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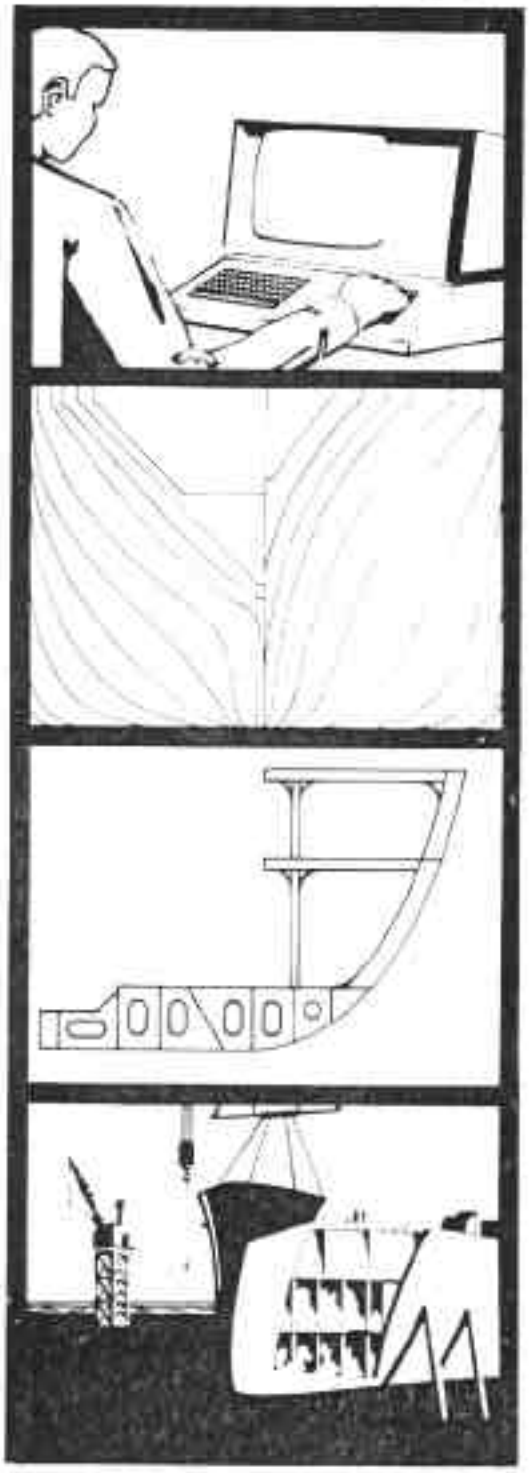

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IN
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SHIPBUILDING EVALUATION AND ANALYSIS SYSTEM

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I. INTRODUCTION

The objective of this paper is to discuss the elements of the computer model , Shipbuilding Evaluation and Analysis System (SFAS) concerning: how SFAS is used in the maritime Administration (MarAd) management decision making process; the capabilities of the model; and the interactive relations between the model users and the shipyards.

SFAS is a group of computer modules designed to provide evaluations and analyses pertinent to all phases of the shipbuilding process. The modules provide various reports and graphical information. The graphical information is in the form of workforce curves and scheduling charts. The following are typcial SFAS applications : workload analyses of shipyards; assessment of building position. availability and facility utilization; mobilization *base* analyses ; depicting the requirements for critical materials in shiphuildinp ; determining shipyard capabilities ; 5-year shipbuilding forecast; budget for U.S. ship construction program with and without CDS; determining labor and training requirements in shipbuilding; analyses of U.S. ship repair and reactivation capabilities; and carriage capacity for specified ship construction programs.

The elements of the SFAS were designed for maximum flexibility to be used by MarAd management in assessing certain situations and also in decision making on policy matters. An individual familiar with ship production terms and production scheduling can *use* most of the SFAS modules by reference to the users guide. Computer programming, or special skills in ADP technology are not required of the user. However, a certain amount of knowledge of terminal operations is a must.

The data base is updated continually with information received from shipyards. Therefore, reliable analyses cannot he accomplished unless there is full cooperation between MarAd and the shipyards. At this time MarAd is enjoying more than sufficient cooperation and this relationship has enabled the model to be very successful.

Questions regarding SFAS development, design, and use should be referred to Ms. Joan Forman, Division of Program Analysis, or MR. John Hotaling, Manager Shipbuilding Analysis, division of Production, Office of SHIP Construction.

The SFAS system has been expanding greatly in its present configuration and now has many more capabilities than its predecessor, the Shipyard Production End Mobilization Model (SPAMM).

II. HISTORY

The Maritime Administration, in accordance with the declaration of policy stated in Title I of the Merchant Marine Act Of 1936 as amended, shall be responsible for fostering the development and maintenance of an American merchant marine sufficient to meet the needs of the national security and of the domestic and foreign commerce' of the United States. In carrying out these responsibilities, the Maritime Administration shall award and administer construction-differential subsidy (CDS) contracts to aid the American merchant marine and the nation's shipbuilding industry. In the execution of this function, the Office of Ship Construction has the responsibility. of developing and maintaining shipyard reporting and information systems; analyzing specific shipbuilding programs; the responsibility of developing methods for measuring shipyard capacity and capabilities; report findings; conclusions and recommendations.

To administer these contracts, as well as to assess the potential for new contracts, the Office of Ship Construction needs a continuous data flow. This data flow and the necessary subsequent analysis are provided for in part by the Shipbuilding Evaluation and Analysis System (SEAS).

In 1973, the Office of Ship Construction developed the Shipyard Production And Mobilization Model (SPAMM) as an efficient tool to display workforce distribution, construction schedules, and steel requirements on an individual yard basis. These capabilities were described in the paper entitled "Shipyard Production and Mobilization Model" presented in March 1974. SPAMM also was used at that time to analyze facility and workforce constraints of the shipbuilding industry under mobilization criteria assumptions. As

become the data backbone of the Shipbuilding Evaluation and Analysis System.

Development of the SFAS system: in its present form began its gestation period with the, installation of a Tektronix 4014-1 Graphic Display Unit in July of 1976. As interactive graphic software was investigated, debugged and implemented by the Engineering Computer Group, the strength and versatility of SPAMM Began to be realized.

Since 1976, the Engineering Computer Group and the Division of Production gained experience with computer graphics and have been able to incorporate many innovative features into the package of program modules to increase the capability and reliability of various routines.

During the second large joint Navy-MarAd mobilization study in 1977, SPAMM was enhanced. significantly in many areas and the present SEAS configuration was conceptualized by the authors.

It became necessary to separate the SPAMM new construction analysis functions from the mobilization study functions. Utility programs were developed to address problems such as interfacing with the Navy Coordinated Ship Data System (CSDS) model and handling large data base changes or producing special output such as steel demand curves. Utility programs developed for special cases became so important to the efficient operation that they are now considered a separate portion of SEAS. Office of Ship Construction management of merchant vessel construction under Title XI of the Merchant Marine Act required an information system that could serve a wide variety of report requirements. This section of the SEAS has been separated because portions of the data bank reside on our inhouse Honeywell computer and are not directly linked to the other portions of the modules without data transfer mechanisms between different computers. Data base concerns have not allowed full integration with the other three areas of SEAS.

III. PURPOSE OF 'THE SEAS MODEL

The SEAS model provides a tool for shipyard workload analyses. Workload analyses can be performed by hand, but for MarAd management there frequently is a severe requirement for fast, and relatively accurate answers. If these two factors were the only criteria, speed is more important than accuracy. Accuracy, within the plus or minus range of 5%, would be considered extremely good for the SEAS model.

Workload analyses usually are either individual yard analyses or total. industry impact studies. An individual shipyard's production scheduling and workload must be considered before a CDS contract can be signed. When a ship owner needs to build a ship, and applies for CDS, the Office of Ship Construction receives and reviews the plans and specification. Part of this review also includes the certification that the shipyard or shipyards that are bidding the job can perform under the terms of the contract. This certification means, in the opinion of the Office of Ship Construction, a yard can perform the contract because they have the management, technical capability, facilities and workforce to handle the proposed work. The Division of Production is responsible for conducting the analysis which forms the basis of these certifications.

Summary analysis for assessment of the industrial impact of various proposed policy or legislative initiatives can be handled easily by SEAS and is useful and important to the industrial analyst.

Total industry impact on policy changes such as Department of Defense funding cutbacks or cargo preference legislation can be analyzed. The overall loss of shipyard workers because of a declining orderbook, or as we saw several years ago, the consideration of over capacity, are important trends that cannot he taken lightly. Specific examples of workload analyses for both an individual shipyard and industry impact will be explored later in the paper.

SEAS also provides the user with a tool and method for assessment of building position availability and facility utilization. 'A specific yard can be

examined in detail by building position scheduling, repair dry dock utilization or even pier space scheduling if required. From a macroscopic perspective, the total facilities avail ability and adequacy can be studied as it relates to "What if" assumptions about projected workload generated by market surveys, proposed legislation, or war game battle damage etc.

The facilities analyses are also divided into relatively the same two areas as the workforce analyses, that is, individual. yard analysis and total industry aggregates.

Peacetime programs such as the Navy and MarAd 5-year shipbuilding programs can increase or decrease drastically as different budget proposals increase or decrease. These "what if" variations are looked at throughout each year. Facilities utilization studies can be in the mobilization area where the requirement for an adequate fleet is specified and dictates a required shipbuilding mix and rate. Rattle damage has to be repaired and the total facilities requirement for the complete U.S. industry is then defined. The total facilities availability is handled by the SEAS model. Peacetime facilities availability studies are also conducted, along with these facilities analyses the inherent material analyses are possible. SEAS has the capability to depict the requirement for critical materials in shipbuilding. Steel demand curves are the only material information presently being used. However, other critical raw materials can be substituted. The shape of the distribution curves can be easily adjusted to enable SEAS to portray demand for many of the critical shipbuilding materials. Again these fall in both mobilization and peacetime analysis categories. Shipbuilding program mixes are analyzed in all of these areas. The interaction is examined between large Nava1 shipbuilding programs, commercial shipbuilding forecasts, drill rig

construction, supply boat activity, along with additional non-ship work. Sensitivity of the industry to MarAd subsidy funding level changes is investigated from time to time for various reasons. The SEAS model is used to tie together the interactions of these "What if" scenarios for overall impact on the U.S. shipbuilding industry.

SEAS interacts within many areas of the Maritime Administration. In the MarAd planning process, the Office of Policy and Plans will frequently conduct a market survey of potential ship construction projects from ship operators and owners. With this market survey and knowledge drawn from the financial aid replacement obligations of the various ship operators, the Office of Policy and Plans generates a 5-year shipbuilding forecast. This forecast has two parts: the ships that are scheduled to have construction-differential subsidy, and those projected that probably will be built without construction-differential subsidy. This 5-year plan is then compared and integrated with the current Navy five year shipbuilding program. The Navy five year shipbuilding program runs in many cycles during the calendar year, depending on the budget cycle or Congressional authorization. A current 5-year plan is shown as Appendix A of this paper. The projected shipbuilding programs have become smaller over the last 2 or 3 years reflecting the worldwide shipping and shipbuilding slump and the concurrent lower demend for ships.

Five year workforce and facility utilization forecasts can he used for: generating the CDS budget ; reviewing the CDS requirements and funding allotments by program planning and budget personnel in MarAd; training and labor requirements can be reviewed by the Office of Labor and Training in MarAd;

and forecasting early warning signals for shipyards in trouble, when they need new contracts, and when workforce level demands go above or below reasonable limits for efficient operation.

IV. REPORTS

Accurate and timely status reports are another important function of the SFAS system. MarAd management requires large amounts of statistical data in the execution of daily business. The monthly shipbuilding progress report is the most popular and most widely used report generated by SEAS.

The report provides all of the top line ship production progress and scheduling information to Marad management in a concise format. All the data available to the division of Production for all major commercial oceangoing and Great Lakes ships under construction in the U.S. is updated continuously in the SFAS data hank. The report is divided into two portions. Tabulated initially are all ships with construction-differential subsidy. The second section is privately financed construction that does not have CDS. The monthlv progress report gives the following data on al! commercial vessels larger than 1000 gross tons under construction in U.S. shipyards:

Yard	Vessel Name
Design	Vessel Owner
Vessel Type	Percent Complete
Deadweight	Contract Award Date
MA Hull	Start Fabrication Date
Builder Hull	Keel Date
Type of Financial Aid	Launch Date
Contract Number	Contract Delivery Date
	Estimated Delivery Date

Copies of this report have been made available separately. Monthly issues are available through the division of Production. Contact Mr. James Bowman, phone 202-377- 2803.

The second most widely distributed report is our TITLE XI (Ship Financing Guarantees) report series. This report has three portions printed separately. Data for this report is acquired from a master Title XI computer file that supports all three separate reports described below. Data collection commences when application for Title XI financing is received by MarAd. The three sections are:

Title XI Project Status Report

The Project Status Report is a quarterly publication reporting project status information of the Title XI applications from January 1977 to present time. Specifically the information displayed in a tabular form for each application is as follows:

Title XI Application Number
Owner Name
Ship Type
Vessel Name
Shipyard Built
Construction Representative Assigned
Award Date of Construction Contract
Contract Delivery Date
Estimated Delivery Date
Trial or Inspection Date
Percent Complete as of a Designated Date
Status of Title XI Application
Type of Title XI Application
Status of Title V Application

This report is intended for Construction Representatives, supervisors, and other personnel that are directly involved in Title XI application approval and vessel construction. Other organizations may also desire the information concerning the project status of Title XI applications.

Title XI Principal Characteristics Report

The Principal Characteristics Report is a quarterly publication reporting hull characteristics information of the Title XI applications from January 1977 to present time. Specifically the information displayed is as follows:

Title Xi Application Number
Owner Name
Ship Type
Vessel Name
Shipyard Built
Beam
Depth
Draft
Deadweight (DWT)
Displacement and Lightship Gross Tonnage

Construction Representative Assigned	Shaft Horsepower (SHP)
Builder and MarAd Hull Number	Vertical Center of Gravity (KG)
Length Overall (LOA)	Machinery, Steel and Outfit Tonnage

This report is intended for use mainly by the Division of Naval Architecture hut many other organizations desiring information on the principal characteristics of Title XI vessels have found it to be very useful.

Title XI Financial Status Report

The Financial Status Report is also a quarterly publication reporting financial status information of the Title XI applications from January 1973 to present time. Specifically, the information displayed is as follows:

Title XI Application Number	Balance Cost Remaining
Owner Name	Contract Number
Ship Type	Contract Delivery Date
Vessel Name	Contract Award
Shipyard Built	Status of Title XI Application
Contract Cost	Type of Title XI Application
Original Mortgage Cost	Status of Title V Application

This report is intended for use mainly by the Office of Ship Financing Guarantees.

In addition to the shipbuilding progress report and the Title XI reports, the Division of Production generates a quarterly shipbuilding status report. This differs significantly from the other shipbuilding reports in that all of the work in each yard is represented, including Naval construction, repair and non-ship work. Information is graphically shown by bar chart schedules for each building position and workload curves yard by yard.

A workload and schedule analysis of all of the shipyards in the active U.S. shipbuilding base is presented in this report each quarter. At present there are 24 yards that are considered to be in the active shipbuilding base. These are the yards that are building or seeking contracts for construction of major oceangoing or Great Lakes vessels 1,000 gross tons or larger.

Recognizing that this is an arbitrary definition, many other yards are included in this quarterly report which may be of interest to some of the users. However, only the active shipbuilders are used in the total industry summation workload curve. The model has the ability to run summations on as many combinations of yards and curves as the user desires. Similar tailor made reports are often generated on a special case basis.

The quarterly shipbuilding status report has a summation of the industry workload showing the workforce requirements to complete all the work under contract in the current orderbook backlog. After the industry summation, each yard is presented alphabetically. First a bar chart schedule of all firm work is presented for each building position in the yard showing the currently scheduled key event dates. On the next page a workload curve is depicted showing workforce requirements and trends within the yard to complete the firm work. This information gives early warning to yards in trouble due to lack of work, or overloaded situations. The relationships between workforce projections and building position schedules are good indicators for the analyst to use in drawing conclusions concerning MarAd programs.

Up until late 1978 this report was widely distributed and enjoyed a mailing list of about 200. However, one shipyard currently considers its building position schedules as proprietary in nature and several shipyards now consider their manpower information as proprietary. In order to respect these positions the Division of Production now has made this report FOR OFFICIAL USE ONLY, FOUO. and restricts distribution to governmental users only. The only schedule information not publicly distributed in the monthly progress

reports are the actual building position assignments. For the purpose of exemplifying the SEAS capability, an abbreviated issue of our quarterly report is given in Appendix A, This is an example of what the individual shipyards contribution resembles and the current summary active shipbuilding base workload curve. Also included is a sample data form MA 832 not normally printed with the report.

V. NEW DATA SOURCES

SFAS is no different than any other computer model, in that, the most important element is the input data. The validity and reliability of the data is extremely dependent upon two key factors: (l) The data base must be current and continually updated; (2) The data must be valid, Therefore, it is of the utmost importance that the shipyards report valid, timely information when required. Also, it is essential for the industrial analyst in charge of the model to have continuous knowledge of the yard programs and capabilities. By frequently visiting the yards in the active shipbuilding base, the analyst can keep abreast of recent shipyard improvements.

The old SPAMM model had a small, but annoying defect in that it built up the workforce demand curves by addition of standard workforce distributions ship by ship. By using standard distributions a very close correlation to actual workforce distribution is given if each of the ships is on schedule and not impacted by other work so that it follows the "normal" curve. Because this rarely happens, these curves were being adjusted frequently to match known delays. The credibility of workforce information was in question because it was always slightly different from a particular yard's curve or NAVSEA information. Although each of the differences could he explained on

a case-by-case, basis, the fact that frequently the yard, MarAd, and the Navy would have three different depictions of the same production workload and schedule became troublesome to management particularity during Congressional testimony. This capability has been retained to be used when actual data may not be available.

During 1977 the issue of what is the nation's "shipbuilding capacity" was a matter of public and industry concern. Navy, MarAd, and Shipbuilders Council of America (SCA) had three separate and distinct appraisals of the industry's ability to produce ships. This highlighted the need to define more accurately the "active. U.S. Shipbuilding Industrial Base. " SCA surveyed all shipbuilders, both members and non-members. Due to the efforts of Mr. Stuart Adamson of the Shipbuilders Council, the definition and common reporting of actual data from the active U.S. shipbuilding industrial base was initiated and is now used extensively.

A new data form incorporating all of the needed information was generated. This was' approved by the Office of Management and Budget in December of 1978, and was given the title Shipbuilding Orderbook and Shipyard Employment, and numbered MA 832. This form, combined with the facility information contained on the standard form 17, titled, Facilities Available for the Construction and Repair, of Ships, provides a relatively accurate depiction of each yard's status.

On August 21 of 1978, the Assistant Secretary of Commerce for Maritime Affairs requested each shipyard in the United States to participate voluntarily in the common reporting of ship construction, production, and workforce information. This would necessitate ail yards to submit a MA 832 form quarterly.

The Office of Ship Construction, Division of Production has developed and maintains the current data hank of all U.S. shipyards actively participating in or seeking construction of major oceangoing and Great Lakes ships 1,000 gross tons or larger. These yards by definition are the active U.S. Ship-building Base. This cooperation of the shipbuilders and the Government provides continuing and accurate data on the staffing requirements and facility availability of the shipbuilding base which is useful in many areas and benefits all participants.

VI. DATA BANK STRUCTURE

Six major data banks are used in the Shipbuilding Evaluation and Analysis System. 'Ihis section will describe the contents of each data bank.

A. SPAMM - Shipbuilding Production and Mobilization Model Data Bank

For each shipyard in the data bank, the following characteristics are given:

1. Name of Shipyard
2. Number of building positions, drydocks, pier spaces, etc.
3. Length and width of each building position when applicable.
4. Vessels presently under construction and their characteristics.
    a. Building position on which the vessel is being built.
    b. Six key event dates:
        1. Contract award
        2. Start of fabrication
        3. Keel
        4. Launch
        5. Contract delivery
        6. Revised delivery

c. Design number

d. Maritime Administration Hull Number

e. Percent of completion

f. Work days to build vessel

g. Code for operator (Navy, Private, CDS)

h. Steel tonnage

1. Name of vessel

j. Vessel owner

k. Builder's hull number

1. LEGEND - used in Monthly Progress Report

m. Mar-Ad's contract number

n. Vessel type

o. Deadweight

P. Percent gain - monthly

B. MOB - Mobilization Data Bank

For each shipyard in the data bank, the following characteristics are given:

1. Name of Shipyard

2. Number of building positions, drydocks, pier spaces, etc.

3. Length and width of each building position when applicable.

4. Vessels in the study and their characteristics.

a. Building position on which the vessel is being constructed, or repaired.

b. Five key event dates.

1. Contract award

2. Start of fabrication

3. Keel

4. Launch

5. Delivery

c. Code for specified vessel type

d. Vessel type

e. Work days to repair or build vessel

f. Code for categorization of vessel manpower

g. Code for operator (Navy, Private, CDS)

h. Amount of steel' to repair or build vessel

C. TITLE XI DATA BANK

For each vessel in the data bank, the following characteristics are given:

1. Title XI application number

2. Vessel design type

3. Vessel owner

4. Vessel type

5. Number of ships for the specified vessel type

6. Vessel name

7. Contract number

8. Trial/Inspection date

9. Percent of completion

10. Percent of completion date

11. Contract award date

12. Contract delivery date

13. Estimated delivery date

14. Actual construction cost

15. Original principal cost

16. Balance cost

17. Government aid - type of Title XI insurance loan
18. Title XI status (pending, approved, withdrawn)
19. Overall length of ship (L.O.A.)
20. Beam
21. Depth
22. Draft
23. Deadweight
24. Steel Tonnage
25. Machinery (tonnage)
26. Outfit (tonnage)
27. Lightship (tonnage)
28. MarAd's hull number
29. Builder's hull number
30. Shaft horsepower
31. KG stability factor
32. Displacement
33. Start of fabrication date
34. Keel date
35. Launch date
36. Revised contract date
37. Work days to build vessel
38. MarAd's design number
39. Percent gain - monthly
40. Name of Shipyard
41. Code for MarAd's construction representative

D. NDRF - National Defense Reserve Fleet

For, each shipyard in the data bank, the following characteristics are given:

1. Name of shipyard
2. Number of building positions, drydocks, pier spaces, etc.
3. Length and width of each building position when applicable.
4. Vessels in the National Defense Reserve Fleet.
   a. Building position on which the vessel is being repaired
   b. Vessel type
   c. Number of days after M-day required to arrive at shipyard
   d. Number of days after M-day to enter building position
5. Number of days after M-day to exit building position
6. Number of days after M-day required to depart from shipyard.
7. Vessel name
8. Code for categorization of vessel manpower
9. Length of vessel
10. Width of vessel
11. Work days to build vessel
12. Code for operator (NDR, NAV, CDS)

E. User's Data Banks -(Ship Mixes)

For each vessel the following characteristics are given:

1. Building position on which the vessel is being repaired
2. Contract award date
3. Start of fabrication date
4. Keel date
5. Launch date
6. Delivery date

7. Rescheduled delivery date

8. Vessel type

9. Work days to build vessel

10. Code for Operator (CDS, NAV, PVT)

11. Steel Tonnage

F. IDB - Industrial Data Bank

The contents in the IDB data bank are obtained from the Maritime Administration's form "Shipbuilding Orderbook and Shipyard Employment" (MA-832). The form is completed by shipyard personnel on a quarterly basis.

For each shipyard the following characteristics are given:

1. Name of shipyard

2. Workforce conversion factor for equivalents to actuals

3. Code for type of workforce

4. Quarterly production workers for eight categories

   a. Ship Construction

      1. MarAd

      2. Navy

      3. Other Federal

      4. Private

   b. Ship Repair

      1. Navy

      2. Other Federal

      3. Private

   c. Non-ship

VII. DISTRIBUTION CURVES

There are several distribution curves used in SEAS. Labor has three different curves : one for activation of NDRF ships, one for mobilization and one for peacetime. The mobilization distribution curve considers three shifts and the percentage of productivity for each shift. As would be expected, the NDRF curve is completely different than a mobilization or peacetime labor curve because the ship will be reactivated rather than constructed.

Only two distribution curves will be discussed; labor (peacetime) and steel.

A. LABOR DISTRIBUTION CURVE

After a shipyard has received a contract award, it must prepare a study of the rate at which labor is to be expended. This study results in a labor load "S" curve, typical of all erection curves, but allows for local variations and influences (Figure VIIa). Examples are: work stoppage from a strike, contract problems, bad weather, poor planning. Vertical coordinates are graduated in percent of total productive labor to be expended by the shipyard on the vessel. The horizontal measurement for the curve is recorded as a percentage of total actual construction time for the vessel. This actual time of construction may be defined as the quasi-building period representing the start of fabrication to vessel completion. In an effort to arrive at a "universal" labor curve, an empirical study of the labor levels of five shipyards throughout the United States was made. The data was entered into a least-squares program on the computer, which developed the composite third-order polynomial curve A, in Figure VIIb. This may be compared to B, which has been used by MarAd, and coincides with the curve used by the Navy. In the beginning, Curve A shows a higher percentage

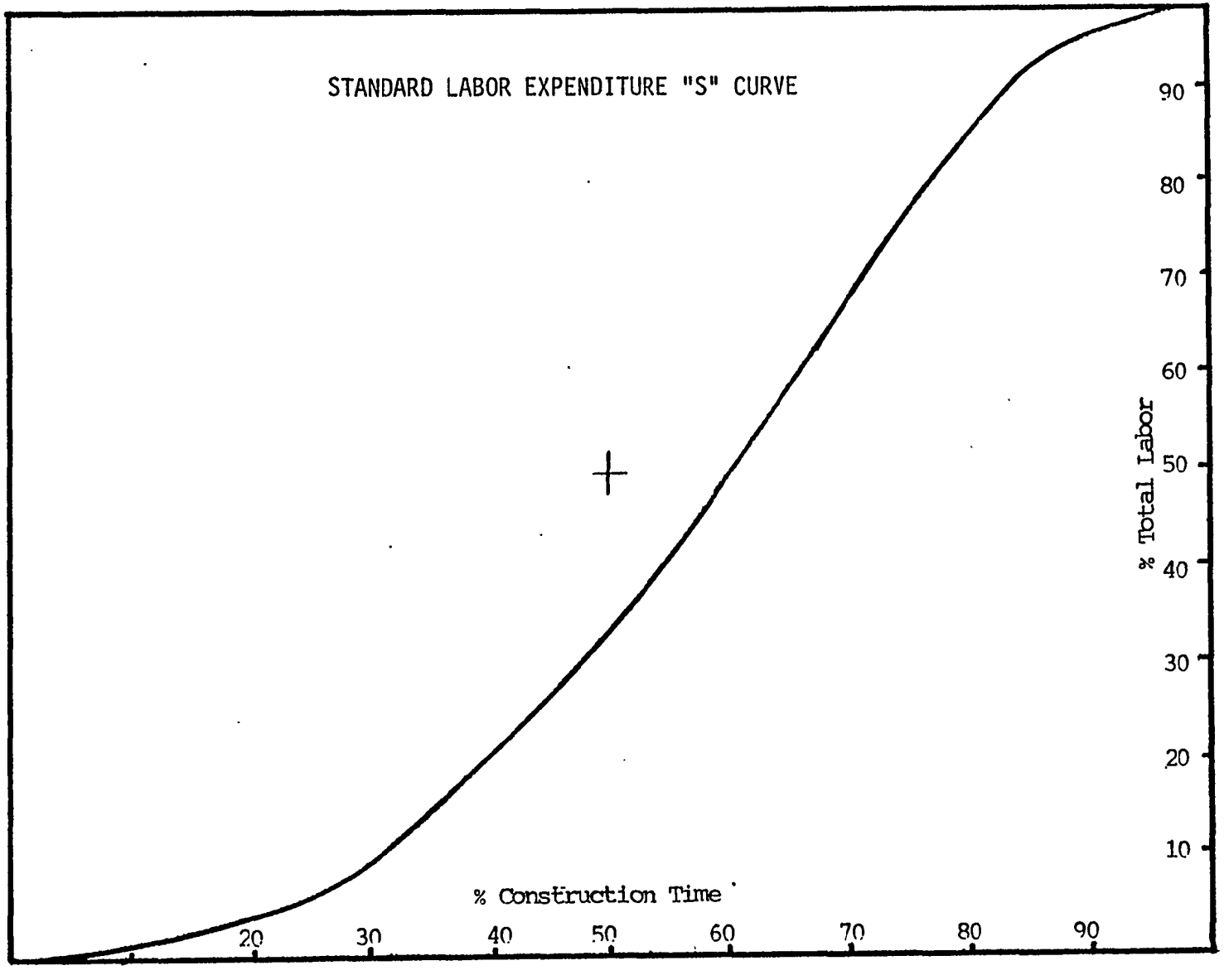

STANDARD LABOR EXPENDITURE "S" CURVE
% Total Labor
10
20
30
40
50
60
70
80
90
% Construction Time
20
30
40
50
60
70
80
90

Figure VIIa

of labor than B, with a slower finish. The greater outfitting requirement of Naval vessels over commercial vessels may explain the discrepancy. It should be noted, however, that at the mid-point in time both curves have the same amount of employment Both curves, in addition, have their highest employment level around launching or between 70-75 percent of vessel completion.

The curves were developed under the concept that the various graduations of length of building period will always have the same corresponding percent of total production labor utilization. Thus, although ships will have different building period lengths-and total labor levels, their production labor distributions will be comparable.

The labor curve is critical in the functioning of the Shipyard Evaluation and Analysis System, as placement of proposed construction will be dependent not only on shipway availability, but on the distribution of labor. It is of utmost importance to maintaina minimum production labor force to ensure timely response to any ship construction demand. Figure VIIc shows the curve used in the Model. It is a synthesis of the Navy curve and MarAd's empirical curve which reflects a more stable level of employment than the Navy curve.

In addition, it allows a higher and longer peak employment level than the original MarAd curve. It is felt that both of these traits will allow the curve to closely reflect the actual employment characteristics of the various yards.

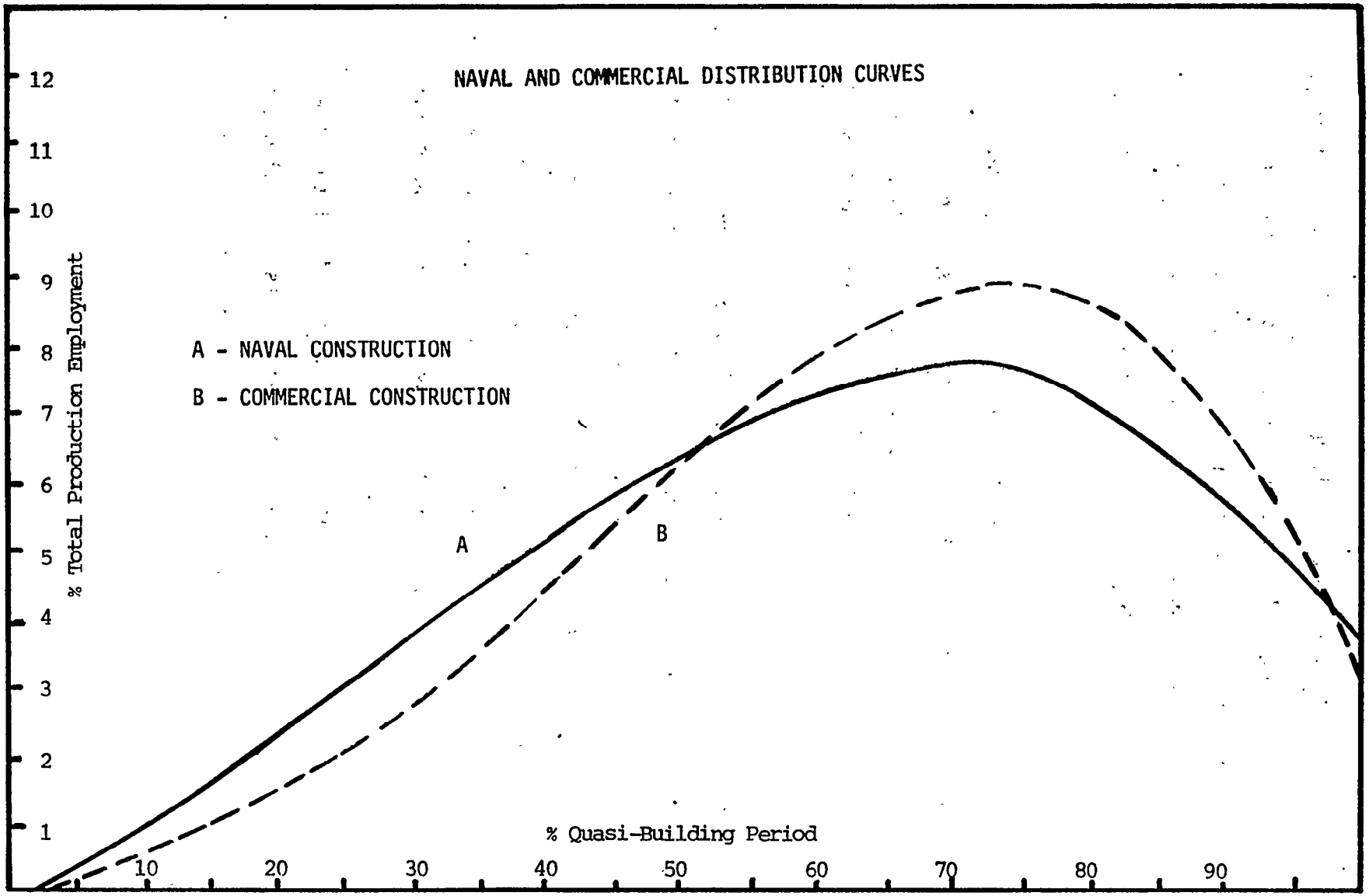

NAVAL AND COMMERCIAL DISTRIBUTION CURVES
A - NAVAL CONSTRUCTION
B - COMMERCIAL CONSTRUCTION
% Total Production Employment
% Quasi-Building Period
A
B
12
11
10
9
8
7
6
5
4
3
2
1
10
20
30
40
50
60
70
80
90

Figure VIIb

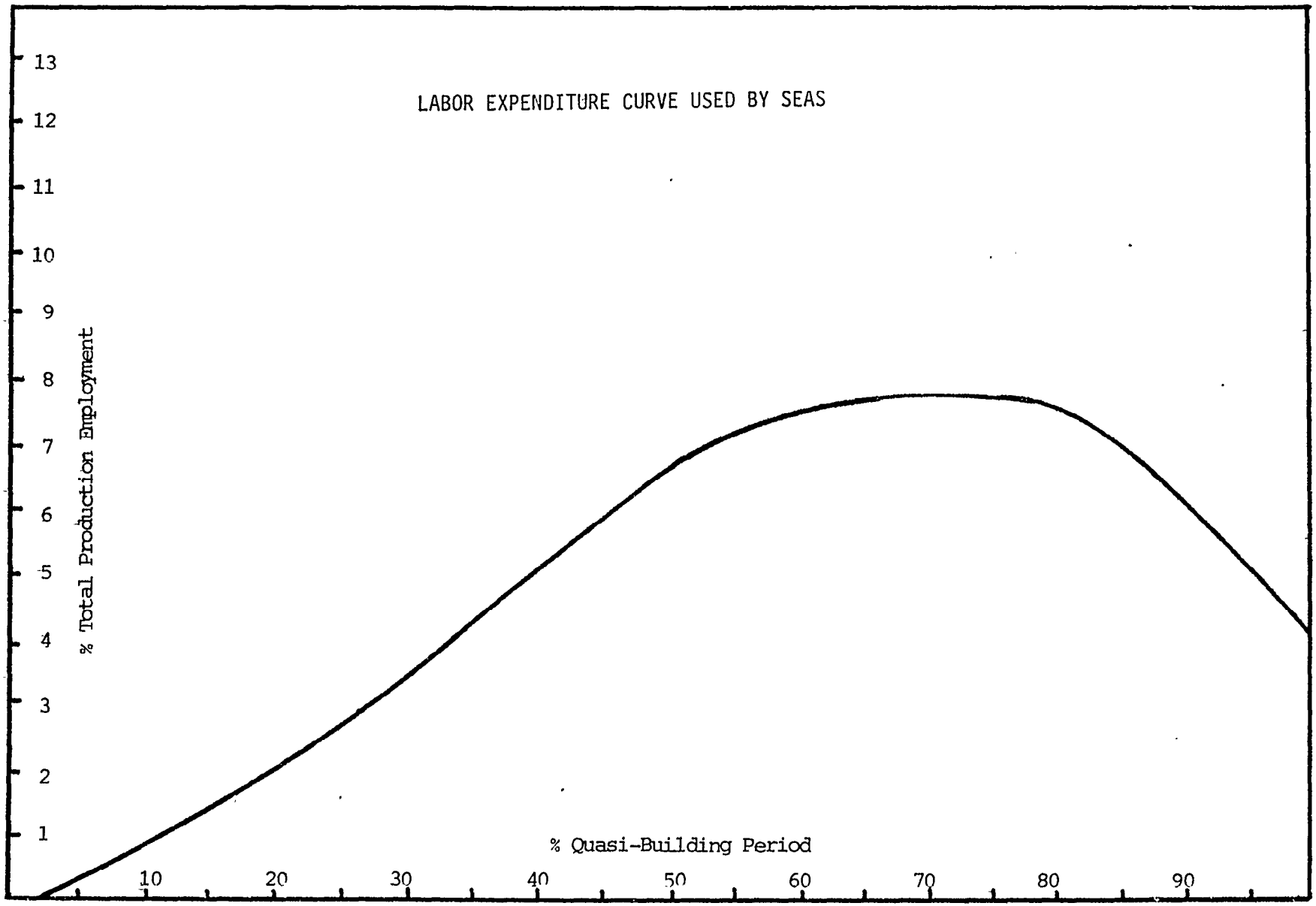

LABOR EXPENDITURE CURVE USED BY SEAS
% Total Production Employment
13
12
11
10
9
8
7
6
5
4
3
2
1
% Quasi-Building Period
10
20
30
40
50
60
70
80
90

Figure VIIc

B. STEEL DISTRIBUTION CURVE

A steel distribution curve has been developed along similar lines as the labor distribution curve. However, the steel steel curve is almost the reverse of the labor curve (see Figure VIId). As .one would expect, the largest amount of steel is required during the early stage of construction.

The vertical coordinates are graduated in percent of total tonnage (short) to be expended by the shipyard, on the vessel. The horizontal measurement for the curve is recorded as a percentage of total actual construction time for the vessel. The actual time of construction may be defined as the quasi-building period ranging from 3 months prior to the start of fabrication to one month after the vessel has been launched. This is a demand curve for steel ordering, assuming 3 month delivery of steel to the yard.

VIII. SOFTWARE MODULES

The Shipbuilding Evaluation Analysis System (SEAS) consists of 31 program modules, 25 Fortran and 6 Management Data Query (MDQ) modules.

The Fortranmodules are grouped according to their primary functions. The three groups are: (1) Shipbuilding Production and Mobilization Model, (2) Mobilization Studies, (3) Utility Routines.

The MDQ modules are used to provide the Title XI applications and Ship Characteristics Reports.

The capabilities and functions of the modules and data banks are discussed in the following paragraphs.

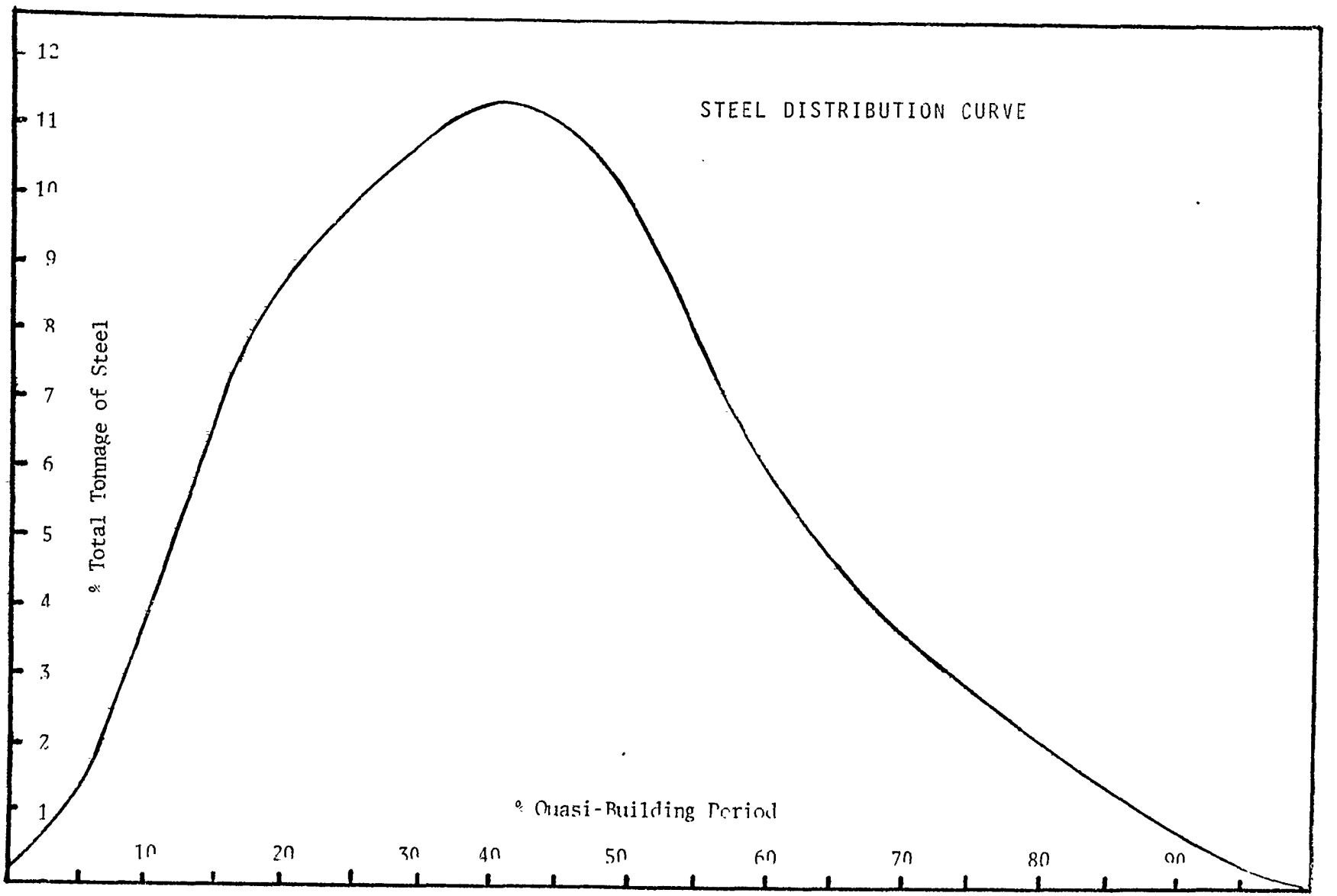

STEEL DISTRIBUTION CURVE
% Total Tonnage of Steel
12
11
10
9
8
7
6
5
4
3
2
1
% Quasi-Building Period
10
20
30
40
50
60
70
80
90

Figure VIId

A. SPAMM - Shipbuilding Production and Mobilization Model

SPAMM has the greatest utilization of the three groups. It provides analyses and management information pertinent to all phases of the shipbuilding process. Examples of pertinent information are: evaluating the feasibility of proposed shipbuilding programs ; identifying the need for construction of new facilities to meet the demands of proposed shipbuilding programs; responding to queries received from a variety of interests, including members of Congress, the Secretary of Commerce, the Department of Defense, and the office of Management and Budget; determining which existing shipyards might construct proposed ships consistent with ship size and delivery date requirements.

The SPAMM data bank is continually updated, and the program modules are accessed daily. The data bank is comprised of more information per ship than other. *data* banks in SEAS, because of variable information required on a daily basis.. Since the data bank has high activity, it is required to be continually accessible.

The program modules are also required to be continually accessible. All modules are interactive, therefore enabling the requested information to be readily available. The information is produced immediately, in a report or graphic format on 8½"X11" paper .

Examples of the program modules capabilities follow:

PBARS - A module designed to provide workload schedule in a bar graph format for a specified ship mix.

The graphic schedule. consists of one bar graph per ship. Each bar graph is determined by six key event dates required in building a ship. The six

dates are: (1) contract award, (2) *start of* fabrication, (3) keel, (4) launch, (5) delivery, and (6) rescheduled delivery. This graphic schedule is extrememly beneficial in that the user can rapidly analyze the ship mix on an individual shipyard basis, and can determine if the ship mix is feasible. The graphic schedule is used for the "Status of Major Shipbuilding in U.S. Commercial Shipyards," quarterly report. See Figure VIIIa.

PCURVES - A module designed to provide a graphic manpower workload distribution curve for ship construction and repair. This enables- managerial personnel to analyze and produce rapid decisionmaking and policy determinat ions. For example, a proposed ship mix workload can be added to the existing manpower to determine if it is feasible for the shipyard to build the proposed ships. See Figure VIIIb.

PLEVEL - A module designed to provide either a graphic manpower workload distribution curve or a report format for ship construction utilizing six categories: Navy, Private and Coast Guard, Construction-Differential Subsidy (CDS), proposed Navy, proposed Private and Coast Guard, and proposed CDS. See Figures VIIIc and VIIId.

PSELBO - A module designed to select shipyards from the SEAS data bank in order to perform workload analyses on shipyards,

PROGRESS - A module designed to provide the monthly "Shipbuilding Progress Report."

PSELIDB - A module designed to select data from the Industrial Data Base.

PSILPRO - A module designed to select data from the Shipbuilding Evaluation Analysis System (SEAS) data bank, for the "Shipbuilding Progress Report ."

PSHIPS - A module designed to give the user a method to create data files [new construction - ships) for a specified ship mix expeditiously with a minimal amount of input.

BUILDING POSITION UTILIZATION

HOMAN SHIPBUILDING CO.

JUNE 11,1979

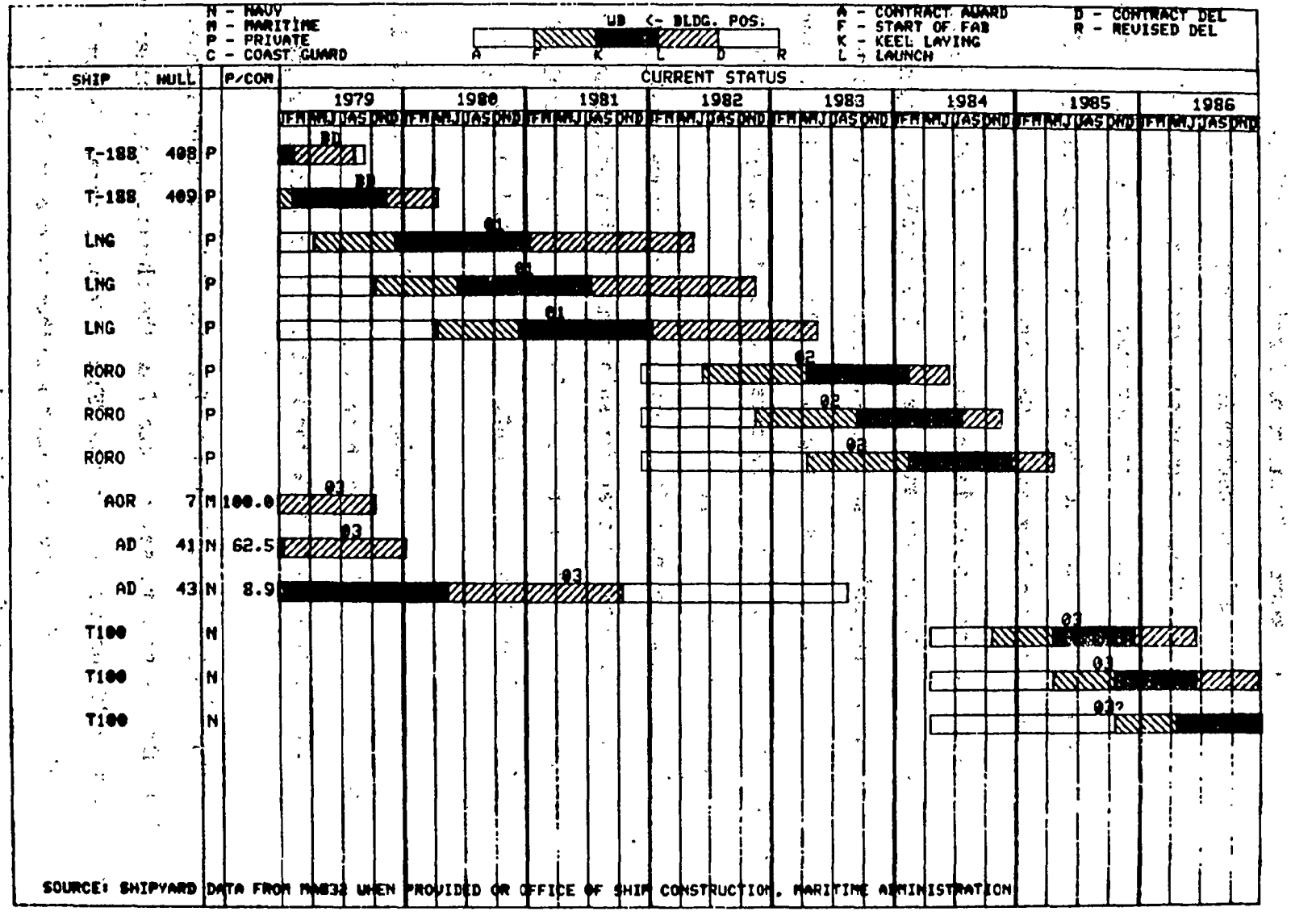
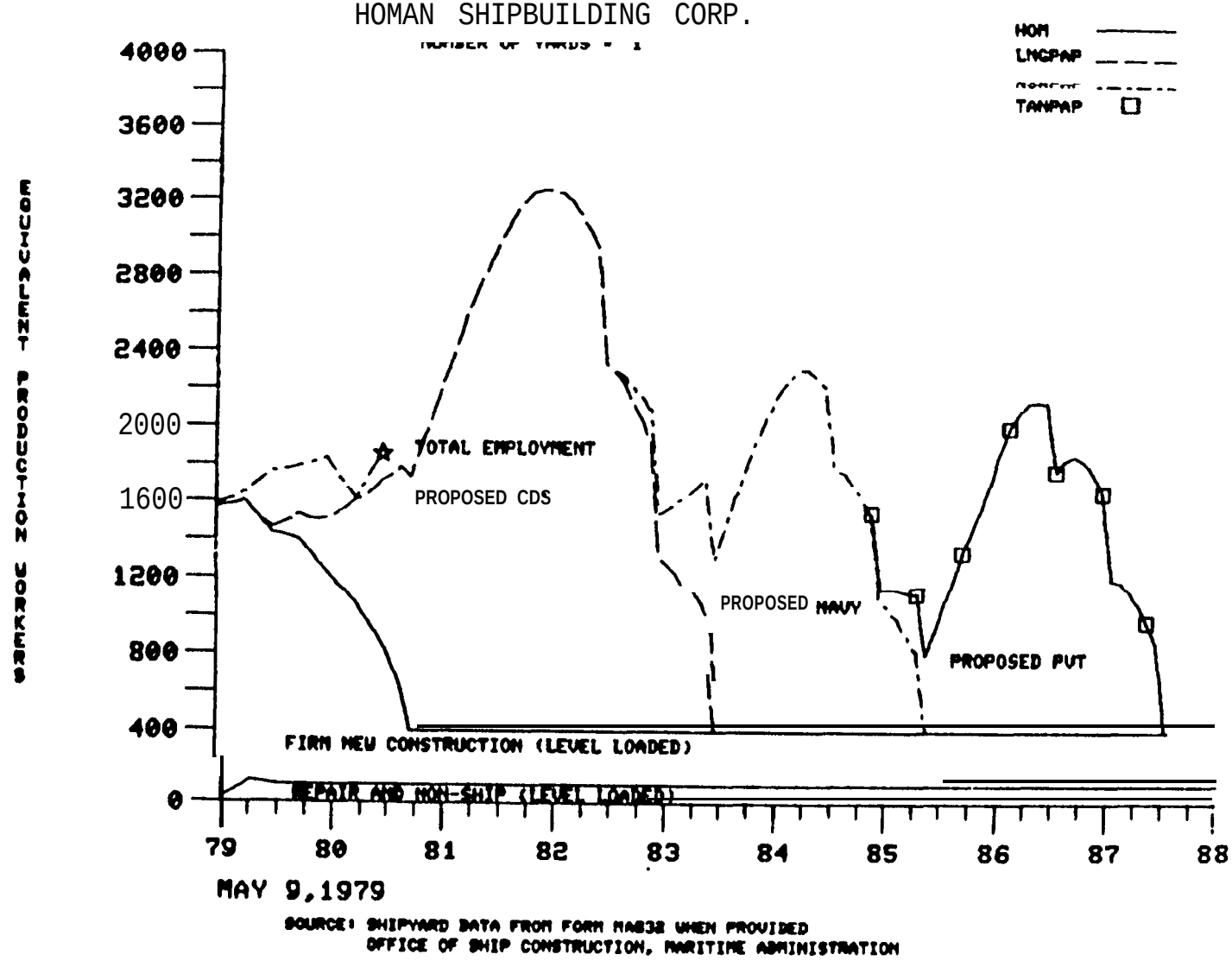


Figure VIIIa

SHIPBUILDING INDUSTRY WORKLOAD PROJECTION

HOMAN SHIPBUILDING CORP.



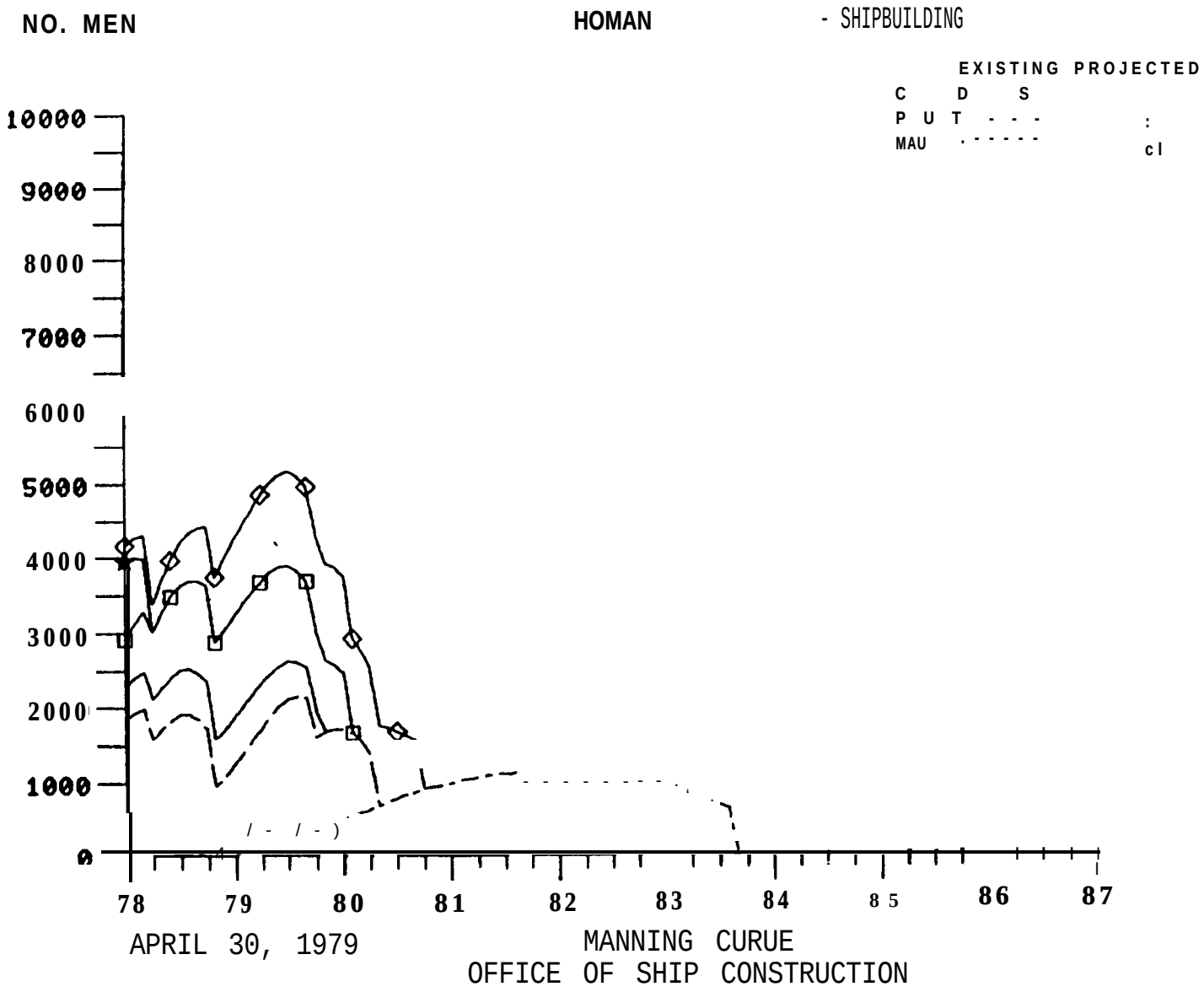


Figure VIIIc

SHIPBUILDING MANPOWER REQUIREMENTS
****

APRIL 30, 1979

SHIPYARD: HOMAN - SHPBLDG

DATE	NAV	PVT	CDS	P/NAV	P/PU	P/CDS
1/78	0	1935	2400	3120	400	4260
2/78	0	1975	2470	3275	399	4300
3/78	0	1590	2115	3010		3380
4/78	0	1715	2265	3255		3690
5/78	5	1830	2405	3470		3970
6/78	20	1910	2505	3625		4195
7/78	30	1915	2520	3690		4330
8/78	45	1845	2460	3685		4400
9/78	70	1740	2365	3630		4420
10/78	95	950	1580	2870		3745
11/78	120	1075	1705	3025		3985
12/78	145	1235	1870	3200		4230
1/79	170	1400	2025	3370		4445
2/79	195	1560	2175	3525		4650
3/79	225	1730	2325	3675		4850
4/79	255	1890	2460	3800		5010
5/79	285	2030	2565	3880		5115
6/79	315	2130	2625	3900		5155
7/79	350	2165	2610	3825		5100
8/79	385	2140	2535	3680		4965
9/79	420	1620	1965	3025		4315
10/79	455	1685	0	2645		3940
11/79	495	1730	0	2580		3870
12/79	535	1730	0	2475		3750
1/80	570	1665	0	0		2915
2/80	610	1545	0	0		2750
3/80	650	1385	0	0		2535
4/80	695	0	0	0		1770
5/80	735	0	0	0		1735
6/80	780	0	0	0		1685
7/80	830	0	0	0		1635
8/80	875	0	0	0		1585
9/80	915	0	0	0		0
10/80	945	0	0	0		0
11/80	965	0	0	0		0
12/80	990	0	0	0		0
1/81	1020	0	0	0		0
2/81	1050	0	0	0		0
3/81	1075	0	0	0		0
4/81	1095	0	0	0		0
5/81	1105	0	0	0		0
6/81	1120	0	0	0		0
7/81	1135	0	0	0		0
8/81	1140	0	0	0		0
9/81	1150	0	0	0		0
10/81	1160	0	0	0		0

Figure VIIId

SHIPBUILDING MANPOWER REQUIREMENTS
****

APRIL 30, 1979

SHIPYARD		DATE	NAV	PVT	CDS	P/NAV	P/PVT	P/CDS
HOMAN	- SHPBLDG	11/81	1165	0	0	0	0	0
		12/81	1170	0	0	0	0	0
		1/82	1170	0	0	0	0	0
		2/82	1170	0	0	0	0	0
		3/82	1170	0	0	0	0	0
		4/82	1165	0	0	0	0	0
		5/82	1160	0	0	0	0	0
		6/82	1150	0	0	0	0	0
		7/82	1135	0	0	0	0	0
		8/82	1110	0	0	0	0	0
		9/82	1080	0	0	0	0	0
		10/82	1050	0	0	0	0	0
		11/82	1015	0	0	0	0	0
		12/82	975	0	0	0	0	0
		1/83	935	0	0	0	0	0
		2/83	890	0	0	0	0	0
		3/83	835	0	0	0	0	0
		4/83	785	0	0	0	0	0
		5/83	730	0	0	0	0	0
		6/83	680	0	0	0	0	0
		7/83	625	0	0	0	0	0
		8/83	0	0	0	0	0	0
?								

Figure VIIId cont.

B. MOB - Mobilization Studies

The Mobilization group is used for Interagency Maritime studies in policy efforts, to determine if an adequate mobilization base exists for the purpose of national defense and for use in national emergency,

The program modules and data banks are used on an average, once a year. Both are highly specialized to determine if there is sufficient shipbuilding facilities, ship repair facilities, a workforce for activation, conversion, repair of Navy combatants, and commercial ships to respond to a mobilization scenario.

The MOB data bank is the largest volume data bank in SEAS. It is composed of approximately 4,000 ships and resides on tape until a mobilization study occurs. The information in the data bank will change significantly for each study, due to the different criteria incorporated in the studies.

The National Defense Reserve Fleet (NDRF) data bank used with mobilization studies, also resides on tape. It is relatively small compared to the MOB and SPAM data banks.

The program modules also reside on tape until a study occurs. All modules are interactive, therefore the requested information is readily available. The information is produced immediately in a report or graphic format on 81/2" X 11" paper.

Examples of the program modules capabilities follow:

PMACCN - A module designed to provide either a graphic manpower workload distribution curve or a report for four categories: Activation, Casualty/ Repair, Commercial, and Navy.

PMOBINY - A module designed to tabulate ships by a specified key event date on a monthly basis. The five key event dates are: (1) award of contract, (2) start of fabrication, (3) keel, (4) launch, (5) delivery.

PMOBIN2 - A module designed to tabulate ships by a specified key event date on 6-month intervals. The five key event dates are: (1) award of contract, (2) start of fabrication, **(3)** keel, (4) launch, (5) delivery.

PSNDRP - A module designed to select data from the National Defense Reserve Fleet data bank.

PSREG - A module designed to select data from the Mobilization Data Bank.

PSTEEL - A module designed to provide a graphic steel (short tons) distribution curve or a report.

ULTZAT - A module designed to provide a Building Position Availability Report, based on existing and proposed contracts.

c. UTILITY **ROUTINES**

The utility modules are designed to perform relatively straight forward tasks. Such tasks are: creating data files, verifying dates, adjusting dates, shifting data, sorting data and assigning steel to vessels.

PASTEEL - A module designed to assign a steel value to vessels according to the type vessel.

PDATE - A module designed to adjust the five key event dates, earlier -or later than the current dates.

PDSHIP - A module designed to give the user a method to create data files for reactivation ships.

PEDIT - A module designed to verify the-key event date.

PSHIFT - A module designed to shift each link of data, in a data file, one position to the left.

PSORT - A module designed to sort several data files into one data file, according to one of the six selected key event dates.

D. TITLE XI

Title XI is a group of Management Data Query (MDQ) program modules designed to provide the status of Title XI applications. Title XI applications are submitted to MarAd for approval, disapproval or withdrawal.

Principal Characteristics Report - A quarterly publication reporting hull characteristics information of the Title XI applications from January 1977 to, present. The report is intended for the Division of Naval Architecture.

Financial Status Report - A quarterly publication reporting financial status information of the Title XI applications from January 1977 to present. The report is intended for **the** Office of Ship Financing Guarantees.

Project Status Report - A monthly publication reporting project stat-us information of the Title XI applications from January 1977 to present time The report is intended for the construction representative, supervisors, and other personnel who are directly involved in Title XI applications.

Print 11 - A module designed to extract data from the Title XI data bank in any format that the user desires.

TWO other MDQ program modules are used to address such issues as: the number of U.S. ships under construction from a specified time frame by vessel type, deadweight and contract value; the number of vessels over 1,000 gross tons, by shipyard, built between two specified dates.

The following two modules have these capabilities and more:

PTABNCON - A module designed to provide tabular reports in variable formats for vessels under construction. A maximum of **15 characteristics are** available in describing each vessel. **A** report may consist of all vessels

over 1,000 gross tons. Another report may consist of a particular type vessel (LNG or Tanker) delivered in a specified time frame.

PTABCONV - A module designed to provide tabular reports in variable formats for vessels under conversion or already converted. A maximum of 15 characteristics are available in describing each vessel. A report may consist of vessels under 1,000 gross tons;

IX. HARDWARE CONFIGURATION

Review Figure Dl for an overview of the hardware configuration. The Division of Production's personnel are responsible for collecting, maintaining, and distributing all data concerning SEAS. They are also responsible for' any special studies, reports, or any other information the model generates. Therefore, they are considered the main user.

They have three pieces of Tektronix equipment located in their immediate area: (1) A Graphic Display Unit (4014-l), (2) A Flexible Disc Memory Unit (4921) and (3) A Hard Copier Unit (4631). The Graphic Display Unit is used to communicate with either the in-house Honeywell computer or the Control Data Corporation (CDC) Time-Sharing System, located in Rockville Maryland.

On occasion, there is a need to transfer a data file from the CDS Time-Sharing System to a printer. This function is accomplished via the CDC Time-Sharing System to the CDC Batch System, known as Cyberlink Note in Figure Dl, the location of the terminal (fourth floor) and the printer (first floor).

During a mobilization study certain reports contain classified information, therefore special handling procedures are required, and these will not be discussed. The teleprocessing communications currently being used is 1200 BAUD.

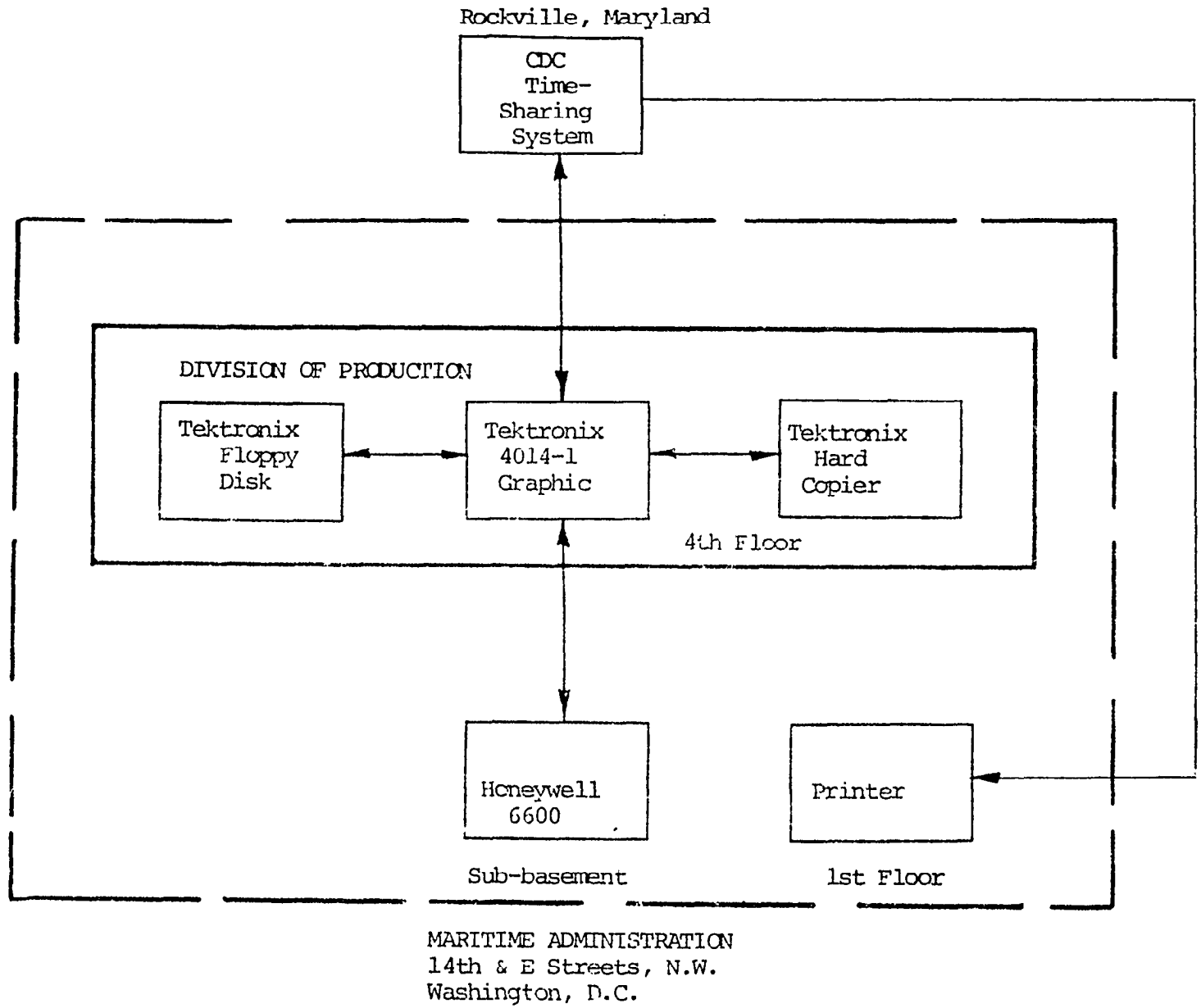

Rockville, Maryland
CDC
Time-
Sharing
System
DIVISION OF PRODUCTION
Tektronix
Floppy
Disk
Tektronix
4014-1
Graphic
Tektronix
Hard
Copier
4th Floor
Honeywell
6600
Printer
Sub-basement
1st Floor
MARITIME ADMINISTRATION
14th & E Streets, N.W.
Washington, D.C.

Figure IXa

X. APPLICATIONS OF THE SEAS MODEL

Typical CDS Budget Request

Shipyard workload impact for outyear programs must be projected to document the CDS budget requests. An objective of the CDS program is to maintain an adequate shipbuilding industry that will meet the mobilization requirements and be adequate for the commercial and national security shipping requirements. **All of the current 24 private shipyards in the Active Shipbuilding** Industrial Base are needed to **meet** this goal. Additionally, all of the other yards in the repair base are needed for the short term emergency scenario. **The 24 shipyards currently in the Active Shipbuilding base are** listed below. Estimates of continuous stable peacetime workforce levels that will provide productive use of current facilities are made. Mobilization **staffing requirements for an extended war have been estimated during a recent** study to be much higher than those shown. The following yards participate in the active shipbuilding base and the aggregate workforce levels are shown.

Alabama DryDock & Shipbuilding Co.
American Ship Building Co. Lorain., OH
Avondale Shipyards, Inc.
Bath Iron Works Corp.
Bay Shipbuilding Corp.
Bethlehem Steel Corp., San Francisco, CA
Bethlehem *Steel Corp.*, Sparrows Point, MD
Equitable Shipyards, Inc.
General Dynamics Corp., Groton, MA
General Dynamics Corp., Quincy, MA
Levingston Shipbuilding Co.
Litton Industries, Ingalls Shipbuilding Div.
Lockheed Shipbuilding & Construction Co.
Marinette Marine Corp.
Maryland Shipbuilding & Drydock Co.
National Steel & Shipbuilding Corp.
Newport News Shipbuilding & Dry Dock Co.
Norfolk Shipbuilding & Drydock Co.
Peterson Builders, Inc.
Sun Shipbuilding & Dry Dock Co.
Todd Shipyards Corp., Galveston, TX
Todd Shipyards Corp., Houston, TX
Todd Shipyards Corp., Los Angeles, CA
Todd Shipyards Corp., Seattle, **WA**

Total Stable Peacetime Workforce Level	110,000
Total Production Peacetime Workforce Level	**81,550**

The following graph "Shipbuilding Tndustry Workload Projection" depicts the employment scenario for the future years. Specifically examination of the graph shows the following:

a) **For the 24 yards in the Active Base workforce levels are** shown in equivalents which compensates for absenteeism, vacations, and overtime.

b) Repair and non-ship work employment has been approximately **13,000.** For convenience this value is straight lined across the graph. With new construction work decreasing it is anticipated that some of these yards will increase repair activity.

c) The solid line represents workforce levels **necessary to complete all** new construction [Navy, private, and CDS) currently under contract.

d) Loaded on top of the firm work is a 5-year Navy building program of approximately 23 ships per year.

e) After the Navy building program, the private construction forecasts, obtained from market surveys, are loaded.

f) A typical low level budget request could contain the following projected vessels :

	80	**81**	**82**	**83**	**84**	**85**
LASH	I		**2**	**2**	**2**	**2**
CONTAINER SMALL			**2**	**2**		**3**
CONTAINER LARGE					**2**	

This is plotted on the curve using the □ symbol.

g) For example, 200 LASH type vessels were spread over the **5-year 80** thru 85 to examine the magnitude of shortfall from a stable production

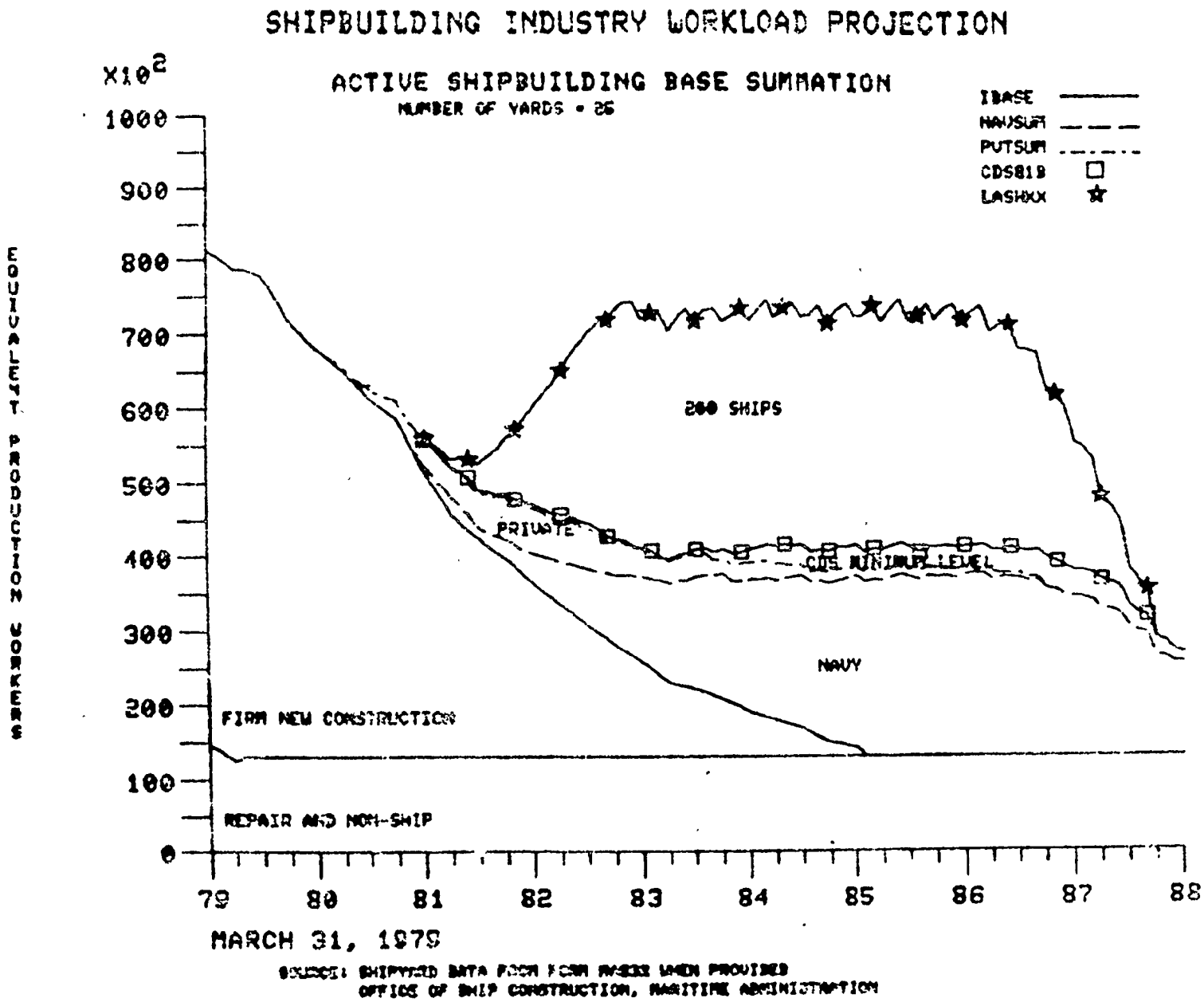

SHIPBUILDING INDUSTRY WORKLOAD PROJECTION
ACTIVE SHIPBUILDING BASE SUMMATION
NUMBER OF YARDS = 25
X10²
EQUIVALENT PRODUCTION WORKERS
IBASE
NAVSUM
PUTSUM
CDS819
LASHXX
1000
900
800
700
600
500
400
300
200
100
0
200 SHIPS
PRIVATE
CDS MINIMUM LEVEL
NAVY
FIRM NEW CONSTRUCTION
REPAIR AND NON-SHIP
79
80
81
82
83
84
85
86
87
88
MARCH 31, 1979
SOURCE: SHIPYARD DATA FROM FORM MA800 WHEN PROVIDED
OFFICE OF SHIP CONSTRUCTION, MARITIME ADMINISTRATION

Figure Xa

employment level of 83,100. The use of LASH type vessels is not intended to portray a shortfall of LASH ships in the fleet, but to provide a planning wedge of national cargo vessels. Two hundred LASH ships produces a level condition at around 73,000 still somewhat short of the goal, yet leaving enough slack to maintain competition. These are plotted using the * symbol.

PROPOSED CARGO PREFFRENCE LEGISLATION OF 1977

Another good example of SEAS function and role in policy analysis can be seen in the assessment of United States shipbuilding capacity for cargo preference legislation done in 1977.

During that time, considerable emphasis was being placed upon an assessment of the capacity of the United States shipbuilding industry. We had seen several studies that superimposed a number of assumptions upon the industry with a subsequent evaluation of the ability to accomplish the required work. There were also on-going individual minianalyses being done on a yard-by-yard basis to determine the adequacy of a particular contractor's ability to perform construction to his contract dates. All of this provided the basis for answering the question, "what is the amount of tanker tonnage that the industry could reasonably he expected to construct if cargo preference legislation is enacted?"

Before any analysis could be done, it was first necessary to define shipbuilding capacity. Shipbuilding capacity is a general term that can be very complex or very simple depending upon the context in which it is used. Annual cargo capacity tonnage construction is the desired output. The most commonly mentioned and analyzed components of a capacity assessment are the workforce and facility constraints. Refore developing those areas,

it should be mentioned that a number of other factors such as profitability, management talent, and component availability contribute to the industry's health, viability, and future well being. These should not be forgotten as part of the shipbuilding capacity of this nation.

Profit and the ability to make a profit is an important consideration. This is closely related to capital investment. One may ask how this is related to shipbuilding capacity. It is apparent that many of our shipyards have made significant capital investments in facilities over the last 10 years. Many of these investments were in anticipation of and in reaction to the tanker construction boom of the early 1970's. The point is not that we have excessive untied capacity; we did not in 1977. Rather, the point is that industry will invest and expand to meet the market if there is a profit to be made.

Another factor contributing to the industry capability and capacity to produce ships is the small hut highly experienced-and competent core of shipyard management talent that runs the nation's -shipyards. These people could Fe considered to be a national asset, and they definitely contribute to capacity. If increased capacity is desired, training of more people in shipbuilding would be a wise investment for the nation.

The component industry is also an often overlooked aspect of producing ships. Within recent memory are delays and disruption problems to ships under construction for the lack of valves, air compressors, propellers, gears, steel plates, welding wire, and castings to name a few. Supplier industry component lead times doubled and tripled during the tanker boom of the mid 70's. This may very well be the critical path constraint for any significant expansion of the industry.

A value for capacity of the shipbuilding industry is really a nebulous quantity, only significant for a point in time evaluation. To have useful meaning, it should he used only when the criteria and assumptions are explained and understood. The overall capacity is flexible by the very nature of the business. To see this, one has to only examine the remarkable advances made in ING ship construction during a relatively short period by U.S. shipyards .

To answer the question of cargo preference tonnage construction capability, both facilities available and the workforce constraints must be analyzed in conjunction with each other. To do this, a forecast of the ships to be built is made and schedules and the workforce estimates are developed for each ship type. Ships to be built are scheduled into the building positions available at each yard behird or in consideration of the base workload under contract. Workforce curves are developed depicting the loading of direct equivalent workers required per month to build the ships loaded into the Vard. And finally, ships are rescheduled or juggled in an iterative process to eliminate unrealistic peaks and valleys in the yard workforce much the same as shipyard management would do.

The following assumptions were applied to yield a realistic estimate of the maximum deadweight tonnage that could Fe constructed t0 meet the demand for tankers under a cargo preference program:

1. The current Navy 5-year shipbuilding plan was loaded on top of the base workload. This plan reflects projected procurements that are relatively well defined and fit into the overall defense plan. There is a high degree of probability that this work will be awarded and therefore it is loaded into the respective shipyards first,

2. Next in priority for way space is the commercial 5-year projection developed by MarAd's Office of Policy and Plans. This plan considers both CDS and private construction with the development of a high, best, and low ship mix scenarios. The best estimate with some minor variations is used to load the individual yards.

3. The maximum direct equivalent yard workforce levels were limited to current levels or allowed to expand based upon historical peacetime data and an assessment of each yard's individual situation. In the face of the workforce problems that many yards have experienced in the 1970 ' s and with al1 the inherent turnover and productivity losses caused by the build ups, shipyards recognized their maximum levels for doing efficient business, and were loaded according to those levels.

4. The remaining capacity after assignment of the Navy and commercial 5-year plans was assigned to construction of cargo preference tankers.

5. A range of tanker sizes were utilized to maximize the tonnage output each yard could construct. These varied 'from small feeder vessels of approximately 30,OOO DWT up to 600,000 DWT being conceptualized by Newport News at that time.

6. If legislation had been enacted at that time, the earliest possible ship construction contract awards would have been in July 1977. However, July 1977 award dates are arbitrary and short term shifts would not affect the conclusions. Contract award assumptions subsequent to July 1977 were contingent upon building position availability in individual shipyards.

7. Tanker sizes up to and including a conceptual 600,000 DWT size possible at Newport News were considered. This allowed the maximum tonnage to he built and also assumed that deepwater port facilities such as SFADOCK and Loop will he on line in the early 1980's.

8. An attempt to load each shipyard facility on a reasonable way schedule was made. Some overlaps are inevitable when scheduling bypothetical building programs. Although these schedule overlaps have been kept to a minimum, it is assumed that shipyards can develop individual work-around plans to accommodate some overlaps as they have done in the nast.

9.This study includes an estimate of present capability only. Capital improvements which could increase capacity are likely to occur if a significant Cargo Preference law is enacted.

The result of the iterative analysis process were tabulated to show the industry capacity in three ways: the number and types of ships; the tanker deadweight tonnage ; and a total industry workforce projection.

The ship mix finally assigned to the projected yards based upon the available building positions and manpower consisted of 165 unawarded ships in the Navy program through 1982, (much larger than now planned), 110 non-tanker commercial ships in the MarAd forecast and 127 tankers for cargo Dreference. No attempt was made to project requirements for skilled crafts within the workforce. However, it is a good possibility that this could further restrict the capacity. The summation of cargo preference tonnage with the total deadweight per vear and cumulative deadweight of 16,270,000 DWT by 1985 based upon deliveries of the projected cargo preference tankers

is shown in the following table. It should be noted **totally** there are seven shipyards that are not currently building large ships. These yards have the facilities to build the vessels as indicated and have all been contacted to confirm their interest in new construction should the market for new tankers become available. Tndustry workload to accomplish these construction projections was estimated by SEAS with a workforce build up to around 190,000 total industry by the end of 1980 being reasonable and attainable at that time.

SUMMATION OF SEAS OUTPUT FOR CARGO PREFERENCE

Estimate of Shipyard Capacity to Build Tanker Tonnage

	Delivered by END 1980		BY End 1985	
Large Shipyards now Engaged in New Ship Construction	(1) T190	‘190,000	(11) T190	2090,000
	(5) T120	600,000	(10) T265	2650,000
	(3)180,000		(15) T120	1800,000
	(I) T225	225,ooo	(6) T600	3600,OOO
			(17) T60	1020,000
			(7) T225	1575,000
	Totals	1,195,000 DWT		12,735,000 DWT
	Delivered BY End 1980		BY End 1985	
smaller shipyards that have capability and have Shown interest	(3) T30	90,000	(9) T30	270,000
	(3) T35	105,000	(13) T35	455,000
	(2) T40	80,000	(7) T40	280,000
	(3) T60,	180,000	(13) T60	780,000
	(2) T70	140,000	(7) T70	490,000
	(1) T90	90, 000	(6) T90	540,900
	(1) T120	120,000	(6) T120	720,000
	TOTAL	805,000 DWT		3,535,OOO DWT
	GRAND TOTAL	2,000,QOO DWT		16,270,OOO DWT

SHIPYARD CERTIFICATIONS

Before a construction- differential. subsidy contract can be executed between the Maritime Administration and a construction yard, the Director of the Office of Ship Construction must certify that in his opinion the contractor has the capabilities in terms of workforce, facilities, management, and technical capability to perform under terms of the construction contract. This certification cannot be done without reliable data and a critical evaluation of the current status of work in the yard's contract orderbook. One of the major sources of this information is SEAS. Through the reports outlined earlier in this paper, current status can be examined. Frequently MarAd may already have a construction representative in the yard to monitor on -going CDS contracts. His on the spot experience and familiarity is useful to the certification. Often a production analyst is sent to the yard's facility for an on-site visual update of the proposed construction facilities and review of the construction process planned. These on-site inspections are extremely valuable in keeping the analyst up to date with ship construction techniques and in touch with cognizant shipyard personnel who may be contacted when problems arise later in the contract.

The four components of the certification are considered. First, workforce availability is of the utmost importance. If a build up is required for the proposed work, an attainable rate must be demonstrated. Historical comparisons are used for assessment of the validity and likelihood of a yard's ability to attain the required build-up rate. Consideration must be made of the source or sources of skilled workers. Recently, one yard was denied a contract by MarAd on the basis that a facility did not actually have a skilled workforce available to draw upon. The facility itself was to be

opened and developed just for the contract and it was determined that the lack of a skilled workforce made it highly unlikely that the contractor would perform under the contract and meet a delivery schedule for the vessel. SFAS has the ability to overlay the proposed-work on the current orderbook and examine the workforce demand. The following graph- shows a hypothetical shipyard's current orderbook with three large tankers and six naval auxiliaries being proposed. The workforce requirements are shown so that a build-up of the current employment is required. However, the 2,000 equivalent worker increase in a period of 2 1/2 years may have been done before and certainly could be assumed to be reasonable.

Facilities availability is the second areas of concern. Although many other areas of the yard may be critical, SEAS only looks at building positions unless the analyst has a reason to-suspect another area is on the critical path for construction.

The next chart shows our hypothetical yard's building position utilization with the proposed Navy and commercial contracts superimposed after the firm work. Many times yards will plan work too tightly for an individual facility. SEAS provides MarAd with-this information in advance,

The third and fourth areas are management and technical capability The analyst must investigate and report his findings in these areas to complete the certification. SEAS cannot contribute to the certification in these areas.

FUTURE DEVELOPMENT

Projection of workforce requirements by major craft skills

A project has been underway for some time to enhance the capabilities of SEXS by providing the capability to project workforce requirements by the major craft skills. Currently SEAS has the capability of distributing proposed direct production workforce requirements to build a ship over a standard distribution curve. This curve was jointly generated and subsequently developed for the SPAMM model by the Engineering Computer Group and the Division of Production about 5 years ago. **This model has served Marad's** interest well and will continue to provide reliable planning and scheduling information for management's use.

However, if this capability could be expanded to include specific trade demands the SEAS model could be a much more dynamic tool.

Without question there is a need to develop industry requirements for reliable workforce projections (in the areas of commercial and Navy Shipbuilding and Repair) on both a normal peacetime and national emergency basis.

We propose to expand our present SEAS model to enable us to project workforce demand curves by the specific skills categories listed below:

1. Electricians
2. Welders
3. Sheetmetal Workers
4. Inside/Outside Machinists
5. Pipefitters
6. Electronic Mechanics
7. Riggers
8. Shipfitters
9. Loftsmen
10. Boilermakers
11. Painters
12. All Other

This development would be immediately useful to the Office of Labor and Training in meeting the overall goals of their project relating to skills training and establishment of shipbuilding job carp centers.

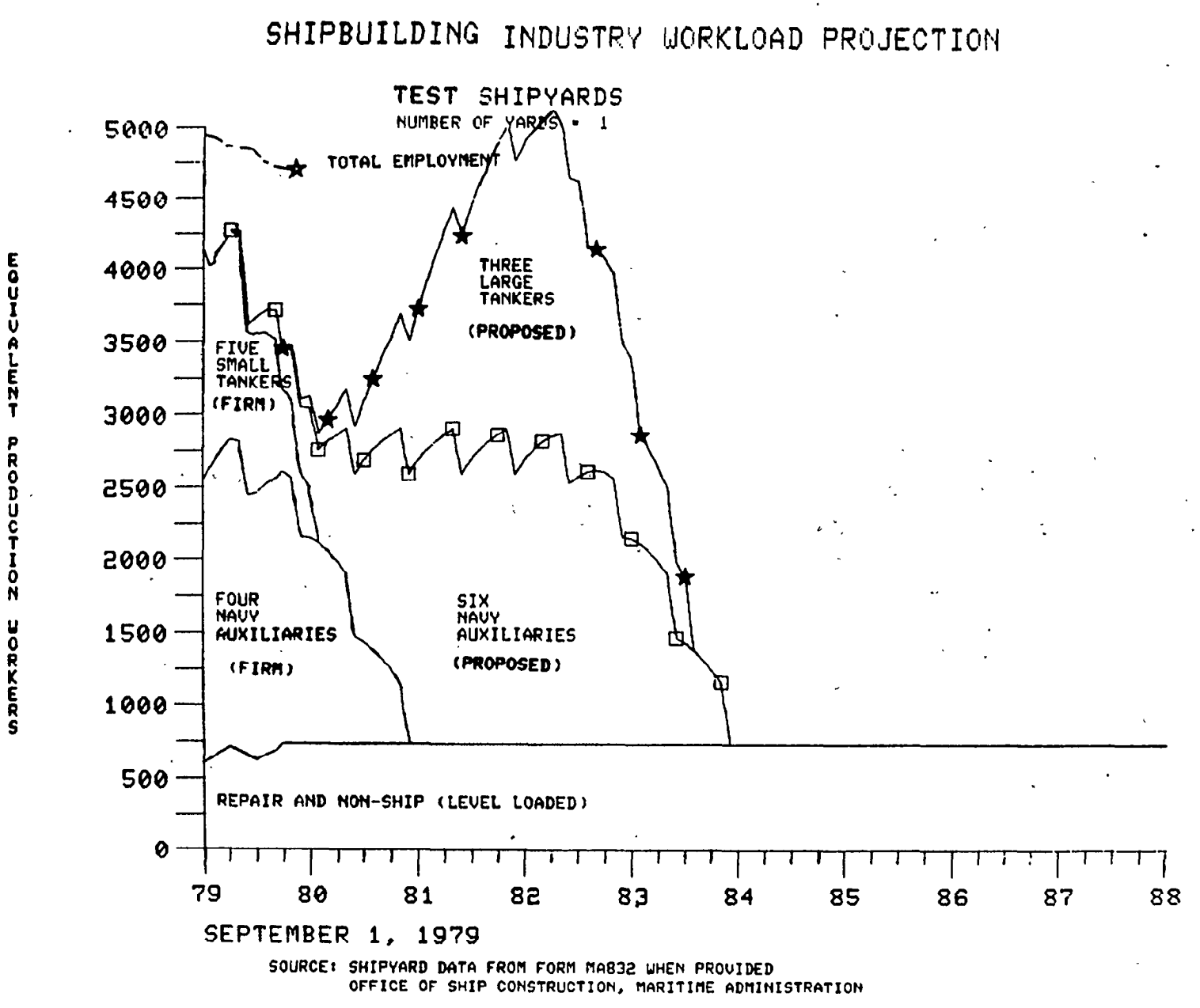

SHIPBUILDING INDUSTRY WORKLOAD PROJECTION
TEST SHIPYARDS
NUMBER OF YARDS = 1
EQUIVALENT PRODUCTION WORKERS
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
TOTAL EMPLOYMENT
THREE LARGE TANKERS (PROPOSED)
FIVE SMALL TANKERS (FIRM)
FOUR NAVY AUXILIARIES (FIRM)
SIX NAVY AUXILIARIES (PROPOSED)
REPAIR AND NON-SHIP (LEVEL LOADED)
79
80
81
82
83
84
85
86
87
88
SEPTEMBER 1, 1979
SOURCE: SHIPYARD DATA FROM FORM MA832 WHEN PROVIDED
OFFICE OF SHIP CONSTRUCTION, MARITIME ADMINISTRATION

Figure Nb

TEST SHIPYARD

BUILDING POSITION UTILIZATION

SEPTEMBER 1, 1979

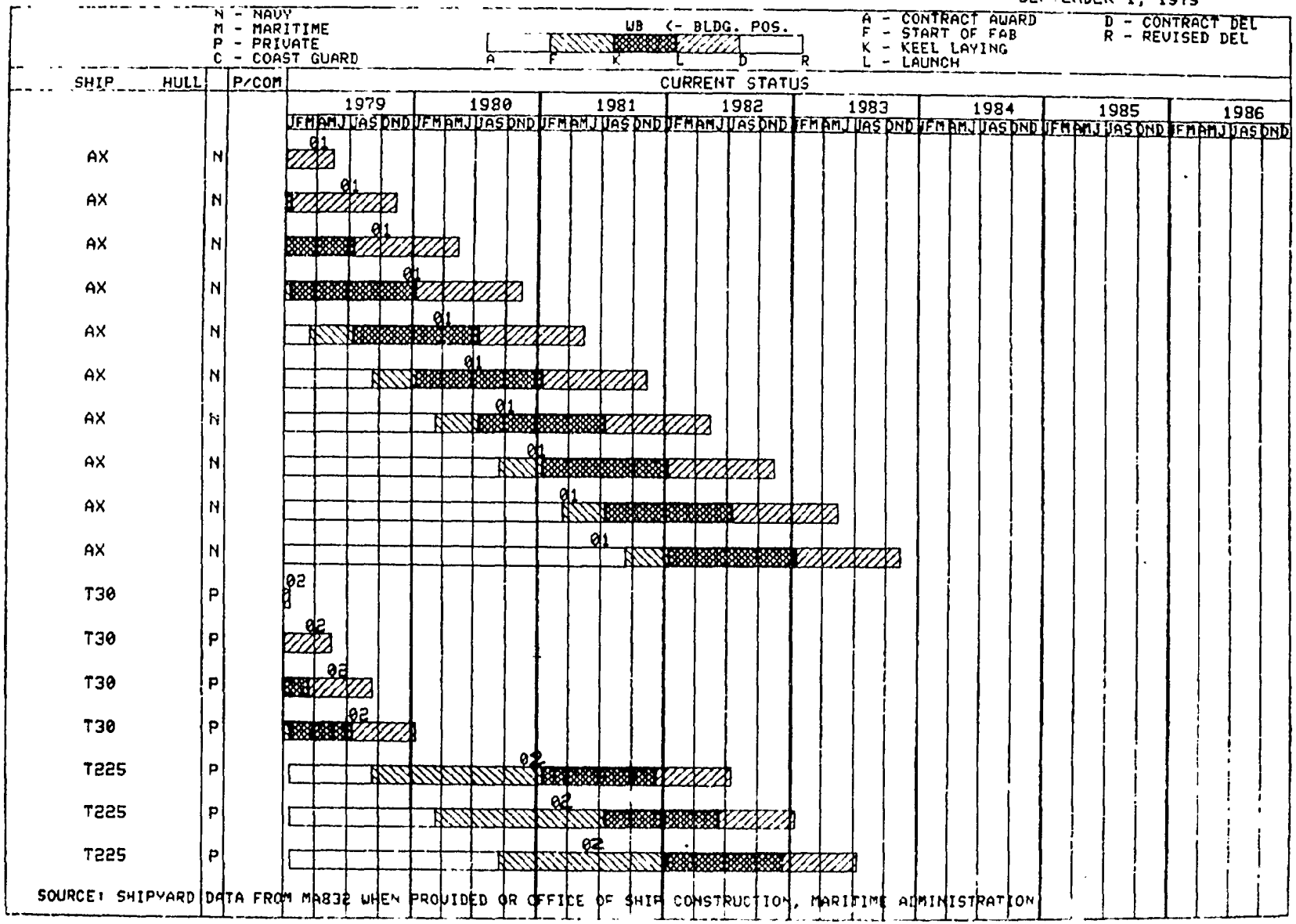


Figure Xc

To do this, data is needed for individual ships so that the skill categories and shapes for specific skill distributions can be generated. It is intended that the shapes can be easily changed or chosen to match individual circunstances. Some individual yards have offered pieces of the needed information. However, there seems to be a data void that must be overcome before this enhancement can be realized. When data becomes available it will be put on a percent worker/percent building time basis from start of construction to delivery so that only the shape of the distribution is actually being analyzed. By using the percent/percent basis no one yard's specific manpower levels can be compromised to a competing shipyard.

To get these curves we will gather data by the broad ship type categories of cargo, tanker, naval auxiliary and naval combatant. A program is being planned that will utilize each ship's individual skill curves, calculate the areas under the curve (which is essential to obtaining the percentage of the total job by trade), and curve fit a standard curve to the sample of data which will produce a representative skill trade production forecast.

SEAS will then only need a specific work days estimate and a proposed building schedule to output a forecast of the workforce demand by skill trade.

It would be tempting to include all major ship categories in the model from the very beginning. We intend to develop a pilot program which focuses on one specific ship type. After demonstrating the model capabilities, it will be only a matter of plugging in information for other categories of vessels to expand the model as needed and as more and more data resources become available. Within a relatively short period of time, we could have something concrete to exhibit to the various entities who would have use

for such information, thereby mitigating any skepticism or hesitation on the part of data sources to release needed information. This would facilitate expansion of the model.

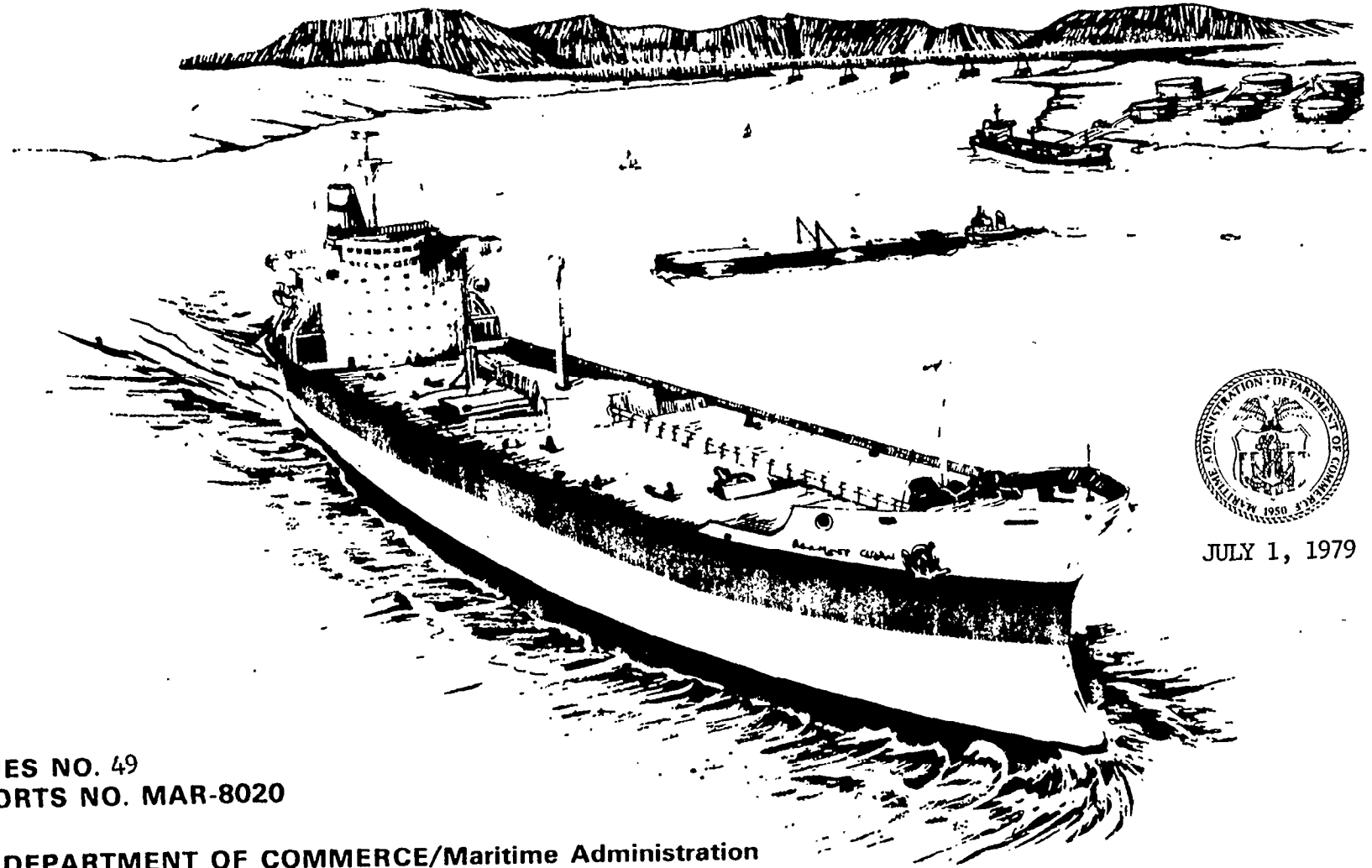
We believe this proposed model will greatly improve our response to the many inquiries and surveys we respond to on a continual basis from outside sources as well as those generated from within MarAd. Also, our management planning capabilities will be greatly enhanced.

In summary, a methodology exists to further develop and enhance the SFAS model to provide a capability for projecting workforce demand curves by specific skill category. Initial programming has been accomplished and data sources are being investigated.

Appendix A - Example Quarterly Shipbuilding Status Report

Appendix B - Five Year Shipbuilding Plans

STATUS OF MAJOR SHIPBUILDING IN U.S. COMMERCIAL SHIPYARDS



JULY 1, 1979

ISSUES NO. 49
REPORTS NO. MAR-8020

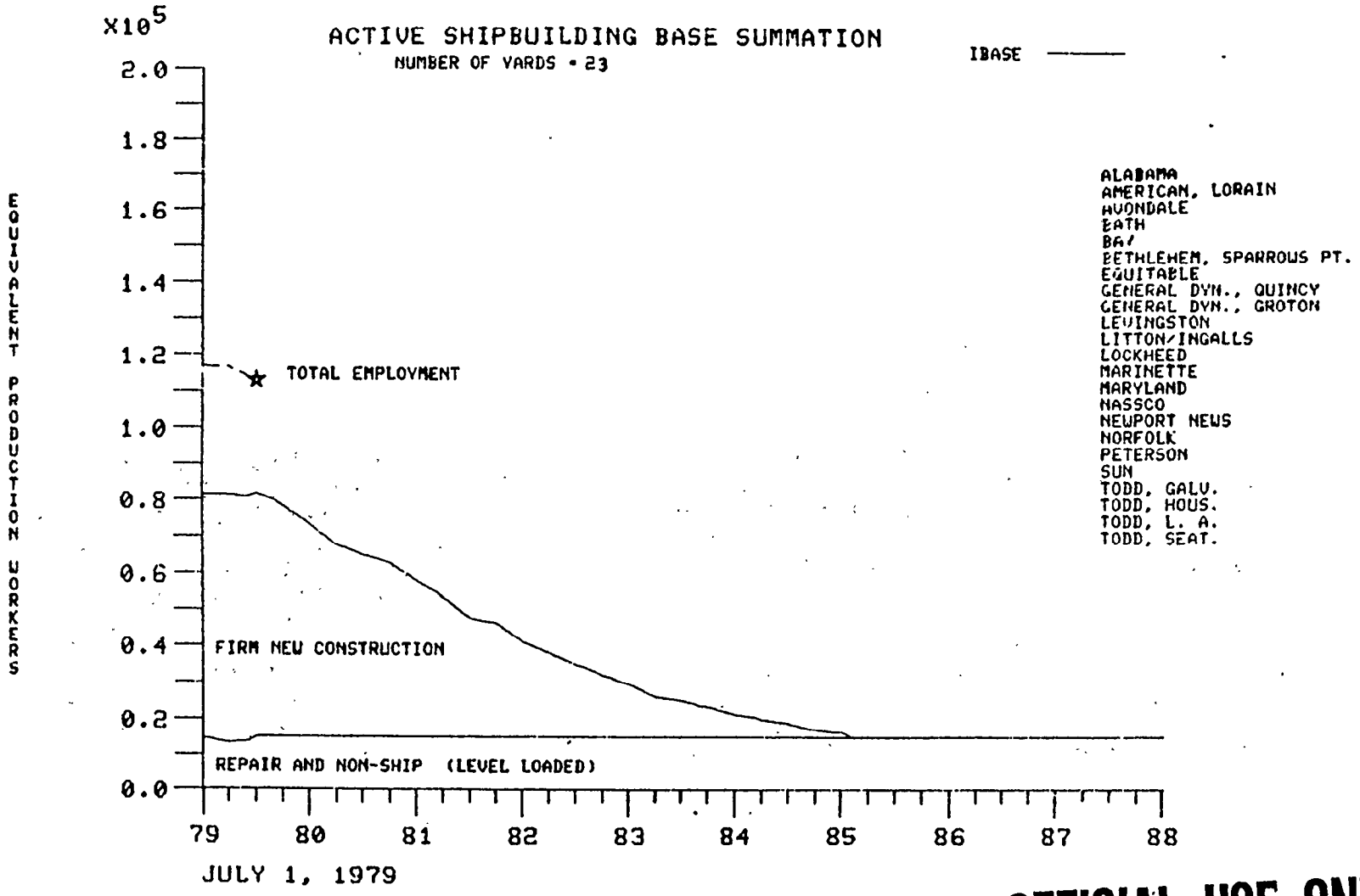
U.S. DEPARTMENT OF COMMERCE/Maritime Administration

FOR OFFICIAL USE ONLY

THIS REPORT, "STATUS OF MAJOR SHIPBUILDING IN U. S. COMMERCIAL SHIPYARDS" IS PRIMARILY DESIGNED TO PROVIDE CURRENT INFORMATIN FOR MANAGEMENT ON THE STATUS OFSHIPBUILDING.IT DEPICTS GRAPHICALLY, THE COMPLETE ORDER BOARD OF EACH MAJOR SHIPYARD HAVING THE CAPABILITY TO CONSTRUCT SHIPS 475' L0A.x 68' BEAM AND OVER. INCLUDED ARE ALL KNOWN MARITIMF ADMTNISTRATION, NAVY, OTHER GOVFRNMENT AND PRIVATE CONTRACTS, FOR NEW OCEANGOING SHIPS AND ALL CONVERSION WORK TO OCEANGOING SHIPS HAVING A CONTRACT VALUE OF $ 1 MILLION AND OVER AND A SHIPYARD AVAILABILITY OF AT LEAST 6 MONTHS. ADDITIONAL INFORMATION INCLUDES DELAYS, PERCENTAGE OF COMPLETION AND TOTAL EMPLOYMENT WHICH IS SUPERIMPOSED ON THE WORKLOAD FOR EACH YARD.EMPl.OYMENT FOR THE LAST QUARTER SHOWN IS ESTIMATED AND WILL BE ADJUJSTED AS ACTUAL DATA IS RECEIVED. DELAY INFORMATION IS ALL INCLUSIVE, i.e., DELAYS DUE TO CHANGES AND EXTRAS REQUIRED BY OWNERS AS WELL AS PRODUCTION DELAYS BY CONTRACTORS DUE TO LABOR SHORTAGES, LATE MATERIAL DELIVERIES, STRIKES, ETC. THIS REPORT IS PUBLISHED QUARTERLY. MARAD AND PRIVATE WORK IS SHOWN AS SCHEDULED 6-30-79 NAVY WORK IS SHOWN AS SCHEDULED 6-l-79

PREPARED BY OFFICE OF SHIP CONSTRUCTION (CODE 723)

SHIPBUILDING INDUSTRY WORKLOAD PROJECTION

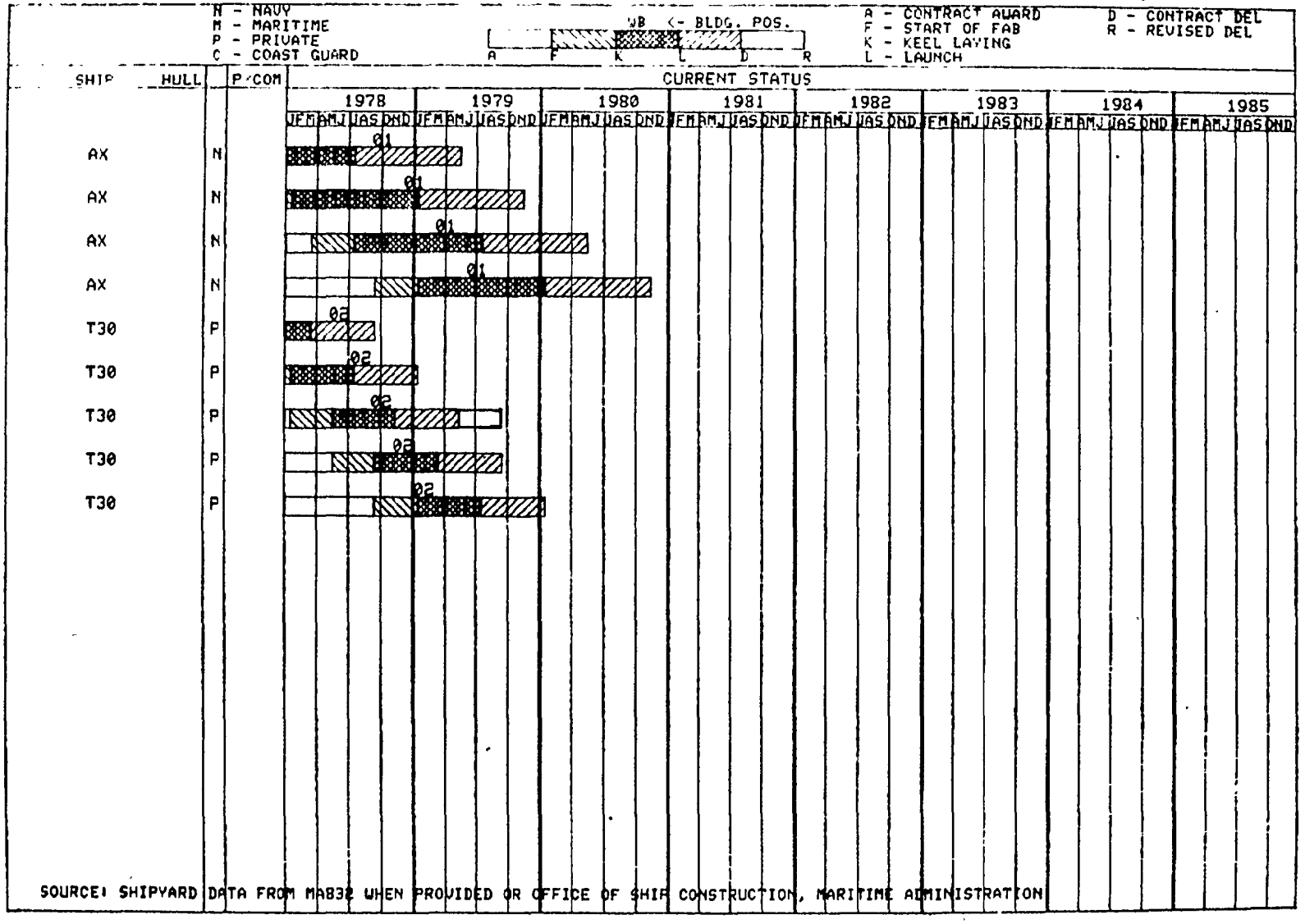


SOURCE: SHIPYARD DATA FROM FORM MA832 WHEN PROVIDED
OFFICE OF SHIP CONSTRUCTION, MARITIME ADMINISTRATION

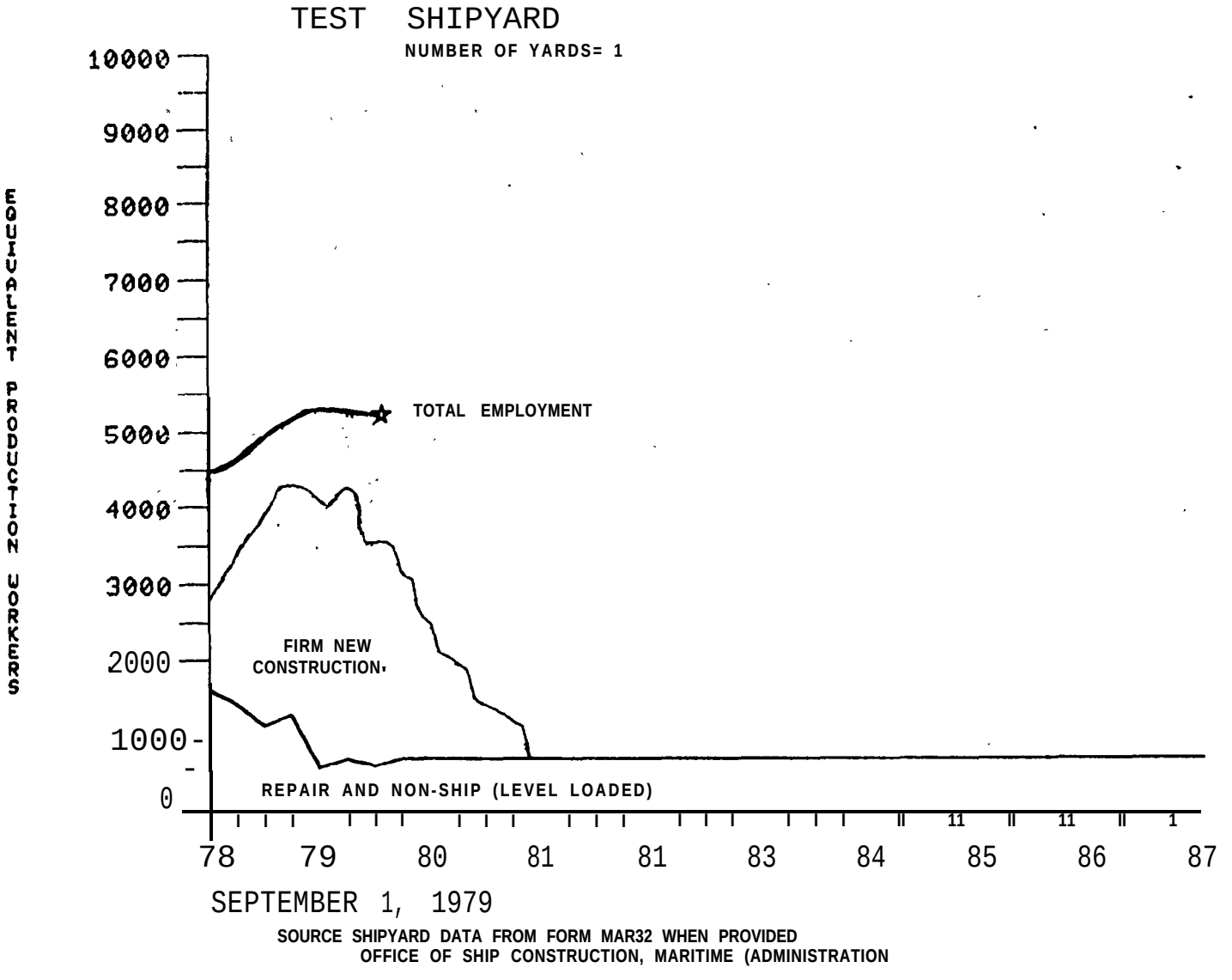
TEST SHIPYARD

BUILDING POSITION UTILIZATION

SEPTEMBER 1, 1979



SHIPBUILDING INDUSTRY WORKLOAD PROJECTION



SOURCE SHIPYARD DATA FROM FORM MAR32 WHEN PROVIDED
OFFICE OF SHIP CONSTRUCTION, MARITIME (ADMINISTRATION

FORM MA-832
(6-78)

U.S. DEPARTMENT OF COMMERCE
MARITIME ADMINISTRATION

SHIPBUILDING ORDERBOOK AND SHIPYARD EMPLOYMENT
(With Projections for Completion of Firm Work Orderbook)

Date: August 27, 1979

Shipyard: Any yard ABC

This report is authorized by law 46 USC 1120 and 46 USC 1121. While you are not required to respond, your cooperation is needed to make the results of this survey comprehensive, accurate and timely.

Current Monthly Average of Total Plant Employees: 5371 Mo. August

Manpower: ☐ EQUIVALENT ☐ ACTUAL

Multiplier: 1.13

	TOTAL PRODUCTION WORKERS	PRODUCTION WORKERS: SHIPBUILDING: TOTAL CONSTRUCTION	SHIPBUILDING: MARAD	SHIPBUILDING: NAVY	SHIPBUILDING: OTHER FEDERAL	SHIPBUILDING: PRIVATE	SHIP REPAIR: TOTAL REPAIR	SHIP REPAIR: NAVY	SHIP REPAIR: OTHER FEDERAL	SHIP REPAIR: PRIVATE	NON SHIP WORK
	1	2	3	4	5	6	7	8	9	10	11
Current Monthly Average	3762	3027	717	1727	130	453	735	306	11	232	186
PROJECTION OF FIRM WORK											
Calendar Year - Quarter 1											
2											
3											
79 4	3196	2466	420	1726	84	236	730	300	20	240	170
Calendar Year 80 - Quarter 1	2759	2029	327	1489	0	213	730	330	20	240	140
2	2068	1348	131	1150	0	67	720	400	20	200	100
3	1470	750	0	750	0	0	720	400	20	200	100
4	1240	520		520			720	400	20	200	100
Calendar Year 81 - Quarter 1	720	0		0			720	400	20	200	100
2											
3											
4											
Calendar Year - Quarter 1											
2											
3											
4											
Calendar Year - Quarter 1											
2											
3											
4											
Calendar Year - Quarter 1											
2											
3											
4											

NOTE: Column 1 = Column 2 + Column 7 + Column 11 Column 2 = Column [illegible] Column 7 = Column 8 + Column 9 + Column 10

[illegible] MM-DC 13136-P78

SCHEDULE OF CURRENT ORDERBOOK CONSTRUCTION DATES

Date: August 27, 1979

Shipyard: Any Yard ABC

Respondent:	Position Title:	Phone:
Fred D. Wizzard	Manager, Production Analysis	202-377-4779

SHIP TYPE	BUILDER HULL NO.	AWARD	START FABRICATION	KEEL	LAUNCH	DELIVERY	BUILDING POSITION	PERCENT COMPLETE	REMARKS
AX	1101	11/7/76	10/6/76	7/1/77	7/14/78	5/15/79	01	100	NAVY
AX	1102	11/7/76	4/5/77	2/3/78	1/30/79	12/1/79	01	75	NAVY
AX	1103	9/21/77	3/17/78	7/17/78	7/2/79	5/28/79	01	69	NAVY
AX	1104	9/21/77	8/30/78	1/3/79	2/3/80	12/1/80	01	47	NAVY
T-30	1105	12/20/76	6/7/77	9/10/79	3/17/78	1/31/78	02	100	CDS
T-30	1106	12/20/76	11/30/77	2/19/78	7/11/78	1/30/79	02	100	CDS
T-30	1107	7/3/77	2/20/78	5/21/78	11/31/78	9/5/79	02	98	ST. GOVT
T-30	1108	9/16/77	5/30/78	9/10/78	3/17/79	9/19/79	02	81	PVT
T-30	1109	1/6/78	9/16/78	1/29/79	8/8/79	2/6/80	02	64	CDS
MISC. REPAIR ONGOING									
D7	699	7/15/79	-	-	-	9/6/79	PS	-	OVHL
BGG	725	8/30/79	-	-	-	10/7/79	PS	-	REPAIR
FERRY	14	7/3/79	-	-	-	8/16/79	DD 3	-	REPOWER
T-25	851	8/1/79	-	-	-	8/27/79	PS	-	REPAIRS

Form Terminology

For the purposes of this form, the following standard terminology has been established as a basis to maintain data consistency between participating data sources:

Ship Type - a designation which will clearly identify different ships under contract. For example

Ship Designation	Ship Type
265,000 DWT Tanker MA Design T1O-S-101b	TlO-S-101b
Fleet Oiler Navy Design A0 Navy Hull Number 177	AO-177
80,000 DWT Tankers No Marad Subsidy	T-80

Start Fabrication - the date direct charging of production worker labor a specific hull occurs that will. sustain construction.

Keel - the date an identifiable section of the hull occupies a building position.

Launch - the date a building position is vacated by moving of a hull section and thus making available this position for another hull.

Percent Complete - the ratio of the total summation of the dollar value of all labor and materials utilized to the total dollar value of the contract or some other suitable ratio method of comparing the total value assessment of labor and material completion to the total value of labor and material required for the contract.

Building Position - the pier, way, basin, drydock or other facility location that is dedicated to either ship construction or conversion.

Production Workers - working foremen and all non-supervisory workers (including lead men and trainees) engaged in fabrication, processing assembling, inspection, handling, receiving, storage, packing, warehousing, shipping and other services

closely associated with the above production operations (exclusions are those workers engaged in construction of major additions or alterations to the plant, maintenance, repair, janitorial., watchman, administrative engineering, technical, supervisory, sales, recordkeeping and other related office services).

Firm Work - work that is contractually on the current orderbook.

Non Ship Work Column - all other production work not charged to an actual shipbuilding project, such as industrial products.

Marad Column - the production work charged only to Title V CDS ship construction or conversion (includes vessels under Title XI mortgage insurance only when Title V is also involved).

Private Column - the production work charged to any private, city, county, or state ship construction or conversion (includes all vessels with only Title XI mortgage insurance).

Other Federal Column - the production work charged to any other federal government ship construction or conversion (such as U.S. Coast Guard or National Oceanic and Atmospheric Administration, etc.).

Manpower (Actual or Equivalent) - select the most convenient type of manpower value that will be displayed for the average men in each period.

- actual men are the actual or planned personnel employment required.
- equivalent men are the total manhours expended (TME), either actual or planned, during a specified time frame divided by the total straight time (TSTHA) hours available per man during that same time frame. (i.e. equivalent men $= \frac{TME}{TSTHA}$)

Multiplier - the conversion factor (M, where M>l) that converts equivalent men into actual men.

(i.e. actual men = M x equivalent men)

Appendix B

Five Year commercial Shipbuilding Forecast
Fiscal Year of Award - July 1979

New Construction (Case I)	FY 79 (Unawarded)	FY 80	FY 81	FY 82	FY 83	FY 84	TOTAL
GLB10	-	1	-	-	-	-	1
GLB14	1	-	-	-	-	-	1
GLB23	-	-	-	-	1	-	1
GLB37	-	1	-	-	-	-	1
GLB60	1	1	2	1	1	-	6
DYB37	-	3*	5*	5*	5*	1*	19
CATUG/TKR	-	-	2	1	-	-	3
CNTR/RORO	-	-	-	-	2*	4*	6
CNTRL	1*	-	-	-	-	3*	4
T35	-	-	-	5[a]	-	-	5
T40	-	-	-	-	3	-	3
Sub-total	3	6	9	12	12	8	50
CASE II							
LNG	-	2*	4*	-	-	-	6
Sub-total	0	2	4	0	0	0	6
CONVERSIONS							
CNTR/RORO	-	2*	-	-	-	-	2
T35/JUMBO	-	1	1	1	1	-	4
T37/JUMBO	-	3	4	-	-	-	7
T50/RP	1	4	-	-	-	-	5
Sub-total	1	10	5	1	1	0	18
TOTAL	4	18	18	13	13	8	74

*Subsidized Vessels
a Possible reduction in number by two vessels

Legend

CNTRL Large Containership
CNTR?RORO Partial Container/RORO
LASH/CNTR 81b LASH/containership
CATUgTKR Tug/Barge Tanker
LNG 125,000 cubic-meter LNG Ship

JUMBO -Jumboized with new forebody
RP- Repowered from steam to diesel propulsion.
GLB- Great Lakes BulkShip
DYB -Dry-BulkShip
T -Tanker

Note: All numbers indicate DWT in thousands, e.g., T-35 means 35,000-DWT tanker.

Navy Five Year Shipbuilding Forecast

May 10, 1979

New Buildings	Unawarded FY'79	FY'80	FY'81	FY'82	FY'83	FY'84	FY'85	Total
LSD-41	-	-	1	-	-	1	1	3
T-ARS	-	-	1	2	1	-	-	4
TRIDENT	-	1	1	1	1	1	2	7
SSN-688	-	1	1	2	1	2	-	7
FA-SSN	-	-	-	-	1	-	2	3
DDG 47	1	1	2	3	3	4	4	18
FFG	-	6	3	2	-	-	-	11
T-AO	-	-	-	-	2	2	-	4
MCM	-	-	-	1	4	4	-	9
T-AGOS	2	5	5	-	-	-	-	12
DDX	-	-	-	-	-	1	-	1
CV	-	1	-	-	-	-	-	1
T-ARC	1	-	-	-	-	-	-	1
Total	4	15	14	11	13	15	9	81
Conversions								
LPH	-	1	-	-	-	-	-	1
DDG-2	-	1	3	3	3	-	-	10
CV SLEP	-	-	1	-	1	-	-	2
T-AK	-	-	1	-	-	-	-	1
Total	-	2	5	3	4	-	-	14
Grand Total	4	17	19	14	17	15	9	95

LEGEND

AD	Destroyer Tender
CVV	Conventional Aircraft Carrier
CV SLEP	Aircraft Carrier (conversion)
DDX	Experimental/Special Purpose Destroyer
DDG-47	Destroyer
DDG-2	Destroyer (conversion)
FFG	Guided Missle Frigate
LSD-41	Dock Landing Ship
MCM	Mine sweeper
SSN-688	Nuclear Attack Sumbarine
T-AGOS	Electronics Surveillance Ship
T-AK	Supply Ship (Conversion)
T-AO	Auxiliary Oiler
T-ARC	Cable Repair Ship
T-ATU	Oceangoing Tug
TRIDENT	Fleet Ballistic Missle Submarine
T-	For use by Military Sealift Command
F-	Being built for a foreign nation
FA-SSN	Nuclear Fleet Attack Submarine