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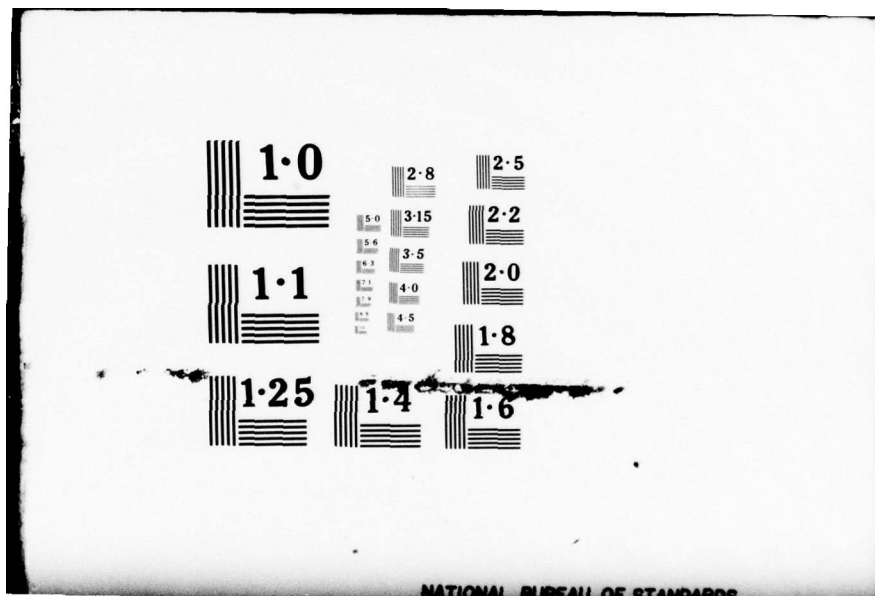
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FINAL REPORT

DEVELOPMENT OF MAINTENANCE MANAGEMENT  
IMPROVEMENT TECHNIQUES FOR  
COMSERVPAC SHIPS

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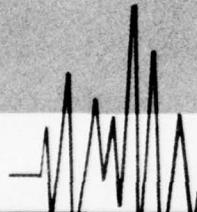
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Prepared for  
COMMANDER, SERVICE FORCE PACIFIC  
and  
PEARL HARBOR NAVAL SHIPYARD

Under Contract N00604-71-C-0431  
(May 1971 through January 1973)

Publication D06-01-1-1212

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ABSTRACT

Tasks conducted by ARINC Research Corporation under a nonpersonal engineering services contract with the Commander, Service Force Pacific, are described. Seventeen major tasks were conducted during the contract period, which extended from May 1971 through January 1973. Support was provided COMSERVPAC in the development of maintenance management improvement techniques for SERVPAC ships.

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## CONTENTS

1.	INTRODUCTION AND SUMMARY . . . . .	1-1
2.	TASK 1: PREPARE/VALIDATE EIC DIAGRAMS . . . . .	2-1
2.1	Task Description . . . . .	2-1
2.2	Task Results . . . . .	2-2
2.2.1	Subtask 1.1 - Prepare SSDI for AO-143 Class Ships . . . . .	2-2
2.2.2	Subtask 1.2 - Prepare SSDI for AOE-1 Class Ships . . . . .	2-2
2.2.3	Subtask 1.3 - Prepare SSDI for ATF Class Ships . . . . .	2-2
2.2.4	Subtask 1.4 - Support SDA System Development . . . . .	2-3
2.2.5	Subtask 1.5 - Develop General Ship Class EIC System Staging Diagrams . . . . .	2-3
2.2.6	Subtask 1.6 - Develop Concepts for Common Language Accounting . . . . .	2-3
3.	TASKS 2 and 4: DEVELOP PROCEDURES AND TECHNIQUES FOR PERFORMING INVENTORY . . . . .	3-1
3.1	Task Description . . . . .	3-1
3.2	Task Results . . . . .	3-1
3.2.1	Subtask 2.1 - Assess Data Sources for Ship Inventory/ Validation in Support of SDA . . . . .	3-1
3.2.2	Subtask 2.2 - Select Data Base for Performing Inventory/Validation . . . . .	3-3
3.2.3	Subtask 2.3 - Prepare Procedure for Ship Validation Using Selected Data Base . . . . .	3-3
3.2.4	Subtask 2.4 - Develop Procedures and Documentation for Validation of USS PONCHATOU LA (AO-148) . . . . .	3-3
3.2.5	Subtask 2.5 - Develop Procedures and Documentation for Validation of USS HENRY B. WILSON (DDG-7) . . . . .	3-4
3.2.6	Subtask 2.6 - Assist with Development of Integrated Plan of Action for Ship Validation . . . . .	3-5
4.	TASK 3: ASSIST IN INVENTORY OF SELECTED SHIP . . . . .	4-1
4.1	Task Description . . . . .	4-1
4.2	Task Results . . . . .	4-1
5.	TASKS 5 AND 6: DEVELOP METHODOLOGY AND PROCEDURES FOR DETERMINING EQUIPMENT OVERHAUL WORK REQUIREMENTS . . . . .	5-1
5.1	Description of Tasks . . . . .	5-1
5.2	Results of Tasks . . . . .	5-1

6.	TASKS 7 AND 8: DEVELOP METHODS, PROCEDURES, AND INSTRUCTIONS FOR PRE-OVERHAUL MATERIAL INSPECTIONS . . . . .	6-1
6.1	Description of Tasks . . . . .	6-1
6.2	Summary of Task Results . . . . .	6-1
6.2.1	Subtasks 7.1, 7.2, and 7.3 - Develop Procedures for Pre-Overhaul Material Inspections . . . . .	6-1
6.2.2	Subtask 7.4 - Develop Procedures for Pre-Overhaul Inspections . . . . .	6-1
6.2.3	Subtask 7.5 - Assist Pre-Overhaul Inspection Teams with Inspection of AO-143 Class Ship . . . . .	6-2
7.	TASKS 9 AND 10: DEVELOP PROCEDURES FOR DETERMINING AND RECORDING POST-OVERHAUL MATERIAL CONDITION . . . . .	7-1
7.1	Description of Tasks . . . . .	7-1
7.2	Results of Tasks . . . . .	7-1
8.	TASK 11: DEVELOP METHODOLOGY FOR PREPARING EQUIPMENT OVERHAUL SPECIFICATIONS . . . . .	8-1
8.1	Description of Task . . . . .	8-1
8.2	Task Results . . . . .	8-1
8.2.1	Subtask 11.1 - Identify Data Sources for Preparing EOS's . . . . .	8-1
8.2.2	Subtask 11.2 - Develop Methods and Rationale for Preparing EOS's . . . . .	8-2
8.2.3	Subtask 11.3 - Develop Format . . . . .	8-2
8.2.4	Subtask 11.4 - Develop Approach for Assessing Alternative Methods of Supplying Replacement Parts . . . . .	8-3
9.	TASKS 12 AND 13: DEVELOP EQUIPMENT OVERHAUL SPECIFICATIONS AND AN INSTRUCTION FOR PREPARATION OF EOS'S . . . . .	9-1
9.1	Description of Task . . . . .	9-1
9.2	Task Results . . . . .	9-1
9.2.1	Subtask 12.1 - Develop Prototype Equipment Overhaul Specification . . . . .	9-1
9.2.2	Subtask 12.2 - Prepare Instruction or Guide for Preparation of EOS's . . . . .	9-1
9.2.3	Subtask 12.3 - Prepare Additional EOS's . . . . .	9-1
10.	TASK 14: PREPARE OVERHAUL CYCLE PLANNING LOGIC NETWORK . . . . .	10-1
10.1	Description of Task . . . . .	10-1
10.2	Task Results . . . . .	10-1
11.	TASKS 15 AND 16: PREPARE DOCUMENTS DESCRIBING COMSERVPAC MAINTENANCE MANAGEMENT POLICIES AND PROCEDURES . . . . .	11-1
11.1	Description of Tasks . . . . .	11-1
11.2	Task Results . . . . .	11-1
11.2.1	Subtask 15.1 - Assist COMSERVPAC in Preparing a Maintenance Management Master Plan . . . . .	11-1
11.2.2	Subtask 15.2 - Prepare Instructions and Procedures in Support of COMSERVPAC Maintenance Management Master Plan . . . . .	11-1



APPENDIX A: PERA PROGRAM TASK PLANS,  
CONTRACT N00604-71-C-0431. . . . . A-1

APPENDIX B: SUMMARY OF PRINCIPAL DATA ITEMS SUBMITTED. . . . . B-1

APPENDIX C: SUMMARY OF TRIPS . . . . . C-1

APPENDIX D: PROPOSED PLAN FOR EVALUATING ALTERNATIVE  
METHODS OF ORDERING REPLACEMENT PARTS . . . . . D-1

## ILLUSTRATIONS AND TABLES

Figure

2-1	AO-143 Class EIC Ship System Diagram, Summary Diagram . . . . .	2-5
2-2	Example of System Diagrams Included in SSDI . . . . .	2-7
2-3	Example of Line Diagrams Included in SSDI . . . . .	2-7
2-4	Properties, Characteristics, and Uses of SSDI . . . . .	2-8
2-4A	SSDI Diagram for AOE-1 Propulsion System (Example 1) . . . . .	2-9
2-4B	SSDI Diagram for AOE-1 Propulsion System (Example 2) . . . . .	2-10
2-4C	SSDI Diagram for AOE-1 Propulsion System (Example 3) . . . . .	2-11
3-1	Example of Completed Worksheet . . . . .	3-6
3-2	Example of Validation Worksheet . . . . .	3-7
3-3	Service Application Code (SAC) Worksheet, Validation Control Center . . . . .	3-8
3-4	Summary Worksheet (EIC), Validation Control Center . . . . .	3-9
3-5	Work Center Validation Progress Status Sheet . . . . .	3-10
3-6	Work Center Validation Status Tracking Chart . . . . .	3-11
3-7	Ship Validation Progress Status Sheet . . . . .	3-12
3-8	Ship Validation Status Tracking Chart . . . . .	3-13
10-1	COMSERVPAC Overhaul Planning, General Task Chart . . . . .	10-3

Table

1-1	Summary of Tasks . . . . .	1-2
4-1	Summary of USS PONCHATOU LA Validation Results . . . . .	4-2
10-1	Index of Tasks, COMSERVPAC Overhaul Planning . . . . .	10-5
11-1	Contents, COMSERVPAC Overhaul and Maintenance Guide . . . . .	11-3

## INTRODUCTION AND SUMMARY

This report summarizes the efforts performed by ARINC Research Corporation under Contract N00604-71-C-0431 during the period May 1971 through January 1973. The Corporation provided nonpersonal engineering services to the Commander, Service Force Pacific and Commander, Pearl Harbor Naval Shipyard, under the following tasks:

<u>Task</u>	<u>Title</u>
1	Prepare/Validate Equipment Identification Code (EIC) Diagrams
2	Develop Procedures and Techniques for Performing Inventories
3	Assist in Conduct of Inventory of Selected Ship
4	Develop Equipment Data Elements
5	Develop Methodology for Equipment Overhaul Determination
6	Develop Overhaul Cycle, Test and Inspection Procedures
7	Develop Methods, Procedures, and Instructions for Pre-Overhaul Material Inspections
8	Assist in Conducting Pre-Overhaul Material Inspection
9	Develop Methods, Procedures, and Instructions for Post-Overhaul Material Inspections
10	Assist in Conducting Post-Overhaul Material Inspections
11	Develop Methodology for Preparing Equipment Overhaul Specifications
12	Develop Instructions for Preparing Equipment Overhaul Specifications
13	Prepare Equipment Overhaul Specification for Selected Equipments
14	Prepare CPM Networks for ATF-Class Ships
15	Prepare Maintenance Management Plan of Action
16	Prepare SERVPAC Maintenance Instruction Manual
17	Engineering Follow-up Status Reporting and Visual Aids

Each task was performed under the direction and guidance of COMSERVPAC and Pearl Harbor Naval Shipyard, and was accomplished in accordance with individual task plans. These plans were updated throughout the period of performance based on guidance received. In some instances, certain of the tasks were combined for purposes of planning and cost-effective accomplishment. Table 1-1 shows the manner in which the tasks were combined, and the section of this report in which task results are discussed.

TABLE 1-1. SUMMARY OF TASKS

Task(s)	Task Plan Title/Last Rev./Date	Ref. Section of this Report
1	Prepare/Validate EIC Diagrams, Rev. C, 15 June 1972	2
2 & 4	Develop Procedures and Techniques for Performing Inventories, Rev. B, 12 June 1972	3
3	Assist in Conduct of Inventory of Selected Ship, Rev. A, 10 March 1972	4
5 & 6	Develop Methodology and Procedures for Determining Overhaul Work Requirements for Selected Ships, Rev. A, 23 June 1972	5
7 & 8	Develop Methods, Procedures, Instructions for Pre-Overhaul Material Inspections, Rev. B, 23 June 1972	6
9 & 10	Develop Procedures for Determining and Recording Post-Overhaul Material Condition, Rev. A, 23 June 1972	7
11	Develop Methodology for Preparing Equipment and Overhaul Specifications, Rev. A, 23 June 1972	8
12 & 13	Develop Equipment Overhaul Specification (EOS) and an Instruction for Preparation of EOS's, Rev. A, 23 June 1972	9
14	Prepare Overhaul Cycle Planning Logic Network, 23 June 1972	10
15 & 16	Prepare Documents Describing COMSERV PAC Maintenance Management Policies and Procedures, 23 June 1972	11
17	Engineering Follow-Up, Status Reporting and Visual Aids (no task plan required for this task)	-

## TASK 1: PREPARE/VALIDATE EIC DIAGRAMS

### 2.1 TASK DESCRIPTION

The objective of this task was to develop methods for depicting or describing ship systems and equipments in a manner that will provide a universal frame of reference for all maintenance and related activities, such as:

- a. Performance by ship's force personnel of pre-overhaul, post-overhaul, and other material inspections;
- b. Grouping of work requests by planning and estimating personnel;
- c. Inventorying of shipboard equipment.

This task comprised the following subtasks:

- Subtask 1.1 – Prepare a Ship Systems Definition and Index (SSDI) for AO-143 class ships. Use as a baseline the EIC-structured system diagrams (staging diagrams) for AO-143 class ships prepared by the Pearl Harbor Naval Shipyard. The SSDI will be a book of EIC-structured system diagrams supplemented with narrative and graphic descriptions defining the ship systems.
- Subtask 1.2 – Prepare an SSDI for AOE-1 class ships.
- Subtask 1.3 – Prepare an SSDI for ATF-class ships.
- Subtask 1.4 – Support Source Data Automation (SDA) system development.
- Subtask 1.5 – Develop a book of EIC-structured system diagrams generally applicable to any Navy ship. This book will contain only the EIC-structured framework, with blocks including the EIC and appropriate noun name, and will not contain narrative and graphic descriptions of the systems or work center assignments. Equipments contained in subsystems will be listed where appropriate.
- Subtask 1.6 – Review the EIC Index and related listings, such as the BuShips Consolidated Index. Determine inconsistencies and anomalies in logic and structure of the EIC Index. Develop proposed changes to the EIC Index that would provide consistent logic between the various systems with respect to system and equipment breakout.

## 2.2 TASK RESULTS

### 2.2.1 Subtask 1.1 — Prepare SSDI for AO-143 Class Ships

ARINC Research prepared an SSDI for AO-143 class ships and submitted it in April 1972 as Technical Note W2-D06-TN01. The SSDI consists of a set of diagrams to the subsystem level depicted in Figure 2-1.

The basic structure of an SSDI diagram is illustrated in Figure 2-2. As illustrated, each block (individual subsystem/equipment) in the diagram includes:

- a. A narrative definition of the subsystem/equipment boundaries (in terms of both what is and is not included).
- b. A listing of the work center(s) responsible for maintenance of associated equipment.
- c. A listing of key maintenance items.

Line diagrams, as shown in Figure 2-3, were prepared for subsystems/equipments where considered necessary to supplement the EIC system diagrams. These diagrams depict system/equipment boundaries and show physical interfaces with other system/equipment blocks.

The SSDI is designed to provide a variety of uses. For example, the diagrams and supporting narrative identify all systems — but only those systems — included in an individual ship class (in this case the AO-143). Hence they provide a basic framework for performing inventory. In addition the diagrams identify system boundaries and interfaces, making them useful for planning repairs and alterations, training shipboard personnel in operation and maintenance, and performing numerous other vital functions. Characteristics and uses of SSDI's are detailed in ARINC Research publication W2-D06-TN01 (March 1972) and summarized in Figure 2-4.

The AO-143 class SSDI was developed as a prototype document to guide the development of similar SSDI's for other classes of ships.

### 2.2.2 Subtask 1.2 — Prepare SSDI for AOE-1 Class Ships

An SSDI was prepared for the USS SACRAMENTO (AOE-1) and submitted in March 1973 as Technical Note W3-D06-TN03. The AOE-1 SSDI was based on the concept and format previously developed for the AO-143. In addition, the propulsion system presentation was modified to portray functional flows, controls, and operations; and pressure and temperature monitoring points. Examples of this presentation are shown in Figures 2-4A through 2-4C.

### 2.2.3 Subtask 1.3 — Prepare SSDI for ATF Class Ships

An SSDI applicable to all SERVPAC ships of the ATF-96 class was prepared and submitted in August 1972 as Technical Note W2-D06-TN05. The ATF-96 class SSDI was prepared according to the concepts and format previously developed for the AO-143 class.

2.2.4 Subtask 1.4 - Support SDA System Development

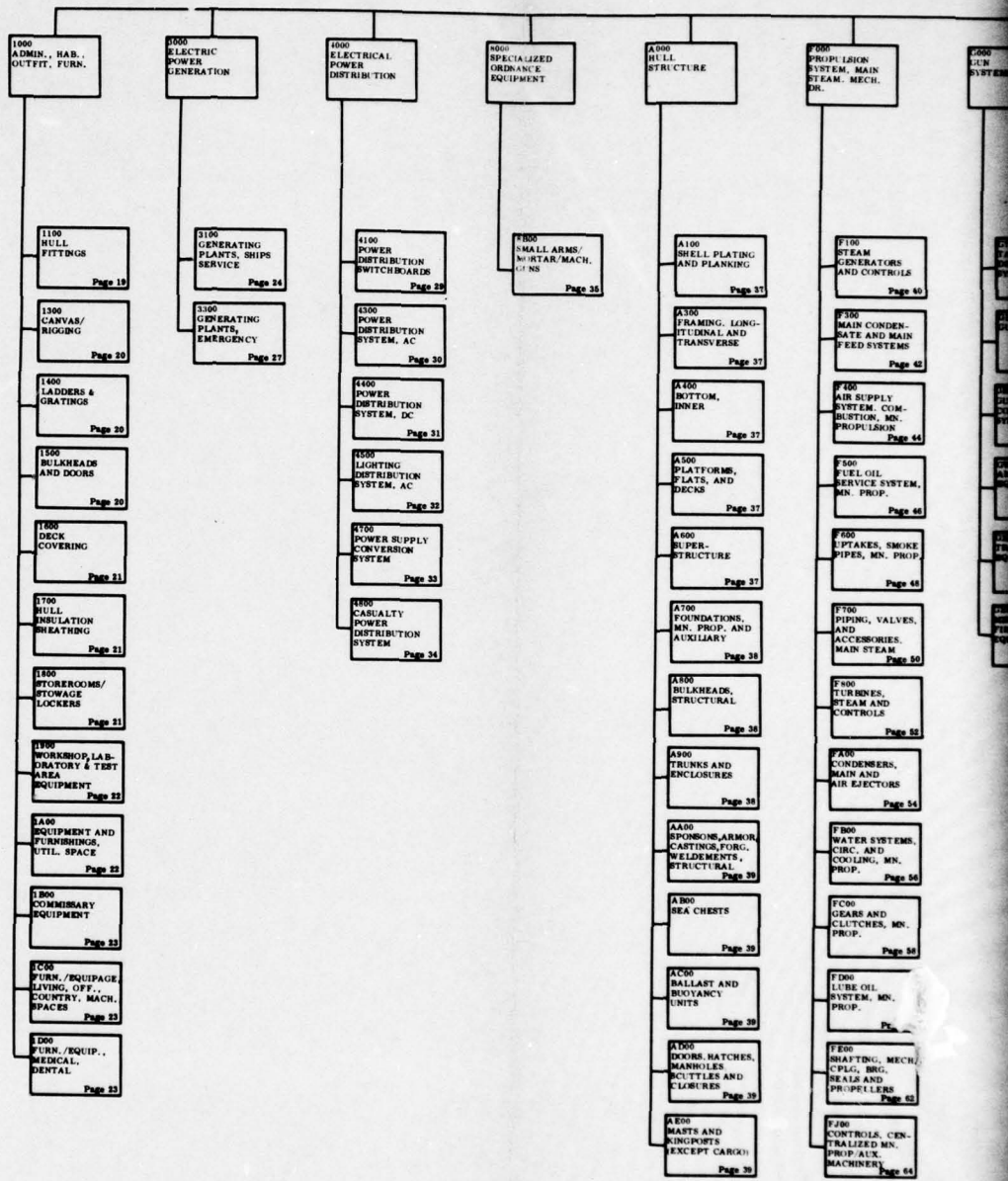
ARINC Research participated in studies and system design efforts related to the development, testing, and evaluation of the 3M Source Data Automation System in SERVPAC ships. Effort under the subtask included the assessment of system design alternatives, evaluation of candidate hardware, analysis of field test results, and performance of various tradeoff analyses. Results of this subtask were summarized in a report submitted to COMSERVPAC in January 1972.

2.2.5 Subtask 1.5 - Develop General Ship Class EIC System Staging Diagrams

ARINC Research prepared a set of staging diagrams having general applicability to all Navy ships. These diagrams, submitted in January 1973 as Technical Note W2-D06-TN02, serve as an index in EIC staging format for all systems and equipments installed in Navy ships, and identify the key maintenance items within each EIC.

2.2.6 Subtask 1.6 - Develop Concepts for Common Language Accounting

ARINC Research evaluated two configuration-accounting methods, the EIC and Work Breakdown Structure (WBS), and developed a recommended approach for merging the two methods to achieve a common-language configuration accounting system. Results of these studies were submitted in January 1973 as Technical Note W2-D06-TN06.





AO-115 CLASS

A000 HULL STRUCTURE

F000 PROPULSION SYSTEM, MAIN STEAM, MECH. DR.

G000 GUN SYSTEMS

L000 NAVIGATION SYSTEMS

R000 INTERIOR COMMUNICATIONS SYSTEMS

R000 COUNTER-MEASURE SYSTEMS

P000 RADAR AND IFF SYSTEMS

Q000 COMM. AND DATA SYSTEMS

S000 SONAR SYSTEMS

T000 AUXILIARY SYSTEMS

ARM. / MACH. Page 35

A100 SHELL PLATING AND PLANKING Page 37

A300 FRAMING, LONGITUDINAL AND TRANSVERSE Page 37

A400 BOTTOM, INNER Page 37

A500 PLATFORMS, PLATS, AND DECKS Page 37

A600 SUPER-STRUCTURE Page 37

A700 FOUNDATIONS, MN. PROP. AND AUXILIARY Page 38

A700 BULKHEADS, STRUCTURAL Page 38

A900 TRUNKS AND ENCLOSURES Page 38

A400 BIRMINGHAM, ARMOR, CASTINGS, FORG. WELDEMENTS, STRUCTURAL Page 38

A800 SEA CHESTS Page 39

A200 BALLAST AND BUOYANCY UNITS Page 39

A100 HATCHES, HAMBLES, SCUTTLES AND CLAMBERS Page 39

A200 MASTS AND MASTPOPTS (EXCEPT CARGO) Page 39

F100 STEAM GENERATORS AND CONTROLS Page 40

F300 MAIN CONDENSATE AND MAIN FEED SYSTEMS Page 40

F400 AIR SUPPLY SYSTEM, COMBUSTION, MN. PROPULSION Page 44

F500 FUEL OIL SERVICE SYSTEM, MN. PROP. Page 44

F600 DUCTS, SMOKE PIPES, MN. PROP. Page 44

F700 PIPING, VALVES, AND ACCESSORIES, MAIN STEAM Page 50

F800 TURBINES, STEAM AND CONTROLS Page 53

F900 CONDENSERS, MAIN AND AIR EJECTORS Page 54

F700 WATER SYSTEMS, CIRC. AND COOLING, MN. PROP. Page 55

FC00 GEARS AND CLUTCHES, MN. PROP. Page 53

F700 LUBE OIL SYSTEM, MN. PROP. Page 60

F800 SHAFTING, MECH. CPLEG, BRG. SEALS AND PROPELLERS Page 62

F200 CONTROLS, CENTRALIZED MN. PROP/AUX. MACHINERY Page 64

G700 TARGET DESIGNATION SYSTEM, MK 3 Page 67

G800 GUN MOUNTS Page 68

G900 GUN FIRE CONTROL SYSTEM, MK 56 Page 68

G700 AMMO HANDLING EQUIPMENT Page 70

G200 TRAINING EQUIPMENT Page 70

G200 MISCELLANEOUS FIRE CONTROL EQUIPMENT Page 70

L100 NAVIGATION SYSTEM, LORAN Page 71

L800 GYROCOMPASS, CIRCUIT LC AND XLC Page 72

LC00 LOG SYSTEM, UNDERWATER, CIRCUIT Y Page 74

LD00 DEAD RECKONING, CIRCUIT TL Page 74

LF00 AID, OPTICAL AND MEC., NAVIGATIONAL Page 75

LG00 COMPASS, MAGNETIC Page 77

LH00 INSTRUMENTS, METEOROLOGICAL Page 78

LJ00 LIGHTS, NAVIGATIONAL Page 79

LK00 LIGHTS, SIGNALING Page 80

M300 AMPLIFIED VOICE COMMUNICATION SYSTEMS Page 81

M400 TELEPHONE SYSTEMS Page 82

M500 ALARM, SAFETY, AND WARNING SYSTEMS Page 83

M600 SHIP ORDER AND INDICATING SYSTEMS Page 85

M700 RECORDING AND PROJECTION SYSTEMS Page 86

R100 DEGAUSSING SYSTEM Page 87

P100 RADAR, SURFACE SEARCH Page 89

P200 RADAR, AIR SEARCH Page 90

P600 IFF EQUIPMENT Page 91

P750 DISPLAY, RADAR Page 92

Q100 ANTENNA SYSTEMS, COMMUNICATIONS Page 93

Q300 TELETYPE Page 94

Q700 AMPLIFIERS, AUDIO Page 95

Q900 MULTICOPLERS, TUNERS, ANTENNA Page 95

Q400 INFRARED SYSTEMS Page 95

Q800 RECEIVERS, COMMUNICATION Page 96

Q200 CONTROL DEVICES, REMOTE COMMUNICATIONS Page 97

Q100 TRANSCIVERS, COMMUNICATIONS Page 98

Q500 TRANSMITTERS, COMMUNICATIONS Page 98

Q700 CRYPTOGRAPHIC EQUIPMENT Page 99

Q800 TEST EQUIPMENT, SPECIAL COMMUNICATIONS Page 99

S600 SONAR SYSTEMS, NAVIGATION Page 101

S700 SONAR SYSTEMS, BATHY THERM. Page 101

T800 HEAT SYSTEMS Page 102

T900 VENT SYSTEMS Page 102

T400 AIR SYSTEMS Page 102

T500 REEF SYSTEMS Page 102

T600 CARGO SYSTEMS Page 102

T700 FUEL SYSTEMS Page 102

T300 FIRE SUPPLY DOWNWAY Page 102

T200 FIRE EXTINGUISHING SYSTEMS Page 102

T100 DOWNWAY SYSTEMS Page 102

T100 SECURITY DEVICES Page 102

T100 FILE AND SYSTEMS Page 102

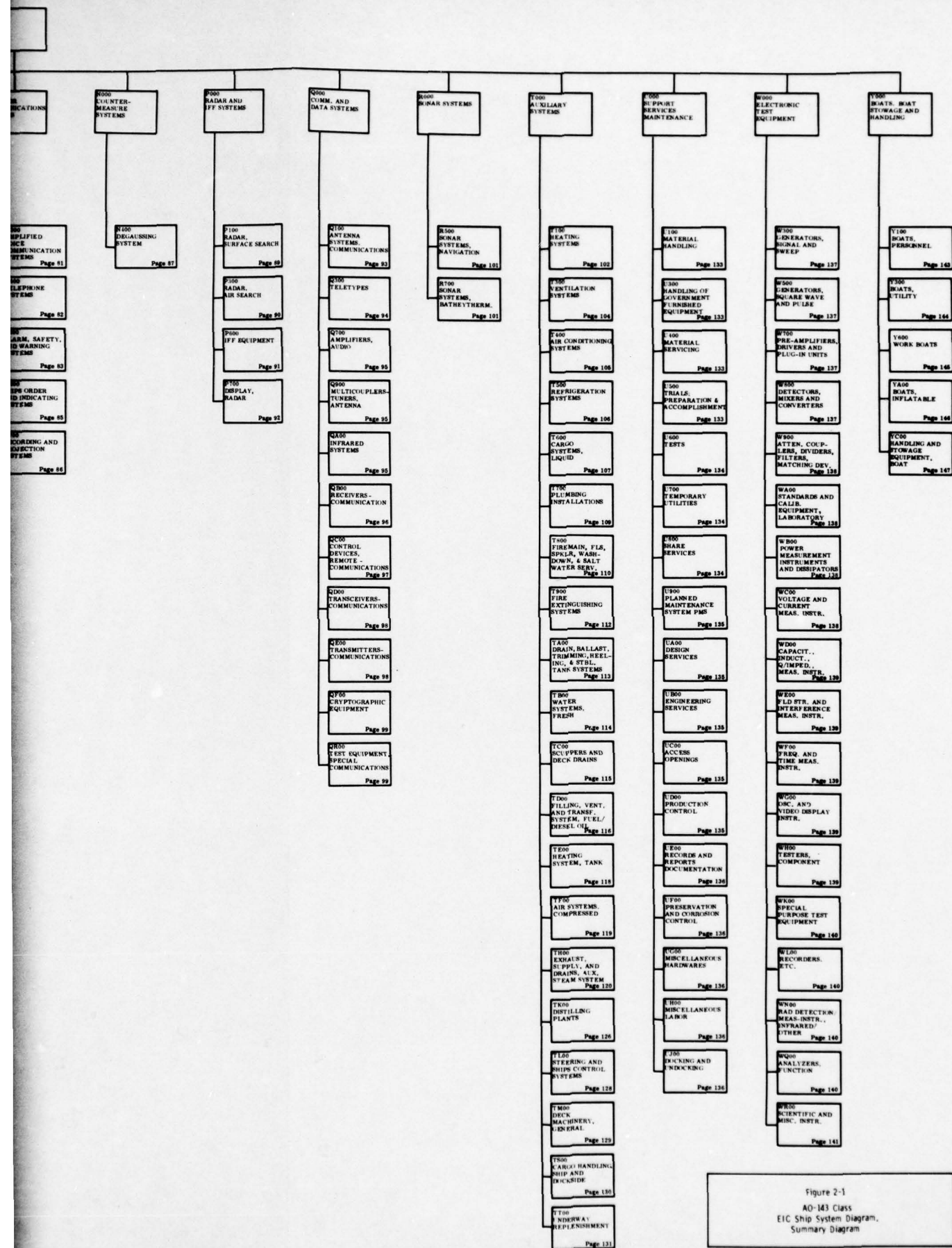
T100 FILE AND SYSTEMS Page 102

T100 FILE AND SYSTEMS Page 102

T100 FILE AND SYSTEMS Page 102

T100 FILE AND SYSTEMS Page 102

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Figure 2-1  
AO-143 Class  
EIC Ship System Diagram,  
Summary Diagram

2

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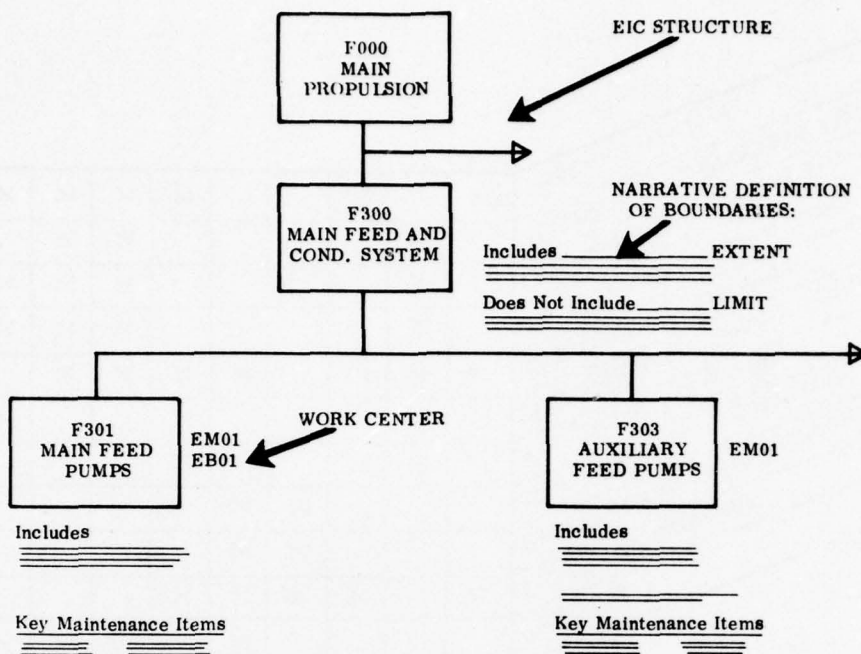


Figure 2-2. Example of System Diagrams Included in SSDI

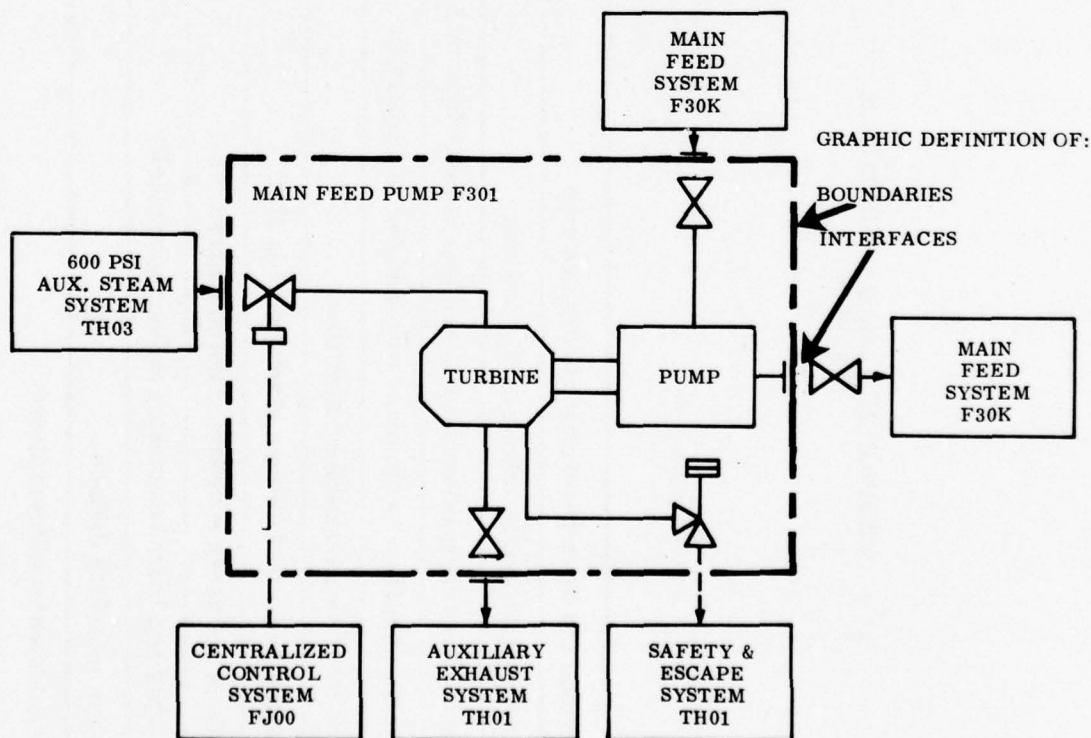


Figure 2-3. Example of Line Diagrams Included in SSDI

PROPERTIES/CHARACTERISTICS OF SSDI	USES OF SSDI									
	Training	CSPM Management	Pre/post Overhaul Inspection	Work Request Preparation	Equipment Validation	Alteration and Repair Planning	Overhaul Management	Test Procedure Development	Improvement Program Develop.	Problem Analysis
Provides top down hierarchy of ship systems	X					X				X
Diagrams tailored to unique configurations	X			X	X	X	X	X	X	
Structured using mathematical discipline (no overlaps or holidays)				X		X				X
Systems identified to the level required for 3M reporting		X	X							
Work center responsibility identified	X	X	X	X	X					
Systems numbered using a standard code (EIC)	X			X	X	X	X	X	X	X
Systems and their boundaries defined narratively	X						X	X	X	X
Systems and their boundaries defined graphically	X						X	X	X	X
System interface defined	X						X	X	X	X
Key maintenance items listed		X	X	X	X	X				

Figure 2-4. Properties, Characteristics, and Uses of SSDI

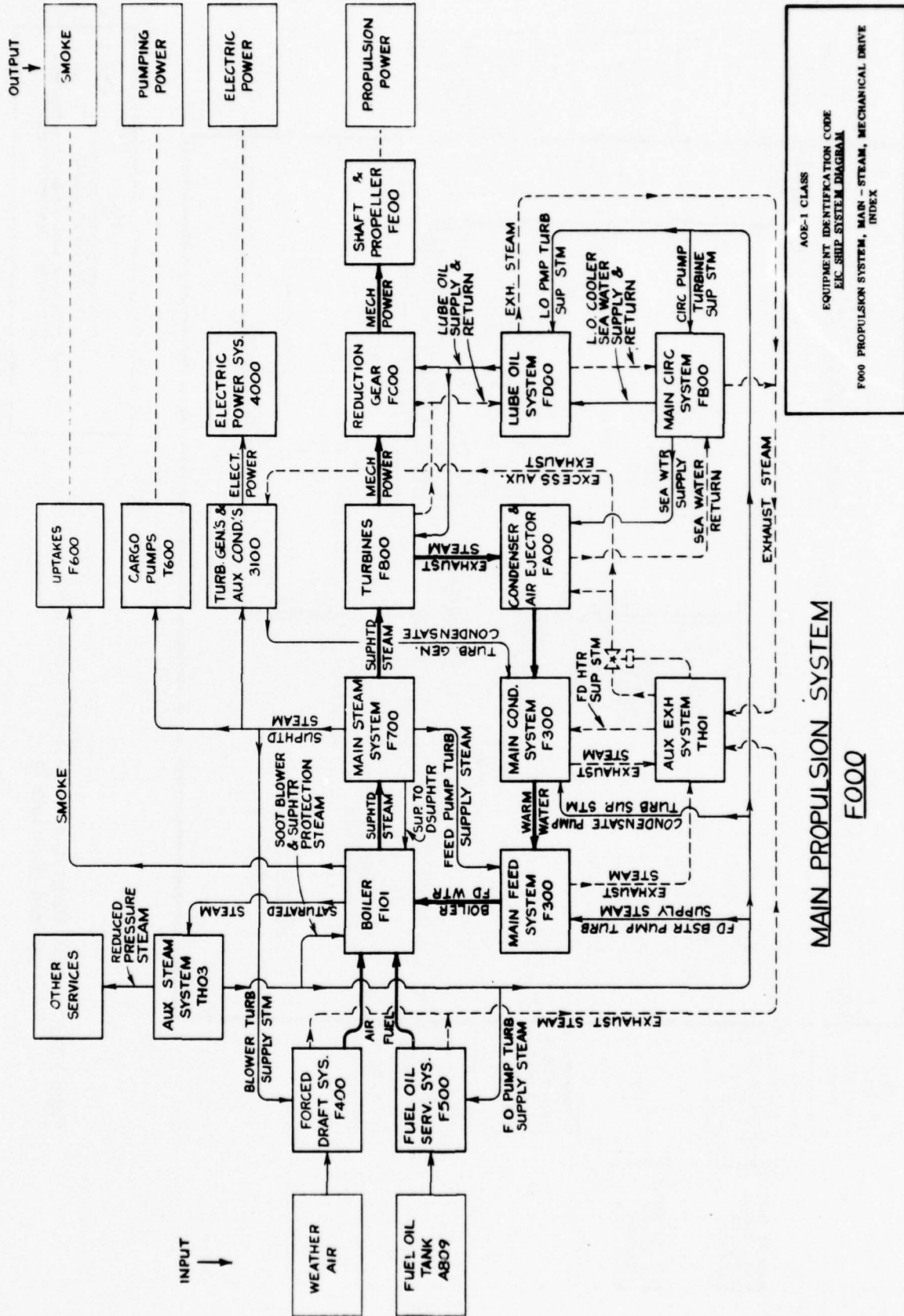
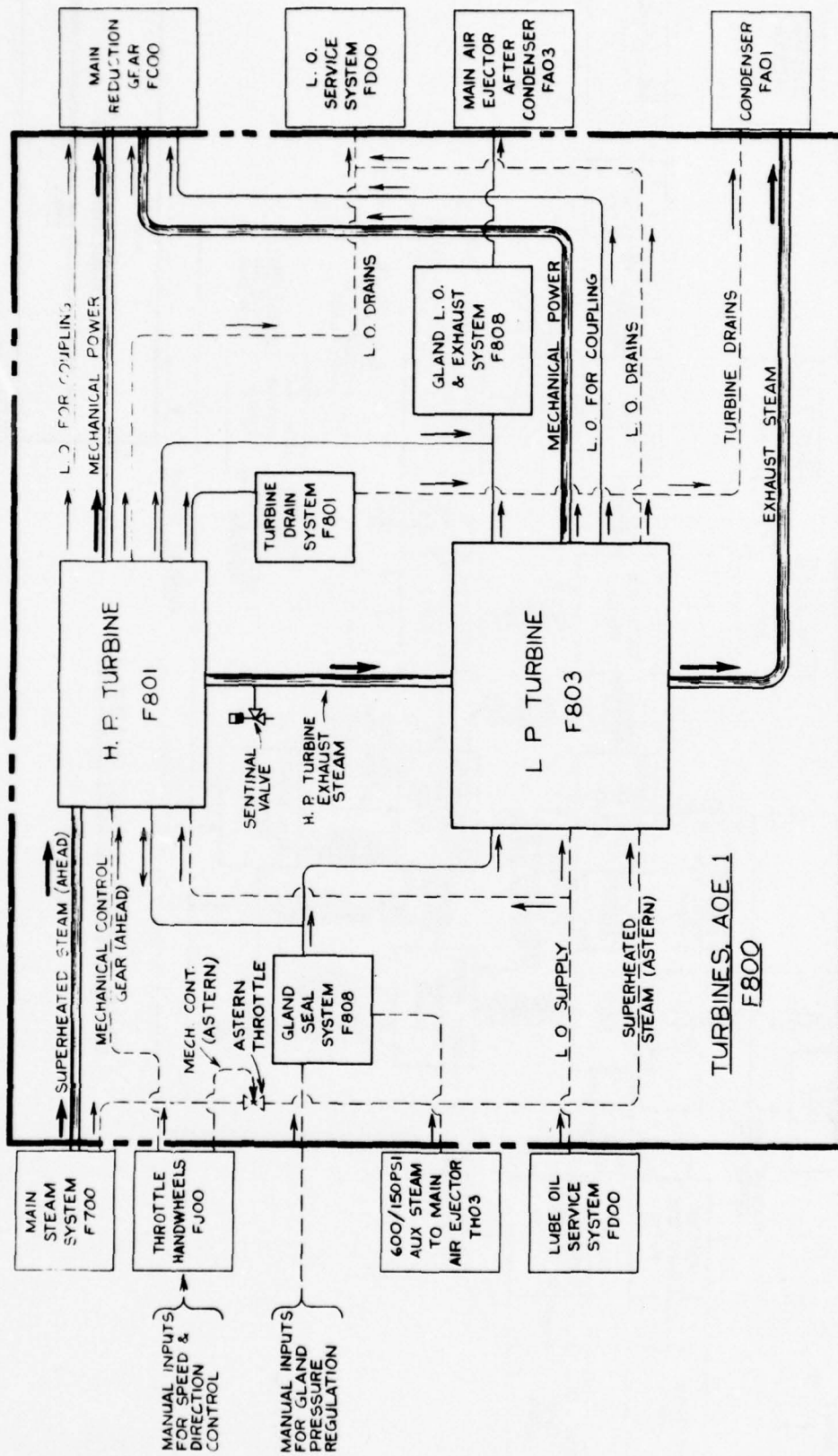


Figure 2-4A. SSDI Diagram for AOE-1 Propulsion System (Example 1)



AOE-1 CLASS  
 EQUIPMENT IDENTIFICATION CODE  
 EIC SHIP SYSTEM DIAGRAM  
 F000 PROPULSION SYSTEM, MAIN-STEAM, MECHANICAL DRIVE  
 F800 TURBINES, STEAM AND CONTROL

SHEET 1 OF 4

Figure 2-4B. SSDI Diagrams for AOE-1 Propulsion System (Example 2)

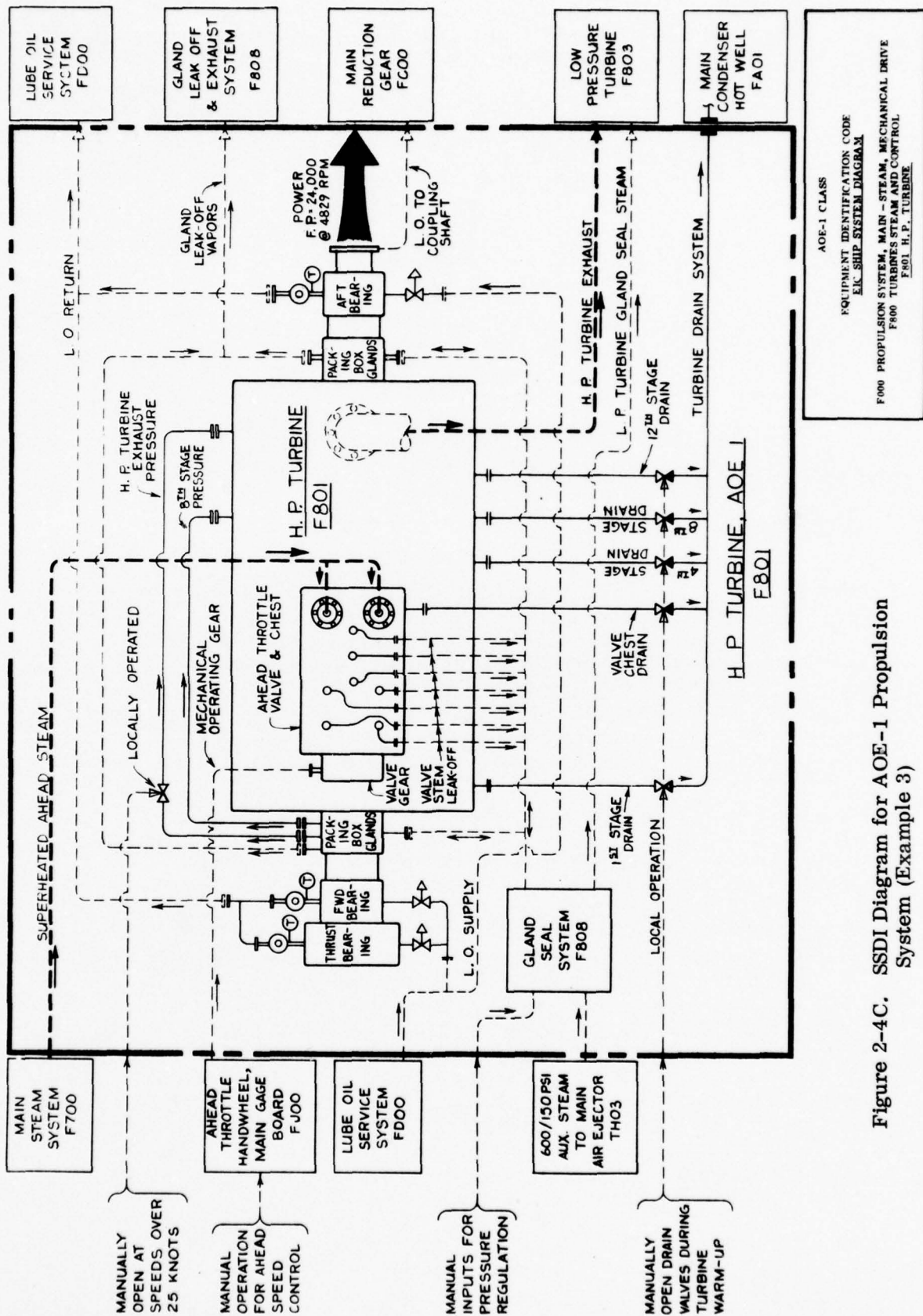


Figure 2-4C. SSDI Diagram for AOE-1 Propulsion System (Example 3)

AOE-1 CLASS  
 EQUIPMENT IDENTIFICATION CODE  
 EIC SHIP SYSTEM DIAGRAM  
 F000 PROPULSION SYSTEM, MAIN STEAM, MECHANICAL DRIVE  
 F800 TURBINES STEAM AND CONTROL  
 FA01 H.P. TURBINE

## TASKS 2 AND 4: DEVELOP PROCEDURES AND TECHNIQUES FOR PERFORMING INVENTORY

### 3.1 TASK DESCRIPTION

The combined objective of Tasks 2 and 4 was to provide procedures, complete with required forms, for conducting inventories of ship equipments. Prime consideration was given to supporting the implementation of the Source Data Automation system. This task included the following subtasks:

- Subtask 2.1 - Identify, investigate, and assess alternative data sources for performing ship inventory or validation in support of Source Data Automation development.
- Subtask 2.2 - Select a data base for performing ship inventory validation.
- Subtask 2.3 - Prepare procedures for performing ship validation using the selected data base.
- Subtask 2.4 - Develop procedures and documentation for validation of equipment on the USS PONCHATOULA (AO-148), using the Ship's Parts Control Center (SPCC) COSAL validation aids as the baseline.
- Subtask 2.5 - Develop procedures and documentation for validation of equipment on the USS HENRY B. WILSON (DDG-7), using PERA (AAW) and NSMSES data as the baseline.
- Subtask 2.6 - Assist in development of an integrated plan of action for Navy-wide validation of ships.

### 3.2 TASK RESULTS

#### 3.2.1 Subtask 2.1 - Assess Data Sources for Ship Inventory/Validation in Support of SDA

Existing data bases were reviewed to determine the extent to which they provide the data elements required for implementation of the Source Data Automation system. The major design characteristics and objectives of SDA impacting on the data requirements included the following:

- a. Plastic Card Applicability. Under the SDA concept, a separate plastic card was to be prepared for each shipboard item or group of items considered significant from the standpoint of maintenance management. Although "significant" is to a large degree subjective, the general criterion was that a plastic card be prepared for each item or group of items for which a separate maintenance data form (OPNAV 4790.2K) is generated under the 3M program. Specific criteria for identifying the level at which plastic cards should be prepared is given in a COMSERVPAC paper entitled,



"Instructions for Determining SDA Card Requirements". That paper provides guidelines for the selection of items for which plastic cards should be made. Hence, the review and investigation of existing data bases took into consideration the manner and degree to which they included all significant maintenance items, and the level of complexity to which the equipment was identified.

- b. Plastic Card Content. The SDA system design requires that the following data elements be embossed on the plastic cards:
  - 1) Noun name (no more than 27 characters)
  - 2) Abbreviated noun name (no more than 16 characters)
  - 3) Equipment Identification Code
  - 4) CID/AEL/RIC
  - 5) Serial number
  - 6) Location on ship
  - 7) Work Center responsible for maintenance

Several existing data bases were reviewed and investigated, including:

- a. Staging diagrams (as prepared under Task 1 of this contract)
- b. List of Effective Pages (LOEP), 3M Planned Maintenance Subsystem (PMS)
- c. Current Ships Maintenance Project (CSMP)
- d. Coordinated Ships Allowance List (COSAL)

These reviews led to the following conclusions:

- a. No existing data file explicitly and exhaustively identifies EIC's for specific equipment items. Therefore in building the data base for SDA implementation it would be necessary to generate EIC's for equipment items.
- b. While neither the LOEP nor the COSAL completely contain all items that should be covered by plastic cards, both of these data sources constituted a substantial inventory of shipboard equipment. Hence, either the LOEP or the COSAL represents a reasonable starting point for building the required SDA data base.
- c. Staging diagrams could be used for determining the EIC for known equipments, or for identifying items not included in the LOEP or COSAL.
- d. The nomenclature used by existing data bases for identifying equipments usually contain more than 16 characters. In building the SDA data base, therefore, noun names would have to be shortened to satisfy the SDA system requirements.

### 3.2.2 Subtask 2.2 - Select Data Base for Performing Inventory/Validation

ARINC Research participated in workshops conducted to explore possible approaches and methods of performing equipment validation in support of SDA. Two data bases, LOEP and COSAL, were selected as candidate baselines.

Previous efforts involved the use of the LOEP as the basis for shipboard validation. Pilot validation programs conducted on several SERVPAC ships led to the conclusions that LOEP would be a satisfactory data base, but that the validation requirements for SDA could be integrated with the requirements for periodic COSAL validation. Consequently, later efforts under this task were based on using COSAL as the data base.

### 3.2.3 Subtask 2.3 - Prepare Procedure for Ship Validation Using Selected Data Base

Prepared and submitted under this subtask was the Work Center Guide for Accomplishment of Shipboard Equipment Validation in Support of Source Data Automation System. This document describes the process of collecting the data required for SDA implementation, where the LOEP is used as the initial data base. Under this procedure, two steps are involved:

- a. Ship's force locates and records the EIC for each item contained in the ship's LOEP. EIC's are located through a review of the ship staging diagrams or the EIC Master Index. The data recorded by ship's force are processed and printed on worksheets, which are then returned to the ship.
- b. Ship's force conducts a walk-through inspection of spaces and, using the Ship Systems Definition and Index as a guide, identifies the additional items to be covered under the SDA system. Figure 3-1 illustrates the product of this step.

In addition to the above procedure, another validation method utilizing COSAL as the initial data baseline was developed. This method, developed specifically for pilot validation programs for the USS PONCHATOULA (AO-148) and the USS HENRY B. WILSON (DDG-7), is summarized in Sections 3.2.4 and 3.2.5 herein. Both validation methods are presented in detail in the report entitled Equipment Validation Material Prepared Under Tasks 2, 3 and 4 of Contract N00604-71-C-0431, submitted in August 1972.

### 3.2.4 Subtask 2.4 - Develop Procedures and Documentation for Validation of USS PONCHATOULA (AO-148)

- a. Instructions for Preparation of Validation Aids (Manual Method)
- b. Instructions for Pre-Validation Organization of Validation Data and Control Forms
- c. Instructions for Operation of Validation Control Center
- d. Instructions for Work Center Validation

The nature and use of these instructions is discussed below.

3.2.4.1 Instructions for Preparation of Validation Aids

This document provides step-by-step guidance for preparing a set of validation worksheets for each component/equipment in the ship's COSAL. Figure 3-1 is a sample of the worksheet produced from the specified procedure.

3.2.4.2 Instructions for Pre-Validation Organization of Validation Data and Control Forms

This document provides instructions and guidance for 1) organizing Validation Control Center working files and 2) filling out the forms necessary for coordinating and monitoring the validation process. The document lists required materials and provides step-by-step procedures for preparing validation control forms, including:

- a. Service Application Code (SAC) Worksheet - Validation Control Center (Figure 3-3)
- b. Summary Worksheet (EIC) - Validation Control Center (Figure 3-4)
- c. Work Center Validation Progress Status Sheet (Figure 3-5)
- d. Work Center Validation Status Tracking Chart (Figure 3-6)
- e. Ship Validation Progress Status Sheet (Figure 3-7)
- f. Ship Validation Status Tracking Chart (Figure 3-8)

3.2.4.3 Instructions for Operation of Validation Control Center

This document provides instructions and guidance to the team of trained validators assigned to a ship to operate the Validation Control Center. This special team provides administrative assistance to ship's force, particularly in keeping track of validation aids and of changes, additions, and deletions to the COSAL. In addition the special team provides technical assistance to the ship in resolving discrepancies and other problems that come up during the validation process. The subject instruction directs the special team in the use of the files and in administering the shipboard validation process, including the use of the validation control forms.

3.2.4.4 Instructions for Work Center Validation

This document provides detailed guidance to ship's force personnel concerning their responsibilities during shipboard validation. Described are the validation process, its purpose, and the step-by-step procedures to be carried out by the work center supervisor and members of his validation team. The document also contains sample worksheets similar to Figure 3-2.

3.2.5 Subtask 2.5 - Develop Procedures and Documentation for Validation of USS HENRY B. WILSON (DDG-7)

ARINC Research participated in the validation program conducted for the USS HENRY B. WILSON (DDG-7) during March and April of 1972. The purpose of the validation was to create a data base for installing a Source Data Automation system aboard the ship.

Planning for the validation was initiated in March 1972. At that time a preliminary copy of the General Ship Class EIC Staging Diagrams was forwarded to the ship. Ship's force tailored the diagrams to the ship by denoting the specific systems/equipment on board and identifying responsible work center(s). ARINC Research prepared an instruction entitled: "Installation of Source Data Automation (SDA) on USS HENRY B. WILSON (DDG-7), Instructions for Preparation and Organization of Validation Aids". This instruction was generally followed in producing the validation aids.

An initial deck of approximately 17,000 val aid cards was produced by NSMSES. From this deck, approximately 1,700 were selected as candidate items for validation. The items were selected on the basis of engineering judgement, using as guidance the ship-tailored general staging diagrams. The objective of the selection process was to choose those items appropriate for coverage by SDA system plastic cards. The 1,700 selected validation aid cards were hand-annotated as to responsible work center. Where more than one work center was responsible for an item of equipment, duplicate cards were produced so that a validation aid could be provided to each work center. NSMSES then processed the data and generated a new deck of validation aids consisting of approximately 3,500 cards.

Validation procedures were coordinated with validation team personnel, including ship officers and work center supervisors. The validation was conducted by ship's force through its regular maintenance organization, with the assistance of ARINC Research personnel. The validation team screened and processed the data. The final data base was then used for producing the set of plastic cards for the ship.

#### 3.2.6 Subtask 2.6 - Assist with Development of Integrated Plan of Action for Ship Validation

ARINC Research participated with personnel of SECAS and other organizations in workshops directed toward the formulation of the validation program being developed to support the implementation of Source Data Automation.

HULL NUMBER	WORK CNTR	EIC	FB01	VALIDATION WORKSHEET		PAGE		
				EM01	REPORT DATE			
							NOMENCLATURE: Pumps	NAME/PLATE/IDENT DATA
PCH CD	ITEM NR	SUF NR	CID AEL RIC	EQUIPMENT NOMENCLATURE	EIC	SERIAL ID	LOCATION CMP RTMNT DECK-FRAME-SIDE	QTY
				016030995	Main Circ Pump	FB01		02
					✓	FB01	6-66-0-E	01
					✓	FB01	6-66-0-E	01
					Relief Valves, 1" IPS	FB01		02
				826003478	CIRC PMP REL VAL	FB01	6-66-0-E	02
				782350009	COMP/1 MG SHAF	FB01	6-66-0-E	01
				782350009	COMP/1 MG SHAF	FB01	6-66-0-E	01

Figure 3-1. Example of Completed Worksheet

CID/ECN NAVCOM MANUAL NO. (32 POS.)		PLAN NO. (32 POS.)		TYPL	
0941#004#2000		03950		12-20-71	
INDEX ENTRY: CAT UT 40FT WD					
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48
01	MFR=MFR=VARIOUS				
02	NAVCOM PLAN#S8228#3#40#1390564				
03	MFR DWG#				
04	MFR ID#				
05	PATTERN NO#1046				
06	EQUIP SPEC#				
07	FSN#				
08	LAPL#NLAPL#				
09	TYPE OF OPERATION#PWR				
10	TYPE OF ENGINE#64HN9				
11	NOTE#THIS APL COVERS MATERIAL FURNISHED WITH THE BOAT				
12	AND INCLUDES REPAIR PARTS, FOR MATERIAL NOT FURNISHED				
13	WITH THE BOAT WHICH IS TO BE REQUISITIONED SEPARATELY				
14	SEE ECN SERIES 2#82000.				
SERVICE APPLICATION#SEE NEXT LINE					Y30A
NOMEN#SMALL BOATS#UTILITY BOAT					CODE#QBKDI
SPCC COMPONENT CHARACTERISTICS RECORD		4 ND - SPCC - 4410/15 (REV. 11-66)			
FOR SHIP AO 0149 VALIDATION		COMPT	QTY INSTL	2	001788

EIC

WORK CENTER DAΦI

27 Letter Noun Name \_\_\_\_\_

Ident/Serial No.	Location COMP/DK/FR/SD
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____

Validated by \_\_\_\_\_

SDA CARD REQUIRED? Yes  No

1	2	3	4	5
---	---	---	---	---

Figure 3-2. Example of Validation Worksheet

SHIP

SAC WORK SHEET - VALIDATION CONTROL CENTER

SAC  EIC  WORK CENTER

Original quantity of val aids assigned to Work Center ----

Day returned to Control Center from Work Center -----

Check - complete, accurate, legible, & SDA Card required: Initial

QUANTITY OF VALIDATION AIDS												
DAY OF VALIDATION	1	2	3	4	5	6	7	8	9	10	11	12
UNCHANGED 4410/15												
REVISED 4410/15												
DELETED (NOT ON BOARD)												
TOTAL												
ADDED (NEW ITEM)												

VAL AIDS incomplete, in error, or SDA Card requirement not clear - Returned to Work Center for additional information or rework.												
CONTROL NO.												
DATE TO W.C.												
DATE TO C.C.												

NEW VALIDATION AIDS ADDED	CONTROL NUMBER											

REMARKS :

Figure 3-3. Service Application Code (SAC) Worksheet, Validation Control Center

SHIP

SUMMARY WORK SHEET (EIC)-VALIDATION CONTROL CENTER

EIC

WORK CENTER

SAC	NO.	NUMBER TURNED IN BY DAY											
		1	2	3	4	5	6	7	8	9	10	11	12
TOTAL													

Figure 3-4. Summary Worksheet (EIC), Validation Control Center





D06-01-1-1212

SHIP

WORK CENTER

VALIDATION STATUS TRACKING CHART

VALIDATION AIDS  
NO. TURNED-IN PER WORK CENTER

0	1	2	3	4	5	6	7	8	9	10	11
DAY OF VALIDATION											

Figure 3-6. Work Center Validation Status Tracking Chart



D06-01-1-1212

SHIP

VALIDATION STATUS TRACKING CHART

VALIDATION AIDS  
NO. TURNED-IN FOR WHOLE SHIP

0	1	2	3	4	5	6	7	8	9	10	11
DAY OF VALIDATION											

Figure 3-8. Ship Validation Status Tracking Chart

### TASK 3: ASSIST IN INVENTORY OF SELECTED SHIP

#### 4.1 DESCRIPTION OF TASK

The objective of this task was to assist ship's forces of selected ships in performing inventory/validation of installed hardware. This task included the following subtasks:

- Subtask 3.1 – Provide guidance to selected ships' crews as necessary in the conduct of shipboard inventory.
- Subtask 3.2 – Assist ship's force in collecting inventory data. Review collected data, ensure that it is usable form, and collate.
- Subtask 3.3 – Evaluate procedures and techniques of Task 2 and recommend changes as necessary.
- Subtask 3.4 – Participate in validation of USS PONCHATOULA (AO-148) using the procedures developed in subtask 2.4.
- Subtask 3.5 – Assist in the conduct of the validation of USS HENRY B. WILSON (DDG-7), using the procedures developed in subtask 2.5.

#### 4.2 TASK RESULTS

Validation of the USS PONCHATOULA (AO-148) and the USS HENRY B. WILSON (DDG-7) were conducted during March and April 1972 using the basic procedures and methods developed under Tasks 2 and 4 of this contract. ARINC Research representatives assisted ship's force personnel in the conduct of both prototype validations.

Principal results of the validation of the USS PONCHATOULA are summarized in Table 4-1.

The data obtained during the validation of both the USS PONCHATOULA and the USS HENRY B. WILSON were used to produce SDA plastic cards for use in maintenance management activities aboard those ships.

The successful application of the procedures developed under Tasks 2 and 4 demonstrated the practicality of the validation methods contained in the procedures.

TABLE 4-1. SUMMARY OF USS PONCHATOU LA VALIDATION RESULTS

Original no. of validation aids	2,039	
Validation aids revised	165	
Validation aids added	130	
Validation aids deleted	212	
Total changes	507	
SDA cards required	1,573	
Work centers validated	14	
Elapsed time for validation	3 weeks	{ 1 week at sea 2 weeks at pier
Man hours expended		
Prior to shipboard validation - by team	144	} 480
During validation - by team	336	
by ship's force	834	

## TASKS 5 AND 6: DEVELOP METHODOLOGY AND PROCEDURES FOR DETERMINING EQUIPMENT OVERHAUL WORK REQUIREMENTS

### 5.1 DESCRIPTION OF TASKS

The combined objective of Tasks 5 and 6 was to develop a procedural approach for inspecting equipments to determine overhaul work requirements. The following subtasks were included:

- Subtask 5.1 – Select generic types of equipment for which overhaul criteria will be developed.
- Subtask 5.2 – For each generic type selected: identify, investigate, and assess the parameters, characteristics and factors that potentially constitute a basis for overhaul decision.
- Subtask 5.3 – For selected equipments, develop inspection, test, or checkoff procedures and data sheets to be used by technicians during preoverhaul inspections. The results of these inspections and tests are to be used to determine the overhaul work requirements for the equipment.

### 5.2 RESULTS OF TASKS

An approach utilizing ship's force personnel to inspect ship systems to determine overhaul work requirements was developed for a portion of the Fire and Tank Cleaning System of AO-143 class ships. That system element was chosen because it contains many of the generic types of equipments found on a ship, such as centrifugal pumps, piping, auxiliary turbines, electric motors, and motor controllers.

The approach basically consists of a systematic visual inspection of the system by ship's force personnel, followed by normal operation of the system and recording of the conditions as found. If defects are discovered during this inspection, ship's force prepares maintenance data forms (4790-2K) to initiate the required repair action.

A pre-overhaul procedure for AO-143 class ships, entitled "Pre-Overhaul Ship-check, Inspection, and Tests, Fire and Tank Cleaning System in the Fireroom", was prepared and submitted to COMSERVPAC. This procedure illustrates one approach to identifying overhaul work requirements. Future application of the procedure will indicate its effectiveness in defining overhaul work requirements.

## TASKS 7 AND 8: DEVELOP METHODS, PROCEDURES, AND INSTRUCTIONS FOR PRE-OVERHAUL MATERIAL INSPECTIONS

### 6.1 DESCRIPTION OF TASKS

The combined objective of Tasks 7 and 8 was to develop methods, procedures and instructions for determining the pre-overhaul condition of selected shipboard equipment/systems, and to assist ship's force in applying these procedures. The following subtasks were included:

- Subtask 7.1 – Develop procedures for planning, conducting, and recording the results of pre-overhaul material conditions.
- Subtask 7.2 – Identify/examine availability of inspection resources and recommend team structure.
- Subtask 7.3 – Assess compatibility of recommended inspection procedures with prevailing practices and procedures.
- Subtask 7.4 – Develop procedures for use during pre-overhaul inspections to determine ship alteration status and applicability.
- Subtask 7.5 – Assist pre-overhaul inspection teams with the inspection of an AO-143 class ship.

### 6.2 SUMMARY OF TASK RESULTS

#### 6.2.1 Subtasks 7.1, 7.2, and 7.3 – Develop Procedures for Pre-Overhaul Material Inspections

ARINC Research prepared a document entitled, Guide for Overhaul Planning Team Accomplishment of Pre-Overhaul Material Inspections, Ship-Checks and Tests. This guide provides the overhaul planning team responsible for assembling the overhaul work requirements package with the information necessary to conduct and coordinate pre-overhaul inspections, shipchecks, and tests.

The emphasis in this guide is for the overhaul planning team to review the overhaul work requirements as delineated by ship's force on maintenance data forms (4790-2K) and contained in the ship's CSMP. After this review the planning team will assist ship's force in inspecting and testing ship systems and equipments only as necessary to clarify or define overhaul work requirements.

#### 6.2.2 Subtask 7.4 – Develop Procedures for Pre-Overhaul Inspections

ARINC Research assisted COMSERVPAC in the development of procedures for determination of ShipAlt applicability and status. The effort, performed under the technical direction of PERA (CSS), included the preparation of a Master ShipAlt Summary for AO-type ships. The Master Summary contained a listing of all ShipAlts



currently applicable to AO types, general information concerning the accountability of each ShipAlt within existing indexes (such as SACS and the ShipAlt Index), and data concerning interfaces between ShipAlts (e. g. , supercession of one ShipAlt by another, and requirements for prior ShipAlt completions). Interfaces were determined from a review of ShipAlt records.

A Master Index was prepared of all ShipAlts for AO-type ships, and this index was used as an input to the preparation of a validation booklet for individual ships of the type. The validation booklet contained a ShipAlt Summary Matrix, a copy of each ShipAlt to be shipchecked, and miscellaneous data that would be required in performing the shipcheck.

Validation booklets for individual ships and the Master Summary for AO's were submitted to COMSERVPAC and PERA (CSS) in June 1972.

6.2.3 Subtask 7.5 - Assist Pre-Overhaul Inspection Teams with Inspection of AO-143 Class Ship

ARINC Research coordinated and assisted with the pre-overhaul inspection of the USS KAWISHIWI (AO-146). This inspection was conducted while the ship was operating out of Subic Bay, P.I., during July and August 1972.

The basic method developed in subtask 7.1 was used during this inspection. Data from the ship's CSMP and maintenance data forms were reviewed. A shipcheck package was compiled consisting of copies of confusing, questionable, incomplete, or ambiguous overhaul work items found during the review. During the pre-overhaul inspection, the discrepancies, redundancies, and gaps in the overhaul work requirements were resolved by inspecting the equipments or subsystems during normal operations in the areas where these problems existed. Ship's force then revised or prepared new maintenance data forms to describe properly the required overhaul work items.

Results of this pre-overhaul inspection were included in the overhaul work package for the USS KAWISHIWI's Regular Overhaul.

## TASKS 9 AND 10: DEVELOP PROCEDURES FOR DETERMINING AND RECORDING POST-OVERHAUL MATERIAL CONDITION

### 7.1 DESCRIPTION OF TASKS

The combined objective of Tasks 9 and 10 was to develop a methodology for determining the material condition of selected systems/equipments at the completion of Regular Overhaul. The following subtasks were included:

- Subtask 9.1 – Develop procedures for determining and recording post-overhaul material conditions.
- Subtask 9.2 – Ensure compatibility of the above procedures with prevailing practices and procedures.
- Subtask 9.3 – Assist COMSERVPAC in determining and recording the material condition of an AO-143 class ship at the completion of an overhaul.

### 7.2 RESULTS OF TASKS

ARINC Research prepared a proposed COMSERVPAC Instruction, "Post-Overhaul CSMP Validation". The purpose of this instruction is to ensure that the 3M Current Ships Maintenance Projects (CSMP) listing is an accurate representation of a ship's material condition.

During overhaul, ship's force prepares maintenance data forms as overhaul repair work is completed or as new repair work is discovered. Near the end of the overhaul, ship's force reviews the status of all repair work and updates the CSMP.

After the updated CSMP is available, shortly after overhaul, the squadron commander designates a team to verify the accuracy of the CSMP. This is done in two steps:

- a. Review documents to ensure that all completed actions, deletions, and deferrals have been incorporated into the CSMP listing.
- b. Inspect selected items from the CSMP listing and other randomly selected ship equipments/subsystems to verify the accuracy of the CSMP listing.

When this inspection is complete the squadron commander's team prepares a report containing its findings and recommendations for improving the accuracy of the CSMP.

In addition to preparing the instruction for validation of the CSMP, ARINC Research personnel assisted the USS KAWISHIWI during its regular overhaul at Pearl Harbor Naval Shipyard starting in November 1972. Specific assistance was provided in reviewing the status of its overhaul repair work package and in preparing inputs for updating the CSMP.

## TASK 11: DEVELOP METHODOLOGY FOR PREPARING EQUIPMENT OVERHAUL SPECIFICATIONS

### 8.1 DESCRIPTION OF TASK

The objectives of Task 11 were to develop a methodology and format for preparing the equipment overhaul specification (EOS); to identify data sources for preparing EOS's; and to investigate alternative methods for the supply of overhaul replacement parts. The task consisted of the following subtasks:

- Subtask 11.1 – Identify data sources for preparing EOS's. Survey a sampling of planning/estimating personnel to identify current data sources used or desired. Assess data requirements for EOS preparation, prepare a listing of data requirements for each type of EOS, and identify available data sources.
- Subtask 11.2 – Develop methods and rationale for preparing EOS's. Examine existing practices to identify alternatives and options that exist relative to preparation. Evaluate each alternative/option.
- Subtask 11.3 – Develop the EOS format. Review existing policy guidance for specifications and develop formats for hull, mechanical, and electrical equipment overhaul specifications. Check the format against prevailing practices; submit it for review/approval.
- Subtask 11.4 – Develop an approach for assessing the alternative methods of supplying overhaul replacement parts.
  - 11.4.1 – Identify and define the alternatives relative to the specification of overhaul replacement parts during the preparation of EOS's.
  - 11.4.2 – Identify the cost factors and associated costs for each alternative.
  - 11.4.3 – Determine the additional information or data required to evaluate alternatives.
  - 11.4.4 – Prepare a technical briefing for COMSERVPAC, and obtain guidance as to further EOS development.

### 8.2 TASK RESULTS

#### 8.2.1 Subtask 11.1 – Identify Data Sources for Preparing EOS's

Under this subtask it was determined that the preparation of overhaul standards requires a broad range of data sources, including technical manuals, military specifications and standards, prevailing standards for quality program requirements, drawings, instruction books, and other documentation, to describe the system/equipment/

component and to establish maintenance practices or procedures. Also needed are historical data (e.g., 3M data on descriptions of prior maintenance actions) that can be used to quantify the nature and extent of past deficiencies and corrective actions; and such specifics as the security classification of the item.

#### 8.2.2 Subtask 11.2 - Develop Methods and Rationale for Preparing EOS's

ARINC Research reviewed and assessed existing policy guidance for the preparation of equipment overhaul specifications, standards, and job orders. A sampling of planning/estimating personnel were surveyed to identify current practices.

The need for standardization and detail in prescribing system equipment and component overhaul requirements has long been recognized in the Navy, and in recent years considerable emphasis has been directed towards the development and utilization of appropriate standards. The most significant program relating to the preparation of EOS's is the Technical Repair Standards (TRS) program. TRS's are developed in accordance with rigid military specifications - MIL-T-24255A delineates the format and requirements for preparing TRS's for submarines, and MIL-T-24424 gives corresponding requirements for systems, equipments, and components used in surface ships. Under the terms of these military specifications, the TRS is a standard, not a procedure or a substitute for a technical manual. The intent of a TRS is to provide specific planned examination, maintenance, and test criteria to be applied during overhaul. While a considerable number of TRS's have been prepared to date, their use has been concentrated in overhaul of submarine systems/components, and is not as yet universal within the Navy. Very few TRS's exist for systems, equipments, and components of Service Force ships.

An underlying question concerning equipment overhaul specifications is what justifies their need. The need for equipment overhaul specifications stems from the fact that the repair/overhaul of equipments is a complex and often costly undertaking, therefore requiring positive management control. In addition such actions are repetitive in nature and performed by a variety of activities, which suggests the desirability of their standardization. Past experience shows that problems arise when overhaul/repair is accomplished on an "inspect and repair as necessary" basis, since the ability to estimate associated cost prior to authorization is minimal. The need for explicitness and standardization in specifying overhaul actions justifies the concept of preparing some type of standard that could be used to provide visibility and control relative to overhaul actions.

#### 8.2.3 Subtask 11.3 - Develop Format

Under this subtask a format was developed patterned after the TRS format and tailored to fit the needs of Service Force ships. The format developed was submitted as Technical Note W3-D06-TN04, February 1973. Included in the format are provisions for overhauling equipment to two desired material conditions:

- a. Satisfactory operating condition with minimum teardown and overhaul expense
- b. Near-new operating condition

Under existing practices, once the need to overhaul an equipment has been determined and recorded on an OPNAV 4790.2K maintenance data form, the degree and method of overhaul is largely determined by the authorization authority and the

job specification preparer. The degree of detail varies considerably and is mainly dependent on the information entered on the maintenance data form and the expertise of the planning personnel. Utilization of an EOS should eliminate in many cases the need for "open and inspect" type jobs, and permit better advanced planning of work and procurement of repair parts.

#### 8.2.4 Subtask 11.4 - Develop Approach for Assessing Alternative Methods of Supplying Replacement Parts

A proposed plan for evaluating alternative methods of ordering replacement parts required for machinery overhaul was developed. A technical briefing was prepared and presented to Service Force maintenance personnel. The proposed plan was developed as discussed below, and is included with this report as Appendix D.

##### 8.2.4.1 Subtask 11.4.1 - Identify/Define Alternatives

It was determined that the following alternative methods for ordering overhaul replacement parts are possible:

- a. Order replacement parts after equipment has been opened and inspected and parts requirements determined.
- b. Assemble replacement part kits where selection of items for inclusion is based on expectation of usage.
- c. Assemble replacement part kits where selection of items for inclusion is based on cost.
- d. Assemble kits where selection of items is based on a combination of usage expectation and cost.

##### 8.2.4.2 Subtask 11.4.2 - Identify Cost Factors and Associated Costs for Each Alternative

A cost model suitable as a framework for collecting the pertinent data and comparing the alternatives was developed. Figure 1 of Appendix D shows the suggested cost breakdown structure and identifies cost elements sensitive to parts ordering policy.

The figure expresses equipment overhaul cost as consisting of "direct" and "indirect" costs. Direct costs are defined as those which could probably be accounted for through prevailing accounting practices of the Type Commander and repair activities in the management of ship overhauls. Indirect costs represent those less-tangible factors not normally accounted for within the framework of the overhaul management.

As further noted in the figure, direct costs may be subdivided into labor and material categories. Labor cost can be subdivided to account for that portion of labor due to parts acquisition.

The purpose of such a cost breakdown structure is to identify all cost elements that could be expected to vary as a function of the alternative selected.

8.2.4.3 Subtask 11.4.3 - Determine Additional Data Required to Evaluate Alternatives

Three approaches were found to be feasible for acquiring the data needed to exercise the cost model developed under subtask 11.4.2. The approaches are:

- a. Controlled test/inspection
- b. Uncontrolled test/inspection
- c. Semicontrolled test/inspection

Consideration of the three alternatives indicates that semicontrolled testing is the most cost-effective means of acquiring the needed data. Under this option, existing data bases would be utilized to the extent possible and then augmented with the necessary additional data by means of tests/inspections as needed. The additional data would be recorded via forms and procedures supplemental to those currently in use.

Under this approach there are two alternatives for ordering replacement parts:

- a. Order replacement parts after opening and inspecting the equipment to be overhauled;
- b. Pre-order a replacement parts kit where the kit would consist of all parts having a greater than 50 percent chance of use (based on experience), and costing less than a pre-established dollar amount.

The data acquisition plan based on the semicontrolled test approach appears in Appendix D.

8.2.4.4 Subtask 11.4.4 - Prepare Technical Briefing and Report

A technical briefing was presented to Service Force maintenance personnel. Appendix D is the report on which the briefing was based. This report includes criteria for selection of replacement parts for inclusion in kits, a data collection form, and recommended data sources.

## TASKS 12 AND 13: DEVELOP EQUIPMENT OVERHAUL SPECIFICATIONS AND AN INSTRUCTION FOR PREPARATION OF EOS'S

### 9.1 DESCRIPTION OF TASK

The objective of this task was to develop prototype equipment overhaul specifications for selected equipments. The following subtasks were included:

- Subtask 12.1 – Develop a prototype equipment overhaul specification (EOS) using the methodology developed in Task 11.
- Subtask 12.2 – Analyze the prototype EOS and prepare an instruction or guide for preparation of EOS's.
- Subtask 12.3 – Prepare additional EOS's for some of the same selected equipments for which pre-overhaul inspections and tests were prepared in Task 5.

### 9.2 TASK RESULTS

#### 9.2.1 Subtask 12.1 – Develop Prototype Equipment Overhaul Specification

A prototype EOS was prepared for the overhaul of the Fire and Tank Cleaning Pump installed on AO-143 class ships. The format and methodology developed in Task 11 were followed. The EOS developed was included in Technical Note W3-D06-TN06 submitted in March 1973.

#### 9.2.2 Subtask 12.2 – Prepare Instruction or Guide for Preparation of EOS's

An Instruction for preparation of EOS's was prepared and submitted in March 1973 as Technical Note W3-D06-TN06. This Instruction was developed on the basis of experience gained in preparing the prototype EOS under subtask 12.1 and the work accomplished under Task 11.

#### 9.2.3 Subtask 12.3 – Prepare Additional EOS's

Under this subtask, EOS's were prepared for the following equipments of AO-143 class ships:

- a. EOS 001 – Fire and Tank Cleaning Pump, EIC T801
- b. EOS 002 – Fire and Tank Cleaning Pump Turbine, EIC T801
- c. EOS 003 – Salt Water Heater and Accessories, EIC T805

These EOS's were submitted as enclosures to Technical Note W3-D06-TN06.

## TASK 14: PREPARE OVERHAUL CYCLE PLANNING LOGIC NETWORK

### 10.1 DESCRIPTION OF TASK

The objective of this task was to develop a logic network depicting the individual steps involved in the overhaul planning process, and to identify responsibilities and interfaces involved with each step. The following subtasks were included:

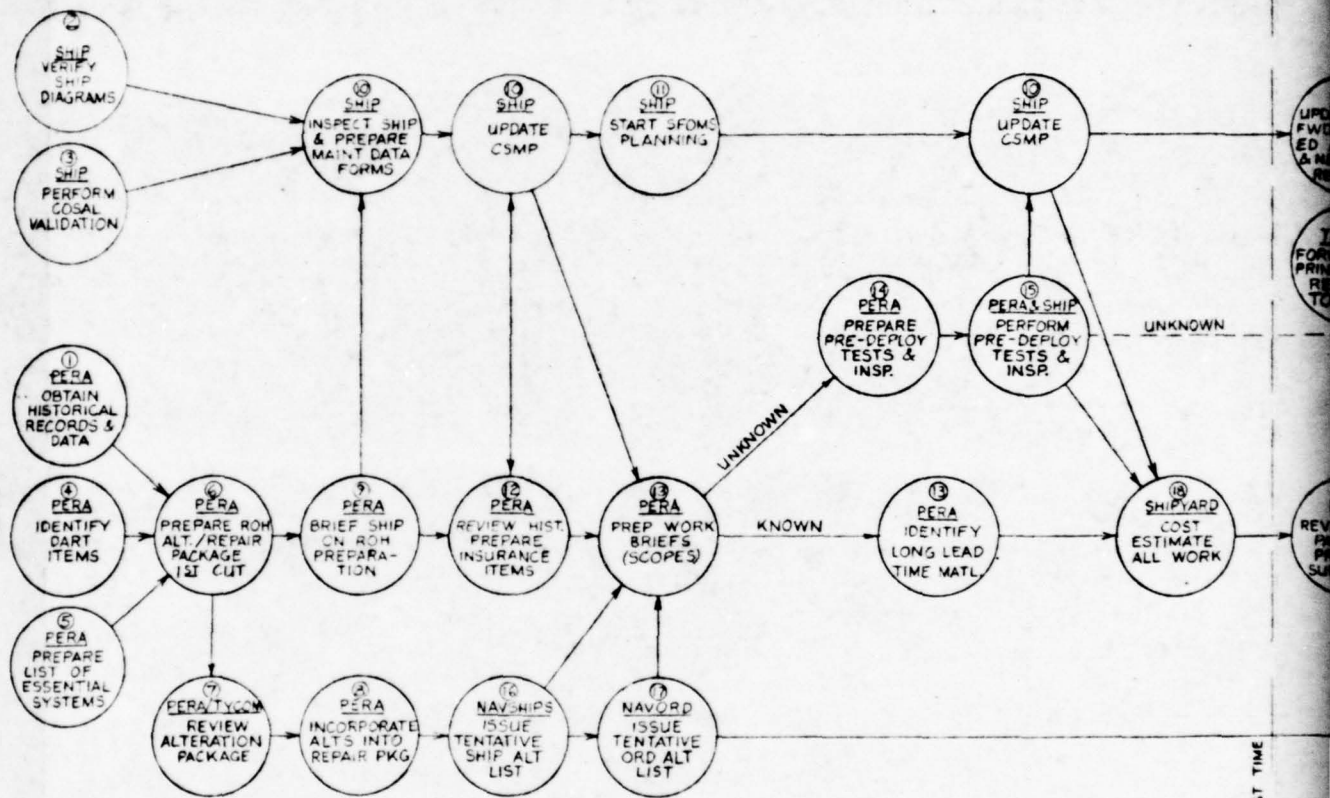
- Subtask 14.1 – Identify the steps involved in the planning process, and the organizations responsible for the required actions.
- Subtask 14.2 – Lay out a logic network showing the interrelationship and sequence between the steps and organizations identified in Subtask 14.1.
- Subtask 14.3 – Prepare a brief description of the steps identified in Subtask 14.1 to supplement the network developed in Subtask 14.2.

### 10.2 TASK RESULTS

ARINC Research prepared for COMSERVPAC the "Overhaul Planning General Task Chart, Task Index and Tasks", dated 15 September 1972. The Task Chart, shown in Figure 10-1, is a logic network depicting the relationship between the individual steps in the overhaul planning process. The Overhaul Planning Task Index, Table 10-1, provides more detail about the overhaul planning tasks and the responsible organizations, and in addition contains general schedule information for accomplishment of the tasks. The Overhaul Planning Tasks document describes each of the tasks shown on the Task Chart.

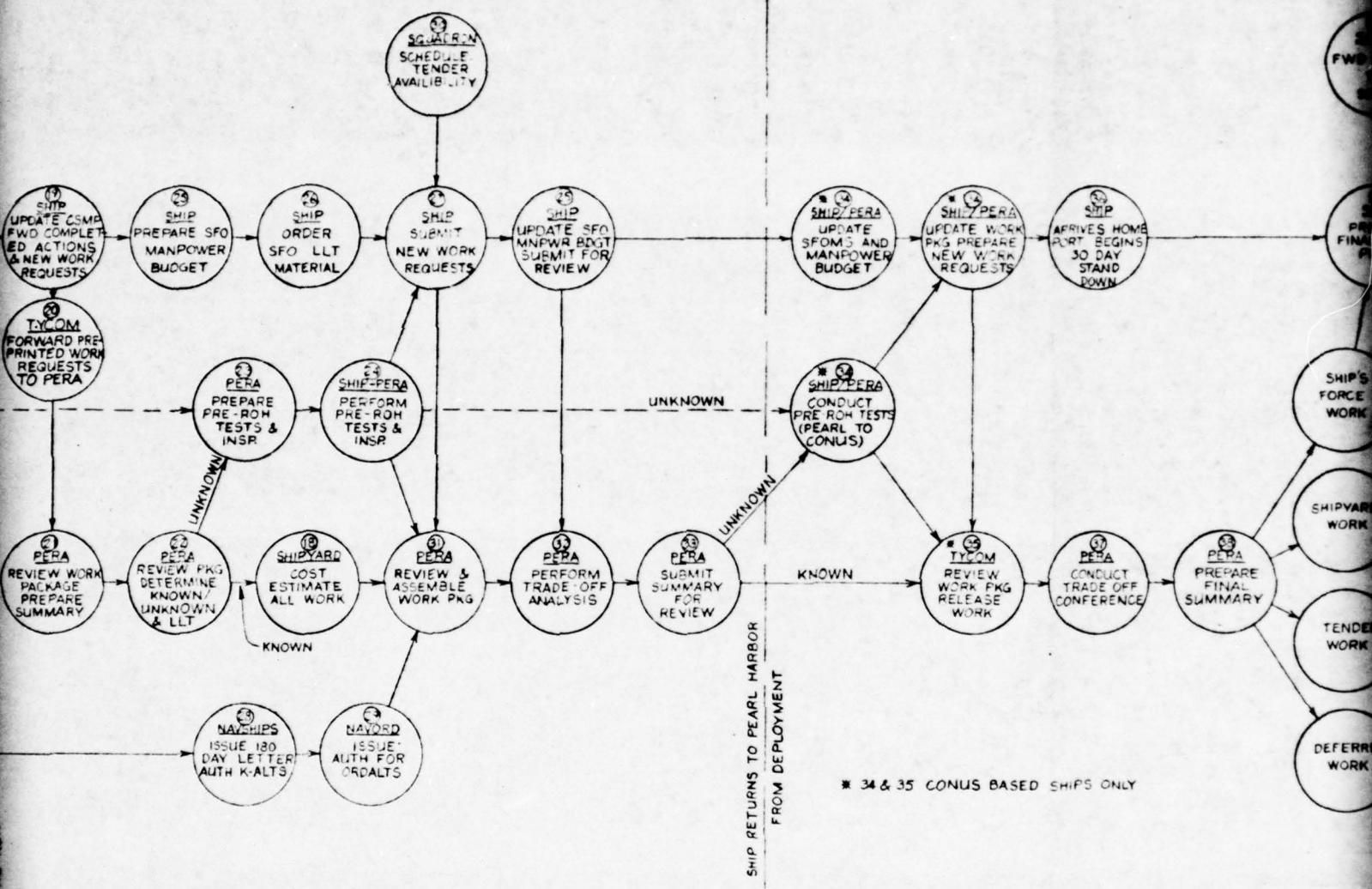
The overhaul planning process depicted by the Task Chart and Index is currently being used to plan most of the COMSERVPAC Regular Overhauls for fiscal year 1973.





SHIP DEPLOYS FOR LAST TIME BEFORE ROH

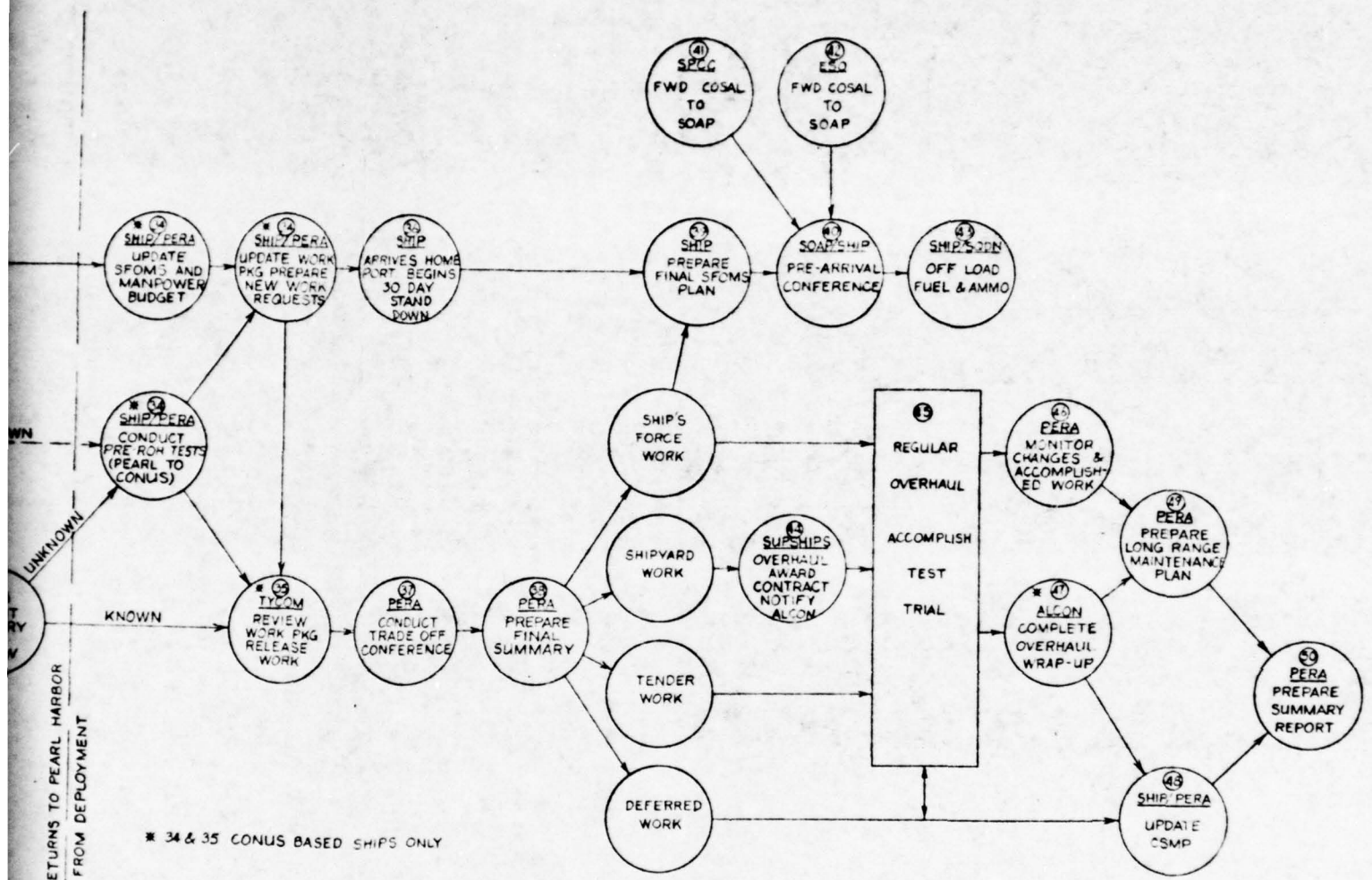
BE



\* 34 & 35 CONUS BASED SHIPS ONLY

SHIP RETURNS TO PEARL HARBOR  
FROM DEPLOYMENT

# BEST AVAILABLE COPY



\* 34 & 35 CONUS BASED SHIPS ONLY

- \* 47 :
1. REVIEW DEFERRED WORK
  2. REVIEW ACCOMPLISHED WORK
  3. PREPARE OVERHAUL CRITIQUE
  4. PREPARE DEPARTURE REPORT
  5. REVIEW ROH DEFICIENCIES - INCLUDING LOGISTICS SUPPORT - DEVELOP PLAN TO CORRECT DEFICIENCIES
  6. UPDATE COSAL
  7. INVENTORY SPARES AND RELOAD

**Figure 10-1**  
**COMSERVPAC**  
**OVERHAUL PLANNING**  
**GENERAL TASK CHART**

SEPT 15, 1972

TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 1 of 7)

Task No.	Target Date*	Task	Action Command
1	Immediately	<p>Obtain historical records and data and have copies of the following for review:</p> <ol style="list-style-type: none"> <li>1. Ship characteristics and mission assignments</li> <li>2. Class Improvement Plan (CIP)</li> <li>3. Ship Improvement Guide (SIG)</li> <li>4. 3M Current Ship's Maintenance Project (CSMP)</li> <li>5. 3M report of completed repairs and alteration actions/condensed history</li> <li>6. Ship Systems Definition and Index (SSDI) or Staging Diagrams</li> <li>7. FMP material supplement and alteration check-off listing</li> <li>8. ORDALT applicability list</li> <li>9. SECAS report</li> <li>10. TYCOM ShipAlt Program "D" and "F" ALTs and AERs</li> <li>11. ROH and RAV departure reports</li> <li>12. CASREPS</li> </ol>	PERA
2	Immediately	Verify Ship Systems Staging Diagrams.	Ship
3	Immediately	Perform COSAL validation.	Ship
4	Immediately	Review and identify DART corrective actions that can be implemented during overhaul.	PERA
5	Immediately	Prepare list of essential systems.	PERA
6	Immediately	<p>Prepare alteration/repair package summary — first cut:</p> <ol style="list-style-type: none"> <li>1. Review FMP ALT and material requirements for programmed ALTs.</li> <li>2. Identify late reprogram requirements.</li> <li>3. Obtain drawings on outstanding ALTs.</li> </ol>	PERA

\*Dates are given in months before or after the start of overhaul except as noted.

TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 2 of 7)

Task No.	Target Date*	Task	Action Command
6 (Cont)		<ol style="list-style-type: none"> <li>4. Review CSMP for action and to scope repair package.</li> <li>5. Review CSMP to determine actions required to indoctrinate ship in preparing adequate description on work requests.</li> <li>6. Review for known/unknown work requirements.</li> </ol>	
7	Immediately	<p>Review forecasted alteration package for:</p> <ol style="list-style-type: none"> <li>1. First time ALT drawing requirements</li> <li>2. Material requirements</li> <li>3. Shipcheck requirements</li> <li>4. Revision to existing drawings</li> <li>5. Planning and schedule events to ensure orderly accomplishment of above events.</li> </ol>	PERA, TYCOM
8	Immediately	Incorporate alteration package (K, D, F, & AER) into repair package and recommend necessary action if required in accordance with FMP procedures.	PERA
9	Prior to Deployment	Brief ship on overhaul preparation including preparation of work requests and SFOMS planning.	TYCOM
10	Prior to Deployment	Inspect ship and prepare maintenance data forms. Review and update CSMP for overhaul requirements.	Ship
11	Prior to Deployment	Start SFOMS planning.	Ship
12	Immediately	Review updated material history report and work requests and prepare actions as required for inclusion of "Insurance items" in work package	PERA

\*Dates are given in months before or after the start of overhaul except as noted.

TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 3 of 7)

Task No.	Target Date*	Task	Action Command
13	Immediately	Review work package. Prepare work briefs (scopes) and identify long-lead-time material.	PERA
14	A-13	Prepare list of predeployment tests and inspections based around known/unknown work requirements. Task activities to shipcheck repair work package based on CSMP and other data.	PERA-Designated Activities (Coordinate with Parent Squadron)
15	A-10	Perform pre-deployment inspections, tests, and shipchecks, and include shipboard review of ALT work package and selected repair work elements from CSMP. Update CSMP.	Ship, PERA; Others Assist
16	A-10	Issue message listing tentative SHIPALTs planned.	NAVSHIPS 427
17	A-10	Issue message listing tentative ORDALTs planned.	NAVORD
18	A-9 Start	Cost estimate all known work and identify missing work.	Shipyard or SUPSHIPS
19	A-9	<u>Ship Deploys</u> - Update CSMP and ROH plan. Forward completed actions.	Ship
20	A-7.5	Forward preprinted work requests to PERA.	TYCOM
21	A-9 to A-6	Review and validate all work requests. Consolidate overhaul planning and identify weaknesses. Prepare integrated work package summary.	PERA
22	A-9 to A-6	Review work package, determine "known" work and identify long-lead-time requirements. Review "unknown" work.	PERA

\*Dates are given in months before or after the start of overhaul except as noted.

TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 4 of 7)

Task No.	Target Date*	Task	Action Command
23	A-6	Prepare pre-overhaul test and inspections tailored around known/unknown work package.	PERA
24	A-6 to A-3	Arrange for and accomplish pre-ROH test and inspections tailored around WESTPAC operations. Include the special pre-ROH tests such as: <ol style="list-style-type: none"> <li>1. UNREP system</li> <li>2. Boiler inspection</li> <li>3. Electronic system</li> <li>4. Ordnance system</li> <li>5. Others as authorized</li> </ol>	Squadron, PERA, Ship
25	A-6	Prepare ship's force manpower budget.	Ship
26	A-6	Order ship's force long lead time material.	Ship
27	A-6	Submit new work requests for items not contained in CSMP.	Ship
28	A-6	Issue 180 day letter on "K" ALT's.	NAVSHIPS
29	A-6	Issue authorization letter on ORDA LT's.	NAVORD
30	A-6	Schedule ROH tender availability and other IMA availabilities.	Squadron
31	A-6 to A-4	Review, refine, and assemble complete ROH work package (scope all repair actions): <ol style="list-style-type: none"> <li>1. Structure by SSDI.</li> <li>2. Identify priority and accomplishing activities.</li> <li>3. Prepare work briefs (scopes) and obtain cost estimates.</li> </ol>	PERA

\*Dates are given in months before or after the start of overhaul except as noted.

TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 5 of 7)

Task No.	Target Date*	Task	Action Command
32	A-3.5	Perform tradeoff analysis.	PERA
33	A-3	Submit summary work package report to ALCON for review. PERA to structure report for TYCOM/squadron/ship concurrence or revision.	PERA
34	A-2.25	<u>Ship Arrives Pearl</u> : Pre-overhaul shipcheck and inspections (Pearl to CONUS): <ol style="list-style-type: none"> <li>1. Conduct special pre-ROH test and inspection.</li> <li>2. Assist ship's force in SFOMS setup.</li> <li>3. Review status of work package update and priorities.</li> </ol>	PERA, Lead Activity, CONUS-Based Ships Only
35	A-2.25	Work package review conference at Pearl.	TYCOM, CONUS-Based Ships Only
36	A-2	<u>Ship Arrives Home Port</u> -- Starts 30 day shutdown.	Ship
37	A-2	Conduct work package tradeoff conference.	PERA
38	A-1.75	Prepare final ROH work package summary. <ol style="list-style-type: none"> <li>1. Identify priority and cost estimates.</li> <li>2. Organize by: <ol style="list-style-type: none"> <li>a. Authorized work for: <ol style="list-style-type: none"> <li>1) Ship's force</li> <li>2) Shipyard</li> <li>3) Tender or IMA</li> </ol> </li> <li>b. Deferred work</li> </ol> </li> </ol>	PERA

\*Dates are given in months before or after the start of overhaul except as noted.



TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 6 of 7)

Task No.	Target Date*	Task	Action Command
39	A-1.5	Prepare final SFOMS plan.	Ship
40	A-1.5	SOAP pre-arrival conference.	SOAP REP
41	A-1.5	SPCC forwards COSAL package to SOAP team.	SPCC
42	A-1.5	ESO mails COSAL package to SOAP team.	ESO
43	A-1.0	Off-load fuel and ammo.	Ship and Parent Squadron
44	A-1.0	Award contract and notify all concerned.	SUPSHIP Overhaul Only
45	A-0.0	Ship enters overhauling activity and accomplishes regular ROH.	All
46	A to C	Monitor changes and work being accomplished.	PERA
47	C + 2 weeks	Complete overhaul — wrap-up: <ol style="list-style-type: none"> <li>1. Review deferred work.</li> <li>2. Review accomplished work.</li> <li>3. Prepare overhaul critique.</li> <li>4. Prepare departure report.</li> <li>5. Review ROH deficiencies, including logistics support. Develop plan to correct deficiencies.</li> <li>6. Update COSAL.</li> <li>7. Inventory spares and reload.</li> </ol>	All
48	C + 1	Update CSMP.	Ship

\*Dates are given in months before or after the start of overhaul except as noted.

TABLE 10-1. INDEX OF TASKS, COMSERVPAC OVERHAUL PLANNING (Sheet 7 of 7)

Task No.	Target Date*	Task	Action Command
49	C + 1	Prepare long range maintenance plan.	PERA
50	C + 2	Assess the effectiveness of the ROH plan and procedures and prepare summary report.	PERA

\*Dates are given in months before or after the start of overhaul except as noted.

## TASKS 15 AND 16: PREPARE DOCUMENTS DESCRIBING COMSERVPAC MAINTENANCE MANAGEMENT POLICIES AND PROCEDURES

### 11.1 DESCRIPTION OF TASKS

The objective of these tasks was to assist COMSERVPAC in the development of a Maintenance Management Master Plan and other maintenance-related documentation. The following subtasks were included:

- Subtask 15.1 – Assist COMSERVPAC in preparing a Maintenance Management Master Plan
- Subtask 15.2 – Prepare documents such as instructions, procedures and manuals which describe details contained in the Maintenance Management Master Plan.

### 11.2 TASK RESULTS

#### 11.2.1 Subtask 15.1 – Assist COMSERVPAC in Preparing a Maintenance Management Master Plan

Under this subtask, ARINC Research prepared a proposed COMSERVPAC Overhaul and Maintenance Guide. The purpose of the guide is to provide planning and management personnel, at all levels and in all related activities, with information relative to maintenance planning and management. Emphasis is on the overhaul phase of ship maintenance, although overhaul is still treated as a single event in the total life cycle maintenance of a ship.

This proposed Overhaul and Maintenance Guide incorporates the results of work from other tasks, particularly Task 14. Contents of the guide are listed in Table 11-1. The proposed guide was submitted in March 1973 as Technical Note W3-D06-TN07.

The basic principles contained in the guide are being implemented on all SERVPAC ships as they come up for overhaul.

#### 11.2.2 Subtask 15.2 – Prepare Instructions and Procedures in Support of COMSERVPAC Maintenance Management Master Plan

ARINC Research assisted COMSERVPAC in developing a COMSERVPAC Habitability Manual. The purpose of the manual was to:

- a. Disseminate to SERVPAC ships all available information regarding the Navywide shipboard habitability improvement program for the purpose of promoting an understanding of both current standards and those new standards being reviewed by the Chief of Naval Operations.
- b. Promulgate guidance to commanding officers concerning desired habitability standards and priorities of accomplishment.

- c. Promulgate a program whereby commanding officers could survey their ship with reference to current standards; establish deficiencies; and recommend accomplishment/deferral and priorities, manpower resources, funding categories, an appropriate timeframe for accomplishment, and an estimate of the costs of the required improvements.

The manual, submitted to COMSERVPAC in August 1972, consisted of the following:

- a. Guidelines for Determination of Habitability Deficiencies – Procedures and checklists for surveying a ship to determine specific nonconformities to prevailing habitability standards.
- b. Guidelines for Establishing Habitability Work Items – Criteria and procedures for grouping deficiencies into discrete, manageable work items for habitability improvement.
- c. Guidelines for Evaluation of Prospective Habitability Improvement Items – Policy, criteria, and procedures relative to justifying or authorizing improvements.
- d. Guidelines for Entering Habitability Improvement Items in the CSMP – Procedures and instructions for filling out the maintenance data form for habitability improvement work items.
- e. Guidelines for Funding of Habitability Improvement Items – A description of the various sources of funds used for accomplishing habitability improvement in SERVPAC ships, and provide guidance to ship's force in the proper and effective planning for the utilization of these resources.
- f. Examples of Habitability Improvement Work Items – Illustrations of completed maintenance data forms.
- g. Habitability Hints – Various suggested projects or recommendations for upgrading shipboard habitability.

TABLE 11-1. CONTENTS, COMSERVPAC OVERHAUL AND MAINTENANCE GUIDE

		CONTENTS
1.	INTRODUCTION . . . . .	1
2.	OVERHAUL AND MAINTENANCE PLANNING . . . . .	3
2.1	Description of Availabilities . . . . .	3
2.1.1	Regular Overhaul . . . . .	3
2.1.2	Restricted Availability . . . . .	3
2.1.3	Technical Availability . . . . .	6
2.2	Organization of Overhaul . . . . .	6
2.2.1	Ship's Force Responsibilities . . . . .	6
2.2.2	Overhauling Activity Responsibilities . . . . .	6
2.2.3	PERA Responsibilities . . . . .	7
2.2.4	COMSERVPAC . . . . .	7
2.3	Planning . . . . .	8
2.3.1	Types of Work . . . . .	8
2.3.2	Planning Procedures . . . . .	8
2.3.3	Basic Principles and Rules . . . . .	9
3.	OVERHAUL . . . . .	11
3.1	Overhaul Management . . . . .	11
3.2	Shipyards Organization . . . . .	11
3.3	Ship's Force Responsibilities . . . . .	12
3.4	Trials . . . . .	13
4.	POST OVERHAUL PROCEDURES . . . . .	15
4.1	Deferred and Accomplished Work . . . . .	15
4.2	Reports . . . . .	15
4.3	Data System Update . . . . .	16
4.4	Long Range Maintenance Plan . . . . .	16
APPENDIX A: Overhaul Planning General Task Chart, Task Index, and Task Descriptions . . . . .		A-1
APPENDIX B: Examples of Good and Back Work Requests . . . . .		B-1
APPENDIX C: COMSERVPAC Priority Definitions . . . . .		C-1
APPENDIX D: Ship's Force Overhaul Management System (SFOMS) Guide . . . . .		D-1
APPENDIX E: COMSERVPAC Overhaul Routines . . . . .		E-1
APPENDIX F: List of COMSERVPAC Instructions (71 Cognizance) . . . . .		F-1

## APPENDIX A

PERA PROGRAM TASK PLANS,  
CONTRACT N00604-71-C-0431

<u>Task</u>	<u>Title</u>	<u>Page</u>
1	Prepare/Validate EIC Diagrams . . . . .	A-3
2 & 4	Develop Procedures and Techniques for Performing Inventories . . . . .	A-13
3	Assist in Conduct of Inventory of Selected Ship . . . . .	A-21
5 & 6	Develop Methodology and Procedures for Determining Overhaul Work Requirements for Selected Equipments . . . . .	A-29
7 & 8	Develop Methods, Procedures, and Instructions for Pre-Overhaul Material Inspections . . . . .	A-37
9 & 10	Develop Procedures for Determining and Recording Post-Overhaul Material Condition . . . . .	A-45
11	Develop Methodology for Preparing Equipment Overhaul Specifications (EOS) . . . . .	A-51
12 & 13	Develop Equipment Overhaul Specifications (EOS) and an Instruction for Preparation of EOS's . . . . .	A-57
14	Prepare an Overhaul Cycle Planning Logic Network . . . . .	A-65
15 & 16	Prepare Documents Describing COMSERVPAC Maintenance Management Policies and Procedures . . . . .	A-71

PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 1

TITLE: PREPARE/VALIDATE EIC  
DIAGRAMS

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: JUNE 21, 1971

Rev A: OCTOBER 22, 1971

Rev B: May 26, 1972

Rev C: June 15, 1972

Approved:

Rev A Approved:

*J. C. M. Arthur*  
*J. C. M. Arthur*


REVISIONS


Rev	Page	Description	Date	CSP Approval
A	4 & 7	Add Sub-task 1.4	10/22/ 72	J.C.McArthur
B	2 3 4-8 4,8,9 10	<ol style="list-style-type: none"> <li>1. Add revision page</li> <li>2. Revised Task Objective</li> <li>3. Revised tasks 1.1, 1.2, 1.3 and 1.4</li> <li>4. Added tasks 1.5 and 1.6</li> <li>5. Revised quality Assurance Provisions</li> <li>6. Deleted Schedule and submitted info.</li> </ol> <p>Items 2 thru 5 to reflect development to date and current technical direction.</p>	12/26/72	J.C.McArthur
C	3	<ol style="list-style-type: none"> <li>1. Added note to indicate substitution of preparation of SSD1 for three ship classes instead of validation/preparation of EIC structured systems diagrams for eleven ship classes as identified in Contract Task 1.</li> </ol>	15 June 72	J.C.McArthur



Task Objectives: The objective of this task is to develop methods for depicting or describing ships systems and equipments which will provide a universal frame of reference for all maintenance and related activities, such as:







- (1) Performance by ship's force personnel of pre-overhaul, post-overhaul and other material inspections.
- (2) Grouping of work requests by planning and estimating personnel.
- (3) Conduct of an inventory of shipboard equipment.

 This task will be accomplished by applying concepts to selected ships or ship classes as "pilot" or prototype programs for further study and evaluation.

 NOTE: This task plan for Task 1 incorporates the requirements of Contract Task 1 and the revised Contract Task 1 as modified by Contract Modification P00002 dated Feb. 18, 1972. The Contract Task 1 identifies subtasks to validate EIC structured ship systems diagrams for the AO 143 Class and to prepare similar EIC structured systems diagrams for the AOG 1 and the ATF Class and also to prepare EIC structured systems diagrams for 8 additional COMSERVPAC ship classes as identified in the contract modification. In reviewing the AO 143 Class EIC structured systems diagrams, alternative methods of presentation were explored. A particular technique, subsequently called "Ships Systems Definition and Index" evolved. This technique offered substantial advantages to COMSERVPAC. Consequently, in lieu of validating and preparing EIC structured systems diagrams for the COMSERVPAC ships as identified in the contract, a Ships Systems Definition and Index was prepared for the AO 143 Class, the AOE 1 and the ATF Class as identified in subtasks 1.1, 1.2, and 1.3 of this Task Plan.

Description of TASK/SUBTASKS:

-  Task 1.1 Prepare AO 143 Class Ship's Systems Definition and Index. Use as a baseline the EIC structured systems diagrams (staging diagrams) of the AO 143 Class Ships which have been prepared by the Pearl Harbor Naval Shipyard. The Ship's Systems Definition and Index will be a book of EIC Structured systems diagrams containing narrative and graphic descriptions defining the ship's systems.
-  Task 1.2 Prepare the AOE 1 Ship's System Definition and Index.
-  Task 1.3 Prepare Ship's Systems Definition and Index for the ATF Class Ships.
-  Task 1.4 Support Source Data Automation (SDA) System development.
-  Task 1.5 Develop a book of EIC structured systems diagrams generally applicable to any U.S. Navy ship. This book of diagrams would contain only the EIC structured framework with blocks containing the EIC and EIC noun name and would not contain narrative and graphic descriptions of the systems or work center assignments. List of equipments contained in sub-systems would be included where appropriate.
-  Task 1.6 Review the EIC Index and other indices such as BuShips Consolidated Index. Determine inconsistencies and anomalies in logic and structure of the EIC Index. Develop proposed changes to the EIC Index that would provide consistent logic between the various systems with respect to system and equipment breakout.

Procedure for Accomplishing Task:

B

1.1 Prepare AO 143 Class Ship's Systems Definition and Index.

Expand the EIC structured systems diagrams (staging diagrams) of the AO 143 class ships prepared by the Pearl Harbor Naval Ship Yard to completely define all the ships systems by identifying system boundaries, interfaces and key maintenance items. In performing this task the following shall be accomplished:

- a. Use the current EIC Master Index. Structure the layout of the ships systems diagrams to reflect the logic, numbering, and nomenclature as contained in the current EIC Index.
- b. Provide a narrative description of each EIC block. This narrative will define the boundary of each block and will describe the extent of the sub-systems and equipments that are included within the block. Where clarity is improved, sub-systems and equipments "not included" shall also be described or listed.
- c. Include a list of "Key Maintenance Items" for each EIC block above the equipment level. These "Key Maintenance Items" are to be a listing of the principal piping arrays, wiring arrays, components and equipments contained within the EIC block. This listing should include "Maintenance significant" items only. The Key Maintenance Items will be used as guidance for performing ship inspections and conducting equipment inventories.
- d. For systems for which the written descriptions do not

clearly define the system, provide a graphic diagram which shows a "picture" of the EIC subsystem. On this "picture" show the system boundaries and indicate the interfacing EIC systems.

- e. Identify each EIC Block to the ship's Work Centers that are responsible for the maintenance of the particular EIC sub-system or equipments.
- f. Prepare a book, to be called "Ship's Systems Definition and Index," that contains all the EIC structured systems diagrams for the AO 143 Class Ship. Include in this book introductory material and an index. The introductory material will describe the contents of the book and also describe the properties and uses of the diagrams contained in the Ship's Systems Definition and Index. Ten copies of the final approved Ship's Systems Definition will be submitted. In addition, the original copy from which the 10 copies are made will also be transmitted.

B 1.2 Prepare AOE 1 Ship's Systems Definition and Index. This sub-task is identical to sub-task 1.1 except that it is for a different ship. "Lessons-learned" from doing sub-task 1.1 will be incorporated into the Ship's Systems Definition and Index for the AOE 1. In addition, a different technique will be used to present the propulsion system graphic descriptions. This technique will utilize some of the "functional" system concepts of presentation. For the propulsion system, the graphic diagrams

will portray:

1. Electrical Interfaces
2. Plumbing and Pneumatic functional flows, controls, valves, etc.
3. Monitoring Sensors
4. Test Points
5. Functional Operation

B 1.3 Prepare Ship's Systems Definition and Index for ATF Class ships. This task is identical to task 1.1 except for a different class ship. Because of the relative simplicity of an ATF compared to an AO or AOE ship, the ATF Ship's Systems Definition and Index will be relatively simple and may not include any graphic diagrammatic presentations of systems and interfaces.

A 1.4 Support Source Data Automation (SDA) Development. Provide technical assistance in conjunction with development of COMSERVPAC 3-M SDA system final design and implementation package with consideration of interfacing SDA with EIC and staging diagram concepts expanded and developed in Sub-tasks 1.1, 1.2, and 1.3.

B The SDA System will use embossed plastic cards (similar to oil company credit cards) to capture system and equipment information that is used in reporting maintenance data in the 3-M System. Key to implementing the SDA System is the determination of equipments and sub-systems for which SDA plastic cards will be made. The EIC structured Ship's Systems Definition and Index is an indispensable tool to be used in making this determination. In addition to developing the Ship's System Definition and Index, assistance will be provided in support of COMSERVPAC development of the 3-M SDA system in the following areas:

- a. Complete System Design
- b. Formulate System Implementation Plan
- c. Identify, Test, Evaluate, Candidate Hardware
- d. Investigate and Evaluate SDA System Expansion Potential
- e. Conduct Expanded Shipboard Test and Evaluation Program
- f. Refine and Test Data Base Expansion Plan

**B** 1.5 Develop a book of EIC structured systems diagrams generally applicable to any U.S. Navy ship. This task will be accomplished in two steps as follows:

- a. Using the current EIC Master Index, construct EIC structured diagrams consisting of related blocks similar to the AO 143 Class EIC structured diagrams prepared by the Pearl Harbor Naval Shipyard without any verbal description. Each block to contain the EIC and EIC noun name. Do this for the whole EIC Master Index.
- b. Under each block at the third level (four digit EIC) which represents a sub-system or major equipment, list the principal equipments, materials, or components that are contained in this four digit EIC sub-system.

The accomplishment of this task will result in presenting the complete EIC Master Index in EIC structured system diagram (staging diagram) format. Prepare these in book form consisting of introductory material, an index, and pages of diagrams covering the entire EIC Master Index. Ten copies of the final, approved General EIC Systems Diagrams will be submitted. In addition, the original copy from which the ten copies are made will be transmitted.

△ B

1.6 Review the EIC Index. Analyse the logic of the EIC structure.

Use the staging diagrams developed in task 1.1, 1.2, 1.3 and 1.5 for this study. Analyse other ship system indices such as the BuShips Consolidated Index (BSCI) and the NAV-SHIPS current WBS proposal. Compare EIC with the BSCI and WBS. Determine areas of inconsistency in logic within the EIC. Develop proposed changes to the EIC which would correct the inconsistencies. Incorporate into these proposed changes as much similarity as practicable with the other indices such as BSCI and WBS without sacrificing the consistent structured system concepts. Prepare a report containing the proposed changes (in staging diagram format) and a write-up of the rationale in support of the changes.

△ B

B Quality Assurance Provisions:

Drafts of system diagrams will be submitted to the Pearl Harbor Naval Shipyard (PHNSY) for review on an "as completed" basis. After review by PHNSY and resolution of any comments, a corrected draft will be submitted to COMSERVPAC for review. After resolution of any comments by COMSERVPAC, a final draft will be prepared and the original and 10 copies will be submitted.



PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 2

(Incorporate Contract Task 4)

TITLE: DEVELOP PROCEDURES AND TECHNIQUES  
FOR PERFORMING INVENTORIES

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: July 16, 1971

Rev A Date: March 10, 1972

Rev B Date: June 12, 1972

Approved:

J.C.M. Arthur

REVISIONS				
Rev	Page	Description	Date	CSP Approval
A	All	1) Retyped and added new sub-tasks 2.4: Develop Validation Procedures for USS Ponchatoula, using SPCC data base; 2.5: Develop Validation procedures for USS Henry B. Wilson using PERA (AAW) and NSMMES data base.  2) Deleted out of date schedule and resources plans.  3) Revised Q.A. Provisions to indicate task status would be reported in Bi-Weekly report.	10 March 72	J.C.M.:Auth
B	3 3  4-7 4-7	1) Revised task objectives. 2) Added note stating requirements of contract task 4 are incorporated within task 2. 3) Revised sub-tasks 2.1-2.5. 4) Added sub-task 2.6.  All to reflect development to date and current technical direction.	12 June 72	J.C.M.:Auth

Task Objective

The purpose of this task is to provide procedures complete with required forms, for conducting an inventory of ship's equipments and systems which could be applicable to all USN ships. The procedures are to cover the collection of inventory data that describe a ship's hardware in a manner compatible with the ships system diagrams prepared under Task 1. Procedures and techniques developed will minimize data collected aboard ship to that necessary to identify equipments, locations and responsible work centers. Data collection procedures and formats shall be organized to be compatible with machine processing techniques. Emphasis will be given to simplifying procedures and techniques to provide for minimum usage of available resources commensurate with required accuracy. Prime consideration will be given to gathering data in support of the Source Data Automation System (SDA) development and implementation. Consideration will be given to obtaining or verifying data required by other users to support configuration accounting systems.

NOTE: Results of this task incorporate the requirements of task 4 of the Contract. A separate task plan for task 4 will not be provided.

## 1. TECHNICAL APPROACH

### DESCRIPTION OF TASK/SUBTASKS:

- B 2.1 Identify, investigate, assess alternative data sources for performing ship inventory or validation in support of Source Data Automation (SDA) development.
- B 2.2 Select a data base for performing ship inventory validation.
- B 2.3 Prepare procedure for performing ship validation using selected data base.
- A 2.4 Develop procedures and documentation for the validation of the equipment on the AO 148, USS PONCHATOUOLA using the Ship's Parts Control Center (SPCC) Cosal Validation Aids as the base line.
- A 2.5 Develop procedures and documentation for the validation of the equipment on the DDG-7, USS HENRY B. WILSON, using PERA (AAW) and NSMSES data as the base line.
- B 2.6 Assist with development of an integrated plan of action for validation of ships navy wide.

PROCEDURE FOR ACCOMPLISHING TASK:

- B 2.1 The set of data elements that are required to describe a ship's installed hardware will be identified. Possible sources of this data will be determined. Possible methods of verifying, correcting and expanding the data sources to include all the data elements required will be identified and assessed in terms of such factors as accuracy, feasibility, cost and time required.
- B 2.2 This information will be used to select a data base for collecting the set of data that describes a ship's equipment and systems in a manner compatible with the staging diagrams developed under Task 1. The data base selected will contain the maximum number data elements common to the requirements of the Source Data Automation System.
- B 2.3 A procedure describing the method for performing a detailed inventory of ship's equipment using the data base selected in sub-task 2.2, will be prepared. The procedure will be applicable to any USN ship. Included in the procedure will be: the step-by-step approach for identifying systems or equipment; methods for correlating inventory documentation; means of updating the inventory; methods of correlating the inventory data with existing information; and consideration of automatic processing methods (computer programs will not be developed). The procedures developed will require minimum data collection aboard ship.
- A 2.4 Detailed procedures for validating the equipment on board the AO 148, USS PONCHATOUOLA will be developed. These procedures will cover the complete validation process for receipt of the

SPCC validation aids through the turn-over of the data back to SPCC, SECAS, NMMFO or other Navy organizations for processing to update the COSAL, make SDA Cards, or other uses. Experience gained in accomplishing Sub-Tasks 2.1, 2.2, 2.3 will be used. The procedures will contain checks to help evaluate the validation process. The procedures will be written for hull, mechanical and electrical equipment validation only. Ordnance and electronic equipment will not be included. ARINC personnel will take part in the actual validation process. Results of the validation will be analysed and evaluated. A report containing documentation of the rationale used during development of the procedures and the evaluation of the results of the validation will be prepared.

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2.5 Detailed procedures for validating the equipment on board the DDG-7, USS HENRY B. WILSON will be developed. These procedures will be basically the same as the procedures developed for sub-task 2.4 except utilizing a different data base and will cover the entire ship including the ordnance and electronics. ARINC personnel will assist in the conduct of the actual validation. The purposes of the validation are: Primarily, to obtain data for SDA implementation; secondarily to obtain experience in the validation process. Results of the validation will be analysed and evaluated.

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A report containing documentation of the rationale used during development of the procedures and the evaluation of

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B

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the results of the validation will be prepared.

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2.6 Results of sub-tasks 2.1-2.5 show that different validation methods, procedures or techniques are best utilized for the different types of equipments found on a ship such as Ordnance; Electronic; and Hull, Mechanical, and Electrical (HM&E) equipments. A chart will be prepared which will show the interrelationships between the various organizations and validation methods. This chart will identify areas requiring further development of methods and interfacing of different organizations. This chart will be presented to the Ship's Equipment Configuration Accounting System (SECAS) program manager for use in developing the integrated plan for Navy wide validation.

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QUALITY ASSURANCE PROVISIONS:

Products of each subtask will be submitted for review. Task status will be reported in Bi-weekly status report.



PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 3

TITLE: ASSIST IN CONDUCT OF INVENTORY OF SELEC-  
TED SHIP

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: NOV 29 1971

Rev A Date: March 10, 1972

Approved:

*J.C. m: Arthur 11/29/71*  
Thomas W. Mackie

TASK 3

REVISIONS				
Rev	Page	Description	Date	CSP Approval
A	All 4, 5, 6	1) Retyped.  2) Added tasks 3.5 to indicate ARINC participation in validation of AO 148, USS Ponchatoula and 3.6 to indicate ARINC assistance in validation of DDG-7, USS Henry B. Wilson.	10 March 72	J. C. M. [Signature]

## TASK OBJECTIVE

The objective of this task is to assist Ship's Force aboard selected ships in performing an inventory/validation of installed hardware using those techniques developed in Task 2 "Develop Procedures and Techniques for Performing Inventories." Assistance is to include providing guidance to crew, assistance in collecting and recording data, review of collected data to ensure that it is in useable form and collating the data. On completion of the inventory the techniques and procedures of Task 2 will be reviewed and changes recommended as necessary.

## 1. TECHNICAL APPROACH

### DESCRIPTION OF TASK/SUBTASKS:

- 3.1 Provide guidance to selected ships crews as necessary in the conduct of Shipboard Inventory.
- 3.2 Assist Ship's force in collecting inventory data.
- 3.3 Review collected data, ensure that it is usable form and collate.
- 3.4 Evaluate procedures and techniques of Task 2 and recommend changes as necessary.
- 3.5 Participate in validation of AO 148, USS Ponchatoula using the procedures developed in sub-task 2.4.
- 3.6 Assist in the conduct of the validation of DDG-7, USS Henry B. Wilson using the procedures developed in sub-task 2.5.

PROCEDURE FOR ACCOMPLISHING TASK:

- 3.1 Using the procedures of Task 2 assist COMSERVPAC and a selected ship's crew in preparing for an inventory/validation of the ship's installed hardware in support of the Ship's Data Automation (SDA) System validation program. This assistance to consist of written guidelines, provision of Ship System Diagrams, discussions with key shipboard personnel or formal instruction as found necessary.
- 3.2 During the actual conduct of the inventory/validation maintain liaison with COMSERVPAC and Ship's personnel to troubleshoot procedures, resolve conflicts and assist with data collection as required.
- 3.3 Provide assistance to COMSERVPAC personnel in reviewing collected data to ensure that it is in a usable form and in collating the data.
- 3.4 On completion of the inventory/validation review the techniques and procedures of Task 2 to determine their effectiveness and recommend changes as necessary.
- 3.5 During validation of the AO 148, USS Ponchatoula, participate in the actual conduct of the validation using the procedures developed in sub-task 2.4. Perform subtasks 3.1, 3.2, 3.3, and 3.4 as outlined above to support the validation effort.
- 3.6 Assist COMSERVPAC with the actual validation of the DDG-7, USS Henry B. Wilson using the procedures developed in sub-

task 2.5. In addition to sub-tasks 3.1, 3.2, and 3.3 as outlined above, assist COMSERVPAC by coordinating the validation efforts of the various participating organizations in accordance with the procedures.

QUALITY ASSURANCE PROVISIONS:

Task status will be reported in Bi-weekly status reports. Any required revisions to Inventory Procedures will be submitted for review and approval.

PERA PROGRAM  
TASK PLAN

CONTRACT NO. Noo604-71-C-0431

TASK 5

(Incorporate Contract Task 6)

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TITLE: DEVELOP METHODOLOGY AND PROCEDURES FOR  
DETERMINING OVERHAUL WORK REQUIREMENTS  
FOR SELECTED EQUIPMENTS

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: July 16, 1971

REV A Date: June 23, 1972

Approved:

J. C. McArthur

11/12/71


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REVISIONS

Rev	Page	Description	Date	CSP Approval
A	<p>1</p> <p>3</p> <p>3</p> <p>2-7</p> <p>4, 5, 6</p>	<p>1. Changed title of Task Plan</p> <p>2. Revised task objective</p> <p>3. Added note stating that contract task 6 requirements are incorporated in Task 5 Plan.</p> <p>4. Re-typed entire Task Plan and added revision page.</p> <p>5. Revised sub-task 5.3 to define that pre-overhaul inspection and test procedures for determining overhaul work requirements are to be developed.</p> <p>6. Deleted sub-task 5.4</p> <p>All to reflect development to date and current technical direction.</p>	<p>6/23/72</p>	<p><i>J-C-M: Auth</i></p>

## TASK OBJECTIVE


 The objective of this task is to develop methodology for determining a basis for making equipment overhaul decisions using the best information available and not requiring elaborate reliability tests or data collection except in unusual cases. Procedures developed are to be fully coordinated with the Planned Maintenance System (PMS) and shall specify what data to collect and how to evaluate the data for refinement of the overhaul criteria. The procedures will incorporate inspection, check-off on work sheets for use by technicians during pre-overhaul inspections to determine work requirements to be accomplished during ship overhauls.

NOTE: This Task Plan incorporates the requirements of Contract Task 6. A separate task plan for Contract Task 6 will not be provided.




## TECHNICAL APPROACH

### DESCRIPTION OF TASK/SUBTASKS:

- 5.1 Select generic types of equipment for which overhaul criteria will be developed.
- 5.2 Identify, investigate and assess the parameters, characteristics and factors (associated with each selected generic equipment type) that potentially constitute a basis for overhaul decision.
-  5.3 For selected equipments, develop inspection, test, or check-off procedures and data sheets to be used by technicians during pre-overhaul inspections. The results of these inspections and tests are to be used to determine the overhaul work requirements for the equipment.



PROCEDURE FOR ACCOMPLISHING TASK:

- 5.1 Generic equipment types (such as pumps, motors, piping etc.) will be identified and ranked in terms of their impact on the overhaul program and their importance to the operation of the ship. Factors such as: existing overhaul practices, mission criticality, reliability and maintainability, cost of overhaul, and population of candidate item, as derived from historical data of COMSERVPAC ships and from interviews with appropriate personnel will be considered. From the ranking developed, generic equipment types will be selected for completion of remaining sub-tasks. Selection will be made in conjunction with government technical personnel.
- 5.2 Potential criteria for establishing a basis for overhaul decision, including but not limited to- age - usage - design parameters - operating environment and material condition as determinable by test/inspection will be identified and assessed to establish their importance and potential applicability. Investigations will be based on available 3M data and will not require elaborate reliability test or data collection.
-  5.3 The potential criteria developed above will be incorporated into the inspection, test or check-off procedures for selected equipments. In developing these procedures, alternate approaches will be investigated:
- a.) One approach would be:
    1. determine "as new" condition
    2. determine maximum "wear limits"
    3. determine actual condition
    4. decide overhaul work requirements.

b.) An alternate approach would be:

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1. determine particular types of failures.
2. determine "symptoms" which precede particular types of failure.
3. determine actual condition in terms of symptoms.
4. decide overhaul work requirements.

A combination of these approaches will be incorporated into the procedures.

A complete prototype procedure, including inspection and/or test data sheets, will be developed for a single equipment such as a centrifugal pump. This prototype procedure will be analysed and tested to determine if use of the procedure will yield the desired results; that is, will use of the procedure and the inspection or test data tell an overhaul planner what the overhaul work requirements are for the equipment.

Additional procedures for pre-overhaul inspection or test of up to a total of 15 selected equipments will be developed incorporating the results of the analysis of the prototype procedure. The additional procedures will be confined to hull, mechanical, and electrical equipments such as winches, motors and pumps. Electronic and ordinance equipment, in-general, will not be considered.

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QUALITY ASSURANCE PROVISIONS:

- 5.1 A recommended list of generic equipment types will be reviewed with government representatives, to select those for which overhaul determination procedures will be developed.
- 5.3 Rough drafts of procedures will be submitted for review on an "as completed" basis prior to final preparation and submittal.

PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 7

(Incorporates Contract Task 8)



TITLE: Develop Methods, Procedures, Instructions for Pre-overhaul Material Inspections

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

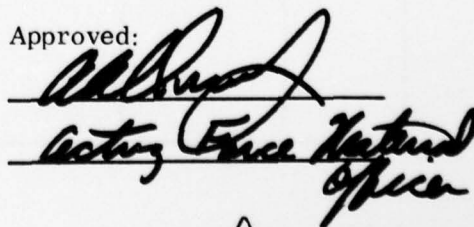
ARINC RESEARCH CORPORATION  
Western Division

Date: OCTOBER 1, 1971

Rev A: MAR 23 1972

Rev B: June 23, 1972

Approved:

  
Acting Force Material  
Officer



REVISIONS				
Rev	Page	Description	Date	CSP Approval
A	All 2 4 - 7 4 & 6	<ol style="list-style-type: none"> <li>1. Renumbered pages</li> <li>2. Added revision page</li> <li>3. Re-typed</li> <li>4. Added Task 7.4 to include ship alt status information as element of pre-overhaul material inspection.</li> </ol>	3/23/72	J.C.M.:auth
B	1 3 5 4, 6	<ol style="list-style-type: none"> <li>1. Changed title to indicate "Pre-Overhaul" Material Inspections.</li> <li>2. Added note stating requirements of Contract Task 8 are incorporated within this plan for Task 7.</li> <li>3. Revised sub-task 7.1 to cross reference Task 5.</li> <li>4. Added Task 7.5 incorporating the requirement to assist in a pre-overhaul inspection, substituted an A0143 Class ship for an ATF Class as identified by Contract Task 8.</li> </ol> <p>All to reflect development to date and current technical direction.</p>	6/23/72	J.C.M.:auth



Task objectives. The objective of this task is to develop methods, procedures and instructions for material inspections to determine pre-overhaul material condition of selected ship's equipment/systems, including habitability. Procedures and methods are to be fully compatible with the 3M System, methods, procedures and techniques developed under other tasks of the PERA program, Board of Inspection and Survey procedures and procedures currently prescribed under the COMSERVPAC Overhaul Improvement Program. Assistance in applying procedures developed to actual inspection/inspections will be provided to selected ship/ships.



Note: The requirements of Contract Task 8 are included in this Task Plan for Task 7. A separate task plan will not be provided for Task 8.




## 1. TECHNICAL APPROACH


### DESCRIPTION OF TASK/SUBTASKS:

7.1 Develop procedures for planning, conducting and recording the results of Pre-Overhaul Material conditions.

7.2 Identify/Examine availability of inspection resources and recommend team structure.

7.3 Assess compatibility of recommended inspection procedures with prevailing practices and procedures.

 7.4 Develop procedures for use during pre-overhaul inspections to determine ship alteration status and applicability.

 7.5 Assist pre-overhaul inspection teams with the inspection of an AO 143 Class Ship.

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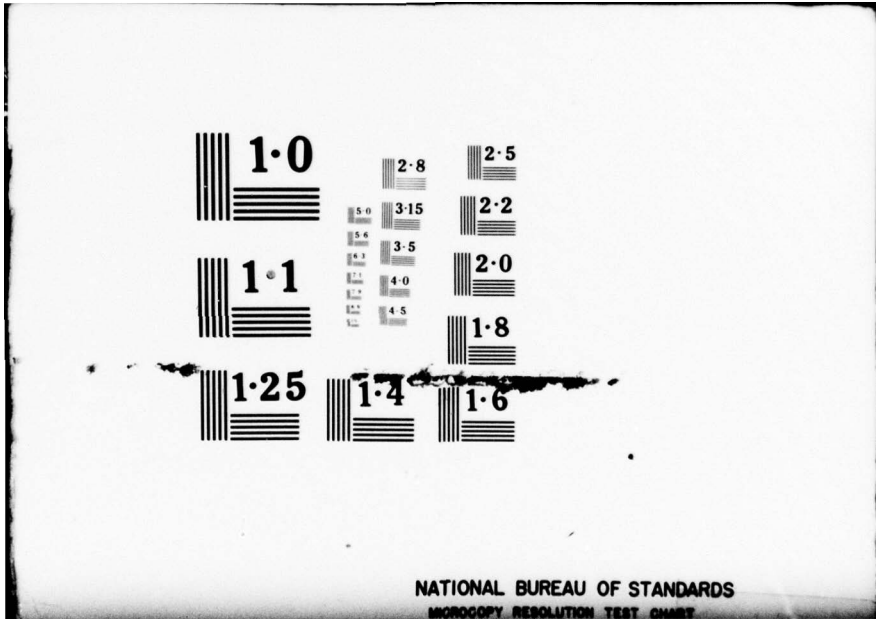
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## PROCEDURE FOR ACCOMPLISHING TASK

7.1 Procedures will be developed and assistance provided with the following objectives:

- a. Determine Material Condition of selected ships equipment/systems including habitability.
- b. Assess degradation in material condition since last overhaul.
- c. Determine effectiveness of the Planned Maintenance System (PMS).
- d. Reveal material deficiencies that should be corrected either prior to extensive operations or during the next scheduled overhaul.
- e. Provide symptomatic and diagnostic data that contribute to the Requirements Planning Phase of the Regular Overhaul Cycle.

Procedures will emphasize those aspects related to the identification of equipments to be inspected/tested, scheduling of inspections/tests, training and indoctrination of ship's force, and acquisition of required support. Procedures, using results from Task 5, where applicable, for conduct of inspections/tests will delineate measurements, visual examinations, etc. to be made by the inspection team during the inspection. The recording section will include instructions for collecting data and reporting the findings, conclusions, and recommendations resulting from the inspections/tests.

7.2 A survey will be made to identify sources for performing pre-overhaul equipment/systems material inspections of SERVPAC ships. Based on results of the survey a recommended team structure for accomplishing the inspections will be provided. Included will be identification of required specialities skill levels. The recommended team will be consistent with available resources.

7.3 Procedures developed will be reviewed to insure they are fully compatible with the systems, methods and procedures of the task objective.

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7.4 Review SHIPALT records, the SHIPALT INDEX, SHIPALT Completion Status (SACs) report and other documentation that describes or denotes the applicability and status of SHIPALTS FOR COMSERVPAC Ships. The purpose of the review is to determine what information is available to perform pre-overhaul planning and provide a data package suitable for validating SHIPALT status and applicability during the pre-overhaul inspections. Initial effort under this task will be directed at AO type Ships

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7.5 Using procedures developed in Task 7.1, assist pre-overhaul inspection teams in conducting inspections of an AO 143 Class Ship. The results of this inspection are to be used to definitize the work requirements for a ship overhaul. Assistance will be provided to instruct personnel in use of procedures and data forms and in pre-organizing the conduct of the inspection. During the pre-overhaul inspection assistance will be provided by monitoring the conduct of the inspection and completion of the data forms to insure that the correct and required information is obtained.

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QUALITY ASSURANCE PROVISIONS

7.1 Procedures developed will be submitted for review by COM-SERPAC and Pearl Harbor Naval Shipyard.

PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 9

(Incorporates Task 10)

TITLE: DEVELOP PROCEDURES FOR DETERMINING  
AND RECORDING POST-OVERHAUL MATERIAL CONDITION

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: NOV 29 1971

Rev A: June 23, 1972

Approved:

J.C. Smith: Arthur 11/29/71  
Thomas W. Markier



REVISIONS

Rev	Page	Description	Date	CSP Approval
A	All	<ol style="list-style-type: none"> <li>1. Retyped and renumbered pages.</li> <li>2. Added revision page</li> <li>3. Revised objective</li> <li>4. Added note stating that requirements for Contract Task 10 are incorporated within this plan for Task 9.</li> <li>5. Reworded Task 9.1 and 9.2.</li> <li>6. Added Task 9.3 incorporating the requirement to assist with the determination of the post overhaul material condition of a ship. Substituted an AO 143 Class Ship for an ATF Class Ship as identified by Contract Task 10.</li> </ol> <p>All to reflect development to date and current technical direction.</p>	6/23/72	J-C.M. Curtis

### TASK OBJECTIVE

The objective of this task is to develop methods, procedures, and instructions for determining and recording the material condition of a ship/selected systems or equipments at the completion of overhaul. These procedures will take into account the work accomplished during the overhaul, the work which was defined for the overhaul, and any incomplete or new work discovered during the overhaul period. The procedures will result in documentation of outstanding work from which a post overhaul maintenance plan can be developed. The procedures developed will be applied to an actual ship.

Note: The requirements of Contract Task 10 are included in this Task Plan for Task 9. A separate task plan will not be provided for Task 10.

## TECHNICAL APPROACH

### DESCRIPTION OF TASK/SUBTASKS:

9.1 Develop procedure for Determining and Recording post-overhaul material condition.

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9.2 Insure compatibility of procedures with prevailing practices and procedures.

9.3 Assist COMSERVPAC in determining and recording the material condition of an AO 143 Class Ship at the completion of an overhaul.

## PROCEDURE FOR ACCOMPLISHING TASK

9.1 Procedures and methods will be developed to determine and to record the post-overhaul material condition of a ship. Application of the procedures will result in a continuation of the information obtained using the Pre-Overhaul Material Inspections. Extensive inspections or tests should not be required except as a part of the overhaul "wrap-up" normally conducted by the overhauling activity and the ship's force. Maximum use will be made of existing information systems to obtain the required data. Generally the procedure will make use of the pre-overhaul work packages. The post-overhaul procedure will require review of the pre-overhaul work package and updating the package to account for work accomplished and new work discovered during the overhaul. The procedure will incorporate the methods to be used to record the post-overhaul material condition of the ship.

9.2 The procedures will be integrated with 3M System Current Ship Maintenance Project (CSMP). Results of using the procedures will be used to formulate the post-overhaul maintenance plan for a ship. (Development of a post-overhaul maintenance plan will not be done in performance of this task.)

9.3 Assist COMSERVPAC in determining and recording the material condition of a ship at the completion of an overhaul. The procedures and data recording methods developed in Sub-task 9.1 will be used to document the post-overhaul material condition of an AO 143 Class Ship in lieu of the ATF Class Ship stated in Contract Task No. 10. Assistance will be provided in terms of instructions on the use of the procedures and data recording methods. Assistance will also be provided to collect and assemble the post-overhaul data and to review it for completeness and correctness.

QUALITY ASSURANCE PROVISIONS

9.1 Procedures developed will be submitted in preliminary draft form to COMSERVPAC for review and approval.

PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-R-0431

TASK 11

TITLE: Develop Methodology for Preparing  
Equipment Overhaul Specifications (EOS)

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: 21 June 1971

Rev A: June 23, 1972

Approved:

J. C. M. Arthur

REVISIONS

Rev	Page	Description	Date	CSP Approval
A	2 2-6 3 4,5	1. Added Revision Page 2. Re-typed and renumbered sub-tasks 3. Deleted reference to Task 13 in objectives 4. Added subtask 11.4 to investigate alternative methods for obtaining overhaul replacement parts. 5. Deleted out-of-date schedule and resources plans. All to reflect development to date and current technical direction.	6/23/72	J. C. Martin

## OBJECTIVE

The objectives of this task are to develop methodology and a format for developing an Equipment Overhaul Specification (EOS), identify data sources for preparing an EOS, and to investigate alternative methods for supply of overhaul replacement parts. The results of this task shall be the basis for accomplishment of Task 12 (Develop Equipment Overhaul Specifications (EOS'S) and an Instruction for Preparation of EOS'S).



## TECHNICAL APPROACH

### Description of Task/Subtasks:

- 11.1 Identify Data Sources for Preparing Equipment Overhaul Specifications.
- 11.2 Develop Methods and Rationale for Preparing Equipment Overhaul Specifications.
- 11.3 Develop Format for Preparing EOS'S.
- 11.4 Develop an Approach for Assessing the Alternative Methods of Supplying of Overhaul Replacement Parts.

PROCEDURE FOR ACCOMPLISHING TASK:

- 11.1 Identify Data Sources for Preparing EOS's. Survey a sampling of planning/estimating personnel to identify current data sources used/desired. Assess data requirements for EOS preparation. Prepare a listing of data requirements for each type of EOS and identify available data source (s).
- 11.2 Develop Methods and Rationale for Preparing EOS's. Examine existing practices to identify alternatives and options that exist relative to preparation. Evaluate each alternative/option.
- 11.3 Develop Format. Review existing policy guidance for specifications and develop formats for hull, mechanical and electrical equipment overhaul specifications. Check format against prevailing practices. Submit format for review/approval.
- 11.4 Develop an approach for assessing the alternative methods of Supplying of Overhaul Replacement Parts.
  - a. Determine general outline of process.
    1. Identify and define the alternatives relative to the specification of overhaul replacement parts during the preparation of EOS's, Methods such as, "Open, Inspect and Replace as Necessary", and the pre-programing of parts-kitting-which may be required for replacement will be considered.
    2. Determine the cost factors and identify costs associated with each alternative identified.
    3. Synthesize a scheme to represent the cost factors of each alternative.
    4. Evaluate and make a determination of additional information or data required to further develop or refine the scheme.
  - b. Prepare a technical briefing and report to COMSERVPAC for review and a determination as to further development.

QUALITY ASSURANCE PROVISIONS

Products of each subtask will be submitted for review; progress will be reported at bi-weekly meetings.

PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 12

(INCORPORATES TASK 13)

△  
TITLE: DEVELOP EQUIPMENT OVERHAUL SPECIFICATIONS  
(EOS) AND AN INSTRUCTION FOR PREPARATION OF  
EOS's

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: NOV 29 1971

Rev A: June 23, 1972

Approved:

*J.C.M. Cuthm 11/29/71*  
Thomas W. Moskin

△

REVISIONS

Rev	Page	Description	Date	CSP Approval
A	1 2 3 3  3-7  6	1. Changed title 2. Added Revision Page 3. Revised objective 4. Added note stating requirements of Contract Task 13 are incorporated in Task 12 Plan. 5. Retyped and completely revised sub-tasks. 6. Revised subtask 12.3 to note that a prototype and only 3 additional (total of 4) EOS'S will be prepared instead of 15 as identified in Contract Task 13.  All to reflect development to date and current technical direction.	     6/23/72	     <i>J. C. M. Auth</i>



## TASK OBJECTIVE

The objective of this task is to develop prototype Equipment Overhaul Specifications (EOS) for selected equipment. The methodology developed in Task 11 will be used to develop these prototype Equipment Overhaul Specifications. The specifications will be developed for the same equipment selected for writing preoverhaul inspection and test procedures for overhaul determination in Task 5. In addition to developing the prototype equipment overhaul specification, the rationale for the contents of the specifications will be documented and a general instruction or guide for preparation of equipment overhaul specifications will be written.

NOTE: This task plan for Task 12 incorporates the requirements of Contract Task 13. A separate task plan for Contract Task 13 will not be provided.

## TECHNICAL APPROACH

### DESCRIPTION OF TASKS/SUBTASKS:

- 12.1 Develop a prototype Equipment Overhaul Specification (EOS) using the methodology developed in Task 11.
- 12.2 Analyse the prototype Equipment Overhaul Specification (EOS) and prepare an instruction or guide for preparation of EOS's.
- 12.3 Prepare additional EOS's for some of the same selected equipments for which pre-overhaul inspections and tests are prepared in Task 5.

## PROCEDURE FOR ACCOMPLISHING TASK

12.1 Develop a prototype Equipment Overhaul Specification using the methodology developed in Task 11. The prototype EOS will be prepared for an equipment such as a centrifugal pump. The EOS will specify overhaul requirements for two desired levels of material condition:

- 1) Satisfactory operating condition with minimum tear-down and overhaul expense;
- 2) Near new operating condition.

The EOS will include:

- 1) Complete reference to applicable plans, manufacturer publications, NAVSHIP documents, etc. . . .
- 2) Statement of which dimensions, clearances, finishes, material composition, hardness or other qualities are of primary importance during overhaul;
- 3) Specifications of which parts are to be repaired or replaced and other actions to be taken regardless of conditions found when equipment is opened;
- 4) Specification of dimensional or other checks to make when equipment is opened to determine additional parts to be repaired, replaced, etc. . . .
- 5) Specification of minimum "as released" condition for equipment after overhaul to each of the two selected levels specifying what dimensions or other qualities of primary importance are to be verified and recorded and which dimensions or qualities can be assumed to be correct;
- 6) Overhaul parts list that specify normal parts required for each level of overhaul including quantity of each required for one unit with complete description data and stock or plan numbers required to obtain the parts both commercially and through the Navy Supply System.



- 7) A list of additional parts that may be required for overhaul if the equipments are in unusually bad condition along with recommended quantity of each for X number of units being overhauled, and including complete descriptive data and stock or plan numbers required to obtain the parts both commercially and through the Navy Supply System.

12.2 Analyse the prototype Equipment Overhaul Specification (EOS). From the analysis, prepare an instruction or guide for preparation of EOS's. The purpose is to provide "How to do it instructions" for the preparation of EOS's. The instructions for developing overhaul specifications should include:

- a. Instructions for selecting equipments adaptable to EOS;
- b. Specification of skill level required to prepare EOS;
- c. Detailed instructions and rationale with adequate examples showing step-by-step how to assemble the required data and make the necessary judgements to prepare EOS;
- d. What data to collect and how to evaluate the data for improvement of the EOS after actual equipments are overhauled by these specifications and placed in service.

A 12.3 Prepare additional EOS's for some of the same selected equipments for which pre-overhaul inspections and tests are prepared in Task 5. The instructions or guide developed in Sub-task 12.2 will be used to prepare these additional EOS's. The purpose of preparing these additional specifications is to "prove" that the use of the instructions or guide developed in subtask 12.2 will produce useful EOS's. Only a maximum of 3 additional EOS's are to be prepared using the instructions or guide.

QUALITY ASSURANCE PROVISIONS

Products of each subtask will be submitted for review. Progress will be reported in the Bi-Weekly Status Reports.

All Procedures and Instructions developed will be compatible with MDCS, 3-M program requirements.

PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-R-0431

TASK 14

TITLE: PREPARE AN OVERHAUL CYCLE PLANNING  
LOGIC NETWORK

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: June 23, 1972

Approved:

J.C.M. Authen 6/22/72

REVISIONS

Rev	Page	Description	Date	CSP Approval

## OBJECTIVE

The objective of this task is to develop a logic network that depicts the overhaul cycle planning process. This network will identify the individual steps involved in the process and the organizations responsible for the required actions. The network will be laid out in the proper time sequence and related key event points in a typical ship overhaul cycle will be noted. The network will show the interrelationship between action organizations and the flow of information required to define work requirements. The network will then illustrate the process for development of work packages from the definition of work requirements for the various phases of the overhaul cycle.

NOTE: Contract Task 14 places emphasis on developing networks for planning the actual overhaul process once the work package is defined. This implies that the process leading to definition of a work package has been developed and is clearly understood by all concerned. Such is not the case. Therefore, this Task Plan is developed to provide a network to serve as a model for the complete overhaul planning process in lieu of a network to serve as a model for the overhaul process itself as identified in Contract Task 14.

## TECHNICAL APPROACH

### DESCRIPTION OF TASK/SUBTASKS:

- 14.1 Identify the steps involved in the planning process and the organizations responsible for the required actions.
- 14.2 Lay-out a logic network showing the interrelationship and sequence between the steps and organizations identified in Subtasks 14.1.
- 14.3 Write-up a brief description of the steps identified in Subtask 14.1 to supplement the network developed in Subtask 14.2.

## PROCEDURE FOR ACCOMPLISHING TASK

- 14.1 Identify the steps involved in the planning process and the organizations responsible for the required actions. Sources such as instructions, pre-overhaul planning letters, 3M documents, organization charts, and policy statements will be reviewed. Consultations with SERVPAC and shipyard personnel will be held. As complete a picture as possible of the present practice of conducting the overhaul cycle planning process will be obtained.
- 14.2 From the information obtained in Subtask 14.1, lay-out an information flow network (diagram) which illustrates an idealized overhaul cycle planning process. This network will illustrate the "ideal" planning process for a complete overhaul cycle. Consideration will be given to the regular overhaul planning process as well as planning for the post-overhaul maintenance activities until the next regular overhaul. The network will show such events as ship checks, trade-offs, updating the 3M Current Ships Maintenance Projects (CSMP), and development of long range maintenance plans. The diagram will indicate the responsible organizations and the informational reports or data compilations required for decision making. Preliminary diagrams will be developed and presented to SERVPAC for discussion and comment. A final diagram incorporating comments will be drawn and submitted.
- 14.3 Write up a brief description of each of the steps involved in the planning process illustrated in the logic network. The description will contain only sufficient information to clarify the abbreviated descriptions contained on the logic network.

QUALITY ASSURANCE PROVISIONS

Preliminary logic networks will be submitted for review as completed.



PERA PROGRAM  
TASK PLAN

CONTRACT NO. N00604-71-C-0431

TASK 15  
(INCORPORATES TASK 16)

TITLE: PREPARE DOCUMENTS DESCRIBING COMSERVPAC  
MAINTENANCE MANAGEMENT POLICIES AND PROCEDURES

Prepared for

- (1) COMSERVPAC
- (2) PEARL HARBOR NAVAL SHIPYARD

Prepared by

ARINC RESEARCH CORPORATION  
Western Division

Date: June 23, 1972

Approved:

J. C. M. Arthur  
6/23/72

REVISIONS

Rev	Page	Description	Date	CSP Approval

## OBJECTIVE

The objective of this task is to develop documents which will replace present COMSERVPAC procedures and instructions such as the Overhaul Improvement Program, COMSERVPACINST 4710.19A Overhaul Guide, and overhaul planning letters. The objective will be achieved by working with COMSERVPAC to prepare a Maintenance Management Master Plan for the SERVPAC organization. The Maintenance Management Master Plan will incorporate the work requirement planning activities identified in the logic network developed in Task 14. In addition, the Master Plan will incorporate the budgeting and scheduling process required for implementation of maintenance activities including alterations and habitability improvement. The Maintenance Management Master Plan will be a written document that defines maintenance management policies, describes required actions, and designates responsible organizations. From the Master Plan, the requirements for individual instructions or procedures will be identified. As these requirements for written instructions or procedures become known, selected procedures will be developed and prepared.

NOTE: The requirements of Contract Task 16 are incorporated in this Task Plan for Task 15. A separate task plan will not be provided for Task 16.

## TECHNICAL APPROACH

### DESCRIPTION OF TASK/SUBTASKS:

- 15.1 Work with COMSERVPAC to prepare a Maintenance Management Master Plan.
- 15.2 Prepare documents such as instructions, procedures and manuals which describe details contained in the Maintenance Management Master Plan.

## PROCEDURE FOR ACCOMPLISHING TASK

- 15.1 Work with COMSERVPAC to prepare a Maintenance Management Master Plan. The basic unit of the Master Plan will be an individual ship overhaul cycle, approximately 3 years. The maintenance management process for a ship overhaul cycle is depicted on the logic network developed in Task 14. The description of this ship overhaul cycle planning logic network will be expanded to describe the COMSERVPAC Force Maintenance Management Master Plan. Sufficient written description will be provided to clearly identify actions and responsibilities with regard to managing repairs, alterations and habitability improvements. The Master Plan will address the long range planning process including requirements determination, budgeting, and scheduling for maintenance actions. The "who", "what", "when" and "why" aspects will be described. The Master Plan developed will be written in such a form that it can be issued to all organizational levels of COMSERVPAC, such as staff, group, squadron and ship, for use in understanding and complying with COMSERVPAC maintenance policies.
- 15.2 Prepare documents such as instructions, procedures, and manuals which describe details contained in the Maintenance Management Master Plan. The Master Plan will identify certain actions such as "prepare manpower budget" or "start Ship's Force Overhaul Management System (SFOMS)." In many cases adequate instructions do not exist describing procedures necessary to accomplish the required actions. As directed by COMSERVPAC, selected instructions, manuals, or procedures will be developed and written. This Task Plan will be revised as necessary to add the requirements for additional documentation. The preparation and written presentation contained in such manuals will be suitable to a man with an eighth grade education.

The manuals will be organized in descending stages such that a reader can obtain the overall picture in one section, subsystems in another and details in others.

QUALITY ASSURANCE PROVISIONS

1. Documents developed in each sub-task will be submitted for review.

APPENDIX B  
SUMMARY OF PRINCIPAL  
DATA ITEMS SUBMITTED

<u>Contract Task No.</u>	<u>Data Item or Title</u>	<u>Identification No.</u>	<u>When Submitted</u>
1	Ship Work Breakdown Structure (WBS) for MDCS, Fourth Level Expansion	WD/HNL-71-013	Sep 1971
1	Report of SDA Design as Developed by SERVPAC	Informal Submittal	Dec 1971
1	AO-143 Class Ship System Definition and Index	W2-D06-TN01	Apr 1972
1	ATF-96 Class Ship System Definition and Index	W2-D06-TN05	Aug 1972
1	General Ship Class EIC Systems Staging Diagrams	W2-D06-TN02	Jan 1973
1	A Concept for Merging EIC and WBS to Achieve a Common Language Configuration Accounting System	W2-D06-TN06	Jan 1973
1	AOE-1 Class Ship Systems Definition and Index	W3-D06-TN03	Mar 1973
2, 3, & 4	Equipment Validation Material Prepared Under Tasks 2, 3, and 4 of Contract N00604-71-C-0431	Attachment to letter WD/CA-72-253	Aug 1972
2, 3, & 4	Letter report on Tasks 2, 3, and 4	WD/CA-72-253	Aug 1972
5 & 6	A Procedure for Determining Overhaul Work Requirements for Fire and Tank Cleaning System in Fire Room of AO-143 Class Ships	W3-D06-TN01	Jan 1973
7 & 8	FMP and SHIPALT Validation Package for USS KAWISHIWI (AO-146) and USS PONCHATOU LA (AO-148)	Enclosure to letter WD/CA-72-170	Jun 1972
7 & 8	Guide for Overhaul Planning Team Accomplishment of Pre-Overhaul Material Inspections, Shipchecks, and Tests	W3-D06-TN02	Jan 1973



<u>Contract Task No.</u>	<u>Data Item or Title</u>	<u>Identification No.</u>	<u>When Submitted</u>
9 & 10	Proposed COMSERVPAC Instruction: Post Overhaul CSMP Validation	W3-D06- TN05	Feb 1973
11	Proposed Plan for Evaluating Alternative Methods of Ordering Replacement Parts Required for Machinery Overhaul	Informal Submittal	Jan 1972
11	Methodology and Recommended Format for Preparing Equipment Overhaul Specifications	W3-D06- TN04	Feb 1973
12 & 13	Guide for Preparing Equipment Overhaul Specifications and Sample Specifications	W3-D06- TN06	Mar 1973
14, 15, & 16	Proposed COMSERVPAC Notice: Habitability Manual	Informal Submittal	Aug 1972
14, 15, & 16	Proposed COMSERVPAC Instruction: Overhaul and Maintenance Guide	W3-D06- TN07	Mar 1973
17	Technical Progress Reports	Biweekly Status Letters 1 thru 42	Every two weeks
17	Report on Ship System Staging Workshop, 27 January to 3 February 1972 at Headquarters, COMSERVPAC	Informal Submittal	Feb 1972
17	Briefing Material for SECAS Validation Workshop at Honolulu, 14-18 February 1972	Informal Submittal	Feb 1972
17	Briefing: "Development of Ship System Diagrams, Progress Report"	Verbal Presentation	Jan 1972
17	Briefing: "Ship Systems Diagrams as a Basis for Testing, Maintaining, and Operating Ship Systems"	Verbal Presentation	Feb 1972
17	Briefing: "Ship System Diagrams"	Verbal Presentation	Apr 1972
17	Briefing: "Development Work Performed by ARINC Research Corporation for COMSERVPAC" (Verbal Final Report)	Verbal Presentation	Jan 1973

APPENDIX C  
SUMMARY OF TRIPS

<u>Personnel</u>	<u>Travel Date</u>	<u>Places Visited and Purpose</u>
N. Scarlett	28 Aug 1971	San Diego — Participate in workshop for MDCS and ship systems diagrams.
N. Scarlett	6 Oct 1971	USS SACRAMENTO (AOE-1), Bangor, Wash. — Provide assistance in conduct of pre-overhaul inspection.
N. Scarlett	11-15 Oct 1971	Cleveland, Ohio; Washington, D. C.; Montgomery, Ala.; Indianapolis, Ind.; Vallejo, Calif. — Discuss SDA equipment requirements with potential suppliers.
N. Scarlett	27-29 Oct 1971	NAVSEC, Hyattsville, Md. — Determine interfacing factors between equipment configuration, accounting system (SECAS), and COMSERVPAC validation/inventory program.
C. McIndoe	29-30 Nov 1971	COMSERVPAC and PHNSY — Present briefing on functional diagram concepts.
N. Scarlett	5-10 Dec 1971	Washington, D. C. — Assist CSP in SDA system presentation.
J. McKernan	19-22 Dec 1971	Santa Ana, Calif., ARINC Research Corp., Western Division — Coordinate contract work.
N. Scarlett	20 Jan 1972	ARINC Research Corp., Honolulu and COMSERVPAC — Discuss Task 11 kitting model and attend ship system diagram workshop.
N. Scarlett	8 Mar 1972	Naval Shipyard, Hunters Point, PERA (CSS) — Work on COMSERVPAC PERA assignments related to contract tasks.
K. Saunders	20 Mar 1972	USS PONCHATOULA (AO-148) — Validate equipment at sea.
N. Scarlett	23 Mar 1972	NAVSHIPYD, Hunters Point, PERA (CSS) — Coordinate revised Task 7 ship alterations status and applicability per overhaul inspection procedures.

<u>Personnel</u>	<u>Travel Date</u>	<u>Places Visited and Purpose</u>
K. Saunders D. Whitnell	5 Apr 1972	San Diego, NAVMMAC PAC — Validation of DDG-7.
J. McKernan	16 Apr 1972	San Diego, Calif. — Attend SECAS debriefing on DDG-7 validation.
P. Reeves K. Saunders	14 May 1972	Hyattsville, Md. — Discuss SECAS validation/SDA implementation process.
J. McKernan	10 July 1972	San Diego, Calif. — Present results of EIC and WBS structure analysis to 3M policy committee.
L. Larsen K. Saunders	27 July 1972	Subic Bay, P.I. — Assist in material inspection of AO-146, Task 8.
J. McKernan	20 Aug 1972	Subic Bay, P.I. — Assist in material inspection of AO-146.
J. McKernan	1 Dec 1972	Hunter's Point Naval Shipyard, PERA (CSS) — Coordinate COMSERVPAC overhaul planning procedures.

D06-01-1-1212

APPENDIX D  
PROPOSED PLAN FOR EVALUATING  
ALTERNATIVE METHODS OF  
ORDERING REPLACEMENT PARTS

1. INTRODUCTION

This plan describes alternative approaches for the development and application of a cost-effectiveness model for evaluating the various methods available for supplying replacement parts for machinery overhaul.

2. BACKGROUND

Parts replaced during machinery overhaul can be acquired in a variety of ways. For example, they can be ordered after the equipment to be overhauled is opened and inspected and the material requirements are established. On the other hand it is possible to pre-program replacement part requirements, assemble kits, and make the kits available to the overhauling activity at the outset of the overhaul period. Under the latter approach, unused parts would be fed back into the supply system. The "kitting" concept, of course, has several variations relatable to the variety of criteria possible for selecting the parts to be included in the kit.

There are obvious as well as unknown advantages and disadvantages associated with each of the above approaches. It is apparent, for example, that initiating an order for replacement parts after inspection minimizes the number of parts that must be maintained within the supply system, but results in maximum possibility of experiencing delay. The "kitting" concept produces the opposite effect. Evaluation of the alternative methods leading to the selection of the best approach requires the following steps:

- a. Identify/define the alternatives.
- b. Identify the cost and effectiveness parameters sensitive to the alternatives.
- c. Acquire, through collection of new data and/or analysis of existing data, the information necessary to quantify the sensitive cost and effectiveness parameters.
- d. Estimate the relative (or absolute) cost and effectiveness associated with each alternative.

It can be reasoned that steps a and b above can be accomplished in a general sense; i.e., relative to any type of machinery subjected to periodic overhaul. Steps c and d, however, should be accomplished for each unique type of equipment since the

relationship between replacement part ordering policy and cost-effectiveness may vary from case to case.

Subsequent sections of this plan provide a detailed description of the recommended approach for accomplishing each of the above steps.

### 3. EVALUATION OF ALTERNATIVE METHODS

#### 3.1 IDENTIFICATION/DEFINITION OF ALTERNATE METHODS FOR ORDERING OVERHAUL REPLACEMENT PARTS

Alternative methods for ordering overhaul replacement parts include:

- a. Alternative 1 – Initiate ordering of replacement parts after equipment has been opened and inspected and parts requirements determined.
- b. Alternative 2 – Assemble replacement part kits on the basis of expected usage.
- c. Alternative 3 – Assemble replacement part kits on the basis of cost.
- d. Alternative 4 – Assemble replacement parts on the combined basis of usage and cost.

#### 3.2 IDENTIFICATION OF EFFECTIVENESS AND COST PARAMETERS

Evaluation of the alternatives identified in the preceding paragraph involves an assessment of the cost and effectiveness associated with each.

##### 3.2.1 Effectiveness

The effectiveness of an overhaul can be measured in terms of either timeliness of overhaul accomplishment or the adequacy of equipment performance subsequent to overhaul. Either of these measures could be influenced by the manner in which replacement parts are ordered. The following specific measures of overhaul effectiveness could be influenced by the approach taken for ordering parts:

- a. Frequency with which (or likelihood that) delays occur in completing an equipment overhaul.
- b. Average length of delay occurring in equipment overhaul.

- c. Frequency with which (or likelihood that) delays associated with equipment overhaul cause slippage in completion of the ship's Regular Overhaul.
- d. Average length of slippage to ship ROH completion date caused by unavailability of equipment replacement parts.
- e. Average calendar time required to accomplish equipment overhaul.
- f. Frequency of corrective maintenance subsequent to overhaul.

### 3.2.2 Cost

The cost of equipment overhaul can also be influenced by the replacement-part ordering philosophy. For example, it may be reasoned that the preprogramming of replacement parts through prior assembly of kits could reduce the required expenditure of ship labor, thereby reducing the overhaul costs. On the other hand, use of the kitting approach could increase the cost associated with maintaining the pipeline of parts required to support a given equipment.

Less tangible cost factors could also impact on the chosen method of acquiring equipment overhaul replacement parts. For example, it can be argued that the preprogramming of replacement parts will result in a lesser chance of overhaul completion delays, thereby "saving" time and/or money.

Evaluation of the alternatives, therefore, involves establishing some form of cost model suitable as a framework for collecting the pertinent data and comparing the alternatives. Figure D-1 is a suggested cost breakdown structure that can be used for this purpose. The figure expresses equipment overhaul cost as consisting of both direct and indirect costs. By definition, direct costs are those that could probably be accounted for through prevailing accounting practices of the Type Commander and repair activities in the management of ship overhauls. Indirect costs represent those less-tangible factors not normally accounted for within the framework of overhaul management.

As further noted in the figure, direct costs may be further divided into labor and material cost. Labor cost can be subdivided to account for that portion of labor due to parts acquisition.

The purpose of this cost breakdown structure is to identify all cost elements that could be expected to vary dependent on the alternative selected.

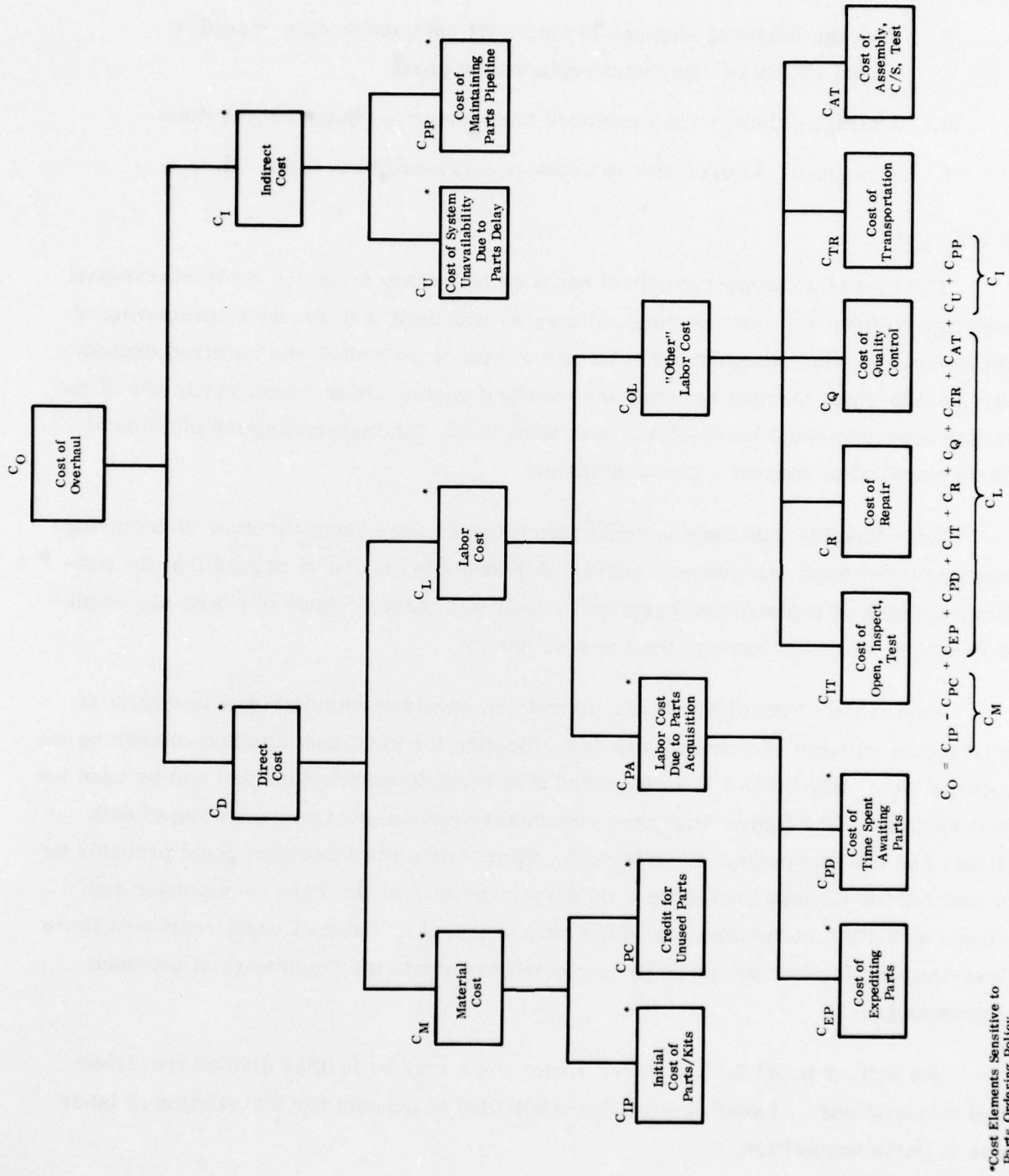


Figure D-1. Cost Breakdown Structure for Equipment Overhaul



### 3.3 ACQUISITION OF DATA

The third step in the evaluation process involves the acquisition of the data required to exercise the cost model for each part-replacement alternative. The necessary data can be acquired by three methods:

- a. Controlled Test
- b. Uncontrolled Test
- c. Semicontrolled Test

A data collection plan is offered below for each of these options.

#### 3.3.1 Controlled Test

Under this option, all data required for evaluation of the alternatives would be collected under "controlled" conditions. Each identified alternative would be implemented on a test basis, with data collection forms and accounting procedures specifically oriented toward the objectives and parameters of the evaluation. Specific items of equipment would be selected as test subjects. Both "estimated" and "actual" data would be gathered.

#### 3.3.2 Uncontrolled Test

Under this option, the part-replacement alternatives would be evaluated essentially on the basis of data recorded under prevailing practices. That is, the data required to quantify cost and effectiveness parameters would be: (1) taken directly, (2) calculated, or (3) deduced from existing data sources such as the following:

- a. Work requests submitted by ship's force during requirements planning
- b. Shipyard planners' estimate sheets prepared during overhaul planning
- c. Arrival and departure reports
- d. Job order specifications
- e. Job order amendments and associated cost estimate sheets
- f. Work schedule sheets and work status reports as used in the normal management of overhaul activity
- g. Messages and other miscellaneous correspondence identifying schedule slippages or delays.

Under this option, no new or supplemental data collection forms or procedures would be initiated. Rather the data now being collected would be consolidated, reformatted, or summarized as needed.

### 3.3.3 Semiconrolled Test

Under this option, existing data bases would be utilized to the maximum extent possible but augmented with additional data. The additional data would be recorded via forms and procedures supplemental to those currently in use. Two distinct part-replacement alternatives are hypothesized:

- (1) Order replacement parts after opening and inspecting the equipment to be overhauled.
- (2) Pre-order a replacement part kit where the kit would consist of all parts that have greater than 50 percent chance of use (based on experience) and cost less than a given dollar amount.

Table D-1 presents a proposed Data Acquisition Plan for this test.

### 3.4 MEASUREMENT/ESTIMATION OF COST AND EFFECTIVENESS FOR ALTERNATIVES

The specific approach to be taken in quantifying the cost and effectiveness of each alternative will depend on the option selected for data acquisition. If a controlled approach to data collection is adopted, the effectiveness and cost of each alternative could be measured; i.e., evaluation of the alternatives would be on the basis of actual results. If an uncontrolled approach is taken, the comparison of the alternatives would be based on estimates deduced from available data. If the semiconrolled approach is taken, some conclusions would be based on fact, others on deduction.

TABLE D-1. PROPOSED DATA ACQUISITION PLAN

Steps	Recommendations
1. Select equipments to be tested.	Select at least two equipments for test purposes. Likely candidates: <ol style="list-style-type: none"> <li>a. Winch</li> <li>b. Main Feed Pump</li> <li>c. Diesel Engine</li> <li>d. S/S Generator</li> </ol>
2. Designate participating overhaul activities.	Select/coordinate with two naval shipyards. One would be designated to overhaul test equipment using "existing practices" with participation to the extent of recording added supplemental data. The other would acquire kits and overhaul equipment using kits.
3. Define/specify kits <ol style="list-style-type: none"> <li>a. Identify all possible replacement parts.</li> <li>b. Determine/estimate lead time, expected usage, and cost.</li> <li>c. Set maximum tolerable kit cost.</li> <li>d. Select items for inclusion in kit using cost-priority trade-off procedure.</li> </ol>	Recommend use COSAL, Part II and Tech Manual.  Cost per COSAL, lead time per S/Y, planner usage per past data.
4. Designated overhaul activity acquires/assembles kits.	Acquire kits sufficient for at least 10 equipment overhaul actions.
5. Prepare supplemental data collection forms.	Use two forms: <ol style="list-style-type: none"> <li>a. Pre-overhaul planning data form</li> <li>b. Post-overhaul report               <ol style="list-style-type: none"> <li>1) EOS App 1</li> <li>2) Delay Data</li> <li>3) Expenditure Accounting</li> </ol> </li> </ol>
6. Collect data.	Collect data for at least 6 months, or for at least 10 actions of each alternative.
7. Analyze data/evaluate alternatives.	

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER D06-01-1-1212	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) DEVELOPMENT OF MAINTENANCE MANAGEMENT IMPROVEMENT TECHNIQUES FOR COMSERVPAC SHIPS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER D06-01-1-1212
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9. PERFORMING ORGANIZATION NAME AND ADDRESS ARINC Research Corp. 2551 Riva Road Annapolis, Maryland 21401		12. REPORT DATE MARCH 1973
11. CONTROLLING OFFICE NAME AND ADDRESS COMMANDER, SERVICE FORCE PACIFIC and PEARL HARBOR NAVAL SHIPYARD		13. NUMBER OF PAGES 79
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		16. DISTRIBUTION STATEMENT (of this Report)  UNCLASSIFIED/UNLIMITED
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18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Tasks conducted by ARINC Research Corporation under a nonpersonal engineering services contract with the Commander, Service Force Pacific, are described. Seventeen major tasks were conducted during the contract period, which extended from May 1971 through January 1973. Support was provided COMSERVPAC in the development of maintenance management improvement techniques for SERVPAC ships.		