobilization production capability to provide air munitions needed to support the level of effort planned for tactical air forces. Since the production capability estimates are the basis upon which stockpile calculations are formed, some fair degree of accuracy had to be obtained in making these estimates.

Both OSD and the Air Force were aware that there was little factual basis for either of their production capability estimates, and the magnitude of the possible error in estimating that capability would likely impact heavily on the total required WRM buy program. OSD used two alternative, idealized assumptions about production build-up capability. One assumed there would be no change in production output during the first six months after D-Day, followed by an instantaneous

rise in production rate at D+6 months to the wartime demand rate; the alternative OSD assumption had the same instantaneous production rate expansion at D+9 months. This OSD aproach was designed to (1) measure the sensitivity of stockpile requirements to Post-D-Day production responsiveness, (2) employ idealized assumptions which, hopefully, bracketed the unknown "real world" responsiveness, and (3) simplify the computations.

The Air Force estimates were somewhat less clearly defined: production will rise to the wartime demand nine months following D-Day, but the manner in which it will rise during those Post-D-Day months was not specified. In both cases, the absence of credible "by-item" planning was a serious limitation. In effect, the OSD estimates based on a 6-month P-Day amounted to a WRM requirement equal to four months' pipeline plus six months' D to P combat consumption, less six months' production at the D-Day production rate. (P-Day is defined as the day on which production of a munition equals demand for that munition, thus D to P time refers to that initial part of a war during which production is lower than demand.) The Air Force calculated three months' pipeline plus nine months' D to P consumption, less some undefined amount of D to P production.

INADEQUACY OF INFORMATION

Obviously, the derivation of WRM requirements was based upon inadequate information. The shortcomings lay not only in the absence of a methodology to evaluate production capability over a specified five-year period under fiscal constraints for a war of indefinite duration, but also in the paucity of data even if the appropriate methodology did exist. To make matters worse, the estimated Vietnam combat consumption was uncertain, compounding the problem of making accurate WRM calculations for a period five years hence.

The most difficult--and least understood--problem facing the logistician was in dealing with the rapidly changing condition of the industrial base itself during the phasedown of Vietnam operations; the production capability (and the WRM requirement) depends upon the level of production activity and, to a great extent, that activity will be

determined by the WRM requirement and the resultant WRM buy. The munitions producers, having expanded significantly during the Vietnam escalation, have proceeded to reduce production during de-escalation. To illustrate the nature of the planning difficulty, consider a firm that is building 1000 units of a munition per month. We can say with certainty that, at the least, it has a mobilization production capability of 1000 per month. If it reduced production to 500, we can then say that its mobilization production capability is 500 immediately, and probably 1000 at some future month. But if it drops to zero production, what can be said of its mobilization production capability? Only that we know it may reach at least 1000 at some future time, providing the tools, equipment and skills are recoverable; but time is ill-defined in most cases. Further, we can say very little about what the production may be during the early months.

In this report, we describe the specific methodology needed to match the demand and supply of munitions into a balanced materiel support posture. The methodology is a straightforward application of munitions supply (industrial production plus available pre-stocks) against munitions demand (anticipated combat consumption) for a contingency of indefinite duration beginning in any one of the five years from FY 1973 through FY 1977, with the principal constraints that (1) all munitions shortages are eliminated by the beginning of FY 1977 providing a contingency does not occur before then, and (2) procurement of WRM (munitions stockpile) is funded in equal or decreasing amounts each year.

PURPOSE OF THE MODEL

This supply/demand model makes visible the by-item munitions position for each of the five years through FY 1977. In addition, it calculates the anticipated availability of each munitions item for each of twenty-four months of a contingency occurring in any one of the five years. For our purposes, twenty-four months is sufficiently long to be considered "indefinite duration."

The report concludes with a discussion of the broader aspects of muntions management. The appendixes contain the computer program and instructions for its use.

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GLOSSARY OF TERMS AND ABBREVIATIONS

AFLC	Air Force Logistics Command
AFSC	Air Force Systems Command
Armed Services Procurement Planning Officer (ASPPO)	The officer or person in charge of the office making direct contact with industrial management for the purpose of negotiating tentative mobilization production schedules.
Cold Production Base	A Cold Base exists when no manufacturing facilities are engaged in producing a given component or end item. This includes both inoperative facilities as well as operative facilities that are not producing the given item.
CONUS	Continential United States
D-Day	The day on which an operation commences or is due to commence. For purposes of this report, "operation" means hostilities.
DD Form 1519	Form used for mobilization production planning with prime contractors for military end-items, government-furnished subassemblies or parts of end-items, or for repair and maintenance items procured and stocked by the military and the Defense Supply Agency.
D to P Concept	The idea of providing for the full materiel support of the military forces during a Limited War by the advance accumulation of reserve stocks in quantities which, combined with peacetime operating stocks and estimated incremental deliveries from post-D-day production, will be sufficient to satisfy the total military demand until P-day.
D to P Time	The period of time from D-day to the point in time when the rate of production equals the rate of consumption.
Hot Production Base	A Hot Base exists when one or more facilities are actively producing some component or end item.
Industrial Preparedness Measure (IPM)	An IPM is any action, study or project which is designed to shorten mobilization production leadtime or to increase mobilization production capacity, except those which are routinely performed under existing policy and regulations.

Industrial Production Base	The total privately owned and government owned industrial production capacity of the U.S., its territories and possessions, as well as capacity located in Canada, which is, or which may be made available in wartime to manufacture items required by the U.S. Armed Forces.
Industrial Readiness and Mobilization Production Planning (IRMP)	IRMP is the name given to a series of actions instituted by OSD that is designed to provide advance planning to insure adequate and timely production of military items during a future limited war.
Level-of-Effort Items	Items for which requirements computations are based on such factors as equipment and personnel density, time and rates of use.
Limited War	Armed conflict short of nuclear war, exclusive of incidents, involving overt engagement of U.S. General Purpose Forces versus the military forces of one or more other nations.
M-Day	The day on which mobilization is to begin.
MAP	Military Assistance Program
MASF	Military Assistance, Service Funded
NATO	North Atlantic Treaty Organization
P-Day	That point in time at which the rate of production of a military item meets, and will continue to meet, the estimated requirement.
PACAF	Pacific Air Forces
PACER FLEX	The nickname assigned to nonnuclear war consumables prestocked as WRM in the CONUS by AFLC to support the planned activities reflected in the War Mobilization Plan. It consists of: (1) Those quantities of war consumables generated to support the sorties identified in the USAF WMP specifically for PACER FLEX; (2) Those quantities of war consumables generated to support sorties identified in the WMP for prepositioning by major commands, but for which the command storage or maintenance capability is not available.

Prepositioned WRM	That portion of WRM which is required to be positioned (located) prior to hostilities at or near the planned point of use or issue to the user, to insure timely support of a specific project (mission) or designated force during the initial phase of war, pending arrival of replenishment shipments (resupply).
Prestocked War Readiness Materiel	That portion of WRM stocked in the CONUS under PACER FLEX which will be used to augment WRM prepositioned stocks.
SEA	Southeast Asia
Sortie	One designated flight of an operational aircraft, usually involving one takeoff and one landing.
Standard Air Munition Packages (STAMP)	STAMPS (WRM) are air transportable packages of war consumables (munitions, tanks, and pylons and expendable hardware) designed to provide initial support for deployed forces.
USAFE	United States Air Forces in Europe
War Consumables	Expendable items directly related, and necessary to a weapon/support system or combat/combat-support activity, for which the expenditure factors or quantities are indicated in the USAF WMP-5.
War Readiness Materiel (WRM)	WRM is that materiel required in addition to peacetime assets to support forces, missions and activities which have been approved in the USAF War and Mobilization Plan (WMP). The term WRM includes the following: stations sets, housekeeping sets, war consumables, spares and repair parts, air transportable housekeeping equipment and supplies, chemical-biological equipment and supplies, petroleum oil and lubricants (POL), rations, and other equipment and supplies designated and/or authorized as WRM in accordance with the policies in AFR 67-44.
War Readiness Spares Kit (WRSK)	An air transportable package of spares and repair parts and related maintenance supplies (remove and replace maintenance concept) (WRM) required to sustain planned wartime or contingency operations of a weapons system for a specified period of time pending resupply. Normally prepositioned with the unit.

I. MOBILIZATION PRODUCTION CAPABILITY

In peacetime, or during a war in which the full industrial production potential of the nation is not used, there exists some level of production capability that can be made available in event of the outbreak of a full-scale conventional war. The size of this capability is clearly dependent upon a host of conditions, among which are the level of peacetime munitions production; the availability of tools, dies, and special equipment needed for expansion of munitions production; the availability of management expertise and labor skills; and the existence of realistic plans, contracts, and agreements between the military users and the industrial suppliers. Clearly, the industrial mobilization production capability will vary over time for each weapon, and for components of weapons. Furthermore, production is quite often a series of production processes that are conducted in different parts of the country. For example, the metal parts of a bomb are seldom procured at the same location as the bomb fuze; and the final loading, assembly and packing of the finished bomb may be the responsibility of a U.S. Army Ammunition Plant.

In this study we consider the production capability to be represented by the production of the finished munition without regard to the processes that make up that production.

MUNITIONS DEMAND

The combat consumption anticipated for any contingency is calculated for each munition and for each aircraft type; the total munitions consumption for all aircraft over any period represents the munitions demand for a particular contingency, usually expressed in terms of "bombs per month," or "dollars worth of bombs per month." The latter dimension is employed to aggregate two or more demand schedules. Figure 1 depicts the demand schedule and the production schedule (that is, the mobilization production capability) for a hypothetical munition.

The shape of the assumed demand schedule is fairly representative of most weapons: demand rises rapidly in the early months as force

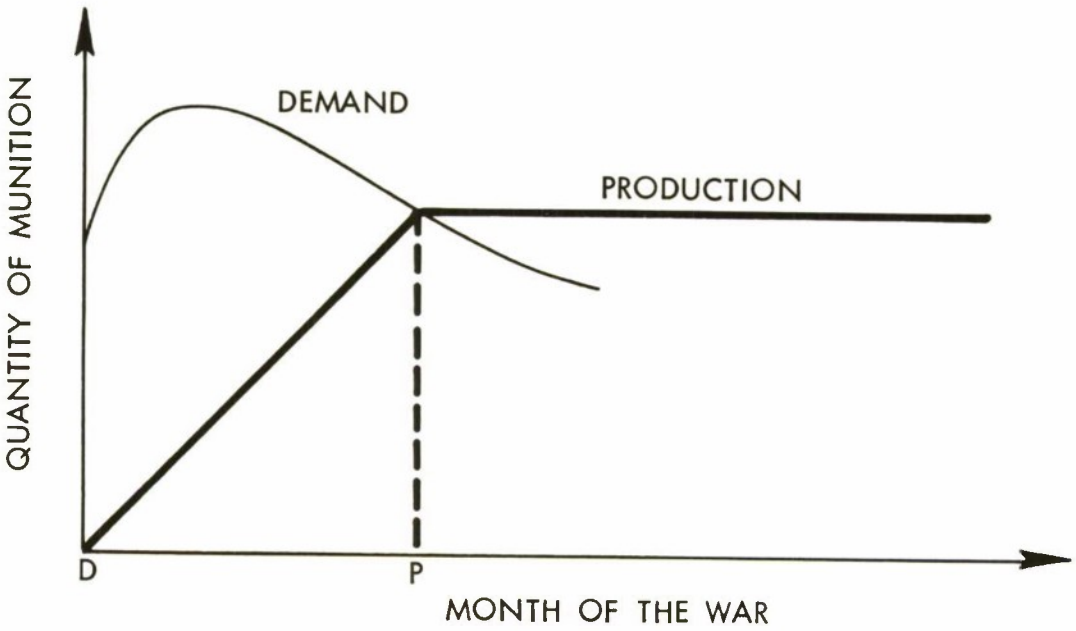

Fig. 1 — Munition production and demand

buildup occurs, and falls off in later months due to a decreasing sortie capability that occurs primarily because of combat attrition. Aircraft replacement can begin to build up the force again, providing aircraft production is brought to bear during the contingency. For the most part, however, munitions production rises fairly rapidly following D-day, while aircraft production can become effective only if the war is of a much longer duration. For munitions planning it is customary to consider the "indefinite" duration to be about twenty-four months simply because full industrial mobilization for munitions is achieved within that period. In Fig. 1 the month in which production equals demand is designated "P" (generally thought of as "P-month" yet referred to as "P-day"); this graph illustrates the notion of "D to P time" as that number of months following D-day during which production is rising to meet demand.

CALCULATING MUNITIONS STOCKPILE REQUIREMENTS

If Fig. 1 represents the production and demand schedules for a war in Asia, the production schedule can be viewed as a supply schedule--that is, quantities of munitions that have been produced *and* transported

to the combat theater--if the pipeline time delay is brought into the picture. Figure 2 shows the same demand and production schedules, with production displaced to the right to show the pipeline time effect.

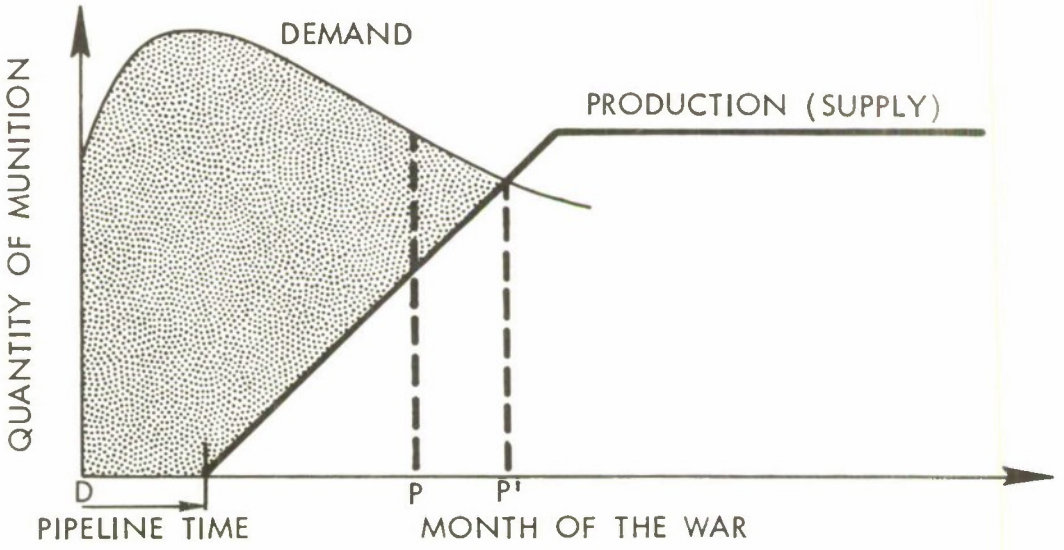

Fig. 2 — Munition production and demand with pipeline delay

By thus displacing the production schedule to account for pipeline time, we have a more meaningful picture of the *effective* munition production, i.e., production that has become available to the combat forces. The graph shows that there is a difference between the planned combat consumption and the estimated production that will become available within the combat theater following D-day. Clearly, even under the best of circumstances as far as production is concerned, there will be some quantity of munitions that production cannot supply to meet the combat consumption because of the pipeline delay.

If the demand and production schedules are accurate, and the pipeline time is correctly estimated, the stockpile requirement for the munition in Fig. 2 is precisely represented by the shaded area between the two schedules. This stockpile is the amount of War Readiness Materiel (WRM) needed for this hypothetical munition.

This representation of WRM differs somewhat from the OSD and Air Force definitions that calculate WRM as follows: pipeline time

consumption, plus D to P combat consumption, less D to P production. The difference can be observed if one compares the shaded area of Fig. 2 to the area between the production and demand schedules of Fig. 1. The reason for the difference is that the OSD and Air Force definitions implicitly assume that demand eventually rises to its peak and remains constant (level) in the later months; in fact, demand falls rapidly after the first few months, and continues to fall due to aircraft attrition (non-availability of sorties) for many months thereafter.

Figure 2 shows that the production capability is excess to demand shortly after P-day. This will be discussed later in more detail, but for now it should be recognized that the current planning technique based on the "D to P concept" does have a built-in disparity, which is noteworthy because:

1. Retention of a given industrial mobilization production capability level presumably costs the government something, and the retention of a level higher than that which is usable may either waste funds or absorb industrial capacity otherwise needed for different munitions. In Fig. 2, the usable production level is that amount shown at P'-day, and not at P-day.
2. The decreasing demand schedule shown in Fig. 2 allows the production schedule to reach the demand schedule as *effective* production--or supply--earlier than is assumed. In other words, the time from P to P' is, in almost every case, less than the pipeline time. This is an important observation in the calculation of WRM requirements, especially when the demand schedule is dropping rapidly. It says that in a period of rapidly falling demand the pipeline time is of much less significance than in a period of level or slightly declining demand.

INDUSTRIAL PREPAREDNESS MEASURES

An Industrial Preparedness Measure (IPM) is defined as any action taken prior to Mobilization Day (M-Day) that will increase the amount of production between D-day and P-day or, what amounts to the same thing,

will shorten the time between D-day and P-day. Some examples of possible IPMs are:

- o decreasing production lead time by pre-stocking raw materials at the production facility
- o modernizing machinery within the production facility to enable more rapid buildup of production following M-day
- o maintaining a "warm" production base at the production facility
- o shortening administrative lead time
- o setting aside portions of production capability at a production facility
- o accelerating production by increased operations, e.g., adding shifts and/or work days.

An IPM represents some improvement to the industrial base that will decrease the WRM requirement. Figure 3 is a graphic representation of the results of an IPM.

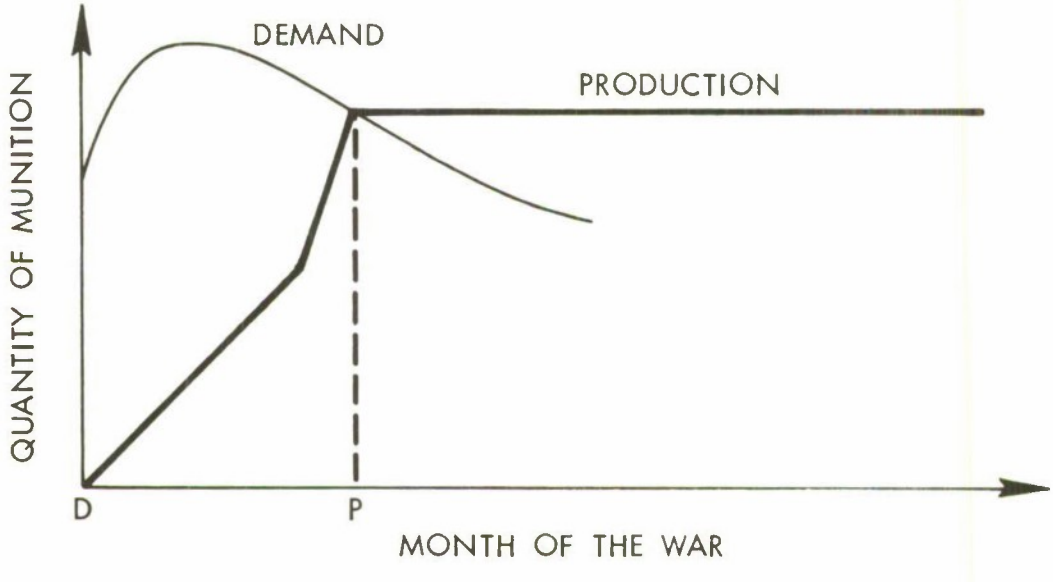

Fig. 3 — Effect of IPM

At some time before P-day, production is accelerated and enables a shorter D to P time than previously (than in Fig. 1). Clearly, moving the production schedule to the left will decrease the total area between the demand and production schedules, which is the same as decreasing the total WRM requirement. The effect of a "warm production base" is shown in Fig. 4. In this case it is assumed that some production of the munition was under way prior to D-day.

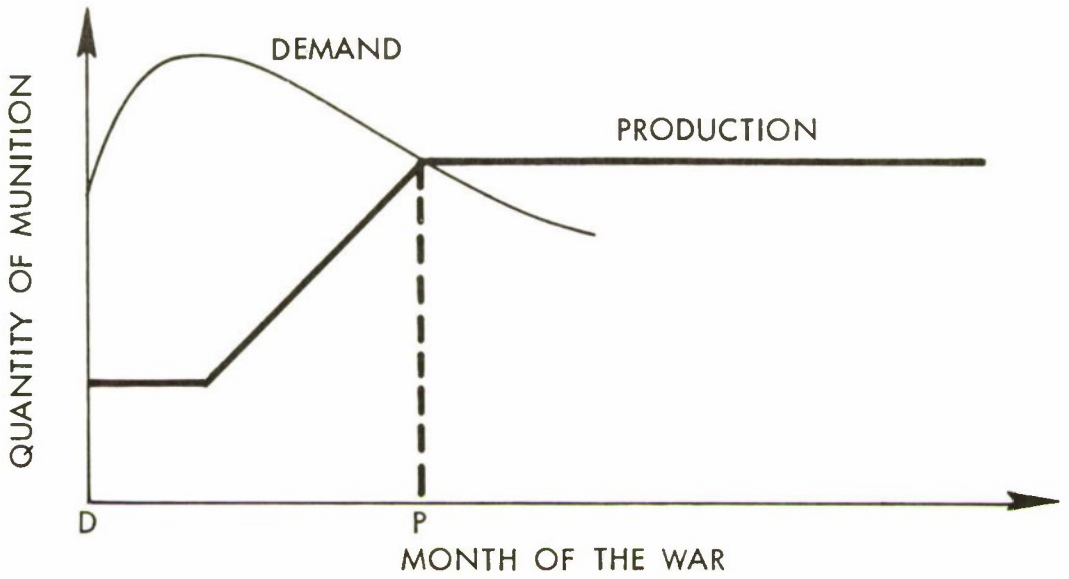

Fig. 4 — Effect of warm production base

Notice that the "WRM saving" is not necessarily the area difference between the production schedule of Fig. 4 and that of Fig. 1 for reasons mentioned previously in the discussion of pipeline time displacement of the production schedule. Only by considering the displaced production schedules can one determine the WRM decrease brought about by the IPM. For the present, it is sufficient to state that the IPM has, in some way, improved effective production and thus decreased the WRM requirement.

THE TRADEOFF BETWEEN WRM AND IPMs

In nearly all cases we must consider that the IPM will incur some cost to the government, whether it be in dollars spent or in allocation

of scarce resources. It is necessary, therefore, to examine each IPM in light of its cost as compared to the savings in WRM stockpile that it will afford.

At first glance this would appear to be a straightforward weighing of one set of costs against the other: the amount paid to the contracting firm for agreeing to provide some improved capability that can be applied against a contingency is compared to the amount of stockpile reduction that the improvement permits, stockpile being directly related to cash outlay of procurement funds.

Upon closer inspection, however, there are some less easily quantified factors which need to be brought into the tradeoff. We can touch on them here briefly so that the general picture is fairly complete.

Recall that the tradeoff question has been superimposed upon a set of production and demand schedules representing an estimate of the conduct of a war occurring at some undetermined future date. Not only is there the likelihood that certain assumptions regarding the war may be incorrect, we must also consider the possibility that such a war will not occur at all or, at least, will not occur for many years. In fact, the very process of industrial improvement and WRM stockpiling increases the capability of our forces to deter that war as well as to fight it. In view of the certainty of continuing technological improvements in weapons systems and weaponeering, the stockpile of today is subject to a continuing obsolescence. For any given weapon, this obsolescence can be represented as a very real cost if one can estimate the obsolescence rate.

Possession of the stockpile further incurs out-of-pocket costs for storage, handling, transportation, inventory control, maintenance, wear-out, and indirect costs such as those represented by discounting the present value of procurement expenditures.

On the other hand, costs to construct and maintain a given level of industrial capability, once obligated, are most likely to continue for as long as the capability is maintained. And it is to be expected that any level of set-aside industrial capacity and/or payments to industrial firms for guaranteed mobilization capability will be politically

burdensome to future administrations whose constituents view the nation as far removed from war both in their estimation of the future and in their experience of several years of peace.

The WRM/IPM tradeoff calculation is incorporated in the cost model in the next chapter. It was recognized at the outset that there are no data on many of the above-mentioned direct and indirect costs involved in the tradeoff question; nevertheless, the capability to account for most of them has been built into the model. Until the deliberate attempt to establish these data has been made, we will be unable to do other than perform the tradeoffs as straightforward comparisons of the costs of IPMs against the procurement costs of WRM that can be foregone as a result of the IPMs.

II. DESCRIPTION OF THE MODEL

The tradeoff between WRM and IPM just described compares the munition supply at any given time against its demand at that time, resulting in a determination of the number of units of shortage and finally an evaluation of the cost of alleviating that shortage by either purchase of WRM and/or purchase of an IPM.

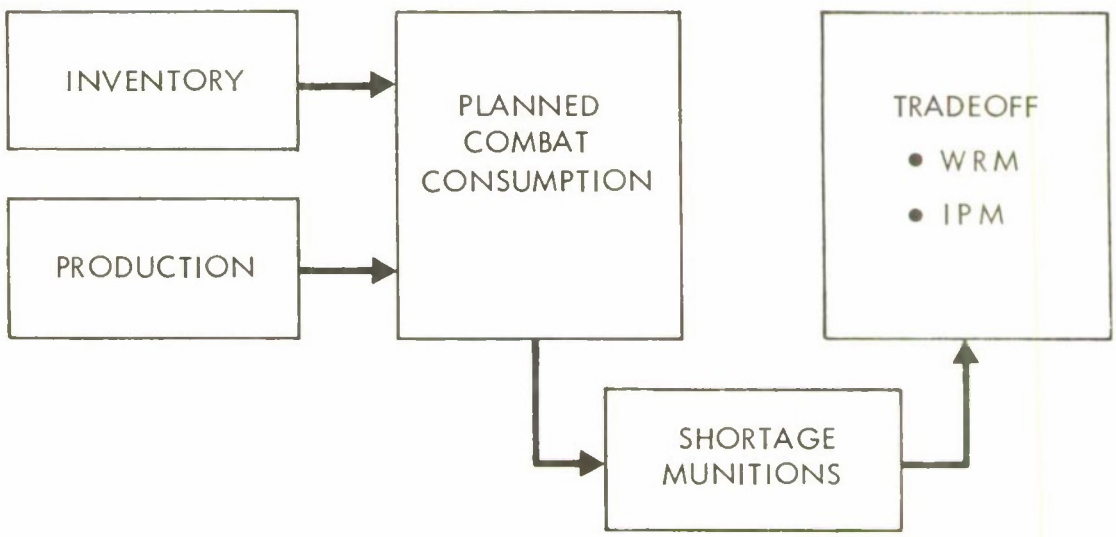

Fig. 5 — WRM/IPM tradeoff

Munition supply consists of available inventory combined with mobilization production capability for that munition. Demand, or Planned Combat Consumption, is calculated from a set of predetermined factors: force size, sortie rate, weapon expenditure per sortie. The force size to be considered is that portion of the total combat force deployed in the contingency area at any particular time. This takes into account the planned schedule for deployment, anticipated attrition of the engaged force, and replacements (if any) from CONUS reserve and/or aircraft production. The sortie rate reflects the characteristics of the particular aircraft type, the anticipated mission requirements, and the logistic support capability. Finally, weapon expenditure

rates are derived from an analysis of weapon costs, sortie costs, target value, and target kill probabilities.

The WRM/IPM tradeoff is part of the overall munitions planning process, and is a noniterative calculation that yields an answer to the question: should we buy this IPM? Beyond this tradeoff calculation, there are several layers of complexity when one considers the total planning requirements for munitions. The magnitude of this complexity can be illustrated by some of the other questions that must be addressed:

- With a given WRM buy over several years, what will the overall shortage position look like in 1974, 1975, etc.?
- What is the specific effect of the shortage of a particular munition in any future year, i.e., in what month will the shortage become apparent, and what percentage of the demand for that month will it represent?
- What munition becomes "long" in any month of a war starting in any future year, and what is the value of that munition as a reasonable substitute for a short munition?
- What would be the effect of policy changes on the WRM requirement? On mobilization production capability requirement? On overall shortages? On WRM buy in any year? (Policy changes such as revised deployment schedules, different war duration or war fighting assumptions, different force sizes, etc.).
- What are the effects of changes in mobilization production capability from one year to the next?
- What is the value, in terms of WRM costs, of reducing pipeline time and/or prepositioning requirements?

These and similar questions need to be answered on a continuing basis if the Air Force planners are to achieve *and maintain* the desired balance between the program force and its materiel support. Furthermore, in view of the increasing relative costs of materiel support as opposed to the costs of the force itself, it is necessary that force planners evaluate alternative force sizes, strategies and tactics in light of the impact of these alternatives on present and future materiel support costs. For example, a family of technologically improved weapons should be evaluated not only with respect to the costs and benefits of

the weapon itself, but also with respect to its effect on the overall WRM stockpile requirement and the industrial mobilization production capability.

THE MODEL

The model, entitled "System for WRM/IRMP* Policy Evaluation" (SWIPE), is shown in block diagram form in Fig. 6. The associated computer program (written in FORTRAN IV) and instructions for its use are contained in the appendixes. The discussion of the actual results obtained with the model runs has been deleted; the model is described in general terms.

THE SWIPE INPUT REQUIREMENTS

With the exception of policy decisions and assumptions, the model treats the following inputs as either specific data or variables:

General
- a. Storage locations
- b. Year and theater of contingency

Munitions
- a. Munitions type/component
- b. Beginning inventory
- c. Item volume, packaged
- d. Item weight, packaged
- e. Procurement unit price
- f. Lot size/unit price relations
- g. Current age of inventory items
- h. Shelf life of inventory items

Wartime Demand
- a. Aircraft type and model
- b. Aircraft type and model, Allies
- c. Force size each month for each type and model
- d. Aircraft activity rate
- e. Expenditure per sortie per munition for each aircraft type and model

Peacetime Supply and Demand
- a. Peacetime production rate
- b. SEA consumption rate
- c. Other production/consumption, e.g., foreign sales, MAP, MASF
- d. Peacetime consumption, e.g., training

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*Industrial Readiness and Mobilization Production Planning.

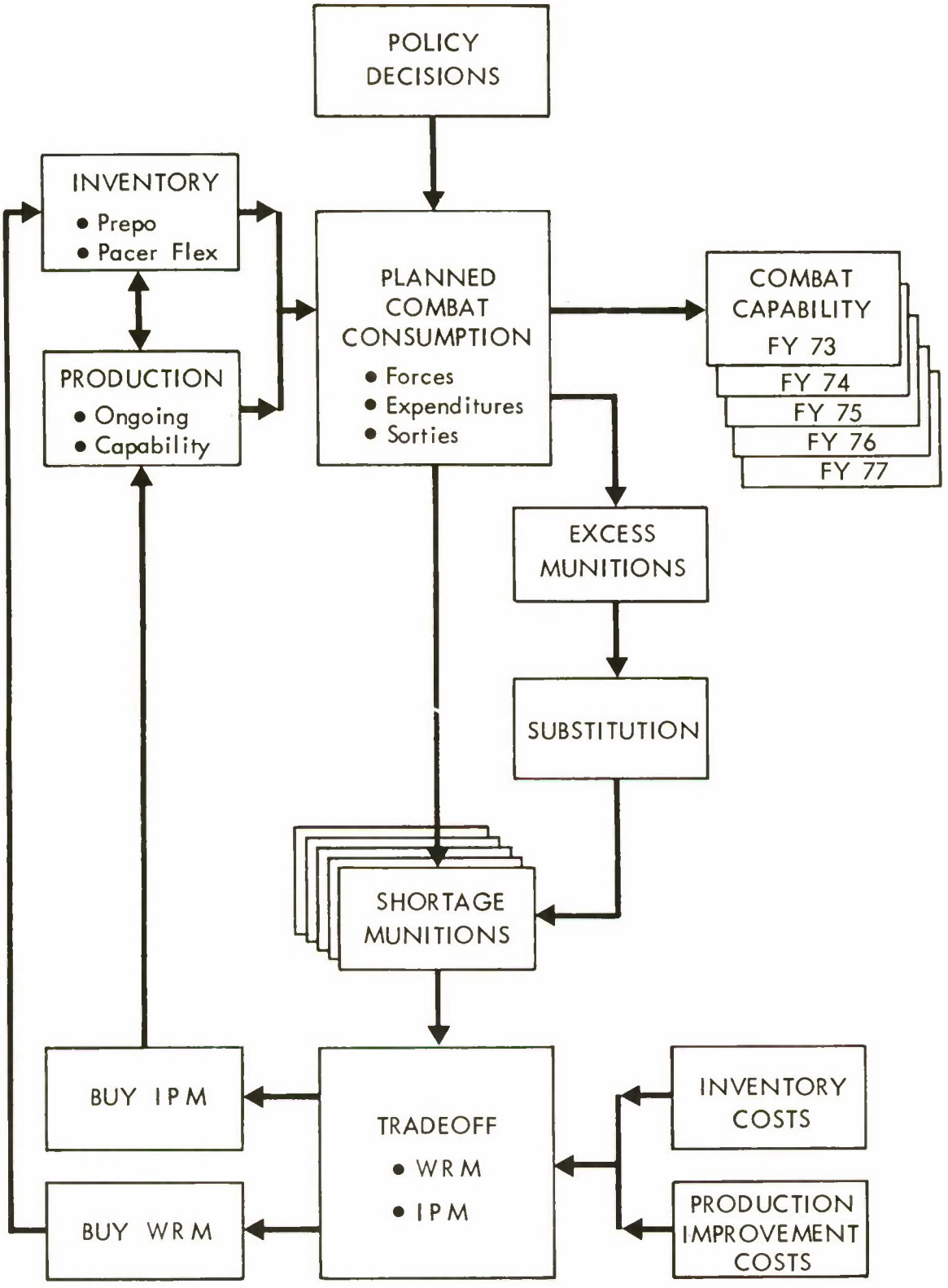


Fig. 6 — System for WRM/IRMP Policy Evaluations (SWIPE)

Transportation

a. Pipeline time
b. First destination costs
c. Inter-theater transportation costs
d. U.S. and overseas port handling costs
e. Intra-theater transportation costs
f. Intra/inter-theater repositioning costs

Storage and Maintenance of Inventory

a. Storage costs
b. Handling costs
c. Inspection and inventory costs
d. Maintenance costs
e. Obsolescence and wearout costs
f. Rewarehousing costs

In our application of existing data to SWIPE, some inputs were aggregated and others were not used at all because we lacked credible data. For example: in the absence of data on lot size/unit price relations, we employed a constant unit price regardless of variations in production levels; although the age and shelf life were entered as data elements, there were no calculations performed relating to wearout, obsolescence, inventory aging, etc.; peacetime consumption figures were either not available or were low enough to make little difference in the overall buy program. By general agreements made at the WRM conference, we aggregated storage costs and applied a standard factor of one cent per pound to all munitions for the procurement year and zero cost thereafter. The only transportation costs considered were those for the first destination charges of new procurement, with a one-time cost of three cents per pound.

To measure the possible effects of some of the missing data, we conducted a series of sensitivity analyses regarding lot size/unit price differentials, pipeline time, and force size variations. Other analyses were conducted primarily to illustrate the methodology and to emphasize the importance of improving the generation of presently unavailable data.

THE SWIPE OUTPUTS

The SWIPE output format and content were tailored to fit the needs of the Air Staff agencies with whom we consulted throughout the study. The output consists of eleven sets of tables, each of which is sufficiently self-explanatory and readable to stand alone if a user's purpose is served by extracting it for permanent reference elsewhere. Some of the data are repeated and/or presented in a different format in more than one table, but for the most part the output is arranged in a sequence of independent units designed to satisfy one or more of the functional requirements that we were able to identify.

By way of introducing the model's uses, there follows a short description of the content of each table. Undoubtedly, there are some applications of the SWIPE output that did not occur to us during this study; all the more reason why it is best that we briefly discuss the output, leaving the matter of applicability of that output to the Air Force user.

Inventory and Procurement Summary for FY ____ (Table 1)

A set of five tables, one for each of five consecutive years, depicting for each munition:

- Initial inventory in thousands (K units)
  - prepositioned munitons
  - PACER FLEX munitions
  - total worldwide inventory
- Unit price of each munition ($)
- Fiscal year buy of each munition
  - amount (K units)
  - cost ($M)
- Additional costs resulting from FY ____ buy
  - transportation ($M)
  - storage ($M)

Summary of Five-Year Buy (Table 2)

A summary of the five parts of Table 1, with each munition described as follows:

- Initial inventory (K units)
- Final inventory (K units)
- 5-year buy
  - amount (K units)
  - cost ($M)
- Additional costs resulting from the 5-year buy
  - transportation ($M)
  - storage ($M)

Wartime Requirements Summary for FY ____ (Table 3)

A set of five tables, one for each of five consecutive years, depicting for each munition:

- Unit price ($)
- Wartime demand for war starting in FY ____
  - amount of demand for the first twelve months of war (K units)
  - amount of demand for the second twelve months of war (K units)
- Amount of inventory (WRM) required (K units)
  - prepositioned munitions
  - PACER FLEX munitions
  - total prepositioned plus PACER FLEX munitions
- Total WRM deficiency at beginning of FY ____
  - amount (K units)
  - percentage of WRM requirement represented by the deficiency
  - cost to purchase the deficiency at unit price stated ($M)

Monthly Production/Demand for War Starting in FY ____ (Table 4)

This set of five tables shows the calculations, for each munition, of the ratio of Mobilization Production Capability to Planned Combat Consumpiton for each of 24 months of a war beginning in each of the five years. P-day, for example, can be identified in each case during the month when the ratio first rises above 0.99. For each munition, the total 24 months' ratio is also presented. The munitions are further described in terms of their "Relative Demand," which is the ratio of the cost of each munition over a 24-month war to the cost of all munitions over a 24-month war.

$ Supply/$ Demand for Each Month of Any War (Table 5)

This single table portrays the ratio of the supply (in dollar value) of munitions in the combat theater to the demand (in dollar value) for each of 24 months of war beginning in each of five consecutive years.

Monthly Munitions Availability: Surplus and Deficits for War Starting in FY ____ (Table 6)

A set of five tables, one for each of five consecutive years, depicting for each munition the amount by which the supply fell short (or was in excess) of demand for each month of the war. Includes a summation for twelve and for twenty-four months.

D to P Information for FY ____ (Table 7)

A set of five tables, one for each of five consecutive years, depicting for each munition the D to P time of its mobilization production capability, the demand for the munition during that D to P time, and the production capability during that D to P time.

WRM/IPM Tradeoffs for FY ____ (Table 8)

A set of five tables, one for each of five consecutive years, depicting for each munition the following information:

- Industrial Preparedness Measure
  - description
  - cost ($M) in that year
- D to P time
  - without the IPM
  - with the IPM
- WRM avoided as a result of the IPM
  - amount (K units)
  - cost ($M)
- Other costs avoided as a result of the IPM
  - transportation ($M)
  - storage ($M)
- Net cost reduction as a result of IPM ($M)

Fiscal Summary for the Five Years (Table 9)

A single table that displays, for each of the five years, the total WRM buy, transportation and storage costs resulting from that buy, and the value of discounted investment over the five-year period.

Year End Posture for FY ____ (Table 10)

A series of five tables, one for each of five consecutive years, printed out as follows:

This is a year-end summary of procurement actions and the resultant materiel support posture for FY ____. Five-year buy must be $ ____ million. You spent $ ____ million for munitions this year. This buy incurred added cost of $ ____ million for transportation to first destination in CONUS; also, $ ____ million for storage. You now have an inventory deficiency of $ ____ million. If war had started at the beginning of this year, production plus inventory would have satisfied __ percent of the demand. If war starts now production plus inventory will satisfy __ percent.

Mobilization Production Capability Summary (Table 11)

A single table that displays, for each of twenty-four months of war, the following information about the estimated industrial mobilization capability:

- Total weight of munitions production (tons)
- Total cost of munitions production ($M)
- Cost per ton produced ($K)

COMBAT CAPABILITY

The SWIPE output permits observation of the diminishing shortages for each munition resulting from a given WRM buy and/or improvement in mobilization production capability over the five years. This is done in the context of "if war had started in FY ____ the shortages ....." for each munition. The shortages are expressed in three ways: (1) quantity of munitions items; (2) dollar value of the shortage; (3) percentage of the total WRM dollar requirement.

To gain some measure of the overall effect from year to year, it is necessary that the munitions availability (or the munitions shortages) be aggregated in some manner. Formerly, this aggregation was accomplished by considering the weight of each munition as a common denominator. However, tonnage has become a less meaningful measure in recent years because of the technological improvements in weaponeering that have greatly increased the specialized application of newer bombs and thus reduced whatever relationship existed between the weight of the bomb and its military worth. Although correlations may exist among similar types of bombs of different weights, across the spectrum of all items the tonnage measure is unsuitable for aggregation.

As mentioned earlier, the basic weapons menu for each aircraft type--and thus the WRM stockpile--is derived from an evaluation of the dollar cost for achieving some level of target destruction. It is thus implicitly assumed that the stockpile/production capability will contain an optimum mix of munitions. Then, given any stockpile with this proportionate share of each munition, we can state with a fair degree of accuracy that the dollar cost of each weapon or group of weapons is representative of its military worth relative to the dollar cost of any other weapon or group of weapons. Similarly, the dollar cost of munitions shortages is a quantification of the military worth that is lost as a result of that shortage. It follows that to the extent shortages occur in a roughly proportional way over all munitions, the dollar cost of the overall stockpile shortages directly measures the decrease in combat capability.

The SWIPE output provides a summary of twenty-four months of war beginning in any of the five years, showing the aggregate supply of munitions for each month compared to the aggregate munitions demand for the same month. The munitions are aggregated by dollar cost. What this output says is: given the particular production capability, inventory position, and combat consumption, the fifth month of a war starting in FY 1975 (for example) will find us equipped with 72 percent of the required munitions, while the twenty-four month total for the FY 1975 war is 81 percent.

The purpose of these calculations is to afford the SWIPE users some view of the effect of alternative procurement strategies on overall weapons availability. This "dollar availability" is not intended to provide an absolute measure, but rather a relative indicator of combat capability. It has been suggested that the "combat capability" of a given stockpile be evaluated by applying the resultant SWIPE output to the model that derived the stockpile mix in the first place (e.g., SABER MIX), thereby relating the WRM procurement decisions to military worth as expressed by target kill potential.

EXCESS MUNITIONS

For the purposes of this study, there are two categories of excess munitions:

1. Those munitions that are obsolete (or otherwise not included within the munitions menu, i.e., one of the SWIPE inputs), but that exist in significant quantities. Although these munitions may not be primary combat items and are out of production, they are usable by the combat forces as substitutes for primary items that are unavailable.
2. Those munitions whose supply becomes greater than the planned combat consumption at some time during any contingency. This occurs at different times for nearly all munitions whenever production increases beyond demand following P-day, and/or levels off at P-day while demand is increasing.

The first category of excess munitions is handled "outside the model," and involves merely adjusting the munitions inventory as appropriate to substitute for existing shortages of primary munitions. This substitution usually occurs after the WRM and industrial base calculations have been made, and there is no effect on those calculations other than to improve the combat capability (supply/demand) during the years when shortages exist.

The second category of excess munitions includes those primary items whose supply has become larger than demand during some month

following D-day. Although they may not represent cost-effective substitutes from the planner's standpoint, it is clear that they may be logically substituted for a short munition when it is determined that such a substitution will result in equal or greater target kill potential. For example, a laser-guided bomb may be a most acceptable substitute for the clustered bomblet in some combat missions. The Rockeye was selected for the weapons menu based largely upon its cost in relation to kill potential. The fact that the laser bomb costs several thousand dollars more than the Rockeye undoubtedly weighed in favor of the less expensive weapons for some missions. Once the war is under way, however, the relative costs of the bombs are no longer as relevant; the fact that there is a shortage in one and an excess supply in the other is the overriding consideration that will govern the decision to employ the available substitute.

That such a situation does occur points up an obvious imbalance in the production system. One must ask: if munition A is short of production capability and munition B has excess production capability, is there some way to "trade" some of the B production for more of the A production? Since B production capability is in excess, is it of any value (resource savings) to arrange for a lesser capability? Should the value of B production capability be considered in a reevaluation of the weapons menu that will take into account the recognizable benefit of a better production base? This suggests that we should adjust the "price" of the munition upward or downward within the cost-effectiveness analysis to reflect the industrial capability as well as the actual procurement cost of the munition, thus recognizing our preference for industrial capability over munitions stockpile.

III. MANAGEMENT IMPLICATIONS

Although this study was essentially quantitative, with emphasis on developing and applying a methodology to assist Air Force planners in preparing annual munitions programs, our close interaction with the Air Staff and Major Air Commands enabled us to observe broader problems that come under the heading of Air Force (and DOD) munitions management. In fact, it was primarily to address these problems that a WRM Conference was convened in Santa Monica in March 1971. Many of the observations that follow were aired with the conference members.

Where specific numbers are cited, they have been drawn from the original Base Case SWIPE output unless otherwise identified.

D TO P TIME

The preponderance of munitions WRM shortages occurs in relatively few munitions types. Eighty percent of the WRM buy is for only eight munitions types. A single munition type accounts for more than $300 million primarily because its production capability supposedly cannot reach wartime demand. Almost without exception, the D to P estimates appear to be unrealistic, i.e., the D to P time is extremely long. SWIPE runs were conducted to test the sensitivity of the WRM requirement to reduction of the D to P time: the WRM requirement was reduced more than $100 million by shortening the D to P estimates by four months for just five munition types.

There is no apparent reason why sizable reductions in D to P time cannot be effected either through improvement of existing contractor or government facilities, or through gradual expansion of the industrial base. There exists a reluctance, it seems, among contracting offices to increase capability horizontally; the apparent reasoning--apart from the absence of appropriate incentives--is that new and untried contractors are less dependable, and smaller firms are more subject to the business vicissitudes that may result in unexpected loss of their mobilization capability. There is ample justification for this reluctance if the contracting office sees its objective as one of

providing only that capability which can be counted on for a D-day occurring twelve months from the date of negotiation of the agreement. We know of not one proposal that has been made by contracting firms, contracting officers, or other munitions managers to gain a more acceptable mobilization production capability for FY 1976 in some of the more costly munitions despite the fact that the effect of FY 76 improved capability, if planned and negotiated in FY 72, will enable the Air Force to make reductions in its current budget year (FY 73) WRM buy. Specifically, one-fourth of any improvement in mobilization production capability that can be negotiated to occur during or before FY 76 can be subtracted from the FY 73 (and subsequent) WRM procurement.

OBSOLESCENCE COSTS

There is presently no consideration given to the cost of obsolescence for weapons in the WRM stockpile. The tradeoff between WRM and IPMs, for example, includes only the procurement cost of WRM and the negotiated cost of the IPM. Of more fundamental importance is the absence of this obsolescence factor from the cost-effectiveness analyses that determine the basic menu of weapons to be stockpiled by the Air Force.

Perhaps the most important aspect of obsolescence costs is that explicit awareness of such costs is the only effective control over indiscriminate proliferation of new weapons types. However technologically improved, a new weapon--or a proposal or stated requirement for a new weapon or weapon capability--must be subjected to scrutiny with regard to the marginal increase in effectiveness (military worth) per dollar of procurement, maintenance, storage, and other holding costs over the useful (i.e., technological) life of the weapon.

ESTIMATING MOBILIZATION PRODUCTION CAPABILITY

The present technique for collecting the all-important estimates of mobilization production capability is inadequate, procedurally cumbersome, and unresponsive to Air Force needs. A principal shortcoming is the reliance upon unsubstantiated contractor estimates of his firm's mobilization production capability. It is naive to expect

a contractor to voluntarily estimate his mobilization production capability at anything near the maximum obtainable if he is aware that in so doing he will forego an assured contract for production of stockpile munitions.

There is wide support being given to the notion that the capability estimates will be improved if the government pays the contractor to conduct planning and analysis of his industrial facility, thereby basing his production estimate on firmer ground. On the one hand, if the government expects a careful analysis to be conducted it cannot expect the contracting firm to provide such service free. On the other hand, there is good reason to expect that the product of the analysis will be simply a more sophisticated expression of the contractor's special interest. However ethical and candid the individual, eventually it is the corporation and not the individual that controls the planning and estimating for which the government is paying.

This does not represent an indictment of contractor planning, per se. But until the system incorporates proper contractor incentives, the Air Force is ill-advised to expend funds to contractors to conduct mobilization production planning within their own firms.

SEPARATION OF PLANNING FOR WRM AND PRODUCTION

The calculation of WRM requirements and the planning of industrial base requirements are necessarily interdependent processes, yet they are not carried out interdependently. Instead, the WRM requirement is established and the industrial planning is made to supplement it. And once the WRM requirement is stated it tends to become a fixed inventory objective upon which industrial capability is added to "fill the gap." The inherent inertia in annual replanning of munitions production and stockpile encourages munitions planners to concentrate upon management of inventory and not upon management of production capability. It is extremely difficult to adopt flexibility with regard to the WRM stockpile under the existing system. If a production order has been let, or if events are set in motion to introduce a production order, reversal is costly, time-consuming, and, practically speaking, nearly impossible.

A principal flaw from the organizational point of view is this: the Air Force Logistics Command is the primary planning and receiving organization for air munitions. Its efforts are directed toward satisfying the overall requirements of the War Consumables Distribution Objective (WCDO). The WCDO elements include WRM, prepositioned stocks, peacetime consumption stocks, new production due in, and mobilization production capability. The WRM requirement is furnished to AFLC by Hq USAF, and is continually changing as forces, deployment plans, strategies and tactics change. Although it is ostensibly an AFLC responsibility to balance the WRM and industrial mobilization production capability, the existing system makes this difficult. Only by fixing some of the variables can AFLC balance the WCDO equation.

The intent of the Industrial Readiness and Mobilization Production Planning Program was to attain a flexible balance between the various parts of the program. Presumably there was an implicit assumption that the agency responsible for orderly munitions planning and procurement would have some hand in the orderly generation of munitions requirements.

THE FIVE-YEAR PLANNING HORIZON

Information systems and control mechanisms that contribute to munitions management are neither oriented toward a standard M-day, nor are they explicitly focused on a five-year planning framework. For example, industrial production capability estimates are solicited and/or updated on the basis of the capability that is available for a contingency occurring in the following fiscal year. If a contractor is unable to provide the needed capability for that contingency because his current production capacity is filled with civilian backorders, the next step will invariably be either (1) to schedule an increased WRM stockpile procurement to make up for the "lost production capability," or (2) to initiate a search for additional capability elsewhere. We have not yet uncovered one instance wherein the contracting officer followed up the lost capability with efforts to determine how and when the capability can be regained.

It has been suggested that the underlying reason for this absence of planning beyond the next one to two years is due to the fact that prior to the 1970 OSD Logistic Guidance there was no requirement for a longer planning period. We believe that this is not the case. The requirement has, in fact, existed for some time; OSD Log Guidance served only to draw attention to its absence by imposing more detailed planning constraints on the Services.

Data systems that support munitions planning are not structured to support a five-year plan. Coordination between Services is hindered by the absence of a standard planning time frame.

DIFFUSION OF PLANNING RESPONSIBILITY

Responsibilities for munitions planning are delegated to a level at which the necessary information and controls are not all available. AFLC and AFSC interact in the planning process, yet each conducts this planning with different ground rules, reporting procedures, etc. Fundamental agreement has yet to be reached on the terms of reference used within the IRMP framework. This is not to fault the planning of either Command, but to draw attention to the general diffusion of planning responsibility. The Air Staff planners who participated in the recent POM submission can attest to the need for standardized reporting and analysis. The AFSC planning system for munitions has been incorporated into their computerized IMPAR system, and appears to satisfy the needs of that Command, but it cannot readily handle the overall Air Force munitions management task, nor are its outputs designed to be directly usable to Air Staff planners.

Inter-service coordination is probably the most difficult area of all and depends upon ad hoc requests for information to a considerable degree. The Air Force lacks the proper mechanism to generate the necessary data from Army Ammunition Plants and Depots, although nearly all of its munitions are either assembled or stored by the Army. The Industrial Funded AAPs receive a sizable amount of Air Force dollars for services rendered, yet the Air Force can optimize its own munitions system only within the constraints imposed by the AAP in many instances. We have not examined this problem in depth as yet, but can say with

certain knowledge that the production capability of some of the munitions included in the Base Case is limited at the Army Load, Assemble and Pack facility, and the WRM buy was sized accordingly. There is no mechanism to identify and reallocate the LAP facility's capacity to permit, for example, a large reduction in Air Force WRM stockpile at some lesser penalty to another Service. Even more basic, however, is the absence of planning data in the Air Staff regarding the AAP capability three, four or five years hence.

OPPORTUNITY FOR IMPROVEMENT OF THE INDUSTRIAL BASE

The WRM buy over the next four or five years represents a sizable procurement program, and one which has potential for effecting some stabilization within the "boom-bust" munitions industry. The appeal of a relatively stable and predictable business arrangement should be exploited by the Air Force to gain more than an increased stockpile of bombs for its money; its long-range objectives can be served if it capitalizes on this spending program to achieve an overall enhancement of the industrial base.

There appear to be no planning efforts under way to achieve maximum benefits from the total procurement program. Recently, contractors have been cancelling their participation in the IRMP program in increasing numbers, presumably in anticipation of a procurement drought following Vietnam phasedown. Only by promulgating a positive policy with regard to munitions procurement will the Air Force reverse the current trend. Unfortunately, attempts to integrate munitions procurement plans will be hindered by the diffusion of planning responsibilities discussed earlier.

Appendix A

USER INSTRUCTIONS FOR SWIPE

This appendix describes the SWIPE program and inputs, the order and format of the input data, the output, and the program procedure. Flowcharts and the program listing are contained in Appendixes B and C, respectively.

INPUTS AND PROGRAM DESCRIPTION

SWIPE inputs fall into five general categories as shown in Table 1 and described below: munition descriptors, cost parameters, peacetime production and consumption, munition wartime demand, and wartime production capability.

Table 1

SWIPE INPUTS

Munition Descriptors	Cost Parameters	Peacetime Production and Consumption	Munition Wartime Demand[a]	Wartime Production Capability
Name Weight Life span Initial inventory	Base unit cost Base lot size Costing curve slope Storage cost 1st destination transportation cost	Production Consumption for training purposes SEA reqments MAP	Force size Sortie rate EPS Preposition reqment time	Mobilization production capability Pipeline time Name of IPM Cost of IPM Improved MPC New peacetime production

[a]By theater

Munition Descriptors

Munition descriptors give each munition type a name (ALPHA) and unit weight (WT).* This category also describes the maximum allowable age, or life span, of each munition type (ALAGE). If a munition exceeds this age at any point in the calculations, it is counted as "obsolete"

*An item in parentheses, e.g. (WT), is the FORTRAN variable name for the preceding input.

and is subtracted from the inventory. Finally, the munition descriptors give the munition inventory on hand at the beginning of the first possible war (INVE). To allow obsolescence calculations, the inventory is given by listing the total units of each age for each munition type.

Cost Parameters

For the munition cost parameters, it is assumed that unit cost may decrease as purchased lot size increases. For each munition, therefore, the user inputs a base unit cost (UNITC), the lot size with which this unit cost is associated (BALOT), and a costing curve "learning" factor (C1). If the user is not interested in using the costing curve, he should set C1 = 1. Also input are a holding or storage cost factor (HOLD) and a first destination transportation cost factor (TRAN).

Peacetime Production and Consumption

The inputs for peacetime production and consumption are the annual peacetime production (PPM) of each munition type and the annual consumption for training purposes (PTC), the Military Assistance Program (MAP), and Southeast Asia requirements (SEA). These figures and the initial inventory position are used to calculate the D-day inventory position that will exist on day one of each war, assuming none of the preceding wars occurred.

Munition Wartime Demand

The Munition Wartime Demand inputs are used to calculate the wartime demand for each munition type. Two or more combat theaters can be considered separately. Input for each theatre are: the monthly tactical force size for each aircraft type in the study (FSIZE); the monthly sortie rate for each aircraft type (SOR); and the average per-sortie expenditure of each munition type for each aircraft type (EPS). The total monthly demands for each munition type are calculated from these factors as follows:

$$DEM(I,M) = \sum_{J} FSIZE(J,M) \times SOR(J,M) \times EPS(I,J),$$

where J = aircraft type

I = munition type

M = month of war.

The preposition requirement time (PPRT) is also input for each theatre and then is calculated as the sum of the monthly demands for the first PPRT months of each war.

Wartime Production Capability

Wartime production capabilities input the mobilization production capability (MPC) for each month for each munition. If the user wishes to examine the effect of purchasing Industrial Preparedness Measures (IPMs), he can input a second set of MPCs along with the cost of each IPM that was used to produce the new MPCs and a code (CODE) that denotes the type of IPM purchased. For this second run, a new peacetime production must be input that takes advantage of the improved MPC.

To calculate the amount of each munition actually available in the war theatre, a pipeline time (PLT) in months must be input since munitions manufactured in CONUS are not available in the war theatre until some months later, because of the delay caused by filling the pipeline. All PACER FLEX munitions (prestocks usually placed in CONUS) are fed into the pipeline on day one of a war and thus are available in the combat theatre in month PLT + 1. The munitions manufactured in month M are available in the theatre in month M + PLT.

INPUTS

The order and format of the SWIPE input data are described below, along with some hypothetical input values. The formats are in standard FORTRAN style.*

*The current version of SWIPE accepts input from punched cards and, for simplicity of operation, assumes the only inputs that vary over the years studied are those pertaining to peacetime production (varied funding) and peacetime consumption of munitions. Therefore it is necessary to enter all other data for one year only. Should the user desire greater flexibility, the main program may easily be modified to suit his needs.

1. Format (24I3)

   NFLAG = number of jobs in run.

2. Format (20A4)

   ALPH (II) = alphanumeric job identification printed on each page of output. (1 card.)

3. Format (24I3)

MPW	NMUN	NAC	KYR1	KYRL	NYRS	PLT	NTPRNT	NYR1NV	NRUNS	MODMPC
24	20	10	73	77	5	3	6	3	2	1

INPRFL	MPC77
1	1

where MPW = number of months in a war ($1 \leq MPR \leq 24$, typically MPW = 24).

MNUN = number of munition types ($1 \leq NMUN \leq 50$).

NAC = number of aircraft types ($1 \leq NAC \leq 38$).

KYR1 = first year for which war expenditures are observed.

KYRL = last year for which war expenditures are observed.

NYRS = number of wars processed ($1 \leq NYRS \leq 5$, NYRS = KYRL - KYR1 + 1).

PLT = pipeline time to war theatre in integer months.

NTPRNT = number of munition types to be printed out in Table 3.

NYR1NV = the maximum number of opening inventory ages input. This is the same as the age of oldest weapon in the run. If the user is not interested in obsolescence considerations, he may set NYRINV = 1.

NRUNS = 1, if no IPM tradeoff is performed.
= 2, if WRM/IPM tradeoff is performed.

MODMPC = 0, if mobilization production capability is not to reflect peacetime production.
= 1, if MPC reflects peacetime production (i.e., set MPC(M) = MAX[MPC(M), PPM/12] where PPM is annual peacetime production).

INPRFL = 0, if inputs not to be printed out.
= 1, if inputs to be printed out.

MPC77 = 0, if MPC for final year studied remains as input.
= 1, if MPC for final year is set equal to MPC for previous year, in order to account for warm base created by previous year's peacetime production.

4. Format (8(1X,2A4))

```
ALPHA(1,1)ALPHA(1,2)     ALPHA(2,1)ALPHA(2,2) ...
      CBU24                    2.75HEAP
```

ALPHA(I,1) and ALPHA(I,2) together comprise the I-th munition type name. (May be up to 8 characters.)

5. Format (10F8.2)

```
WT(1)    WT(2) ...

1000.00   2150.50
```

WT(I) = weight in lb per munition of type I.

6. Format (16F5.2)

```
TRAN(1)   TRAN(2) ...
  .03       .04
```

TRAN(I) = dollars/pound for first destination transportation for I-th munition type.

7. Format (26F3.0)

```
ALAGE(1)   ALAGE(2)   ALAGE(3) ...
  2          1          4
```

ALAGE(I) = the life span in years of munition type I. The user should set this number to 8 for all munitions if he is not interested in considering obsolescence.

8. Format (F5.3)

```
HOLD DISC
.052  .10
```

HOLD = holding cost factor. A number representing dollars per pound for holding costs. Holding costs are for storage and maintenance.

DISCR = discount rate on peacetime buy dollars.

9. Format (8I9)

```
INVE(1,1,1)   INVE(1,1,2)   INVE(1,1,3) ...
   30000.        2000.         1100.
```

INVE(I,1,N) = the number of munition type I of age N in opening inventory. Inventory for next munition should start on new card. If the user is not interested in obsolescence considerations, he should enter only one inventory figure in the first 9 columns of a card for each munition (i.e., assume all munitions are 1 year old).

10. Format (8F9.0)

```
BALOT(1)   BALOT(2)   BALOT(3) ...
 5600.       920.      8200.
```

BALOT(I) = base lot size of munition type I with which basic unit cost is associated.

11. Format (16F5.2)

C1(1)	C1(2)	C1(3) ...
.9	1.0	.95

C1(I) = slope of "learning curve" for costing of peacetime production for the I-th munition type.

Formats 12a to 12d should be done for year 1 only. After format 12d has been completed, the user repeats 12a to 12d for subsequent years.

12a. Format (8F9.0)

PPM(1,K)	PPM(2,K) ...
30000.	20000.

PPM(I,K) = peacetime production of I-th munition type in K-th year.

12b. Format (8F9.0)

PTC(1,K)	PTC(2,K) ...
1500.	1000.

PTC(I,K) = peacetime consumption of I-th number type in K-th year.

12c. Format (8F9.0)

SEA(1,K)	SEA(2,K) ...
1000.	800.

SEA(I,K) = Southeast Asia requirements of I-th munition type in K-th year.

12d. Format (8F9.0)

MAP(1,K)	MAP(2,K) ...
2000.	1700.

Military Assistance Program requirements of I-th munition type in K-th year.

Repeat 12a to 12d for each year being considered.

13. Format (10F8.2)

UNITC(1)	UNITC(2) ...
2000.00	1100.00

UNITC(I) = basic unit cost of I-th munition type.

14. Format (16F5.2)

FSIZE(J,1)	FSIZE(J,2) ...
1.0	0.8

FSIZE(J,M) = J-th aircraft type force size* in war theatre for month M of war. One enters force size for first aircraft type, month 1, then first aircraft type month 2, month 3, etc. A new card is started for next aircraft type.

15. Format (16F5.0)

SOR(J,1)	SOR(J,2) ...
3000.	2450.

SOR(J,M) = monthly sortie "rate"* in war theatre of J-th aircraft type in month M of war. One enters sortie rates for a given aircraft for month 1, 2, 3, and so forth. A new card is started for new aircraft type.

16. Format (8F9.4)

EPS(1,J)	EPS(2,J) ...
.2973	.2992

EPS(I,J) = expenditure per sortie in war theatre of I-th munition type on J-th aircraft type of war. One enters EPS for a given aircraft for munition types 1, 2, 3, and so forth. A new card is started for a new aircraft type.

---

*The SWIPE program was originally set up to determine monthly munitions demand in the following manner:

$$\text{Demand}(I,M) = \sum_{J=1}^{NAC} 30 \cdot \text{FSIZE}(J,M) \cdot \text{SOR}(J,M) \cdot \text{EPS}(I,J),$$

where FSIZE(J,M) = the force size of the J-th aircraft type in the M-th month,

SOR(J,M) = the daily sortie rate for the J-th aircraft type in the M-th month, and

EPS(I,J) = the average expenditure per sortie of the I-th munition in the J-th aircraft type.

For the initial application of the SWIPE program, actual force size data were not available, but total sorties flown per aircraft type per month were known. Therefore, formats 14, 15, 17, and 18 were adjusted accordingly; actual monthly sorties flown were entered for sortie "rate" and FSIZE was set to 1. FSIZE was retained as a variable so that if the user wishes he might vary it about the value 1 to see the effect on WRM requirements of increasing or decreasing activity.

17. Format (16F5.2)

FSIZE1(J,1)	FSIZE1(J,2)	FSIZE1(J,3)
1.2	.95	.96

FSIZE1(J,M) = force size of J-th aircraft in M-th month. This is entered as for format 14, for a second war theater to determine preposition requirements in that theater. Again, the user should start a new card for a new aircraft.

18. Format (16F5.0)

SOR1(J,1)	SOR1(J,2)	SOR1(J,3)
3050.	2400.	2450.

SOR1(J,M) = Sortie "rate" for J-th aircraft type, entered as in format 15. A new card is started for a new aircraft.

19. Format (8F9.4)

EPS1(1,J)	EPS1(2,J) ...
.3429	.3391

EPS1(I,J) = Expenditures per sortie for I-th munition type on J-th aircraft type. This is to be entered as in format 16. The user starts a new card for a new aircraft type.

20. Format (16F5.2)

PPRT(1,1)	PPRT(2,1) ...
2.0	2.0

PPRT(I,L) = Prepositioning requirement time in months of I-th weapon. Different theaters are designated by L = 1, 2, etc. PPRT is entered for all weapons for place 1 first. A new card is started for place 2.

21. Format (10F8.0)

MPC(I,1)	MPC(I,2)	MPC(I,3) ...
10000.	12000.	20000.

MPC(I,M) = monthly mobilization production capability of I-th weapon in month M. One enters MPC for a given weapon for all months considered. A new card is started for a new weapon.

The preceding completes the inputs unless NRUNS = 2 (see input 3), in which case a WRM/IPM tradeoff is performed and the following inputs are added.

22. Format (20A4)

ALPH(II) (as in format 2) is a new alphanumeric run identification printed on each output page where IPMs are examined.

23. Format (8F9.0)

```
PPM(1,K)   PPM(2,K) ...
 1000.       500.
```

PPM(I,K) is defined as in item 12a; i.e., it is equal to the peacetime production of the I-th munition in the K-th year. The user inputs new peacetime production figures (lessened through purchase of IPM) or re-inputs old PPM figures. As in format 12a, there should be a set of PPM for each year considered. Therefore complete input 23 for year 1; then, starting on a new card, repeat for year 2, and so on.

24. Format (16(1X,A4))

```
CODE(1,)   CODE(2,) ...
IPM        NONE
```

CODE(I,K) = alphanumeric code (no more than four characters) for type of IPM buy for I-th munition. The user must input "NONE" if no IPM is used for I-th munition type.

25. Format (8F9.0)

```
IPM(1)   IPM(2) ...
10000.   150000.
```

IPM(I) = dollar cost of IPMs for I-th weapon.

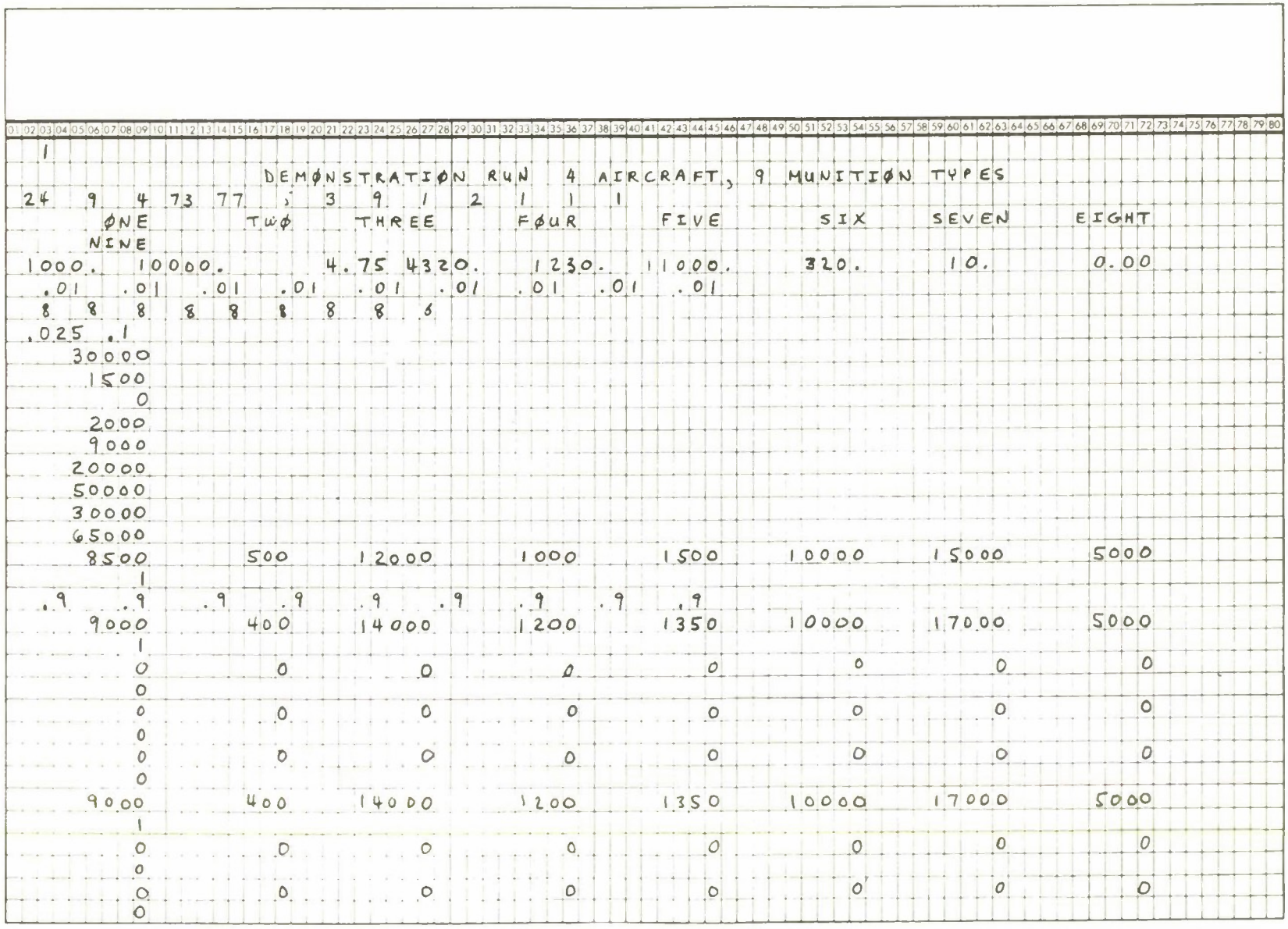
26. Format (10F8.0)

MPC(I,1) MPC(I,2) ...

MPC(I,K,M) is described as in format 21. That is, MPC(I,M) is the mobilization production capability of the I-th munition in month M. A new card is started for a new munition type. These are new MPCs that reflect changes due to purchased IPMs. MPC must be input here for all munitions whether or not there is a change.

Figure A1 shows the input charts used for the demonstration run, which involved 4 aircraft types and 9 munition types for the 5-year period, FY 1973-1977.

FORM 20
8 FEB 66



```
1
                    DEMØNSTRATIØN RUN  4 AIRCRAFT, 9 MUNITIØN TYPES
24  9  4 73 77  ;  3  9  1  2  1  1  1
     ØNE        TWØ     THREE      FØUR      FIVE       SIX      SEVEN     EIGHT
     NINE
1000.  10000.        4.75 4320.    1230.  11000.     320.      10.        0.00
 .01   .01   .01   .01   .01   .01   .01   .01   .01
 8  8  8  8  8  8  8  8  6
.025 .1
   30000
    1500
       0
    2000
    9000
   20000
   50000
   30000
   65000
    8500        500     12000      1000      1500     10000     15000      5000
       1
 .9    .9    .9    .9    .9    .9    .9    .9    .9
    9000        400     14000      1200      1350     10000     17000      5000
       1
       0          0         0         0         0         0         0         0
       0
       0          0         0         0         0         0         0         0
       0
       0          0         0         0         0         0         0         0
       0
    9000        400     14000      1200      1350     10000     17000      5000
       1
       0          0         0         0         0         0         0         0
       0
       0          0         0         0         0         0         0         0
       0
```

Fig. A1 — Input

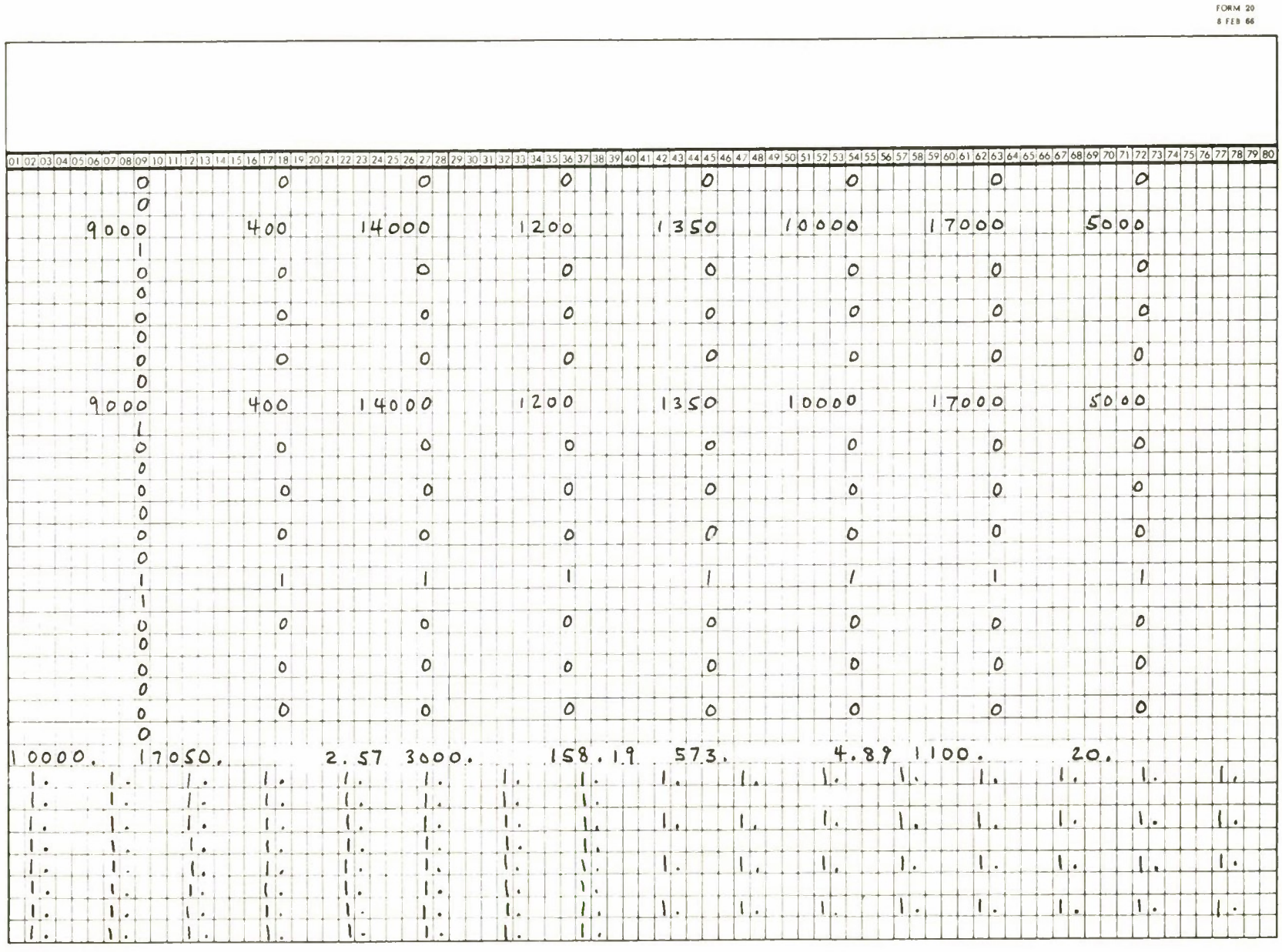


Fig. A1 — Continued

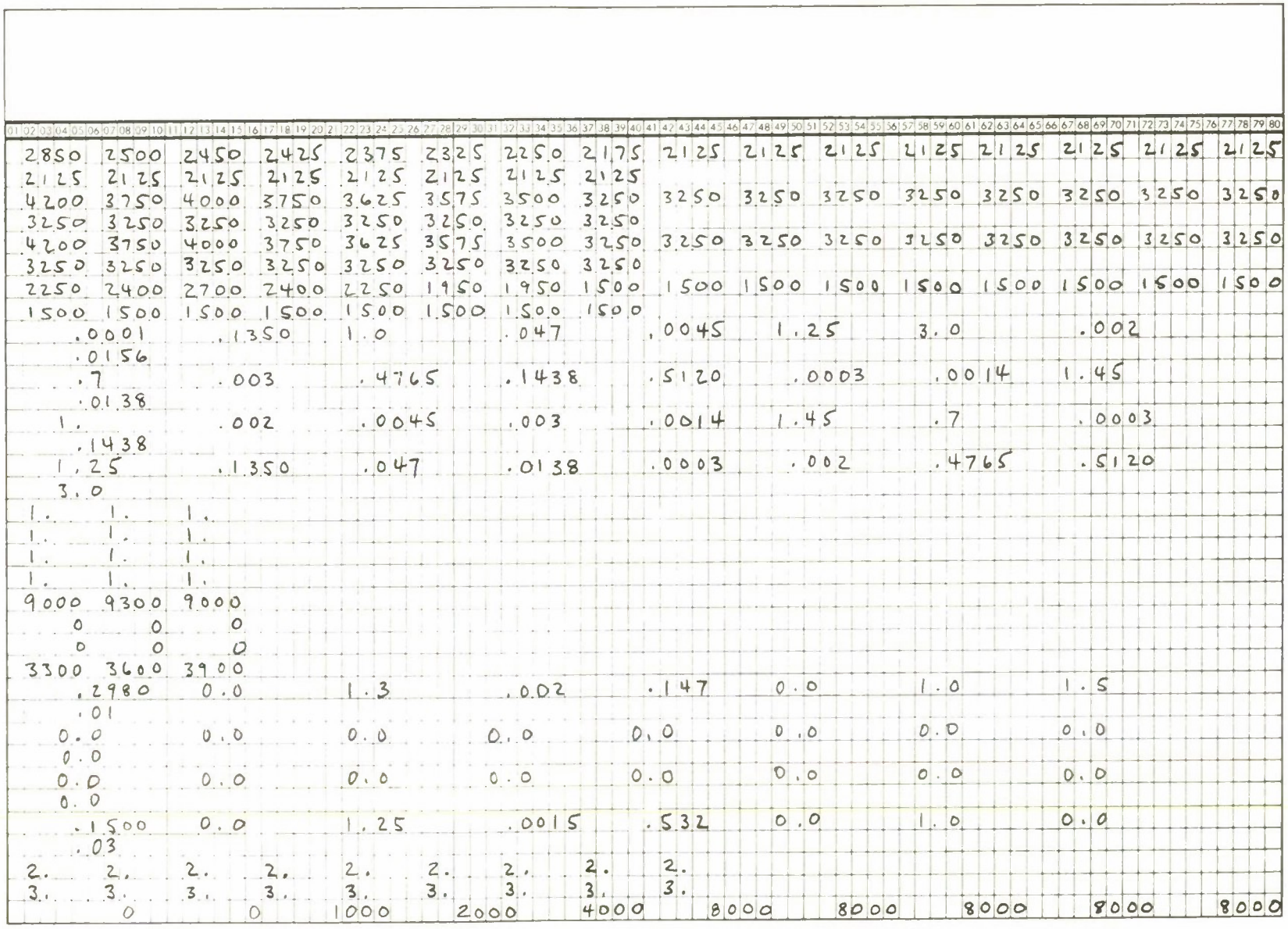


Fig. A1 — Continued

FORM 20
8 FEB 66

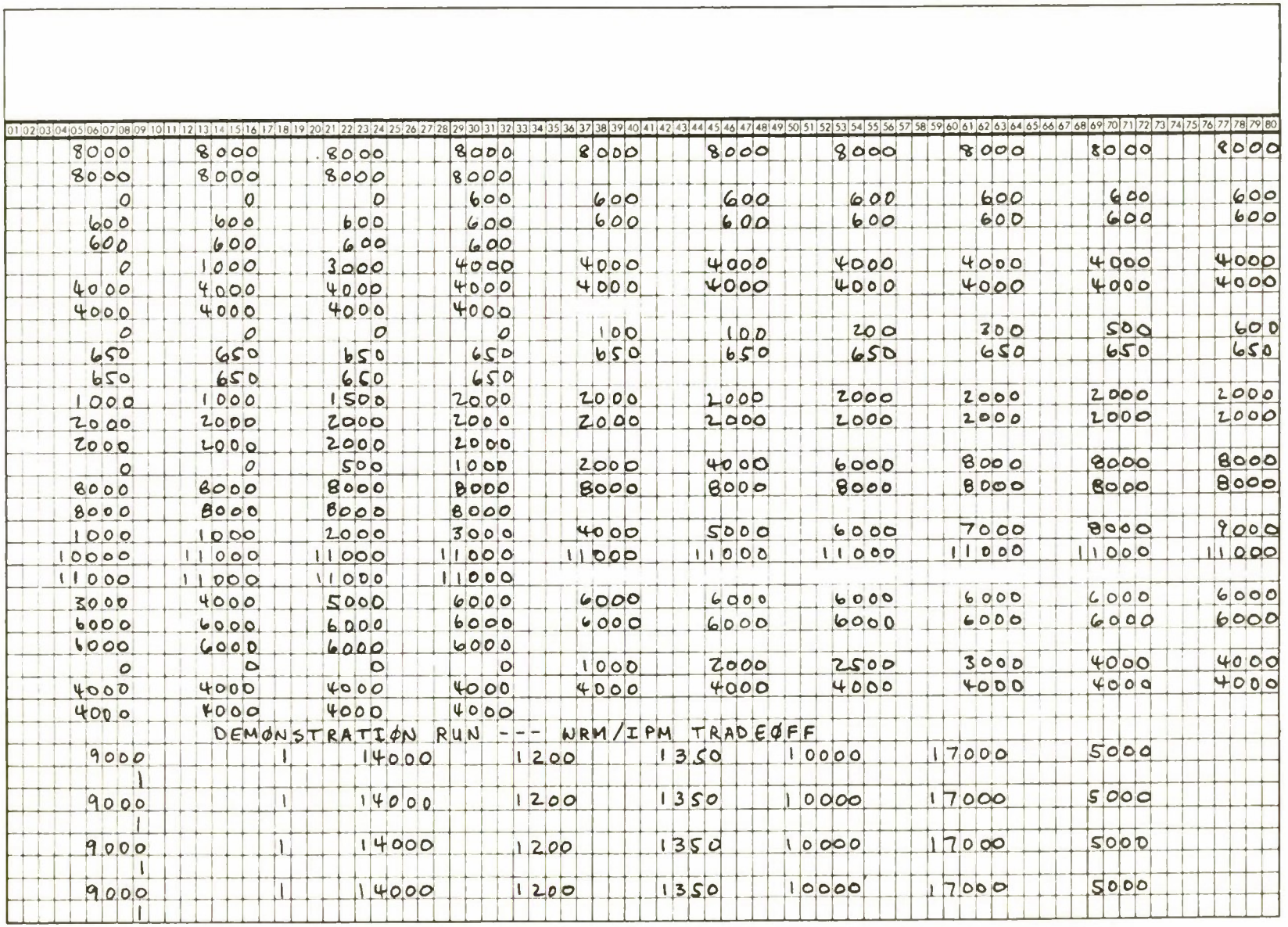
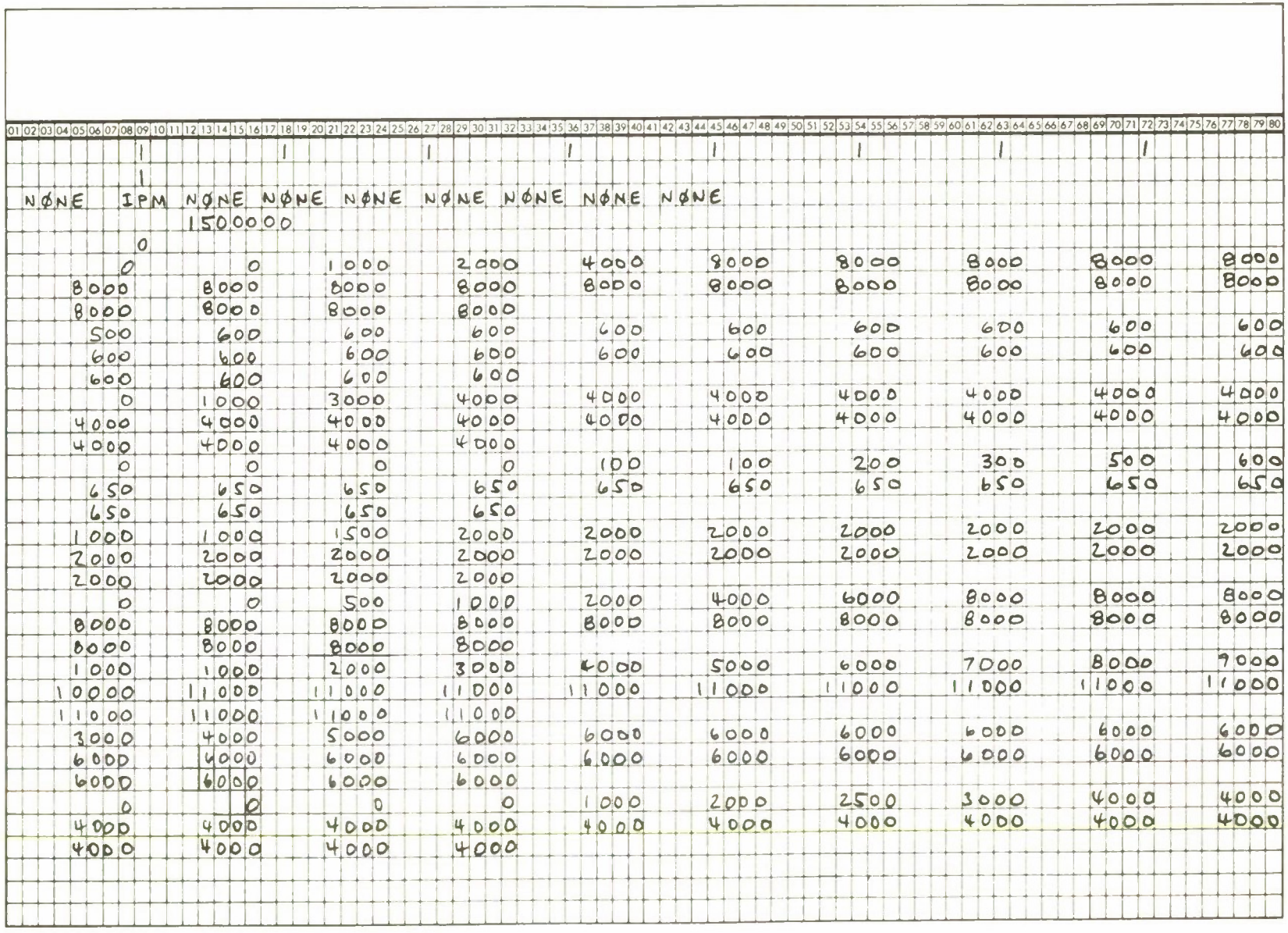


Fig. A1 — Continued

FORM 20
8 FEB 66



NØNE	NØNE	NØNE	NØNE	NØNE	NØNE	NØNE	NØNE	NØNE	
IPM									
150000									
0									
0	0	1000	2000	4000	8000	8000	8000	8000	8000
8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
8000	8000	8000	8000						
500	600	600	600	600	600	600	600	600	600
600	600	600	600	600	600	600	600	600	600
600	600	600	600						
0	1000	3000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000						
0	0	0	0	100	100	200	300	500	600
650	650	650	650	650	650	650	650	650	650
650	650	650	650						
1000	1000	1500	2000	2000	2000	2000	2000	2000	2000
2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
2000	2000	2000	2000						
0	0	500	1000	2000	4000	6000	8000	8000	8000
8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
8000	8000	8000	8000						
1000	1000	2000	3000	4000	5000	6000	7000	8000	9000
10000	11000	11000	11000	11000	11000	11000	11000	11000	11000
11000	11000	11000	11000						
3000	4000	5000	6000	6000	6000	6000	6000	6000	6000
6000	4000	6000	6000	6000	6000	6000	6000	6000	6000
6000	6000	6000	6000						
0	0	0	0	1000	2000	2500	3000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000						

Fig. A1 — Continued

OUTPUT

Output consists of 11 table types, some of which exhibit indices of combat preparedness for each year studied whereas others are complete run summaries and appear only once. Munition quantities are in thousands; costs are in millions of dollars unless otherwise stated. Each table is described and illustrated with a demonstration run. With the exception of Table 8, which shows the WRM/IPM tradeoff, the runs involve nine munitions and four aircraft. Two theaters will be used for illustration. They are designated "THTR 1" and "THTR 2" for convenience. In this illustration, THTR 2 is the "war theater" in which an indefinite duration contingency is examined.

Table 1, Inventory and Procurement Summary for FY ____, is a set of five tables, one for each of five years, FY 73-77. Each row in the table contains information on one munition type. The columns, reading from left to right, contain the following information:

- Item: Munition identification code
- Initial Inventory
  - THTR 1 prepo: Quantity prepositioned at opening of year
  - THTR 2 prepo: Quantity prepositioned at opening of year
  - PACER FLEX: Remaining quantity in open inventory
  - Total: Total of USAFE, PACAF, and PACER FLEX
- Unit price: Price of each munition, given in dollars and equal to $UNITC \cdot (PPM/BALOT)^{C1}$,
  where UNITC = base unit price
  PPM = peacetime buy in units
  BALOT = base lot size
  C1 = learning curve exponent
- FY buy
  - Units: Total for year
  - Cost: Total for year
- Added costs
  - Trans: First destination transportation costs for munitions, calculated from cost per pound of packaged weight
  - Storage: Storage costs on year's purchase, calculated from cost per pound of packaged weight.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 1. **INVENTORY AND PROCUREMENT SUMMARY FOR FY 73**

ITEM	INITIAL INVENTORY (K) THTR 1 PREPO	THTR 2 PREPO	PACER FLEX	TOTAL	UNIT PRICE ($)	FY BUY UNITS (K)	FY BUY COST ($M)	ADDED COSTS TRANS ($M)	ADDED COSTS STORAGE ($M)
ONE	6.49	23.51	0.0	30.00	9913.49	9.00	89.22	0.09	0.22
TWO	0.0	1.50	0.0	1.50	17638.23	0.40	7.06	0.04	0.10
THREE	0.0	0.0	0.0	0.0	2.51	14.00	0.04	0.00	0.00
FOUR	0.05	1.95	0.0	2.00	2918.00	1.20	3.50	0.05	0.13
FIVE	6.36	2.64	0.0	9.00	160.74	1.35	0.22	0.02	0.04
SIX	0.0	20.00	0.0	20.00	573.00	10.00	5.73	1.10	2.75
SEVEN	25.20	24.80	0.0	50.00	4.80	17.00	0.08	0.05	0.14
EIGHT	27.45	2.55	0.0	30.00	1100.00	5.00	5.50	0.00	0.00
NINE	0.39	24.05	40.55	65.00	20.00	0.00	0.00	0.0	0.0

Table 2, Summary of 5-Year Buy, is a single table summarizing annual peacetime buys of munitions over FY 73-77 period.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 2. **SUMMARY OF 5 YEAR BUY**

ITEM	INITIAL INVENTORY (K)	FINAL INVENTORY (K)	FY 73-77 BUY UNITS (K)	FY 73-77 BUY COST ($M)	ADDED COSTS ($M) TRANS	ADDED COSTS ($M) STORAGE
ONE	30.00	66.00	36.00	356.92	0.36	0.90
TWO	1.50	3.10	1.60	28.26	0.16	0.40
THREE	0.0	56.00	56.00	0.14	0.00	0.01
FOUR	2.00	6.80	4.80	14.01	0.21	0.52
FIVE	9.00	14.40	5.40	0.87	0.07	0.17
SIX	20.00	60.00	40.00	22.92	4.40	11.00
SEVEN	50.00	118.00	68.00	0.3_	0.22	0.54
EIGHT	30.00	50.00	20.00	22.00	0.00	0.01
NINE	65.00	65.00	0.00	0.00	0.0	0.0

Table 3, Wartime Requirements Summary for FY ____, is a set of five tables, one for each FY 73-77.

- Item
- Base Unit Price: In dollars
- Demand
  - Demand, D1-D12: Unit demand for first 12 months of war
  - Demand, D13-D24: Unit demand for second 12 months of war
- Required Inventory
  - **THTR 1: Prepositioned munitions requirement.**
    THTR 2: Prepositioned munitions requirement.
    PACER FLEX: Additional units necessary to fill PACAF WRM requirement completely, calculated as follows:

$$\text{PACER FLEX requirement} = \sum_{M=PLT+1}^{\text{End of War}} \text{MAX}\left[\text{Demand}_M - \text{MPC}_{M-PLT}, 0\right],$$

where M = month
PLT = pipeline time
MPC = mobilization production capability

- Total: Total of THTR 1, THTR 2, and PACER FLEX
- Deficiency
  - Units: Difference between inventory on-hand and inventory required
  - Percent of Total: Unit deficiency divided by total required inventory
  - Cost: Base unit price multiplied by the number of units deficient.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 3. WARTIME REQUIREMENTS SUMMARY FOR FY 73

ITEM	BASE UNIT PRICE ($)	---DEMAND (K)--- D1-D12	D13-D24	---------REQUIRED INVENTORY-------- THTR1	THTR2	PACERFLEX	TOTAL	-------DEFICIENCY-------- UNITS (K)	% OF TOTAL	COST ($M)
ONE	10000.00	101.76	88.80	6.49	29.50	34.15	70.15	40.15	57.23	401.45
TWO	17050.00	7.13	6.07	0.0	2.10	1.81	3.91	2.41	61.66	41.14
THREE	2.57	49.46	45.10	32.41	13.89	7.39	53.70	53.70	100.00	0.14
FOUR	3000.00	7.89	7.17	0.05	2.22	4.07	6.34	4.34	68.45	13.02
FIVE	158.19	22.03	20.14	6.36	6.17	2.16	14.69	5.69	38.73	0.90
SIX	573.00	96.71	88.47	0.0	27.10	39.37	66.47	46.47	69.91	26.63
SEVEN	4.89	124.61	112.43	25.20	35.28	51.87	112.35	62.35	55.50	0.30
EIGHT	1100.00	73.89	65.83	27.45	21.11	7.35	55.91	25.91	46.35	28.50
NINE	20.00	77.36	60.54	0.39	24.05	53.34	77.79	12.79	16.44	0.26

Table 4, Monthly Production/Demand for War Starting in FY ____, is also calculated for each of the five years.

- Item
- Percent of Total Cost: Also known as the relative demand ratio and equals ($ demand for munition I)/(total $ demand) in month one
- Production/Demand Ratio
  - Months after Mobilization (M-day=D-day): For 24 months of war, and equals MPC(M)/DEM(M),
    where MPC(M) = production capability in units for month M
    DEM(M) = wartime demand in units for month M
  - 1-24 Total: Total production divided by total demand over 24-month war.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 4. **MONTHLY PRODUCTION/DEMAND FOR WAR STARTING IN FY 73**

ITEM	PERCENT OF TOTAL COST	MONTHS AFTER MOBILIZATION (M-DAY=D-DAY) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1-24 TOTAL
ONE	78.23	8	8	10	21	45	94	95	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	84
TWO	9.95	5	5	5	90	93	101	103	117	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	96
THREE	0.51	23	26	67	92	95	97	99	105	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	94
FOUR	2.33	13	14	14	14	15	15	31	50	84	100	109	109	109	109	109	109	109	109	109	109	109	109	109	109	75
FIVE	0.77	46	52	73	103	107	108	111	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	108
SIX	4.82	9	10	9	12	24	49	76	108	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	82
SEVEN	0.55	11	13	17	27	37	48	59	74	85	96	107	117	117	117	117	117	117	117	117	117	117	117	117	117	84
EIGHT	6.73	41	60	70	90	94	97	99	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	99
NINE	0.62	0	0	0	0	14	31	39	59	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	53

Table 5, $ Supply/$ Demand, is a single table portraying the ratio of the supply of munitions in the combat theatre to the demand for each of 24 months of war for each of the five years.

- War Starts in FY
- $ Supply/$ Demand
  - Months after Mobilization (M-day=D-day): For each of 24 months of war, this is the percentage of total munitions dollars demanded that were available:

$$\frac{\sum_{I} \text{Min}(\text{Avail}_{I,M}, \text{Dem}_{I,M})}{\sum_{I} \text{Demand}_{I,M}} \text{ for a given month M,}$$

    where $\text{Avail}(I,M) = \text{Avail}(I,M-1) - \text{Min}[\text{Dem}(I,M-1), \text{Avail}(I,M-1)]$
  - 1-24 Total: Percentage of total dollar demand available over 24-month war.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 5. **$ SUPPLY/$ DEMAND**

WAR STARTS IN FY	MONTHS AFTER MOBILIZATION (M-DAY=D-DAY) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1-24 TOTAL
1973	96	94	3o	10	12	16	35	60	96	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	79
1974	100	94	91	38	13	16	35	60	96	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	84
1975	100	99	94	90	46	17	36	60	96	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	88
1976	100	100	97	96	89	59	37	61	98	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	93
1977	100	100	100	98	94	90	93	63	98	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	97

Table 6, Munitions Availability--Surplus and Deficits for War Starting in FY ____, is a set of five tables calculated in 2 sections (months 1-12 and months 13-24) for each fiscal year.

- Item
- Percent of Total Cost: Also known as the relative demand ratio and equals ($ demand for munition I)/(total $ demand) in one month
- Surplus and Deficits
  - Months after Mobilization (M-day=D-day): Covers either months 1 through 12 or 13 through 24 depending upon which section of table they are in. In any case, the figure represents the number of munitions long or short at the end of the indicated month
  - 12(24) Month Deficit: Indicates the total munition *shortage* over 12(24) months. This is not the algebraic sum of the previous columns, but is equal to the sum of those columns that showed shortages (negative entries) only.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 6. **MUNITIONS AVAILABILITY — SURPLUS AND DEFICITS FOR WAR STARTING IN FY 73**

ITEM	PERCENT OF TOTAL COST	MONTHS AFTER MOBILIZATION (M-DAY=D-DAY) 1	2	3	4	5	6	7	8	9	10	11	12	12 MONTH DEFICIT
ONE	78.23	13.56	4.19	-5.99	-8.62	-8.22	-7.51	-6.38	-3.40	0.60	1.20	1.80	2.40	-40.14
TWO	9.95	0.80	0.12	-0.60	-0.63	-0.60	-0.56	0.02	0.11	0.20	0.30	0.39	0.49	-2.41
THREE	0.51	-4.97	-4.41	-4.50	-3.17	-3.05	-1.13	-0.02	0.20	0.44	0.68	0.92	1.16	-21.28
FOUR	2.33	1.18	0.48	-0.26	-0.54	-0.57	-0.56	-0.54	-0.50	-0.49	-0.39	-0.29	-0.09	-4.33
FIVE	0.77	0.47	-1.46	-2.06	-0.93	-0.87	-0.34	0.20	0.52	0.84	1.16	1.48	1.80	-5.68
SIX	4.82	10.35	1.78	-7.09	-7.64	-7.39	-7.26	-6.89	-5.43	-3.37	-1.37	0.63	1.26	-46.46
SEVEN	0.55	12.24	0.56	-10.48	-9.63	-9.32	-8.41	-7.13	-5.51	-4.36	-3.36	-2.36	-1.36	-61.98
EIGHT	6.73	-4.69	-6.67	-7.18	-3.67	-2.41	-1.18	-0.07	0.52	1.03	1.55	2.06	2.58	-25.91
NINE	0.62	16.60	8.77	0.00	32.73	25.37	18.92	12.49	8.44	5.40	2.85	0.80	-0.24	-0.24

ITEM	PERCENT OF TOTAL COST	MONTHS AFTER MOBILIZATION (M-DAY=D-DAY) 13	14	15	16	17	18	19	20	21	22	23	24	24 MONTH DEFICIT
ONE	78.23	3.00	3.60	4.20	4.80	5.40	6.00	6.60	7.20	7.80	8.40	9.00	9.60	-40.14
TWO	9.95	0.58	0.67	0.77	0.86	0.96	1.05	1.15	1.24	1.34	1.43	1.52	1.62	-2.41
THREE	0.51	1.40	1.64	1.89	2.13	2.37	2.61	2.85	3.09	3.33	3.57	3.82	4.06	-21.28
FOUR	2.33	0.01	0.06	0.11	0.16	0.22	0.27	0.32	0.37	0.43	0.48	0.53	0.58	-4.33
FIVE	0.77	2.13	2.45	2.77	3.09	3.41	3.73	4.05	4.38	4.70	5.02	5.34	5.66	-5.68
SIX	4.82	1.89	2.51	3.14	3.77	4.40	5.02	5.65	6.28	6.91	7.53	8.16	8.79	-46.46
SEVEN	0.55	-0.36	0.64	2.27	3.90	5.53	7.16	8.79	10.42	12.05	13.68	15.31	16.94	-62.35
EIGHT	6.73	3.09	3.60	4.12	4.63	5.15	5.66	6.18	6.69	7.21	7.72	8.23	8.75	-25.91
NINE	0.62	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-12.78

Table 7, D to P Information for FY ____, is a set of five tables, one for each fiscal year.

- Item
- D-P Demand: The sum of the wartime demand during the months preceding P-day, where P-day is defined as that time when Mobilization Production Capability meets wartime demand
- D-P Time: The number of the first month in which production meets demand
- D-P Production: Total number of munitions produced prior to P-day.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 7. **D TO P INFORMATION FOR FY 73**

ITEM	O-P DEMAND (K)	O-P TIME	O-P PROD (K)
ONE	64.76	8.	24.50
TWO	3.42	6.	1.30
THREE	26.60	7.	17.34
FOUR	6.10	10.	1.60
FIVE	6.18	4.	3.50
SIX	59.79	8.	15.50
SEVEN	105.88	11.	46.84
EIGHT	40.39	7.	30.00
NINE	137.90	25.	72.51

Table 8, WRM/IPM Tradeoffs for FY ____, appears only when a WRM/IPM tradeoff is performed. This is a set of five tables, one for each fiscal year.

- Item
- IPM
  - Iden: IPM identification code; write "none" if no IPM
  - Cost
- D-P Time
  - W/O IPM: D-P time before buying the added IPM production capacity
  - W/IPM: D-P time after IPM purchase
- WRM Avoided
  - Units: Number of WRM units no longer required due to IPM purchase
  - Cost: WRM dollars saved through IPM purchase
- Other Costs Avoided
  - Trans: First destination transportation costs associated with WRM saved with IPM
  - Storage: Storage cost associated with WRM saved with IPM
- Net Reduction: Net savings from purchase of IPM equals the WRM cost avoided, plus the transportation and storage costs avoided, minus the IPM cost

DEMONSTRATION RUN --- WRM/IPM TRADEOFF

TABLE 8. **WRM/IPM TRADEOFFS FOR FY 73**

ITEM	IPM IDEN	IPM COST ($M)	O-P TIME W/O IPM	O-P TIME W/IPM	WRM AVOIDED UNITS (K)	WRM AVOIDED COST ($M)	OTHER COSTS AVOIDED ($M) TRANS	OTHER COSTS AVOIDED ($M) STORAGE	NET REDUCTION ($M)
ONE	NONE	0.0	8.	8.	0.0	0.0	0.0	0.0	0.0
TWO	IPM	1.50	6.	6.	1.59	27.19	0.16	0.40	26.25
THREE	NONE	0.0	7.	7.	0.0	0.0	0.0	0.0	0.0
FOUR	NONE	0.0	10.	10.	0.0	0.0	0.0	0.0	0.0
FIVE	NONE	0.0	4.	4.	0.0	0.0	0.0	0.0	0.0
SIX	NONE	0.0	8.	8.	0.0	0.0	0.0	0.0	0.0
SEVEN	NONE	0.0	11.	11.	0.0	0.0	0.0	0.0	0.0
EIGHT	NONE	0.0	7.	7.	0.0	0.0	0.0	0.0	0.0
NINE	NONE	0.0	25.	25.	0.0	0.0	0.0	0.0	0.0
		1.50				27.19	0.16	0.40	26.25

Table 9, Fiscal Summary for FY 73-77, is one table summarizing the peacetime buy for the years studied.

- o Fiscal Year
- o Buy: Cost of peacetime buy for given year
- o Trans: First destination transportation costs
- o Storage
- o Total: Total of Buy, Trans, and Storage
- o Interest: Interest on buy and expenses (transportation and storage) at chosen percent.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 9. **FISCAL SUMMARY FOR FY 73-77 ($M)**

FISCAL YEAR	BUY	TRANS	STORAGE	TOTAL	INTEREST @ 10.0%	TOTAL PLUS INTEREST
1973	111.34	1.35	3.39	116.08	53.873	169.95
1974	111.34	1.35	3.39	116.08	38.422	154.50
1975	111.34	1.35	3.39	116.08	24.377	140.46
1976	111.34	1.35	3.39	116.08	11.608	127.69
1977	0.10	0.00	0.00	0.10	0.0	0.10
TOTAL	445.47	5.42	13.54	464.42	128.280	592.70

Table 10, Year End Posture for FY ____, appears once for each fiscal year and is self-explanatory.

TABLE 10. **YEAR END POSTURE FOR FY 73**

THIS IS A YEAR-END SUMMARY OF YOUR PROCUREMENT ACTIONS AND THE RESULTANT MATERIEL SUPPORT POSTURE FOR FY 73. FIVE YEAR BUY MUST BE $ 511.70

YOU SPENT $111.34 MILLION FOR MUNITIONS.

THIS BUY INCURRED ADDED COSTS OF $ 1.35 MILLION FOR TRANSPORTATION TO FIRST DESTINATION IN CONUS; ALSO, $ 3.39 MILLION FOR STORAGE.

YOU NOW HAVE AN INVENTORY DEFICIENCY OF $ 400.35 MILLION.

IF WAR HAD STARTED AT THE BEGINNING OF THIS YEAR, PRODUCTION PLUS INVENTORY WOULD HAVE SATISFIED 79% OF THE DEMAND. IF WAR STARTS NOW PRODUCTION PLUS INVENTORY WILL SATISFY 84%.

Table 11, Mobilization Production Capability, is a single table that displays for the first 24 months of a war the following information about the estimated industrial mobilization capability:

- Month: From 1 to 24
- Tons/Month: Total (over all munitions) tons of munitions produced in that month
- $M/Month: Total in millions of dollars of MPC for month
- $K/Ton: Dollars (in thousands) per ton produced.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

TABLE 11. **MOBILIZATION PRODUCTION CAPABILITY**

MONTH	TONS/MONTH	$M/MONTH	$K/TON
1	6200.43	12.31	1.986
2	6205.43	13.41	2.162
3	6740.62	17.10	2.537
4	11465.50	38.04	3.318
5	18125.50	58.64	3.235
6	31285.50	99.81	3.190
7	42661.50	101.27	2.374
8	54037.50	102.73	1.901
9	54629.50	103.36	1.892
10	55005.50	103.66	1.885
11	55273.50	103.82	1.878
12	55433.50	103.82	1.873
13	55433.50	103.82	1.873
14	55433.50	103.82	1.873
15	55433.50	103.82	1.873
16	55433.50	103.82	1.873
17	55433.50	103.82	1.873
18	55433.50	103.82	1.873
19	55433.50	103.82	1.873
20	55433.50	103.82	1.873
21	55433.50	103.82	1.873
22	55433.50	103.82	1.873
23	55433.50	103.82	1.873
24	55433.50	103.82	1.873
TOTAL	1062265.00	2103.89	1.981

At the user's option (set INPRFL = 1), the SWIPE program prints out all inputs and the calculated planned combat consumption for each munition, as shown in Figs. A2 and A3. In addition, it prints out the force size and sortie rates for each aircraft, as shown in Fig. A4.

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

MUNITION ONE
WEIGHT 1000.00
TRANSPORTATION 0.01
ALLOWABLE AGE 8.
INITIAL INVENTORY 30000
BASE LOT SIZE 8500. RATE FOR LEARNING CURVE=0.15

YEARS	1973	1974	1975	1976	1977
UNIT COST	10000.	10000.	10000.	10000.	10000.
PEACE PRODUCTION	9000.	9000.	9000.	9000.	1.
PEACE CONSUMPTION	0.	0.	0.	0.	0.
SEA	0.	0.	0.	0.	0.
MAP	0.	0.	0.	0.	0.
EXPENDITURES PER SORTIE					
AIRCRAFT					
1	0.0001	0.0001	0.0001	0.0001	0.0001
2	0.7000	0.7000	0.7000	0.7000	0.7000
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.2500	1.2500	1.2500	1.2500	1.2500

Figure A2

DEMONSTRATION RUN 4 AIRCRAFT, 9 MUNITION TYPES

MUNITION ONE

YEARS	1973	1974	1975	1976	1977
MPC, MONTH					
1	750.	750.	750.	750.	750.
2	750.	750.	750.	750.	750.
3	1000.	1000.	1000.	1000.	1000.
4	2000.	2000.	2000.	2000.	2000.
5	4000.	4000.	4000.	4000.	4000.
6	8000.	8000.	8000.	8000.	8000.
7	8000.	8000.	8000.	8000.	8000.
8	8000.	8000.	8000.	8000.	8000.
9	8000.	8000.	8000.	8000.	8000.
10	8000.	8000.	8000.	8000.	8000.
11	8000.	8000.	8000.	8000.	8000.
12	8000.	8000.	8000.	8000.	8000.
13	8000.	8000.	8000.	8000.	8000.
14	8000.	8000.	8000.	8000.	8000.
15	8000.	8000.	8000.	8000.	8000.
16	8000.	8000.	8000.	8000.	8000.
17	8000.	8000.	8000.	8000.	8000.
18	8000.	8000.	8000.	8000.	8000.
19	8000.	8000.	8000.	8000.	8000.
20	8000.	8000.	8000.	8000.	8000.
21	8000.	8000.	8000.	8000.	8000.
22	8000.	8000.	8000.	8000.	8000.
23	8000.	8000.	8000.	8000.	8000.
24	8000.	8000.	8000.	8000.	8000.
REQ, MONTH					
1	9953.	9953.	9953.	9953.	9953.
2	9375.	9375.	9375.	9375.	9375.
3	10175.	10175.	10175.	10175.	10175.
4	9375.	9375.	9375.	9375.	9375.
5	8975.	8975.	8975.	8975.	8975.
6	8515.	8515.	8515.	8515.	8515.
7	8388.	8388.	8388.	8388.	8388.
8	7400.	7400.	7400.	7400.	7400.
9	7400.	7400.	7400.	7400.	7400.
10	7400.	7400.	7400.	7400.	7400.
11	7400.	7400.	7400.	7400.	7400.
12	7400.	7400.	7400.	7400.	7400.
13	7400.	7400.	7400.	7400.	7400.
14	7400.	7400.	7400.	7400.	7400.
15	7400.	7400.	7400.	7400.	7400.
16	7400.	7400.	7400.	7400.	7400.
17	7400.	7400	7400.	7400.	7400.
18	7400.	7400.	7400.	7400.	7400.
19	7400.	7400.	7400.	7400.	7400.
20	7400.	7400.	7400.	7400.	7400.
21	7400.	7400.	7400.	7400.	7400.
22	7400.	7400.	7400.	7400.	7400.
23	7400.	7400.	7400.	7400.	7400.
24	7400.	7400.	7400.	7400.	7400.

Figure A3

PIPELINE REQ TIME

THEATRE 1	2.00	2.00	2.00	2.00	2.00
THEATRE 2	3.00	3.00	3.00	3.00	3.00

DEMONSTRATION RUN 4 AIRCRAFT, 4 MUNITION TYPES

AIRCRAFT 1

	1973		1974		1975		1976		1977	
MONTH	FSIZE	SORTIE	FSIZE	SORTIE	FSIZE	SORTIE	FSIZE	SORTIE	FSIZE	SORTIE
1	1.00	2850.	1.00	2850.	1.00	2850.	1.00	2850.	1.00	2850.
2	1.00	2500.	1.00	2500.	1.00	2500.	1.00	2500.	1.00	2500.
3	1.00	2450.	1.00	2450.	1.00	2450.	1.00	2450.	1.00	2450.
4	1.00	2425.	1.00	2425.	1.00	2425.	1.00	2425.	1.00	2425.
5	1.00	2375.	1.00	2375.	1.00	2375.	1.00	2375.	1.00	2375.
6	1.00	2325.	1.00	2325.	1.00	2325.	1.00	2325.	1.00	2325.
7	1.00	2250.	1.00	2250.	1.00	2250.	1.00	2250.	1.00	2250.
8	1.00	2175.	1.00	2175.	1.00	2175.	1.00	2175.	1.00	2175.
9	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
10	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
11	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
12	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
13	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
14	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
15	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
16	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
17	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
18	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
19	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
20	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
21	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
22	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
23	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
24	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.	1.00	2125.
THEATRE 1										
1	1.00	9000.	1.00	9000.	1.00	9000.	1.00	9000.	1.00	9000.
2	1.00	9300.	1.00	9300.	1.00	9300.	1.00	9300.	1.00	9300.
3	1.00	9000.	1.00	9000.	1.00	9000.	1.00	9000.	1.00	9000.

Figure A4

PROGRAM PROCEDURE

MAIN

The MAIN program reads the card input data and calls the subroutines. It also changes C1(I), "learning curve" slope, into C1(I), learning curve exponent for the function XEWP. Often a munition is being produced at an annual peacetime rate that exceeds early months' mobilization production capability estimates; therefore, if the user wants MPC to reflect the warm base created by annual peacetime production, the MAIN program sets the MPC for each month--MPC(M) equal to MAX[MPC(M),PPM/12]. MAIN then calls subroutines CALDEM, INPRINT, PEACE, PRINTP, WAR, and TABLE9 to complete calculations. If the variable NRUNS is set to 1, the run is terminated and no WRM/IPM tradeoff is calculated. If NRUNS is set to 2, then a WRM/IPM tradeoff is calculated and MAIN reads the additional data necessary, and then passes control to subroutine CHART.

CHART performs the tradeoff by calling PEACE, PRINTP, WAR, and TABLE9, thus rerunning the whole program sequence and comparing the costs of the all-WRM case with the IPM case.

CALDEM

Subroutine CALDEM calculates planned wartime demands in THTR 1 and THTR 2. THTR 1 demands are calculated only to determine THTR 1 preposition requirements.

$$TDEM(I,K,L,M) = \sum_{J} FSIZE(J,K,M) \cdot SOR(J,K,M) \cdot EPS(I,J,K),$$

where I = munition type
J = aircraft type
K = year
L = theatre
M = month

and TDEM = total demand
FSIZE[FSIZE1 for USAFE] = force size
SOR[SOR1] = sortie rate
EPS[EPS1] = expenditures per sortie

The program is formatted to read FSIZE[FSIZE1] as 1 and SOR[SOR1] as the total number of sorties flown by a given aircraft type fleet per month. FSIZE[FSIZE1] as a variable has utility insofar as it allows the analyst to determine the effects of increasing or decreasing force size by a given percentage by setting FSIZE > 1 or < 1, respectively. Alternatively, the actual force size may be input if desired by changing the format.

TITLE

Subroutine TITLE prints at the top of the output page the job description title [ALPH(II)] input by the user. For example--CASE B1, 10 MUNITIONS, 8 AIRCRAFT, APRIL 1970.

INPRINT

Subroutine INPRINT prints out all input data. INPRINT also prints out the demands calculated in CALDEM.

PEACE

Subroutine PEACE calculates the peacetime munitions status on a per-munition, annual basis. Opening inventory is input according to the age of the munition. Ages are compared to munition life spans, and obsolete munitions are removed from the opening inventory and noted. Inventory for the following years is determined as follows:

Add year's peacetime production to opening inventory.

Subtract year's consumption using oldest munitions first.

Remove any unused munitions that have become obsolete over the year. Thus opening inventory of year N+1, which equals closing inventory in year N, is calculated.

Calculate preposition requirements by summing demand over the preposition requirement time.

Then allocate munitions in each year's inventory first to THTR 1 prepo, second to THTR 2 prepo, and third to PACER FLEX.

Subroutine PEACE also calculates peacetime buy costs by multiplying the number of each kind of munition purchased by unit price,

$$\text{PRICE}(I) = \text{UNITC}(I) \left(\frac{\text{PPM}(I)}{\text{BALOT}(I)} \right)^{\text{C1}(I)},$$

where UNITC(I) = base unit cost

PPM(I) = peacetime production (buy)

BALOT(I) = base lot size

C1(I) = learning curve function exponent for the I-th munition type.

PRINTP

Subroutine PRINTP calculates and prints Tables 1, 2, and 3. For each munition type I, it calculates the number of units potentially

available *through mobilization production capability* in the war theatre. In other words, for month M

$$TOTAV(M) = \sum_{R=1}^{M-PLT} MPC(R),$$

where PLT = pipeline time

MPC(R) = mobilization production capability in month R.

Then, for each munition, PRINTP calculates surpluses and deficits on a month-to-month basis by comparing what is available in month M (given the war has been fought in months 1 through M-1 and given that a munition is always expended if it is demanded and available). In this way, PRINTP calculates total shortages and by adding these to the preposition requirements* arrives at the total WRM requirement for each munition. PRINTP then constructs and prints Table 1, Inventory and Procurement Summary. Then it constructs and prints Table 2, Summary of 5-Year Buy, and finally it calculates and prints Table 3, Wartime Requirements Summary.

WAR

Subroutine WAR calculates and prints Tables 4 through 7, which contain wartime effectiveness measures. The number of each munition potentially available in the war theatre month-by-month is calculated, including prepositioned weapons; PACER FLEX, which arrives in theatre month PLT + 1, where PLT = pipeline time; and MPC(M), which arrives in theatre month M + PLT. Then munitions actually available in month M are calculated, given previous months' wartime demands and expenditures. Finally, the month-to-month surpluses and deficits are calculated. These figures are used later.

Subroutine WAR then calculates the relative demand ratio based on the wartime demand in month 1. The relative demand ratio is

$$\frac{\$ \text{ demand (munition 1)}}{\text{Total } \$ \text{ demand (over all munitions)}},$$

*Preposition requirement time is typically equal to pipeline time.

and gives the user an idea of the relative "importance" of a given munition.

Table 4, Monthly Production/Demand for War Starting in FY ____, is then calculated and printed. In calculating and printing Table 5, $ Supply/$ Demand, figures developed earlier in the subroutine are used. $ Supply/$ Demand for each month equals

$$\sum_{I=1}^{NMUN} RDR(I) \frac{MIN[TDEM(I), TOTAV(I)]}{TDEM(I)},$$

where NMUN = the number of different munition types,
RDR = the relative demand ratio just described,
TDEM(I) = total demand in a given month for munition type I,
TOTAV(I) = total amount of munition type I available in the theatre that month.

Next, WAR calculates and prints Table 6, Munitions Availability--Surplus and Deficits for War Starting in FY ____. The figures for this table are developed in the early portions of this subroutine. Table 7, D to P Information, is then printed. P-day for a given munition is defined as that day when production capability meets demand. For each munition, Table 7 shows which month P-day occurred in, the amount of pre P-day demand, and the amount of pre P-day production.

TABLE9

Subroutine TABLE9 calculates and prints Tables 9, 10, and 11. Table 9, Fiscal Summary, reviews the total peacetime buy for all the years studied, including first destination transportation costs and storage costs. Also, dollars are shown straight and discounted at the rate the user inputs. TABLE9 then calculates Tables 10, Year End Posture, and 11, Mobilization Production Capability.

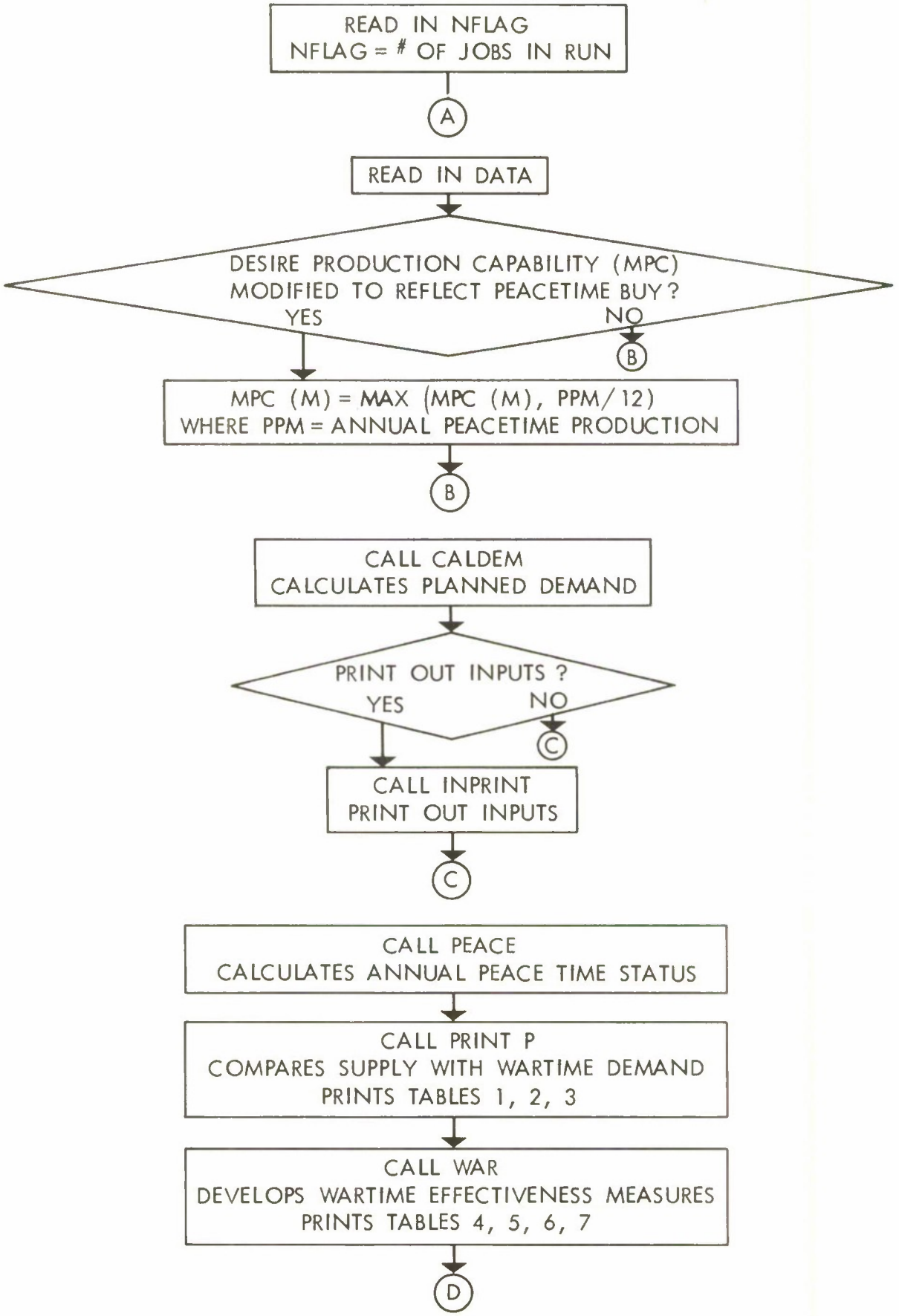
CHART

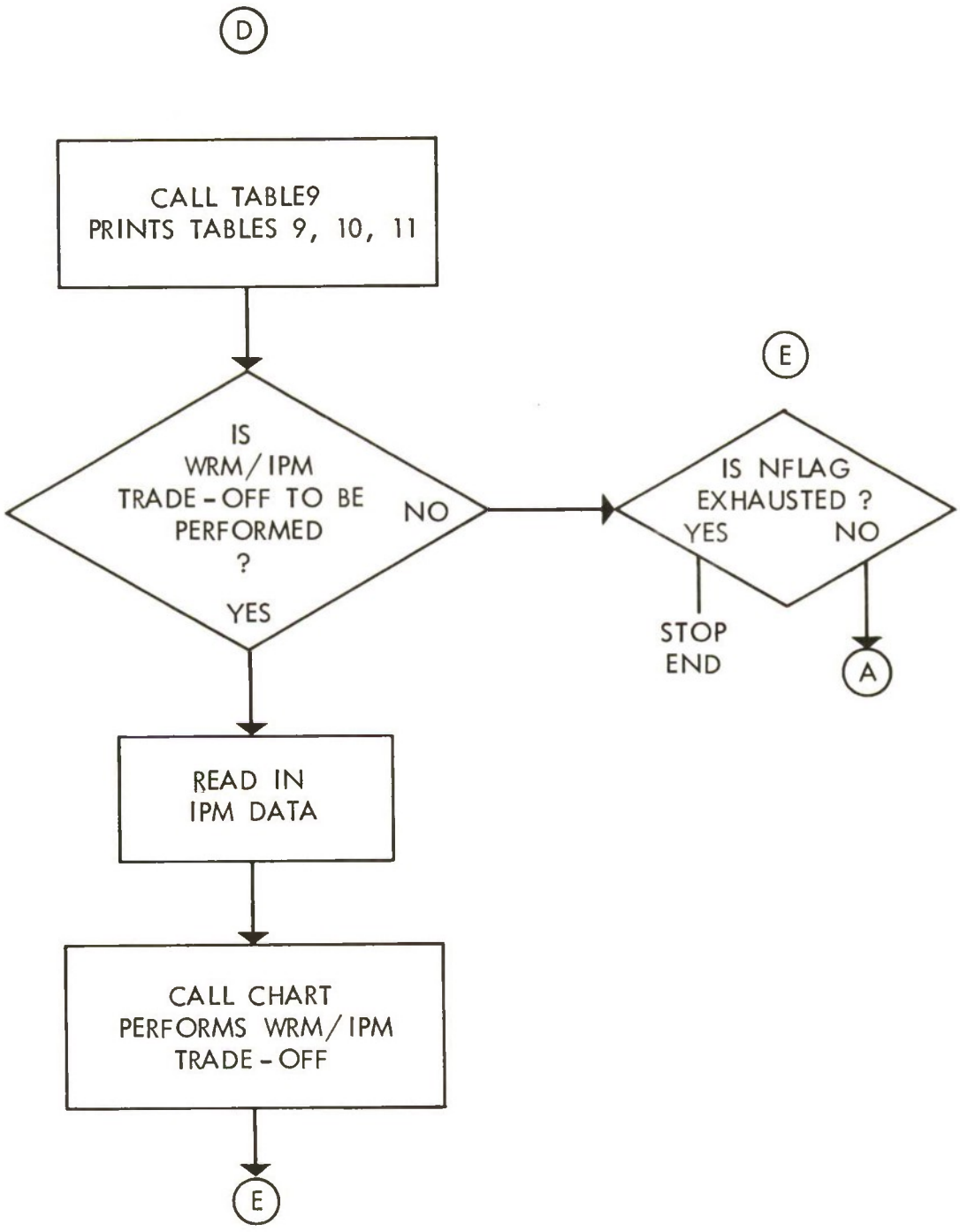
Subroutine CHART performs the WRM/IPM tradeoff. It compares the WRM requirements of munitions before and after the purchase of IPMs and, taking the IPM cost into account, arrives at the net savings resulting from the IPM. Subroutine CHART prints out these results in Table 8, WRM/IPM Tradeoffs.

Appendix B

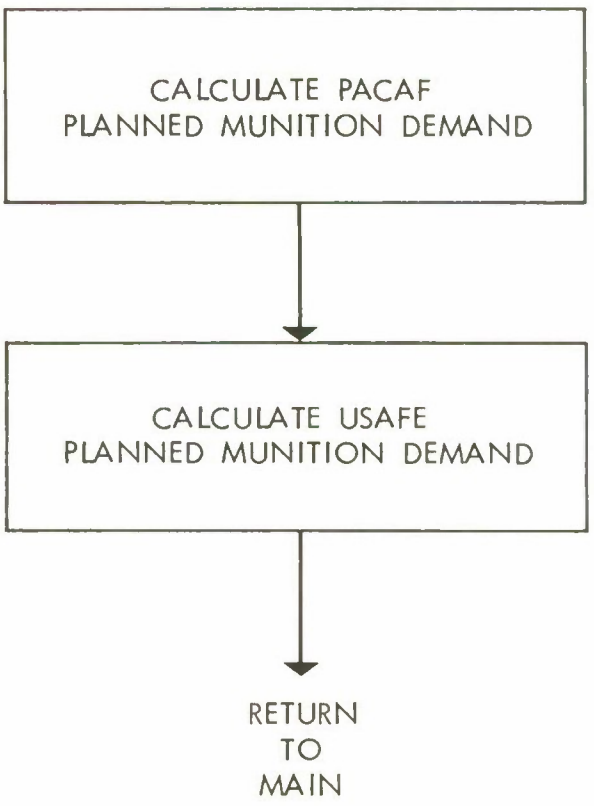
SWIPE FLOW CHARTS

MAIN

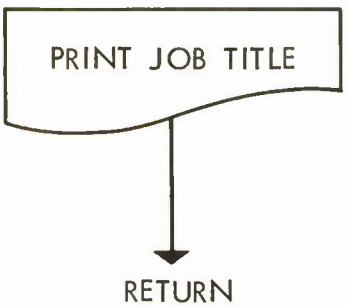

READ IN NFLAG
NFLAG = # OF JOBS IN RUN
A
READ IN DATA
DESIRE PRODUCTION CAPABILITY (MPC) MODIFIED TO REFLECT PEACETIME BUY?
YES
NO
B
MPC (M) = MAX (MPC (M), PPM/12)
WHERE PPM = ANNUAL PEACETIME PRODUCTION
B
CALL CALDEM
CALCULATES PLANNED DEMAND
PRINT OUT INPUTS ?
YES
NO
C
CALL INPRINT
PRINT OUT INPUTS
C
CALL PEACE
CALCULATES ANNUAL PEACE TIME STATUS
CALL PRINT P
COMPARES SUPPLY WITH WARTIME DEMAND
PRINTS TABLES 1, 2, 3
CALL WAR
DEVELOPS WARTIME EFFECTIVENESS MEASURES
PRINTS TABLES 4, 5, 6, 7
D


D
CALL TABLE9
PRINTS TABLES 9, 10, 11
IS
WRM/IPM
TRADE-OFF TO BE
PERFORMED
?
NO
YES
E
IS NFLAG
EXHAUSTED ?
YES
NO
STOP
END
A
READ IN
IPM DATA
CALL CHART
PERFORMS WRM/IPM
TRADE-OFF
E

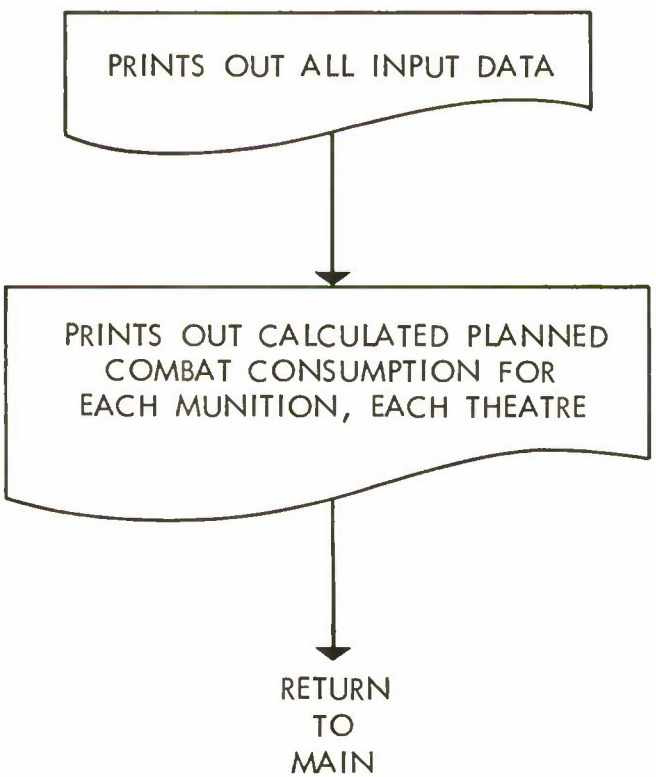
CALDEM


CALCULATE PACAF
PLANNED MUNITION DEMAND
CALCULATE USAFE
PLANNED MUNITION DEMAND
RETURN
TO
MAIN

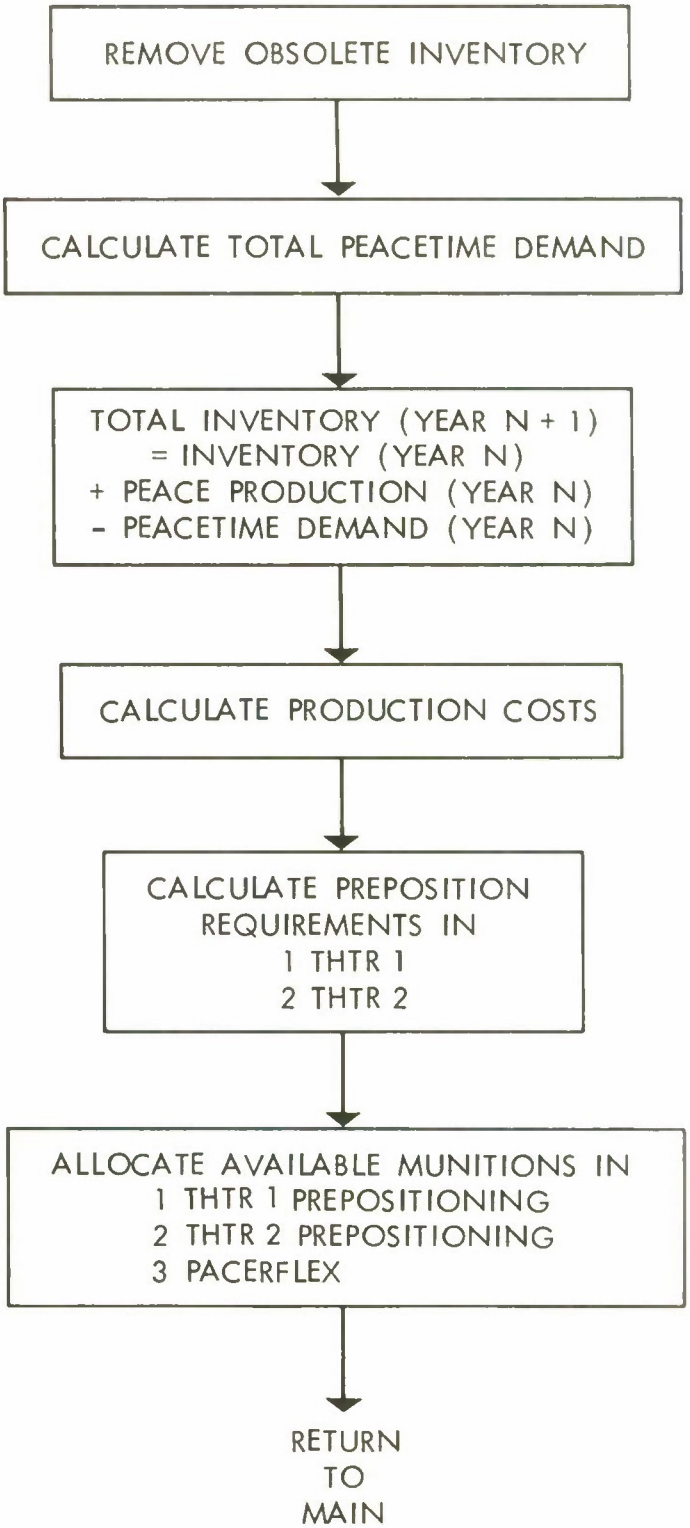
TITLE



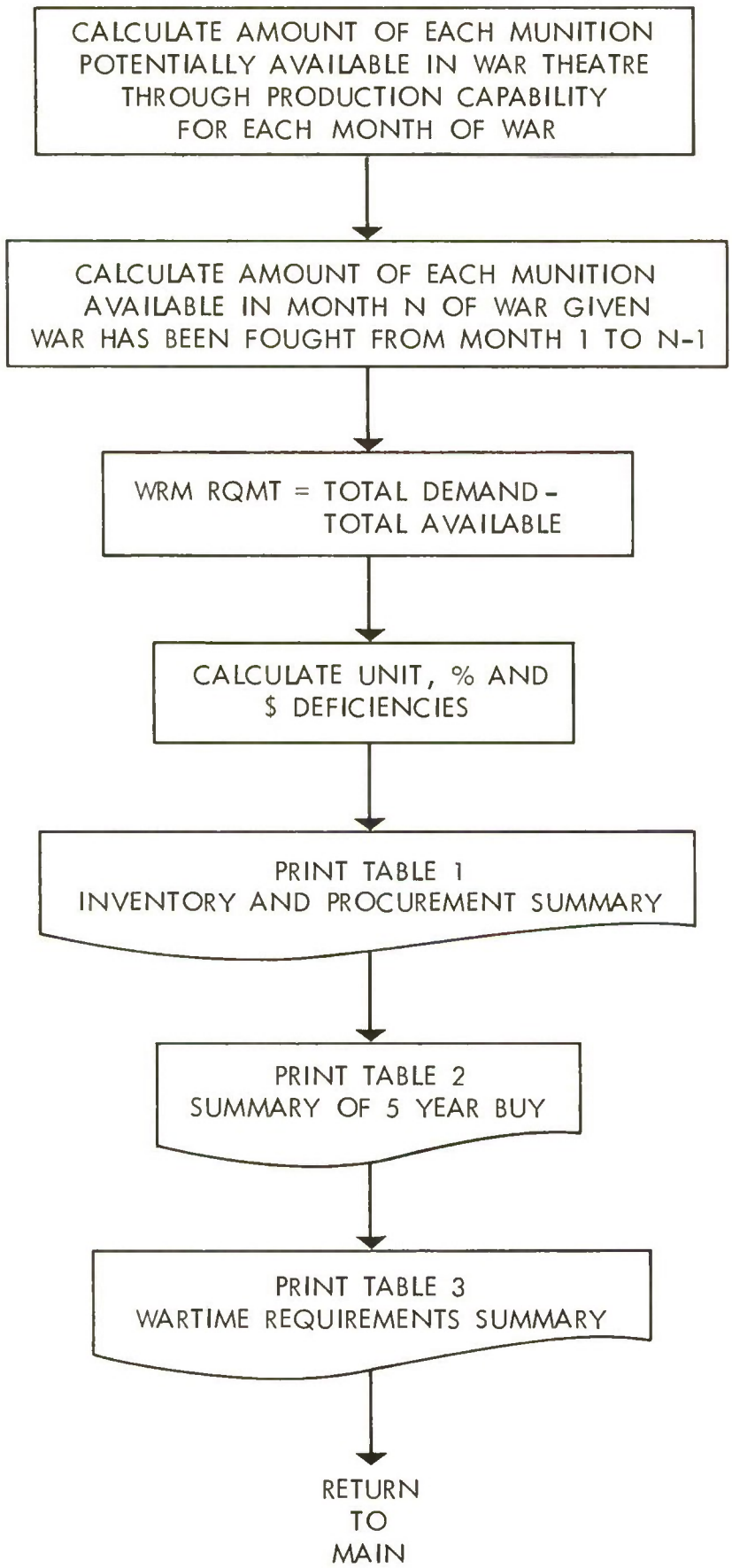
INPRNT



PEACE

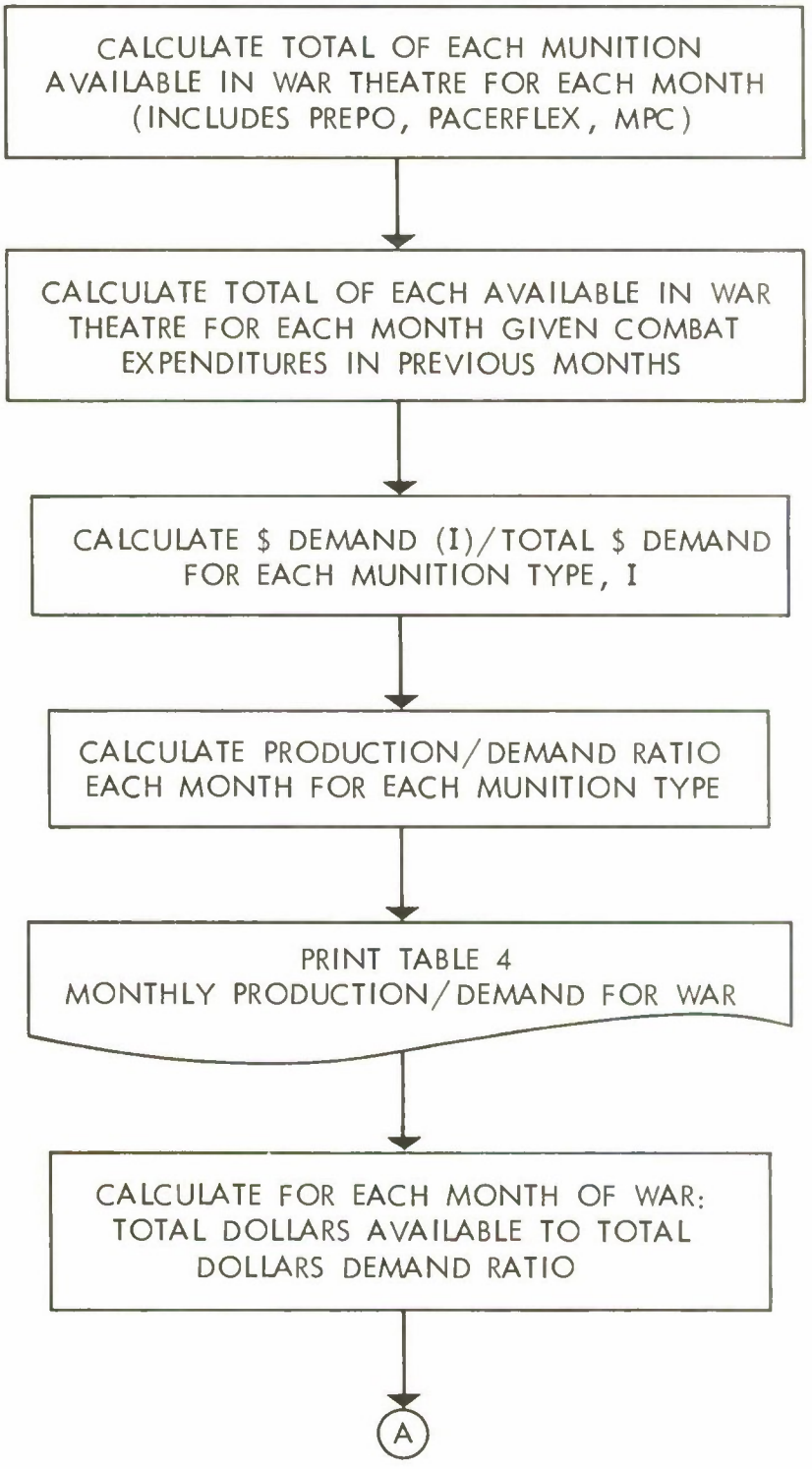

REMOVE OBSOLETE INVENTORY
CALCULATE TOTAL PEACETIME DEMAND
TOTAL INVENTORY (YEAR N + 1)
= INVENTORY (YEAR N)
+ PEACE PRODUCTION (YEAR N)
- PEACETIME DEMAND (YEAR N)
CALCULATE PRODUCTION COSTS
CALCULATE PREPOSITION
REQUIREMENTS IN
1 THTR 1
2 THTR 2
ALLOCATE AVAILABLE MUNITIONS IN
1 THTR 1 PREPOSITIONING
2 THTR 2 PREPOSITIONING
3 PACERFLEX
RETURN
TO
MAIN

PRINTP

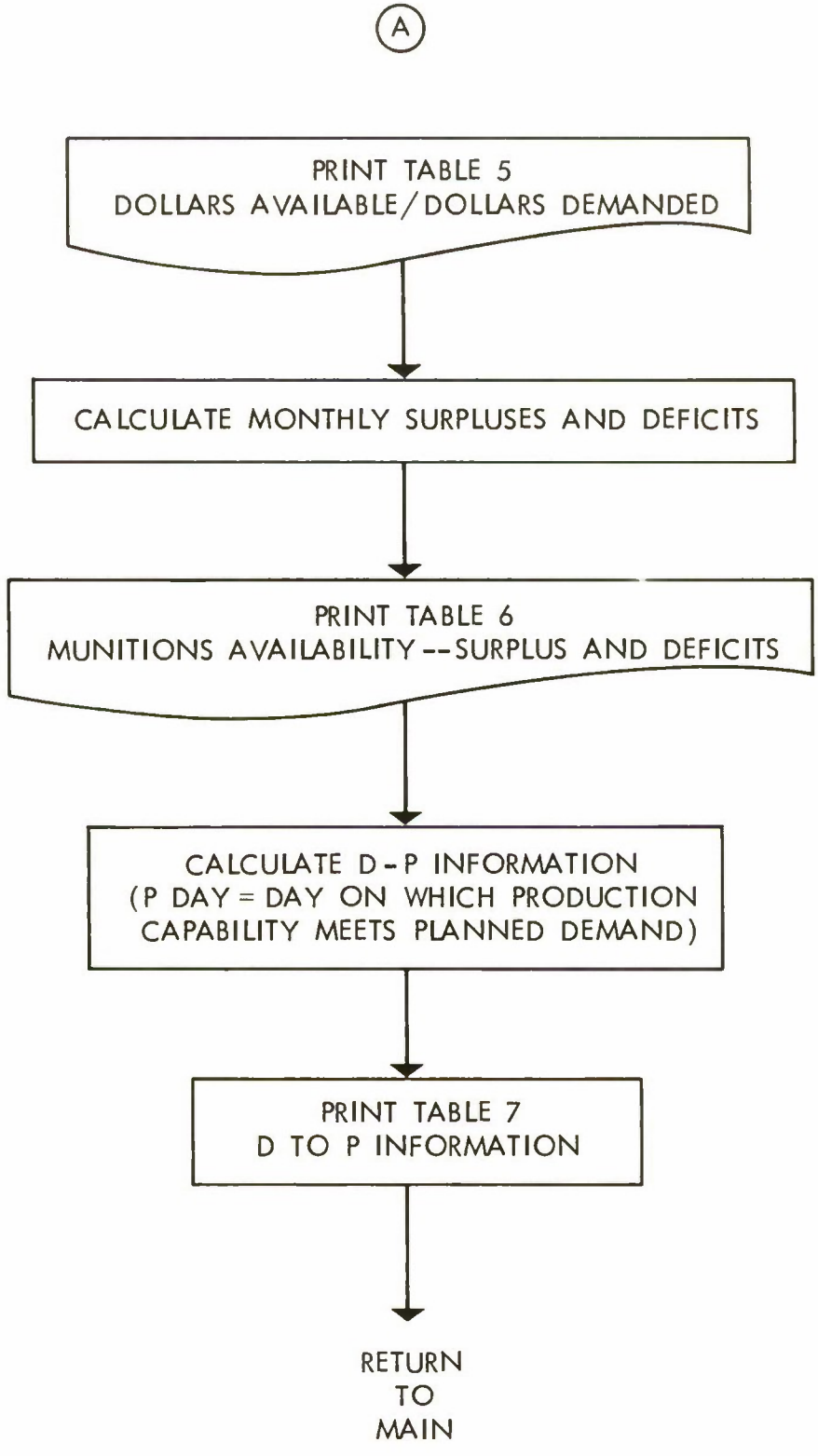

CALCULATE AMOUNT OF EACH MUNITION POTENTIALLY AVAILABLE IN WAR THEATRE THROUGH PRODUCTION CAPABILITY FOR EACH MONTH OF WAR
CALCULATE AMOUNT OF EACH MUNITION AVAILABLE IN MONTH N OF WAR GIVEN WAR HAS BEEN FOUGHT FROM MONTH 1 TO N-1
WRM RQMT = TOTAL DEMAND - TOTAL AVAILABLE
CALCULATE UNIT, % AND $ DEFICIENCIES
PRINT TABLE 1 INVENTORY AND PROCUREMENT SUMMARY
PRINT TABLE 2 SUMMARY OF 5 YEAR BUY
PRINT TABLE 3 WARTIME REQUIREMENTS SUMMARY
RETURN TO MAIN

WAR

(PLAYING THE WAR)



WAR, CONT'D


A
PRINT TABLE 5
DOLLARS AVAILABLE/DOLLARS DEMANDED
CALCULATE MONTHLY SURPLUSES AND DEFICITS
PRINT TABLE 6
MUNITIONS AVAILABILITY--SURPLUS AND DEFICITS
CALCULATE D-P INFORMATION
(P DAY = DAY ON WHICH PRODUCTION
CAPABILITY MEETS PLANNED DEMAND)
PRINT TABLE 7
D TO P INFORMATION
RETURN
TO
MAIN

CHART

(FOR WRM/IPM TRADEOFF)

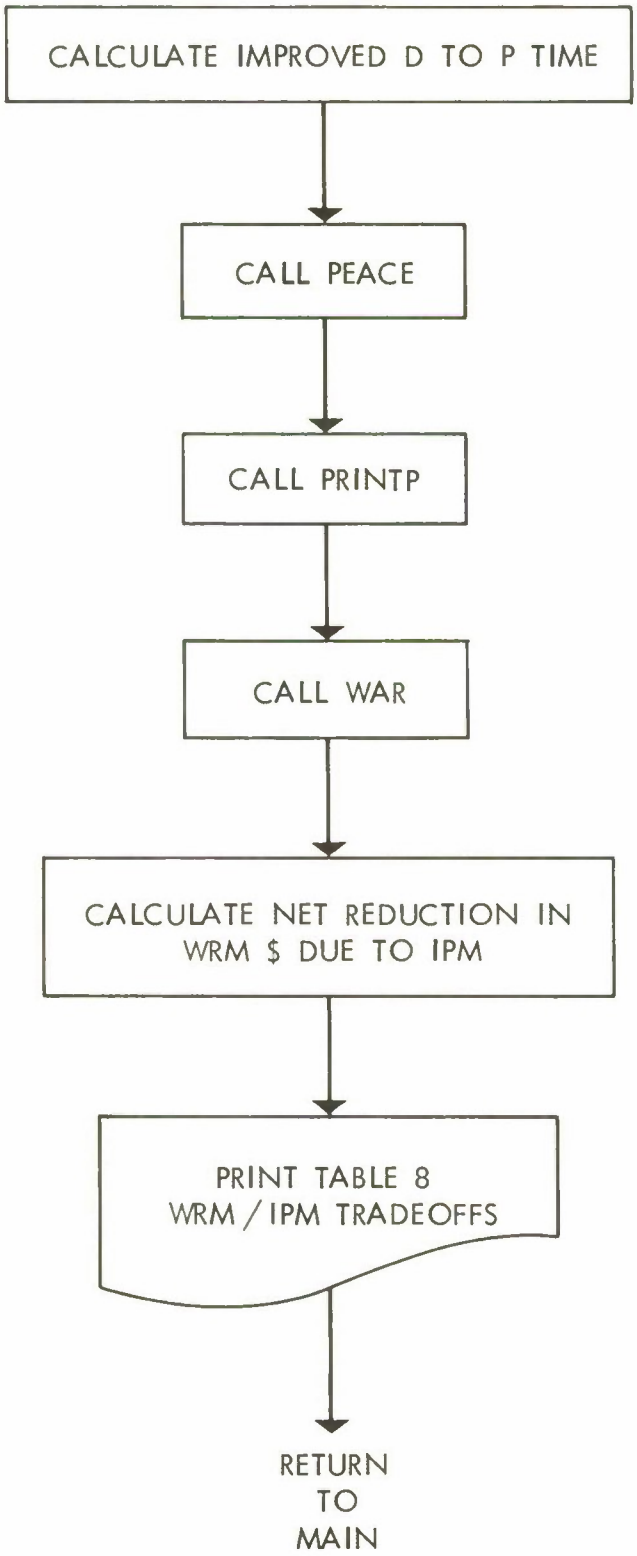


TABLE9

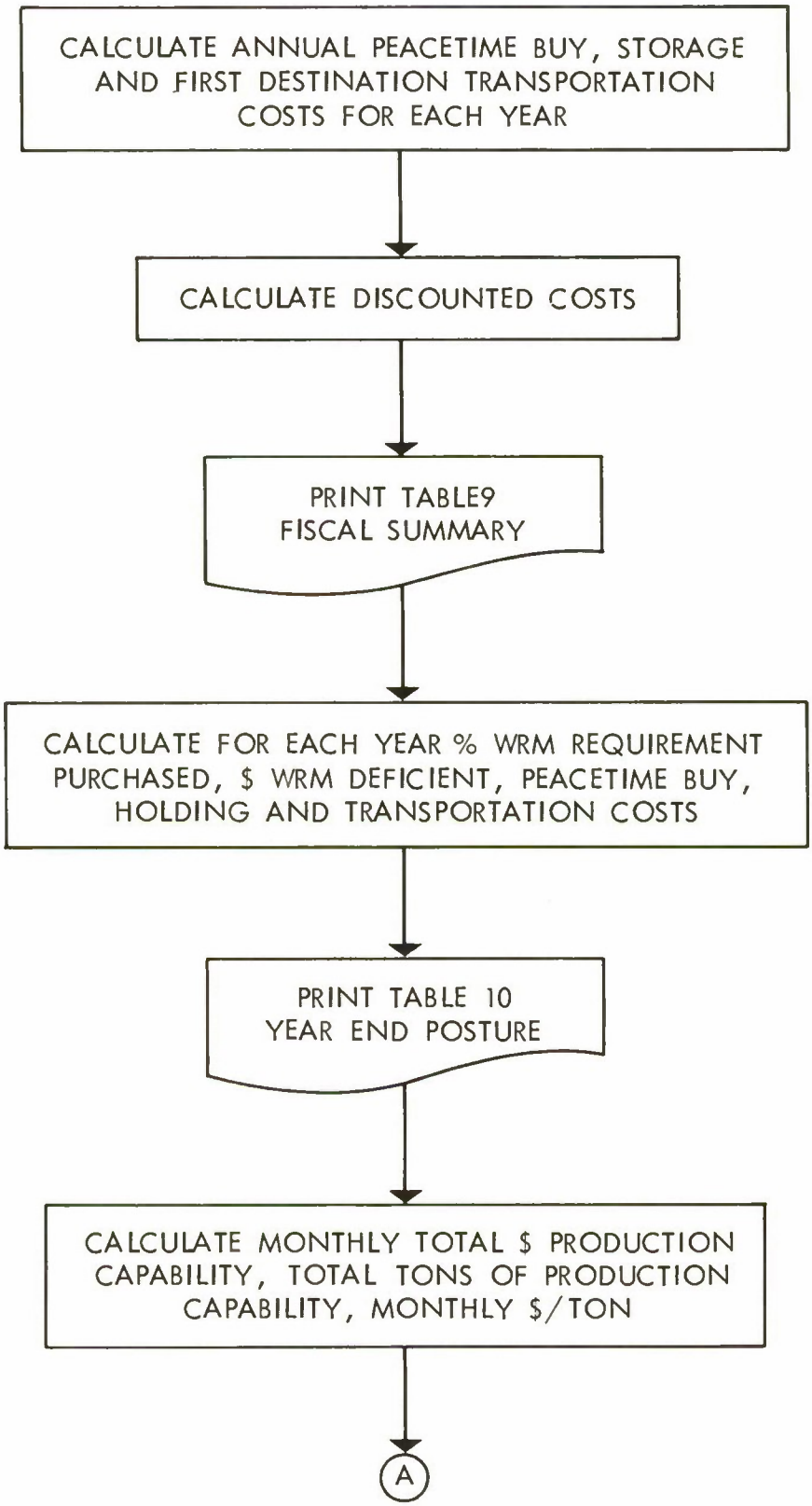
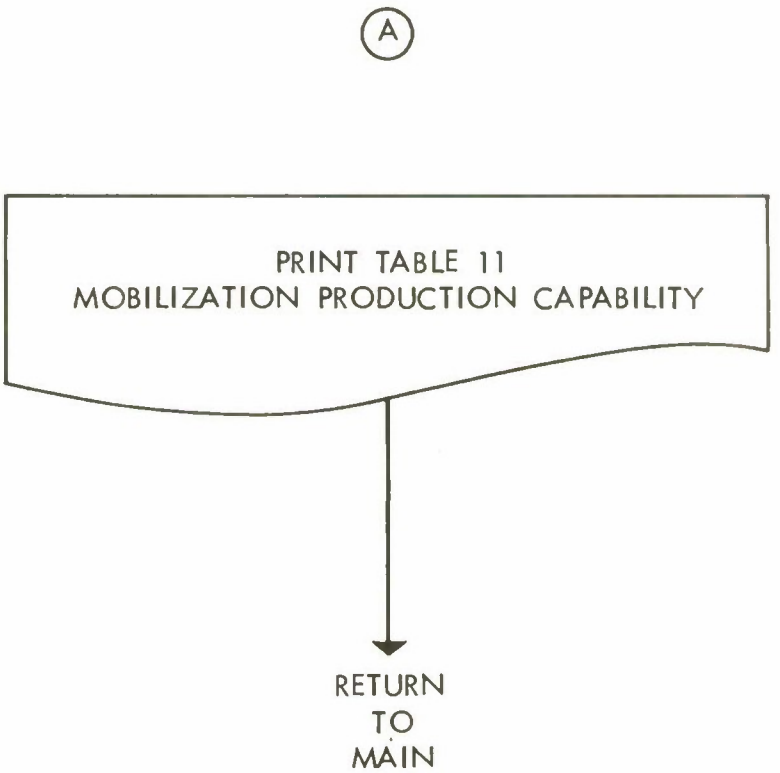

CALCULATE ANNUAL PEACETIME BUY, STORAGE AND FIRST DESTINATION TRANSPORTATION COSTS FOR EACH YEAR
CALCULATE DISCOUNTED COSTS
PRINT TABLE9 FISCAL SUMMARY
CALCULATE FOR EACH YEAR % WRM REQUIREMENT PURCHASED, $ WRM DEFICIENT, PEACETIME BUY, HOLDING AND TRANSPORTATION COSTS
PRINT TABLE 10 YEAR END POSTURE
CALCULATE MONTHLY TOTAL $ PRODUCTION CAPABILITY, TOTAL TONS OF PRODUCTION CAPABILITY, MONTHLY $/TON
A

TABLE 9, CONT'D



Appendix C

SWIPE COMPUTER PROGRAM

```
C
C              INDICES
C          I MUNITION TYPE
C          J AIRCRAFT TYPE
C          K YEAR WAR STARTS
C          L THEATRE
C          M MONTH
C          N AGE OF MUNITION
C                        INPUTS
C    NFLAG           NUMBER OF JOBS TO BE RUN
C    ALPH(II)        JOB TITLE ARRAY
C    MPW             DURATION OF WAR (MONTHS)
C    NMUN            NUMBER OF MUNITION TYPES
C    NAC             NUMBER OF AIRCRAFT TYPES
C    KYR1            YEAR 1
C    KYRL            LAST YEAR
C    NYRS            NUMBER OF YEARS CONSIDERED
C    PLT             PIPELINE TIME
C    NTPRNT          NUMBER OF MUNITIONS EXAMINED IN SELECTED LIST
C    NYRINV          NUMBER OF YEARS OF INVENTORY (OPENING)
C    NRUNS           1: NO IPM   2: IPM
C    MODMPC          0: REGULAR MPC   1: MPC INCLUDES PEACETIME PRODUCTION
C    INPREL          0: DO NOT PRINT OUT INPUTS   1: PRINT OUT INPUTS
C    MPC77           0: NO CHANGE   1: MPC(YEAR LAST)=MPC(YEAR PREVIOUS)
C    ALPHA(I)        MUNITION NAMES
C    WT(I)           MUNITION WEIGHT FACTOR
C    TRAN(I)         FIRST DESTINATION TRANSPORTATION COEFFICIENT
C    ALAGE(I)        LIFETIME OF MUNITION I
C    HOLD            HOLDING COST FACTOR
C    DISCR           DISCOUNT RATE
C    INVE(I,1,N)     NUMBER OF INVENTORY ITEMS OF AGE N AT START OF TEST
C    BALOT(I)        BASE LOT SIZE OF THE I TH MUNITION
C    C1(I)           FIRST CONSTANT IN COSTING FUNCTION
C    PPM(I,K)        PEACETIME PRODUCTION
C    PTC(I,K)        PEACETIME CONSUMPTION
C    SEA(I,K)        SEA REQUIREMENTS
C    MAP(I,K)        MILITARY SALES, AID, ETC.
C    UNITC(I)        BASE UNIT COST OF MUNITION
C    FSIZE(J,M)      FORCE SIZE (THTR2)
C    SOR(J,M)        SORTIE RATE/MONTH (THTR2)
C    EPS(I,J)        MUNITION EXPENDITURE PER SORTIE (THTR2)
C    FSIZE1(J,M)     FORCE SIZE (THTR1)
C    SOR1(J,M)       SORTIE RATE/MONTH (THTR1)
C    EPS1(I,J)       MUNITION EXPENDITURE PER SORTIE (THTR1)
C    PPRT(I,L)       PREPOSITION REQUIREMENT TIME FOR EACH THEATRE
C    MPC(I,M)        MOBILIZATION PRODUCTION CAPABILITY
C    CODE(I)         CODE FOR IPM PURCHASE TYPE FOR I TH WEAPON
C    IPM(I)          IPM COSTS
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ FSIZE(38,5,24),FSIZE1(38,5,3),SOR(38,5,24),
     1SOR1(38,5,3),EPS(50,38,5),EPS1(50,38,5)
      INTEGER PLT
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
```

```
      PRINT 9010
      PRINT 9012
      PRINT 9014
      PRINT 9016
      PRINT 9018
      PRINT 9020
      PRINT 9022
      PRINT 9024
      PRINT 9026
      PRINT 9028
      PRINT 9030
      PRINT 9032
      PRINT 9034
      PRINT 9036
      PRINT 9038
      PRINT 9040
      PRINT 9042
      PRINT 9044
      PRINT 9046
      PRINT 9048
      PRINT 9050
      PRINT 9052
      PRINT 9054
      PRINT 9056
      PRINT 9058
      PRINT 9060
      PRINT 9062
      PRINT 9064
9010 FORMAT(1H1,29X,'THIS SIMULATION RUN OF THE SWIPE (SYSTEM FOR WRM',
     1'/IRMP POLICY EVALUATION)')
9012 FORMAT (25X,'COMPUTER MODEL SHOWS THE COSTS AND IMPACTS OF YOUR',
     1' FIVE YEAR MUNTIONS PROCURE-')
9014 FORMAT (25X,'MENT PLAN.  IT IS A MANAGEMENT INFORMATION TOOL. ',
     1' IT DOES NOT MAKE MANAGEMENT')
9016 FORMAT (25X,'DECISIONS.'/)
9018 FORMAT (30X,'YOU CAN VARY THE FOLLOWING INPUT DATA:'/)
9020 FORMAT (33X,'AIRCRAFT TYPE                MUNITIONS TYPE')
9022 FORMAT (33X,'FORCE SIZE                   MUNITIONS COST')
9024 FORMAT (33X,'SORTIE RATE                  PIPELINE TIME')
9026 FORMAT (33X,'EXPENDITURE RATE             PEACETIME PRODUCTION')
9028 FORMAT (33X,'MUNITIONS INVENTORY          WARTIME PRODUCTION',
     1' CAPABILITY')
9030 FORMAT (33X,'TRANSPORTATION COST          LEARNING CURVE SLOPE')
9032 FORMAT (33X,'STORAGE COST'/)
9034 FORMAT (30X,'ALSO, YOU MAY APPLY LOT SIZE COST DIFFERENTIALS,',
     1' INTEREST, AND DISCOUNT.'/)
9036 FORMAT (30X,'IN ADDITION TO THE PROCUREMENT AMOUNTS AND COSTS, ',
     1'THE OUTPUT TABLES')
9038 FORMAT (25X,'DEPICT THE MAGNITUDE AND DURATION OF ANY MUNITIONS',
     1' DEFICIENCIES OVER 24 MONTHS')
9040 FORMAT (25X,'OF WAR STARTING IN EACH OF FIVE YEARS.'/)
9042 FORMAT (25X,'TABLE 1.  INVENTORY AND PROCUREMENT SUMMARY FOR ',
     1'FY-- (5 YEARS)'/)
9044 FORMAT (25X,'TABLE 2.  SUMMARY OF 5 YEAR BUY'/)
9046 FORMAT (25X,'TABLE 3.  WARTIME REQUIREMENTS SUMMARY FOR FY',
     1'-- (5 YEARS)'/)
9048 FORMAT (25X,'TABLE 4.  MONTHLY PRODUCTION/DEMAND FOR WAR',
```

```
     1' STARTING IN FY-- (5 YEARS)'/)
 9050 FORMAT (25X,'TABLE 5.  $ SUPPLY/$ DEMAND'/)
 9052 FORMAT (25X,'TABLE 6.  MUNITIONS AVAILABILITY -- SURPLUS AND ',
     1'DEFICITS FOR WAR STARTING IN')
 9054 FORMAT (35X,'FY-- (5 YEARS)'/)
 9056 FORMAT (25X,'TABLE 7.  D TO P INFORMATION FOR FY-- (5 YEARS)'/)
 9058 FORMAT (25X,'TABLE 8.  WRM/IPM TRADEOFF'/)
 9060 FORMAT (25X,'TABLE 9.  FISCAL SUMMARY FOR FY 73-77'/)
 9062 FORMAT (25X,'TABLE 10.  YEAR END POSTURE FOR FY--'/)
 9064 FORMAT (25X,'TABLE 11.  MOBILIZATION PRODUCTION CAPABILITY')
C
C            READ IN DATA
C
      READ (5,7) NFLAG
    7 FORMAT (24I3)
      DO 9000 JJJ=1,NFLAG
      READ (5,2000)  (ALPH(II,1),II=1,20)
 2000 FORMAT(20A4)
 2005 FORMAT ('1',24X,20A4)
 2006 FORMAT (25X,20A4)
 2007 FORMAT(35X,'-------------------------------------------------',
     1'----------'///)
      READ(5,1060)MPW,NMUN,NAC,KYR1,KYRL,NYRS,PLT,NTPRNT,NYRINV,NRUNS,
     1                  MODMPC,INPRFL,MPC77
 1060 FORMAT(24I3)
      DO 10 I=1,NMUN
      DO 10 N=1,10
      INVE(I,1,N)=0
   10 CONTINUE
      READ (5,1150)(ALPHA(I,1),ALPHA(I,2),I=1,NMUN)
 1150 FORMAT(8(1X,2A4))
 1095 FORMAT(16F5.2)
      READ(5,1030)(WT(I),I=1,NMUN)
      READ (5,1095) (TRAN(I),I=1,NMUN)
      READ(5,1080)(ALAGE(I),I=1,NMUN)
 1080 FORMAT(26F3.0)
      READ (5,1085) HOLD,DISCR
 1085 FORMAT (16F5.3)
      DO 1111 I=1,NMUN
      READ(5,1070) (INVE(I,1,N),N=1,NYRINV)
 1070 FORMAT(8I9)
 1111 CONTINUE
      READ (5,1075) (BALOT(I),I=1,NMUN)
 1075 FORMAT  (8F9.0)
      READ (5,1077) (C1(I),I=1,NMUN)
 1077 FORMAT (16F5.2)
      DO 1078 I=1,NMUN
      C1(I)=1./C1(I)
      C1(I)=-ALOG(C1(I))/.693147
 1078 CONTINUE
      DO 1050 K=1,NYRS
      READ(5,1040)(PPM(I,K),I=1,NMUN)
 1040 FORMAT(8F9.0)
      READ(5,1040)(PTC(I,K),I=1,NMUN)
      READ(5,1040)(SEA(I,K),I=1,NMUN)
      READ(5,1040)(MAP(I,K),I=1,NMUN)
 1050 CONTINUE
```

```
      READ(5,1030)(UNITC(I,1),I=1,NMUN)
 1030 FORMAT (10F8.2)
      DO 1113 J=1,NAC
      READ(5,1077) (FSIZE(J,1,M),M=1,MPW)
 1010 FORMAT(16F5.0)
 1113 CONTINUE
      DO 1114 J=1,NAC
      READ(5,1020) (SOR (J,1,M),M=1,MPW)
 1020 FORMAT (16F5.0)
 1114 CONTINUE
      DO 1112 J=1,NAC
      READ(5,1000) (EPS(I,J,1),I=1,NMUN)
 1000 FORMAT(8F9.4)
 1112 CONTINUE
      DO 1117 J=1,NAC
      READ(5,1077) (FSIZE1(J,1,M),M=1,3)
 1117 CONTINUE
      DO 1118 J=1,NAC
      READ(5,1020) (SOR1(J,1,M),M=1,3  )
 1118 CONTINUE
      DO 1116 J=1,NAC
      READ(5,1000) (EPS1(I,J,1),I=1,NMUN)
 1116 CONTINUE
      DO 1122 L=1,2
      READ(5,1110) (PPRT(I,1,L),I=1,NMUN)
 1110 FORMAT(16F5.2)
 1122 CONTINUE
      DO 1121 I=1,NMUN
      READ(5,1120) (MPC(I,1,M),M=1,MPW)
 1120 FORMAT (10F8.0)
 1121 CONTINUE
      DO 1152 K=2,NYRS
      DO 1125 I=1,NMUN
      UNITC(I,K)=UNITC(I,K-1)
 1125 CONTINUE
      DO 1138 J=1,NAC
      DO 1130 M=1,MPW
      FSIZE (J,K,M)=FSIZE(J,K-1,M)
      SOR(J,K,M)=SOR(J,K-1,M)
 1130 CONTINUE
      DO 1132 M=1,3
      FSIZE1(J,K,M)=FSIZE1(J,K-1,M)
      SOR1(J,K,M)=SOR1(J,K-1,M)
 1132 CONTINUE
      DO 1135 I=1,NMUN
      EPS(I,J,K)=EPS(I,J,K-1)
      EPS1(I,J,K)=EPS1(I,J,K-1)
 1135 CONTINUE
 1138 CONTINUE
      DO 1147 I=1,NMUN
      DO 1140 L=1,2
      PPRT(I,K,L)=PPRT(I,K-1,L)
 1140 CONTINUE
      DO 1145 M=1,MPW
      MPC(I,K,M)=MPC(I,K-1,M)
 1145 CONTINUE
 1147 CONTINUE
```

```
 1152 CONTINUE
C
C            ADJUST MPC TO REFLECT PEACETIME PRODUCTION
C
      IF (MODMPC.NE.1) GO TO 1190
      DO 1180 K=1,NYRS
      DO 1170 I=1,NMUN
      XPPM=PPM(I,K)/12.
      DO 1160 M=1,MPW
      IF(MPC(I,K,M).GE.XPPM) GO TO 1170
      MPC(I,K,M)=XPPM
 1160 CONTINUE
 1170 CONTINUE
 1180 CONTINUE
 1190 CONTINUE
      IF (MPC77.NE.1) GO TO 1210
      NYRSM1=NYRS-1
      DO 1200 I=1,NMUN
      DO 1200 M=1,MPW
      MPC(I,NYRS,M)=MPC(I,NYRSM1,M)
 1200 CONTINUE
 1210 CONTINUE
      FLAG=0.
C
C            CALCULATE PLANNED WARTIME DEMAND
C
      CALL CALDEM
C
C            PRINT OUT INPUTS
C
      IF(INPRFL.EQ.1) CALL INPRNT
C
C            CALCULATE PEACETIME MUNITIONS STATUS
C
      CALL PEACE
C
C            CALCULATE AND PRINT TABLES 1, 2, 3
C
      CALL PRINTP
C
C            CALCULATE AND PRINT TABLES 4, 5, 6, 7
C
      CALL WAR
C
C            CALCULATE AND PRINT TABLES 9, 10, 11
C
      CALL TABLE9
      IF(NRUNS.EQ.1) GO TO 6000
C
C            START WRM/IPM TRADEOFF (TABLE 8.)
C
      READ (5,2000) (ALPH(II,1),II=1,20)
      DO 6010 K=1,NYRS
      READ(5,1040)(PPM(I,K),I=1,NMUN)
 6010 CONTINUE
      READ (5,1001)(CODE(I,1),I=1,NMUN)
 1001 FORMAT (16(1X,A4))
```

```
      READ (5,1040) (IPM(I,1),I=1,NMUN)
      DO 2001 I=1,NMUN
      READ (5,1120)  (MPC(I,1,M),M=1,MPW)
2001  CONTINUE
      DO 3070 K=2,NYRS
      DO 3070 I=1,NMUN
      CODE (I,K)=CODE(I,K-1)
      IPM(I,K)=0.
      DO 3060 M=1,MPW
      MPC(I,K,M)=MPC(I,K-1,M)
3060  CONTINUE
3070  CONTINUE
      IF(MODMPC.NE.1) GO TO 3100
      DO 3090 K=1,NYRS
      DO 3090 I=1,NMUN
      XPPM=PPM(I,K)/12.
      DO 3080 M=1,MPW
      IF(MPC(I,K,M).GE.XPPM) GO TO  3090
      MPC(I,K,M)=XPPM
3080  CONTINUE
3090  CONTINUE
3100  CONTINUE
      IF (MPC77.NE.1) GO TO 6010
      NYRSM1=NYRS-1
      DO 2003 I=1,NMUN
      DO 2003 M=1,MPW
      MPC(I,NYRS,M)=MPC(I,NYRSM1,M)
2003  CONTINUE
      CALL CHART
6000  CONTINUE
9000  CONTINUE
      STOP
      END
```

```
      SUBROUTINE CALDEM
C
C             CALCULATES PLANNED WARTIME DEMAND IN
C                     THTR1 and THTR2.
C
C
      INTEGER PLT
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ FSIZE(38,5,24),FSIZE1(38,5,3),SOR(38,5,24),
     1SOR1(38,5,3),EPS(50,38,5),EPS1(50,38,5)
C
C             CALCULATE WARTIME DEMAND TDEM(I,K,L,M)
C             WAR THEATRE FIRST (THTR2).
C
      DO 20 K=1,NYRS
      DO 20 I=1,NMUN
      DO 20 M=1,MPW
      TDEM(I,K,2,M)=0.
      DO 20 J=1,NAC
      TDEM(I,K,2,M)=TDEM(I,K,2,M)+FSIZE(J,K,M)*EPS(I,J,K)*SOR(J,K,M)
   20 CONTINUE
C
C             OTHER THEATRE NEXT (THTR1)
C
      DO 40 K=1,NYRS
      DO 40 I=1,NMUN
      DO 40 M=1,3
      TDEM(I,K,1,M)=0.
      DO 40 J=1,NAC
      TDEM(I,K,1,M)=TDEM(I,K,1,M)+FSIZE1(J,K,M)*EPS1(I,J,K)*SOR1(J,K,M)
   40 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE TITLE
C
C            PRINTS JOB DESCRIPTION ON EACH OUTPUT PAGE
C
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
 2005 FORMAT(1H1,24X,20A4)
 2007 FORMAT(35X,50H--------------------------------------------------,
     1       10H----------,/)
      WRITE(6,2005)(ALPH(II,1),II=1,20)
      WRITE(6,2007)
      RETURN
      END
```

```
      SUBROUTINE INPRNT
C
C           PRINTS OUT INPUT DATA
C
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ FSIZE(38,5,24),FSIZE1(38,5,3),SOR(38,5,24),
     1SOR1(38,5,3),EPS(50,38,5),EPS1(50,38,5)
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
      INTEGER IYEAR(5)
      IYEAR(1)=1900+KYR1
      IF(NYRS.EQ.1)GO TO 7
      DO 5 K=2,NYRS
      IYEAR(K)=IYEAR(K-1) +1
    5 CONTINUE
    7 DO 300  I=1,NMUN
      CALL TITLE
      WRITE(6,10)ALPHA(I,1),ALPHA(I,2)
   10 FORMAT(1X,'MUNITION',2A4)
      WRITE(6,20)       WT(I),TRAN(I),ALAGE(I)
   20 FORMAT(1X,                    'WEIGHT',F14.2/1X,'TRANSPORTATION',
     1      F6.2/1X,'ALLOWABLE AGE',F6.0)
      WRITE(6,30)(INVE(I,1,N),N=1,NYRINV)
   30 FORMAT(1X,'INITIAL INVENTORY',8I8)
      WRITE(6,40)BALOT(I),C1(I)
   40 FORMAT(1X,'BASE LOT SIZE',F9.0,' RATE FOR LEARNING CURVE',F5.2)
      WRITE(6,50)(IYEAR(K),K=1,NYRS)
   50 FORMAT(7H0 YEARS,10X,5I15)
      WRITE(6,60)(UNITC(I,K),K=1,NYRS)
   60 FORMAT(1X,'UNIT COST',7X,5F15.0)
      WRITE(6,70)(PPM(I,K),K=1,NYRS)
   70 FORMAT(1X,'PEACE PRODUCTION',5F15.0)
      WRITE(6,80)(PTC(I,K),K=1,NYRS)
   80 FORMAT(1X,'PEACE CONSUMPTION',F14.0,4F15.0)
      WRITE(6,90)(SEA(I,K),K=1,NYRS)
   90 FORMAT(1X,'SEA',13X,5F15.0)
  100 FORMAT(1X,'MAP',13X,5F15.0)
      WRITE(6,100)(MAP(I,K),K=1,NYRS)
      WRITE(6,110)
  110 FORMAT(1X,'EXPENDITURES PER SORTIE'/1X,'AIRCRAFT')
      DO 130 J=1,NAC
      WRITE(6,120) J,(EPS(I,J,K),K=1,NYRS)
  120 FORMAT(I6,14X,5F15.4)
  130 CONTINUE
      WRITE(6,140)
  140 FORMAT('ONATO THEATRE'/1X,'AIRCRAFT')
      DO 160 J=1,NAC
      WRITE(6,120)J,(EPS1(I,J,K),K=1,NYRS)
  160 CONTINUE
      CALL TITLE
      WRITE(6,10)ALPHA(I,1),ALPHA(I,2)
      WRITE(6,50)(IYEAR(K),K=1,NYRS)
      WRITE(6,170)
  170 FORMAT(' MPC. MONTH')
```

```
      DO 200 M=1,MPW
      WRITE(6,180)M,(MPC(I,K,M),K=1,NYRS)
  180 FORMAT(I6,10X,5F15.0)
  200 CONTINUE
      WRITE(6,210)
  210 FORMAT('OREQ. MONTH')
      DO 220 M=1,MPW
      WRITE(6,180)M,(TDEM(I,K,2,M),K=1,NYRS)
  220 CONTINUE
      WRITE(6,230)
  230 FORMAT('THTRI.MONTH')
      DO 240 M=1,3
      WRITE(6,180)M,(TDEM(I,K,1,M),K=1,NYRS)
  240 CONTINUE
      WRITE(6,245)
  245 FORMAT('OPIPELINE REQ TIME')
      DO 270 L=1,2
      WRITE(6,250)L,(PPRT(I,K,L),K=1,NYRS)
  250 FORMAT(' THEATRE',I2,6X,5F15.2)
  270 CONTINUE
  300 CONTINUE
      DO 380  J=1,NAC
      CALL TITLE
      WRITE(6,320) J
  320 FORMAT('0AIRCRAFT',I6)
      WRITE(6,305)(IYEAR(K),K=1,NYRS)
  305 FORMAT(/5X     ,I15,4I20)
      WRITE(6,310)
  310 FORMAT(1X,'MONTH    FSIZE      SORTIE     FSIZE      SORTIE     ',
     1'FSIZE      SORTIE     FSIZE      SORTIE     FSIZE      SORTIE')
      DO 340  M=1,MPW
      WRITE(6,330)M,(FSIZE(J,K,M),SOR(J,K,M),K=1,NYRS)
  330 FORMAT(I4,6X,5(F5.2,F10.0,5X) )
  340 CONTINUE
      WRITE(6,350)
  350 FORMAT('0THEATRE 1')
      DO 360 M=1,3
      WRITE(6,330) M,(FSIZE1(J,K,M),SOR1(J,K,M),K=1,NYRS)
  360 CONTINUE
  380 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PEACE
C
C             CALCULATES PEACETIME MUNITIONS STATUS BY YEAR
C
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
      INTEGER PLT
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ RDR(50,5)    ,TOTAV(50,5,24),PDR(24),IPDR(24),
     1DIFF(50,5,24),DIF(24),DTP(50,5),DTP1(50,5),DTPP(50,5),DTPD(50,5),
     2TIPM(5),PFXRQ1(50,5),OBS(50,5),PFX(50,6),PRE(50,6,2),INV(50,6),
     3PCOST(5),PCOS(50,5),PPR(50,6,2),NWCON(50,5),HOLD78(50),HOLDCT(5),
     4HOLDC(50,5),      PFXRQ(50,5),PS(50,5),TPS(5),TRANCT(5),TTRAN(50),
     5A(10463)
C
C             REMOVE FIRST YEAR OBSOLESCENT INVENTORY
C
      DO 10 I=1,NMUN
   10 OBS(I,1)=0.
      DO 20 I=1,NMUN
      JJ=ALAGE(I)+2
      IF(JJ.GT.10)GO TO 20
      DO 15 JJJ=JJ,10
      IF(INVE(I,1,JJJ).EQ.0)GO TO 20
      OBS(I,1)=OBS(I,1)+INVE(I,1,JJJ)
      INVE(I,1,JJJ)=0
   15 CONTINUE
   20 CONTINUE
C
C             CALCULATE REMAINING INVENTORY FOR FIRST YEAR
C
      DO 30 I=1,NMUN
      INV(I,1)=0
      NN=ALAGE(I)+1
      DO 30 N=1,NN
      INV(I,1)=INV (I,1)+INVE(I,1,N)
   30 CONTINUE
C
C                   CALCULATE PEACE TIME DEMAND
C
      DO 40 K=1,NYRS
      DO 40 I=1,NMUN
      NWCON(I,K)=PTC(I,K)+MAP(I,K)+SEA(I,K)
   40 CONTINUE
C
C                   CALCULATE FUTURE INVENTORY
C
      NYRSP1=NYRS+1
      DO 140 I=1,NMUN
      JJ=ALAGE(I)+2
      DO 110 K=2,NYRSP1
C
C                   ADD NEW PRODUCTION
C
```

```
      INVE(I,K,1)=PPM(I,K-1)
C
C                  ADD INVENTORY CARRIED FROM LAST YEAR
C
      DO  60 N=2,JJ
      INVE(I,K,N)  =INVE(I,K-1,N-1)
   60 CONTINUE
C
C            SUBTRACT PEACETIME CONSUMPTION USING OLDEST FIRST
C
      D=NWCON(I,K-1)
      N  =JJ+1
   70 N=N-1
      IF(N.EQ.0)GO TO 90
      IF(INVE(I,K,N).GE.D)GO TO 80
      D=D-INVE(I,K,N)
      INVE(I,K,N)=0
      GO TO 70
   80 INVE(I,K,N)=INVE(I,K,N)-D
C
C            COUNT OBSOLESENT WEAPONS IF ANY
C
      OBS(I,K)=INVE(I,K,JJ)
      INVE(I,K,JJ)=0
      GO TO 110
   90 WRITE(6,100)I,K
  100 FORMAT('1*** ERROR PEACE CONSUMPTION EXCEEDS INVENTORY *',2I6)
      OBS(I,K)=0.
  110 CONTINUE
C
C                  CALCULATE TOTAL INVENTORY (NOT OBSOLETE)
C
      JJ=ALAGE(I)+1
      DO 130 K=2,NYRSP1
      INV(I,K)=0
      DO 120 N=1,JJ
      INV(I,K) =INV(I,K) +INVE(I,K,N)
  120 CONTINUE
  130 CONTINUE
  140 CONTINUE
C
C                  CALCULATE PRODUCTION COSTS
C
      DO 160 K=1,NYRS
      HOLDCT(K)=0.
      PCOST(K)=0.0
      DO 150 I=1,NMUN
      PRICE=XEWP(C1(I),      BALOT(I),PPM(I,K),UNITC(I,K))
      PCOS(I,K)=PRICE*(PPM(I,K)-MAP(I,K))
      HOLDC(I,K)=WT(I)*HOLD*(PPM(I,K)-MAP(I,K))
      PCOST(K)=PCOST(K)+PCOS(I,K)
      HOLDCT(K)=HOLDCT(K)+HOLDC(I,K)
  150 CONTINUE
  160 CONTINUE
C
C            CALCULATE PREPOSITION REQUIREMENTS
C
```

```
      DO 180 L=1,2
      DO 180 K=1,NYRS
      DO 180 I=1,NMUN
      PPR(I,K,L)=0
      MM=PPRT(I,K,L)
      DO 170 M=1,MM
      PPR(I,K,L)=PPR(I,K,L)+TDEM(I,K,L,M)
  170 CONTINUE
      PPR(I,K,L)=PPR(I,K,L)+(PPRT(I,K,L)-MM)*TDEM(I,K,L,MM+1)
  180 CONTINUE
      NYP1=NYRS+1
      DO 175 I=1,NMUN
      PPR(I,NYP1,1)=PPR(I,NYRS,1)
      PPR(I,NYP1,2)=PPR(I,NYRS,2)
  175 CONTINUE
C
C           ALLOCATE INVENTORY BETWEEN PREPOSITIONING AND PACERFLEX
C
      NYRSP1=NYRS+1
      DO 190 K=1,NYRSP1
      DO 190 I=1,NMUN
      X=INV(I,K)
      PRE(I,K,1)=AMIN1(X,PPR(I,K,1))
      PRE(I,K,2)=AMIN1(X-PRE(I,K,1),PPR(I,K,2))
      PFX(I,K)=X-PRE(I,K,1)-PRE(I,K,2)
  190 CONTINUE
      NYRSM1=NYRS-1
 5000 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PRINTP
C
C            CALCULATES AND PRINTS TABLES 1, 2, 3

      COMMON/TABLE/ MMSI(6),SHORT1(6)
      INTEGER PLT
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ RDR(50,5)    ,TOTAV(50,5,24),PDR(24),IPDR(24),
     1DIFF(50,5,24),DIF(24),DTP(50,5),DTP1(50,5),DTPP(50,5),DTPD(50,5),
     2TIPM(5),PFXRQ1(50,5),OBS(50,5),PFX(50,6),PRE(50,6,2),INV(50,6),
     3PCOST(5),PCOS(50,5),PPR(50,6,2),NWCON(50,5),HOLD78(50),HOLDCT(5),
     4HOLDC(50,5),     PFXRQ(50,5),PS(50,5),TPS(5),TRANCT(5),TTRAN(50),
     5A(10463)
      REAL TBUY(50),DBUY(50),THOLD(50)
      INTEGER IYEAR(5)
C
C            CALCULATE WRM REQUIREMENT (PFXRQ(I,K))
C            CALCULATE MUNITIONS POTENTIALLY AVAILABLE IN WAR THEATRE
C               AS A RESULT OF MOBILIZATION PRODUC TON CAPABILITY
C
      NPLTP1=PLT+1.
      NPLTP2=PLT+2.
      DO 25 K=1,NYRS
      DO 25 I=1,NMUN
      TOTAV(I,K,NPLTP1)=MPC(I,K,NPLTP1-PLT)
      DO 18 M=NPLTP2,MPW
      TOTAV(I,K,M)=TOTAV(I,K,M-1)+MPC(I,K,M-PLT)
   18 CONTINUE

C
C            CALCULATE MUNITIONS AVAILABLE IN WAR THEATRE GIVEN DEMAND
C
C
      TUSED=0.
      MPWM1=MPW-1
      DO 19 M=NPLTP1,MPWM1
      DIFF(I,K,M)=TOTAV(I,K,M)-TDEM(I,K,2,M)
      TUSED=TUSED+AMIN1(TOTAV(I,K,M),TDEM(I,K,2,M))
      TOTAV(I,K,M+1)=TOTAV(I,K,M+1)-TUSED
   19 CONTINUE
      DIFF(I,K,24)=TOTAV(I,K,24)-TDEM(I,K,2,24)
C
C            CALCULATE TOTAL SHORTAGES AND THUS WRM REQUIREMENT
C
      PFXRQ(I,K)=0.
      DO 21 M=NPLTP1,MPW
      PFXRQ(I,K)=PFXRQ(I,K)+AMIN1(DIFF(I,K,M),0.)
   21 CONTINUE
      PFXRQ(I,K)=-PFXRQ(I,K)
   25 CONTINUE
      DO 10 K=1,NYRS
      IYEAR(K)=K+1899+KYR1
```

```
   10 CONTINUE
      DO 20 I=1,NMUN
      TBUY(I)=0.
      DBUY(I)=0.
      THOLD(I)=0.0
      TTRAN(I)=0.
   20 CONTINUE
      GHO=0.
      GDB=0.
C
C                                  ---TABLE 1.---
C
      DO 75 K=1,NYRS
      TRANCT(K)=0.
      CALL TITLE
      KK=K+KYR1-1
      WRITE(6,30) KK
   30 FORMAT (32X,'TABLE 1.    **INVENTORY AND PROCUREMENT SUMMARY FOR',
     1' FY',I3,'**'//)
      WRITE(6,40)
   40 FORMAT (14X,'-------INITIAL INVENTORY (K)-------',17X,'-----',
     1'FY BUY------      --ADDED COSTS--')
      WRITE(6,50)
   50 FORMAT(5X,'ITEM',5X,' THTR1 ',5X,' THTR2 ',5X,'PACER',5X,'TOTAL',
     1  4X,'UNIT PRICE',3X,'UNITS',8X,'COST',5X,'TRANS',3X,'STORAGE')
       WRITE(6,55)
   55 FORMAT(14X,'PREPO',5X,'PREPO',5X,'FLEX ',17X,'($)',10X,'(K)',
     1    7X,'($M)',6X,'($M)',5X,'($M)')
      XTRAN=0.
      XTOT=0.
      DO 65 I=1,NMUN
      THOLD(I)=THOLD(I)+HOLDC(I,K)
      TBUY(I)=TBUY(I)+PPM(I,K)-MAP(I,K)
      DBUY(I)=DBUY(I)+PCOS(I,K)
      PRICE=XEWP(C1(I),BALOT(I),PPM(I,K),UNITC(I,K))
      PRE1=PRE(I,K,1)/1000.
      PRE2=PRE(I,K,2)/1000.
      PFX1=PFX(I,K)/1000.
      ANV1=INV(I,K)/1000.
      PCOS1=PCOS(I,K)/1000000.
      HOLDC1=HOLDC(I,K)/1000000.
      TRAN1=TRAN(I)*WT(I)*(PPM(I,K)-MAP(I,K))/1000000.
      TOT1=TRAN1+PCOS1
      XTRAN=XTRAN+TRAN1
      XTOT=XTOT+TOT1
      TTRAN(I)=TTRAN(I)+TRAN1
      TRANCT(K)=TRANCT(K)+TRAN1
      UBUY=(PPM(I,K)-MAP(I,K))/1000.
      WRITE (6,60)ALPHA(I,1),ALPHA(I,2),PRE1,PRE2,PFX1,ANV1,
     1        PRICE,UBUY,PCOS1,TRAN1,HOLDC1
   60 FORMAT(1X,2A4,4F10.2, F13.2,F 9.2,F12.2,2F10.2)
   65 CONTINUE
      GHO=GHO+HOLDCT(K)
      GDB=GDB+PCOST(K)
      HO=HOLDCT(K)/1000000.
      PC=PCOST(K)/1000000.
   75 CONTINUE
```

```
C
C                                  ---TABLE 2.---
C            CALCULATE AND PRINT SUMMARY OF FIVE YEAR INVENTORY BUY, ETC
C
      NYP1=NYRS+1
      THO=0.
      CALL TITLE
      PRINT 80,NYRS
   80 FORMAT (41X,'TABLE 2.    **SUMMARY OF',I2,' YEAR BUY**'//)
      KKK=KYRL+1
      WRITE(6,85) KYR1,KYRL
   85 FORMAT (15X,'INITIAL',5X,'FINAL         ---FY',I3,'-',I2,'BUY---',
     15X,'ADDED COSTS ($M)')
      WRITE(6,87)
   87 FORMAT(14X,'INVENTORY',3X,'INVENTORY',5X,'UNITS',8X,'COST',
     1      5X,'TRANS',3X,'STORAGE')
       WRITE(6,88)
   88 FORMAT(5X,'ITEM',8X,'(K)',9X,'(K)', 9X,'(K)',9X,'($M)')
      DO 89 I=1,NMUN
      P1=PRE(I,1,1)/1000.
      P2=PRE(I,1,2)/1000.
      P3=PRE(I,NYP1,1)/1000.
      P4=PRE(I,NYP1,2)/1000.
      ANVB=INV(I,1)/1000.
      ANVE=INV(I,NYP1)/1000.
      PX1=PFX(I,1)/1000.
      PX6=PFX(I,NYP1)/1000.
      TB=TBUY(I)/1000.
      DB=DBUY(I)/1000000.
      TH=THOLD(I)/1000000.
      SH=TTRAN(I)
      WRITE(6,90) ALPHA(I,1),ALPHA(I,2),ANVB,ANVE,TB,DB,SH,TH
   90 FORMAT(1X,2A4,4F12.2,2F10.2)
   89 CONTINUE
      G1=GHO/1000000.
      G2=GDB/1000000.
C
C                                  ---TABLE 3.---
C
      DO 170 K=1,NYRS
               SHORT1(K)=0.
      CALL TITLE
      KK=K+KYR1-1
      PRINT 110,KK
  110 FORMAT(30X,'TABLE 3. WARTIME REQUIREMENTS SUMMARY FOR FY',I3//)
      WRITE(6,115)
  115 FORMAT (15X,'BASE       ---DEMAND (K)---      ---------REQUIRED ',
     1'INVENTORY--------      -------DEFICIENCY--------')
      WRITE(6,120)
  120 FORMAT(5X,'ITEM',3X,'UNIT PRICE',3X,'D1-D12',3X,'D13-D24',
     1      5X,'THTR1 ',5X,'THTR 2',1X,'PACERFLEX',5X,'TOTAL',5X,'UNITS',
     2      6X,'% OF',6X,'COST')
       WRITE(6,125)
  125 FORMAT(14X,'($)',70X,'(K)',6X,'TOTAL',6X,'($M)')
      DO 160 I=1,NMUN
      DTP(I,K)=1.
      DTPP(I,K)=0.
```

```
      DTPD(I,K)=0.
      DO 145 M=1,MPW
      TDE=.985*TDEM(I,K,2,M)
      IF (MPC(I,K,M).GE.TDE) GO TO 150
      DTP(I,K)=DTP(I,K)+1.
      DTPP(I,K)=DTPP(I,K)+MPC(I,K,M)
      DTPD(I,K)=DTPD(I,K)+TDEM(I,K,2,M)
  145 CONTINUE
  150 PS(I,K)=UNITC(I,K)*PFXRQ(I,K)
      TPS(K)=TPS(K)+PS(I,K)
      IF (I.GT.NTPRNT) GO TO 160
      DEM12=0.
      DO 102 M=1,12
      DEM12=DEM12+TDEM(I,K,2,M)
  102 CONTINUE
      DEM12=DEM12/1000.
      DEM24=0.
      DO 104 M=13,24
      DEM24=DEM24+TDEM(I,K,2,M)
  104 CONTINUE
      DEM24=DEM24/1000.
      PRE1=PPR(I,K,1)/1000.
      PRE2=PPR(I,K,2)/1000.
      PFX1       =PFXRQ(I,K)/1000.
      PFXS    =PS(I,K)/1000000.
       X=PRE1+PRE2+PFX1
      Y=X-INV(I,K)/1000.
      IF(Y.LE.0) Y=0.
                 SHORT1(K)=SHORT1(K)+Y*UNITC(I,K)/1000.
      Z=Y*100./X
      ZD=UNITC(I,K)*Y/1000.
      WRITE (6,130) ALPHA(I,1),ALPHA(I,2),UNITC(I,K),DEM12,DEM24,PRE1,
     1PRE2,PFX1,X,Y,Z,ZD
  130 FORMAT(1X,2A4,F12.2,9F10.2)
  160 CONTINUE
  170 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE WAR
C
C           PLAYS THE WAR, CALCULATES AND PRINTS TABLES 4, 5, 6, 7
C
      COMMON/TABLE/ MMSI(6),SHORT1(6)
      DIMENSION XMSI(24),RSR(24),IRSR(24),MSI(24),TOSHO(50,5)
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
      INTEGER PLT,PLTP2
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ RDR(50,5)    ,TOTAV(50,5,24),PDR(24),IPDR(24),
     1DIFF(50,5,24),DIF(24),DTP(50,5),DTP1(50,5),DTPP(50,5),DTPD(50,5),
     2TIPM(5),PFXRQ1(50,5),OBS(50,5),PFX(50,6),PRE(50,6,2),INV(50,6),
     3PCOST(5),PCOS(50,5),PPR(50,6,2),NWCON(50,5),HOLD78(50),HOLDCT(5),
     4HOLDC(50,5),     PFXRQ(50,5),PS(50,5),TPS(5),TRANCT(5),TTRAN(50),
     5A(10463)
C
C              CALCULATE TOTAL MUNITIONS POTENTIALLY AVAILABLE
C              IN WAR THEATRE EACH MONTH
C
      DO 90 K=1,NYRS
      DO 90 I=1,NMUN
      DO 50 M=1,PLT
   50 TOTAV(I,K,M)=PRE(I,K,2)
      TOTAV(I,K,PLT+1)=PRE(I,K,2)+PFX(I,K)+MPC(I,K,1)
      PLTP2=PLT+2
      DO 60 M=PLTP2,24
      TOTAV(I,K,M)=TOTAV(I,K,M-1)+MPC(I,K,M-PLT)
   60 CONTINUE
   90 CONTINUE
C
C              CALCULATE MUNITIONS ACTUALLY AVAILABLE IN WAR THEATRE
C              EACH MONTH FOR THE GIVEN DEMAND
C
      DO 100 K=1,NYRS
      DO 100 I=1,NMUN
      TUSED=0.
      MPWM1=MPW-1
      DO 95 M=1,MPWM1
      DIFF(I,K,M)=TOTAV(I,K,M)-TDEM(I,K,2,M)
      TUSED=TUSED+AMIN1(TOTAV(I,K,M),TDEM(I,K,2,M))
      TOTAV(I,K,M+1)=TOTAV(I,K,M+1)-TUSED
   95 CONTINUE
      DIFF(I,K,MPW)=TOTAV(I,K,MPW)-TDEM(I,K,2,MPW)
      TUSED=TUSED+AMIN1(TOTAV(I,K,MPW),TDEM(I,K,2,MPW))
  100 CONTINUE
C
C           CALCULATE FOR EACH MUNITION PERCENT OF TOTAL $ DEMAND
C
      DO 130 K=1,NYRS
      DOLARS=0.
      DO 120 I=1,NMUN
      RDR(I,K)=TDEM(I,K,2,1)*UNITC(I,K)
      DOLARS=DOLARS+RDR(I,K)
```

```
  120 CONTINUE
      DO 130 I=1,NMUN
      RDR(I,K)=RDR(I,K)/DOLARS
  130 CONTINUE
C
C                                  ---TABLE 4.---
C            CALCULATIONS FOR PRODUCTION/DEMAND RATIO TABLE
C
      DO 160 K=1,NYRS
      CALL TITLE
      KK=K+KYR1-1
      PRINT 145,KK
  145 FORMAT (27X,'TABLE 4.   **MONTHLY PRODUCTION/DEMAND FOR WAR',
     1' STARTING IN FY',I3,'**'//)
      PRINT 146
  146 FORMAT (12X,'PERCENT OF',30X,'MONTHS AFTER MOBILIZATION',
     1' (M-DAY=D-DAY)',34X,'1-24')
      PRINT 147,(M,M=1,MPW)
  147 FORMAT (5X,'ITEM',3X,'TOTAL COST',2X,24I4,4X,'TOTAL'/)
      DO 160 I=1,NMUN
      X=0.
      Y=0.
      DO 150 M=1,MPW
      IF(TDEM(I,K,2,M).EQ.0.) GO TO 151
      PDR(M)=MPC(I,K,M)/TDEM(I,K,2,M)
      GO TO 152
  151 PDR(M)=9.99
  152 X=X+MPC(I,K,M)
      Y=Y+TDEM(I,K,2,M)
      IF(PDR(M).GT.9.99)PDR(M)=9.99
  150 IPDR(M)=(PDR(M)+.005)*100.
      DR=(RDR(I,K)+.00005)*100.
      IF(Y.EQ.0.) GO TO 168
      TPDR=X/Y
      ITDR=(TPDR+.005)*100.
      IF (ITDR.GT.999) ITDR=999
      PRINT 170,ALPHA(I,1),ALPHA(I,2),  DR,(IPDR(M),M=1,MPW),ITDR
  170 FORMAT (1X,2A4,5X,F6.2,4X,24I4,5X,I3)
      GO TO 160
  168 PRINT 165,ALPHA(I,1),ALPHA(I,2)
  165 FORMAT (1X,2A4,32X,' *  *  *  *  *  *  *  *  *  NOT DEMANDED',
     1'  *  *  *  *  *  *  *  *  *')
  160 CONTINUE
C
C                                  ---TABLE 5.---
C            CALCULATE AND PRINT 'DOLLARS AVAILABLE/DOLLARS DEMANDED'
C
      CALL TITLE
      PRINT 200
  200 FORMAT (45X,'TABLE 5.   **$ SUPPLY/$ DEMAND**'//)
      PRINT 180
  180 FORMAT (1X,'WAR STARTS',32X,'MONTHS AFTER MOBILIZATION',
     1' (M-DAY=D-DAY)',37X'1-24')
      PRINT 148,(M,M=1,MPW)
  148 FORMAT (2X,'IN FY',8X,24I4,7X,'TOTAL'/)
      DO 260 K=1,NYRS
      KK=K+KYR1+1899
```

```
      DO 235 M=1,24
      XMSI(M)=0
  235 CONTINUE
      XXMSI=0
      DO 240 I=1,NMUN
      X=0.
      Y=0.
      DO 237 M=1,MPW
      IF(TDEM(I,K,2,M).EQ.0.) GO TO 238
      XXX=TOTAV(I,K,M)/TDEM(I,K,2,M)
      GO TO 239
  238 XXX=0.
  239 RSR(M)=RDR(I,K)*AMIN1(XXX,1.)
      XMSI(M)=XMSI(M)+RSR(M)
      X=X+AMIN1(TOTAV(I,K,M),TDEM(I,K,2,M))
      Y=Y+TDEM(I,K,2,M)
  237 CONTINUE
      IF(Y.EQ.0.) GO TO 240
      YYY=X/Y
      TRSR=AMIN1(YYY,1.)*RDR(I,K)
      XXMSI=XXMSI+TRSR
      ITSR=(TRSR+.005)*100.
  240 CONTINUE
      DO 245 M=1,MPW
      MSI(M)=(XMSI(M)+0.005)*100.
  245 CONTINUE
      MMSI(K)=(XXMSI+.005)*100.
      PRINT 250,KK,(MSI(M),M=1,MPW),MMSI(K)
  250 FORMAT ( 3X,I4, 8X,24I4,7X,I4)
  260 CONTINUE
C
C                                  ---TABLE 6.---
C            CALCULATE AND PRINT SUMMARY OF SURPLUS AND DEFICITS
C
      DO 370 K=1,NYRS
      DO 300 I=1,NMUN
      TOSHO(I,K)=0.
      DO 300 M=1,12
      IF(DIFF(I,K,M).LT.0.) TOSHO(I,K)=TOSHO(I,K)+DIFF(I,K,M)
  300 CONTINUE
      CALL TITLE
      KK=K+KYR1-1
      PRINT 310,KK
  310 FORMAT (16X,'TABLE 6.   **MUNITIONS AVAILABILITY -- SURPLUS',
     1' AND DEFICITS FOR WAR STARTING IN FY',I3,'**'//)
      PRINT 320
  320 FORMAT (12X,'PERCENT OF',32X,'MONTHS AFTER MOBILIZATION',
     1' (M-DAY=D-DAY)',30X,'12 MONTH')
      PRINT 340,(M,M=1,12)
  340 FORMAT (5X,'ITEM',3X,'TOTAL COST',4X,12(I2,6X),1X,'DEFICIT'/)
      DO 360 I=1,NMUN
        DR=(RDR(I,K)+.00005)*100.
      DO 342 M=1,12
      DIF(M)=(DIFF(I,K,M)+5.)/1000.
  342 CONTINUE
      TOSH=(TOSHO(I,K)+5.)/1000.
      PRINT 350, ALPHA(I,1),ALPHA(I,2),  DR,(DIF(M),M=1,12),TOSH
```

```
350 FORMAT (1X,2A4,3X,F6.2,4X,12F8.2,3X,F9.2)
360 CONTINUE
    DO 366 I=1,NMUN
    DO 366 M=13,24
    IF(DIFF(I,K,M).LT.0.) TOSHO(I,K)=TOSHO(I,K)+DIFF(I,K,M)
366 CONTINUE
    PRINT 365
365 FORMAT (///,1X)
    PRINT 321
321 FORMAT (12X,'PERCENT OF',32X, 'MONTHS AFTER MOBILIZATION',
   1' (M-DAY=D-DAY)',30X,'24 MONTH')
    PRINT 340,(M,M=13,24)
    DO 367 I=1,NMUN
    DR=(RDR(I,K)+.00005)*100.
    DO 368 M=13,24
    DIF(M)=(DIFF(I,K,M)+5.)/1000.
368 CONTINUE
    TOSH=(TOSHO(I,K)+5.)/1000.
    PRINT 350,ALPHA(I,1),ALPHA(I,2),  DR,(DIF(M),M=13,24),TOSH
367 CONTINUE
370 CONTINUE

                              ---TABLE 7.---
        CALCULATE AND PRINT D TO P INFORMATION

    DO 500 K=1,NYRS
    CALL TITLE
    KK=K+KYR1-1
    PRINT 400,KK
400 FORMAT (36X,'TABLE 7.   **D TO P INFORMATION FOR FY',I3,'**'//)
    PRINT 410
    PRINT 420
    PRINT 425
410 FORMAT (53X,'D-P',5X,'D-P',5X,'D-P')
420 FORMAT(43X,'ITEM',5X,'DEMAND',2X,'TIME',5X,'PROD')
425 FORMAT (53X,'(K)',13X,'(K)'/)
    DO 450 I=1,NMUN
    DTPP2=(DTPP(I,K)+5.)/1000.
    DTPD2=(DTPD(I,K)+5.)/1000.
    PRINT 430,ALPHA(I,1),ALPHA(I,2),DTPD2,DTP(I,K),DTPP2
430 FORMAT(39X,2A4,1X,F9.2,4X,F3.0,2X,F8.2)
450 CONTINUE
500 CONTINUE
380 CONTINUE
    RETURN
    END
```

```
      SUBROUTINE CHART
C
C             PERFORMS WRM/IPM TRADEOFF
C
      INTEGER PLT
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ RDR(50,5)    ,TOTAV(50,5,24),PDR(24),IPDR(24),
     1DIFF(50,5,24),DIF(24),DTP(50,5),DTP1(50,5),DTPP(50,5),DTPD(50,5),
     2TIPM(5),PFXRQ1(50,5),OBS(50,5),PFX(50,6),PRE(50,6,2),INV(50,6),
     3PCOST(5),PCOS(50,5),PPR(50,6,2),NWCON(50,5),HOLD78(50),HOLDCT(5),
     4HOLDC(50,5),      PFXRQ(50,5),PS(50,5),TPS(5),TRANCT(5),TTRAN(50),
     5A(10463)
      DATA XNONE/'NONE'/
      FLAG=1.
      DO 50 K=1,NYRS
      DO 25 I=1,NMUN
      DTP1(I,K)=DTP(I,K)
      PFXRQ1(I,K)=PFXRQ(I,K)
   25 CONTINUE
      TIPM(K)=0.
      DO 50 I=1,NMUN
      TIPM(K)=TIPM(K)+IPM(I,K)
   50 CONTINUE
      CALL PEACE
      CALL PRINTP
      CALL WAR
C
C                                  ---TABLE 8.---
C           CALCULATE WRM/IPM TRADEOFF
C              CALCULATES NET REDUCTION DUE TO IPM
C
      DO 500 K=1,NYRS
      CALL TITLE
      KK=K+KYR1-1
      PRINT 400,KK
  400 FORMAT (38X,'TABLE 8.   **WRM/IPM TRADEOFFS FOR FY',I3,'**'//)
      WRITE (6,405)
      WRITE (6,410)
      WRITE (6,420)
  405 FORMAT (84X,'OTHER COSTS')
  410 FORMAT (18X,'IPM',18X,'D-P TIME',12X,'WRM AVOIDED',13X,
     1'AVOIDED ($M)',12X,'NET')
  420 FORMAT (5X,'ITEM     IDEN   COST ($M)     W/O IPM   W/IPM      ',
     1'UNITS (K)    COST ($M)     TRANS   STORAGE     REDUCTION ($M)'/)
      TSPFXD=0.
      TTRANS=0.
      TSTOR=0.
      TREDUC=0.
      DO 450 I=1,NMUN
      PFXD=(PFXRQ1(I,K)-PFXRQ(I,K))/1000.
      IF (CODE(I,K).EQ.XNONE) PFXD=0.
      IPMC=IPM(I,K)/1000000.
```

```
      SPFXD=(UNITC(I,K)*PFXD)/1000.
      TRANS=TRAN(I)*WT(I)*PFXD/1000.
      STOR=(HOLD*WT(I)*PFXD)/1000.
      REDUC=SPFXD+TRANS+STOR-IPM(I,K)/1000000.
      TSPFXD=TSPFXD+SPFXD
      TTRANS=TTRANS+TRANS
      TSTOR=TSTOR+STOR
      TREDUC=TREDUC+REDUC
      WRITE (6,430) ALPHA(I,1),ALPHA(I,2),CODE(I,K),IPMC,DTP1(I,K),
     1DTP(I,K),PFXD,SPFXD,TRANS,STOR,REDUC
  430 FORMAT (1X,2A4,5X,A4,F9.2,F13.0,F9.0,F14.2,F11.2,F12.2,F9.2,
     1F15.2)
  450 CONTINUE
      TIPMC=TIPM(K)/1000000.
      WRITE (6,460) TIPMC,TSPFXD,TTRANS,TSTOR,TREDUC
  460 FORMAT (/18X,F9.2,36X,F11.2,F12.2,F9.2,F15.2)
  500 CONTINUE
      CALL TABLE9
      RETURN
      END
```

```
      SUBROUTINE TABLE9
      COMMON/TABLE/ MMSI(6),SHORT1(6)
      COMMON/INPUTS/ NYRS,NMUN,NAC,KYR1,KYRL,PLT,PPRT(50,5,2),ALAGE(50),
     1INVE(50,6,10),PTC(50,5),MAP(50,5),SEA(50,5),MPC(50,5,24),WT(50),
     2UNITC(50,5),PPM(50,5),MPW,ALPHA(50,5),IPM(50,5),NTPRNT,ALPH(20,2),
     3NRUNS,FLAG,BALOT(50),C1(50),TRAN(50),NYRINV,CODE(50,5),DISCR,HOLD
      COMMON/DEVEL/ TDEM(50,5,2,24)
      COMMON/WARCOM/ RDR(50,5)    ,TOTAV(50,5,24),PDR(24),IPDR(24),
     1DIFF(50,5,24),DIF(24),DTP(50,5),DTP1(50,5),DTPP(50,5),DTPD(50,5),
     2TIPM(5),PFXRQ1(50,5),OBS(50,5),PFX(50,6),PRE(50,6,2),INV(50,6),
     3PCOST(5),PCOS(50,5),PPR(50,6,2),NWCON(50,5),HOLD78(50),HOLDCT(5),
     4HOLDC(50,5),     PFXRQ(50,5),PS(50,5),TPS(5),TRANCT(5),TTRAN(50),
     5A(10463)
      INTEGER PLT
      REAL MPC, MAP, IPM, IPMC, IPMS,INV1
C
C                                  ---TABLE 9.---
C            CALCULATE PEACETIME BUY SUMMARY FOR ALL YEARS STUDIED
C
      CALL TITLE
      WRITE (6,600) KYR1,KYRL
  600 FORMAT (36X,'TABLE 9.   **FISCAL SUMMARY FOR FY',I3,'-',I2,
     1' ($M)**'//)
      WRITE (6,610)
  610 FORMAT(21X,'FISCAL',45X,'INTEREST',5X,'TOTAL PLUS')
      DISC=DISCR*100.
      WRITE (6,620) DISC
  620 FORMAT(22X,'YEAR       BUY      TRANS     STORAGE       TOTAL      ',
     1'@ ',F4.1,'%        INTEREST'/)
      PCOSTT=0.
      HOLDTT=0.
      TRANTT=0.
      TOTALT=0.
      DISCOT=0.
      TPIT=0.
      DO 700 K=1,NYRS
      KK=1899+KYR1+K
      PCOST1=PCOST(K)/1000000.
      HOLDT1=HOLDCT(K)/1000000.
      TOTAL=PCOST1+TRANCT(K)+HOLDT1
      DISCOU=((1.+DISCR)**(KYRL-KYR1-K+1)-1.)*TOTAL
      IF (K.EQ.NYRS) DISCOU=0.
      TPI=TOTAL+DISCOU
      WRITE (6,630) KK,PCOST1,TRANCT(K),HOLDT1,TOTAL,DISCOU,TPI
  630 FORMAT(22X,I4,F10.2,F9.2,F10.2,F12.2,F12.3,F14.2)
      PCOSTT=PCOSTT+PCOST1
      HOLDTT=HOLDTT+HOLDT1
      TRANTT=TRANTT+TRANCT(K)
      TOTALT=TOTALT+TOTAL
      DISCOT=DISCOT+DISCOU
      TPIT=TPIT+TPI
  700 CONTINUE
      WRITE (6,710) PCOSTT,TRANTT,HOLDTT,TOTALT,DISCOT,TPIT
  710 FORMAT(/22X,'TOTAL',2F9.2,F10.2,F12.2,F12.3,F14.2)
C
C                                  ---TABLE 10.---
C            CALCULATE AND PRINT YEAR END POSTURES
```

```
C
      DO 900 K=1,NYRS
      KK=KYR1+K-1
      PRINT 800,KK
  800 FORMAT (//////39X,'TABLE 10.    **YEAR END POSTURE FOR FY',
     1I3,'**'//)
      PC=PCOST(K)/1000000.
      HO=HOLDCT(K)/1000000.
      PRINT 810
  810 FORMAT (                  25X,'THIS IS A YEAR-END SUMMARY OF YOUR',
     1' PROCUREMENT ACTIONS AND THE RESULTANT')
      IF (K.NE.1) GO TO 818
      ZZZ=PC+SHORT1(K+1)
      PRINT 812,KK,ZZZ
  812 FORMAT (31X,'MATERIEL SUPPORT POSTURE FOR FY',I3,'.',
     1'  FIVE YEAR BUY MUST BE $',F7.2/)
      GO TO 828
  818 PRINT 820, KK
  820 FORMAT (31X,'MATERIEL SUPPORT POSTURE FOR FY',I3/)
  828 PRINT 830,PC
  830 FORMAT (25X,'YOU SPENT $',F6.2,' MILLION FOR MUNITIONS.'/)
      PRINT 840,TRANCT(K)
  840 FORMAT (25X,'THIS BUY INCURRED ADDED COSTS OF $',F5.2,
     1' MILLION FOR TRANSPORTATION TO FIRST')
      PRINT 850,HO
  850 FORMAT (31X,'DESTINATION IN CONUS; ALSO, $',F5.2,' MILLION ',
     1'FOR STORAGE.'/)
      IF (K.EQ.NYRS) SHORT1(K+1)=0.
      PRINT 860,SHORT1(K+1)
  860 FORMAT (25X,'YOU NOW HAVE AN INVENTORY DEFICIENCY OF $',
     1F7.2,' MILLION.'/)
      PRINT 870
  870 FORMAT (25X,'IF WAR HAD STARTED AT THE BEGINNING OF THIS YEAR,',
     1' PRODUCTION PLUS INVENTORY')
      IF (K.EQ.NYRS) GO TO 910
      PRINT 880,MMSI(K)
  880 FORMAT (31X,'WOULD HAVE SATISFIED ',I3  ,'% OF THE DEMAND.',
     1'  IF WAR STARTS NOW PRODUCTION')
      PRINT 890,MMSI(K+1)
  890 FORMAT (31X,'PLUS INVENTORY WILL SATISFY ',I3  ,'%.')
  900 CONTINUE
      GO TO 930
  910 PRINT 920,MMSI(K)
  920 FORMAT (31X,'WOULD HAVE SATISFIED ',I3  ,'% OF THE DEMAND.')
  930 CONTINUE
C
C                                ---TABLE 11.---
C           CALCULATE AND PRINT SUMMARY OF MPC
C
      CALL TITLE
      PRINT 3000
 3000 FORMAT (35X,'TABLE 11.    **MOBILIZATION PRODUCTION CAPABILITY',
     1'**'//)
      PRINT 3010
 3010 FORMAT (5X,'MONTH',25X,'TONS/MONTH',18X,'$M/MONTH',18X,'$K/TON'/)
      TTPM=0.
      TDPM=0.
```

```
      DO 3040 M=1,MPW
      TPM=0.
      DPM=0.
      DO 3030 I=1,NMUN
      TPM=TPM+MPC(I,1,M)*WT(I)/2000.
      DPM=DPM+MPC(I,1,M)*UNITC(I,1)/1000000.
3030  CONTINUE
      DPT=1000.*DPM/TPM
      PRINT 3035,M,TPM,DPM,DPT
3035  FORMAT (5X,I3,F36.2,F26.2,F25.3)
      TTPM=TTPM+TPM
      TDPM=TDPM+DPM
3040  CONTINUE
      TDPT=TDPM*1000./TTPM
      PRINT 3050,TTPM,TDPM,TDPT
3050  FORMAT (/3X,'TOTAL',F36.2,F26.2,F25.3)
      RETURN
      END
```

```
      FUNCTION XEWP (C1,BALOT,PPM,UNITC)
C
C           THIS IS THE COST/QUANTITY 'LEARNING CURVE' FUNCTION
C
      XEWP=UNITC*(PPM/BALOT)**C1
      RETURN
      END
```