**Military Sealift Command**
Washington Navy Yard
Washington, D.C. 20398-5100 COMSC INSTRUCTION 3540.6

# ENGINEERING OPERATIONS AND MAINTENANCE MANUAL (EOMM)

## RECORD OF CHANGES

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DEPARTMENT OF THE NAVY
COMMANDER MILITARY SEALIFT COMMAND
WASHINGTON, D.C. 20398-5100

REFER TO:
COMSCINST 3540.6
N7
26 MAR 1992

COMSC INSTRUCTION 3540.6 W/CH-2

Subj: ENGINEERING OPERATIONS AND MAINTENANCE MANUAL (EOMM)

1. Purpose. To provide a reference for ashore and afloat personnel who conduct engineering operations, maintenance management and administration.

2. Cancellation. COMSCINSTs 4101.2, 4700.7B, 4700.11, 4700.12, 4710.7C, 4730.8, 9094.1B, 9100.1B, 9560.2B, 9560.3. The reporting requirements RCS OPNAV 9094-1, MSC 4700-15 and MSC 4730-2 have been included in this manual.

3. Applicability. This instruction is applicable to all MSC ships for procedures relating to requirements, practices, and methods. For non-civil service manned ships, many provisions of the operating contract will be at variance and will govern. Nothing in this document is construed to be a modification of the contract.

4. Background. The EOMM consolidates to the extent feasible, COMSC policies relating to engineering operations, maintenance, repair, administration and management. This leads to fewer individual instructions. When more detailed information is required on a subject than is feasible or prudent to include in the EOMM, other instructions are referenced.

5. Action

a. Action addressees shall adhere to the provisions of this instruction.

b. Nothing in this instruction is to be construed as relieving the Master, Chief Engineer or any member of the ship's force of their responsibility as defined by law, nor shall it preclude the exercise of sound judgement at all times.

c. The EOMM is a dynamic document. It will be amended as necessary to respond to changing operational, maintenance and technological requirements. Feedback from the users of this document is essential to ensure that it is kept accurate and current. Comments are encouraged and should be directed to COMSC (Code N7) with a copy to the Administrative Area Commander. Comments should identify the applicable chapter and paragraph, describe the specific problem and propose changes to resolve the problem.

6. <u>Short Title</u>. The approved short title of this instruction is the EOMM.

D.F. CHANDLER
Vice Commander

Distribution:
COMSCINST 5000.19
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# CHAPTER 1

# INTRODUCTION

## 1.0 INTRODUCTION

The EOMM serves to familiarize MSC ship's force and shore-based personnel with engineering maintenance, repair, alteration, administration and management policy.

# CHAPTER 2

## DUTIES AND RESPONSIBILITIES OF ENGINEERING MEMBERS OF THE SHIP'S FORCE

### 2.0 CHIEF ENGINEER

a. The Chief Engineer is responsible for the proper operation, maintenance, preservation, safety and cleanliness of Engine Department spaces and equipment. The Chief Engineer also provides management direction to engineering personnel in their duties and pursuing their long term career goals.

b. The Chief Engineer shall:

(1) Verify that licensed engineers know their duties and responsibilities as described in COMSCINST 3120.2D (Administrative and Operating Procedures for MSC Ships).

(2) Conduct personnel evaluations of engineering members of the ship's force.

(3) Maintain records of shipboard training and evaluations of engineering members of the ship's force.

(4) Counsel, instruct and assist engineering members of the ship's force in enrolling in study and training programs available to MSC employees as addressed in COMSCINST 12410.25 (Civilian Marine (CIVMAR) Career Development Plan) or provided through other sources such as union schools, upgrade schools, Naval correspondence courses and manufacturers' training courses.

(5) Whenever possible, assign at least one licensed engineer to assist technical representatives so that engineers may benefit from the expertise of the technical representative.

(6) Direct watchstanding arrangements which will maintain safe and reliable engine room operation.

(7) Ensure that newly-reporting licensed and unlicensed engineers are familiar with:

(a) Watchstanding requirements (paragraph 2.1.3).

(b) Those areas of the ship under the cognizance of the Engine Department.

(c) Requirements for entries in the Engine Room Log.

(d) Requirements for making routine rounds.

(e) Requirements for ensuring that information needed to maintain records in the Shipboard Automated Maintenance Management (SAMM) system (paragraph 7.3) is obtained and provided to the Chief Engineer.

(f) Engine room safety procedures (chapter 15).

(g) Policies and standing procedures in effect for Engine Department personnel (including those identified in chapter 11).

(8) Ensure that engineering casualty exercises are conducted in accordance with COMSCINST 3541.6A (Engineering Casualty Exercises).

(9) Report equipment and machinery requiring repair and planned schedule for repair action to the Master.

**2.1 LICENSED ENGINEERS**

Duties and responsibilities of licensed engineering members of the ship's force are addressed in COMSCINST 3120.2D. When reporting to a ship, an engineer shall first locate his/her assigned station for fire and boat drills. The engineer shall become familiar with the machinery plant, locating safety devices, critical gages and isolation valves and tracing out piping systems. The engineer shall locate motor controls for fire pumps, emergency shutdown controls for fuel pumps, emergency trips and remote operators. In addition, each engineer shall be familiar with:

a. The use of internal communication systems.

b. Escape routes from machinery spaces.

c. Engine room alarm systems.

d. The location and operation of firefighting equipment, damage control (chapter 13) equipment and fire detection and containment devices in and for the machinery spaces.

e. The condition and reliability of all equipment and machinery and the procedures involved in switching remotely operated machinery to the manual and local mode.

f. Operating parameters for on-line machinery.

g. Procedures for putting machinery and systems on-line.

h. Maintenance and repair requirements.

i. Maintenance and repair recordkeeping requirements (paragraph 2.1.3, chapter 7, paragraph 15.2.2.6).

j. Engine room safety procedures (chapter 15).

**2.1.1 ENGINEERING WATCHSTANDING**

The engineering watch officer shall inspect, operate and test machinery and equipment as required during the course of his/her watch. The engineering watch officer's primary responsibility is the safe and efficient operation and upkeep of machinery affecting the safety of the ship.

**2.1.2 ASSUMING THE WATCH**

Prior to assuming the watch, the engineering watch officer shall make a thorough inspection of the engineering spaces, steering flat and all other spaces under the Engine Department's cognizance. This inspection shall include review, observation or identification of:

a. The condition, system use and mode of operation of main and auxiliary systems.

b. Special modes of operation dictated by equipment failure or adverse ship conditions.

c. Adverse or potentially adverse conditions caused by bad weather, ice or contaminated or shallow water.

d. Standing orders and special instructions of the Chief Engineer for the operation of the ship's systems and machinery (paragraph 11.1).

e. Engine Room Log entries from the previous watch.

f. The type and extent of work being performed on machinery and systems, personnel involved and potential hazards.

g. Fuel, lube, feedwater and potable water levels in all tanks and sumps.

h. The condition and water level of bilges.

i. The condition of monitoring and control console equipment with attention to that equipment which is being operated in manual mode.

j. The location, availability and condition of firefighting equipment.

k. The Tag Out Log Book (paragraph 15.2.2.6) entries.

**2.1.3 WATCHSTANDING**

The engineering watch officer shall:

a. Supervise engine room machinery operation during the assigned watch interval. In the event the watch officer is incapacitated or unable to stand the assigned watch or any portion thereof, he/she shall inform the Chief Engineer of the circumstances and request that arrangements be made for a substitute watch officer.

b. Direct the engineering members of the ship's force in operating machinery and systems in manual mode.

c. Verify at the start of each watch and at regular intervals thereafter, the condition of operating machinery, bilge levels and machinery temperatures and pressures. Any machinery not functioning properly or requiring special service or any other abnormal condition shall be noted in the Engine Room Log. Timely corrective action shall be initiated.

d. Respond promptly to bridge orders for changes in engine direction or speed. Such changes shall be noted in the Engine Room
R) Bell Book or bell logger (if installed).

e. Note in the Engine Room Log any bypassing of systems or machinery, any machinery which is put on line or taken off line during the watch, any maintenance which is performed during the watch either by the ship's force or industrial assistance, any transferring of fuel, potable water or lube oil accomplished during the watch and all other non-routine occurrences.

f. Perform routine maintenance and repair that does not interfere with machinery plant monitoring duties.

g. Support any member of the Engine Department authorized by the Chief Engineer to perform maintenance and repair work. Support required may include isolating and tagging out (paragraph 15.2.2) machinery to be worked on, starting machinery after service for testing or for putting on-line and recording maintenance in the Engine Room Log.

h. Be aware of the work of the ship's force in the machinery spaces so that operational requirements are not compromised by ongoing work.

i. Verify that equipment, machinery and systems are tagged out (paragraph 15.2.2) to prevent operation during maintenance and repair.

j. Act as the Authorizing Officer for equipment, machinery and system tag out procedures (paragraph 15.2.2).

k. Notify the bridge immediately in the event of fire.

l. Notify the bridge immediately in the event of actual or impending machinery plant malfunction or failure which may affect operations, cause a reduction in the ship's speed or ability to maneuver or any similar threat to safety.

m. Take immediate corrective action for the safety of the ship, its machinery and the ship's force.

n. Notify the Chief Engineer immediately of any malfunction in machinery spaces which may endanger the safe operation of the ship, or cause a breakdown of propulsion machinery, auxiliary machinery, monitoring systems or governing systems.

o. Take all precautions to avoid polluting the marine environment (chapter 17).

p. Notify the Chief Engineer when Standby Engines, Arrival or Departure is called.

q. Make complete and accurate entries in the Engine Room Log, and if the ship is equipped with the electronic Engine Room Log Book (ERLOG), make Engine Room Log entries in electronic format. With the ERLOG, the engineering watch officer will download the machinery data and night orders to the data collector. ERLOG signature occurs when the watch engineer uploads the log book data to the Chief Engineer with his password. (A

**2.1.4 TURNING OVER THE WATCH**

a. The engineering watch officer shall review with the relieving watch officer:

(1) Any variations from normal plant operation or performance.

(2) Any unusual equipment alignment or mode of operation.

(3) Ongoing maintenance and repair work including identification of equipment, machinery or systems "tagged out" (paragraph 15.2.2).

(4) Adverse or potentially adverse conditions resulting from bad weather, ice or contaminated or shallow water.

(5) Standing orders and special instructions of the Chief Engineer for the operation of the ship's systems and machinery (paragraph 11.1).

b. The engineering watch officer shall not turn over the watch to the relieving watch officer if he/she has reason to believe that the latter appears in any way impaired or incapable of carrying out assigned duties effectively. In these instances, the watch officer shall notify the Chief Engineer of the relieving engineer's condition so that medical, disciplinary or other appropriate action may be taken and a substitute watch officer may be assigned.

### 2.2 UNATTENDED ENGINE ROOM OPERATION

Many ships within the MSC fleet are equipped with extensive engine room automation to reduce engine room manning requirements. The automation and fire detection on those ships which are classed by the American Bureau of Shipping (ABS) as Automatic Control System for Unattended Engine Room (ACCU) or Automatic Bridge Control System for Unattended Engine Room (ABCU) permits engineers to perform maintenance and repair work during normal working hours rather than standing watches around-the-clock. After normal working hours, licensed engineers will respond to alarm conditions as necessary. Inspection and certification procedures for ships equipped with unattended engine rooms are established by Section 41 of the ABS Rules for Building and Classing Steel Vessels and Title 46 CFR 46.

#### 2.2.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES

The Administrative Area Commander shall ensure that regulatory requirements necessary to maintain the ship's unattended engine room certification are met.

#### 2.2.2 CHIEF ENGINEER'S DUTIES

The Chief Engineer shall maintain Engine Room Logs. On those ships equipped with a bell logger, an Engine Room Bell Book need not be maintained. To protect against fire, flooding and other hazards, the Chief Engineer shall direct that equipment and valve alignment be checked and double-checked. The Chief Engineer shall direct routine inspection rounds of the engineering spaces to check those items identified in paragraphs 2.1.2 in addition to other items as necessary. In addition to corrective maintenance, routine preventive maintenance and checks shall be accomplished as stated in the ship's Shipboard Automated Maintenance Management (SAMM) System (paragraph 7.3). Other duties of the Chief Engineer in managing an unattended engine room are identified in paragraph 3.2.6.1.

A) **2.2.2.1 DUTY ENGINEER**

The Chief Engineer shall assign on a rotating basis from among the available assistant engineers, a duty engineer for the following periods: 0800 hours to 1600 hours, 1600 hours to 2400 hours and 0000 hours to 0800 hours. Duty engineers shall perform machinery and equipment checks, pump up settlers, check day tanks for water contamination, check lube oil levels in sumps of operating and standby equipment and shall ensure the safe and efficient operation of the engineering plant and perform those duties as prescribed in paragraphs 2.1.2, 2.1.3 and 2.1.4.

# CHAPTER 3

# REGULATORY REQUIREMENTS AND INSPECTIONS

## 3.0 REGULATORY REQUIREMENTS

a. Maintenance and repair standards for MSC ships are based primarily on the rules of the American Bureau of Shipping (ABS) and the regulations of the United States Coast Guard (USCG). These rules and regulations impose minimum standards that must be met to maintain valid ABS classification and USCG Certificates of Inspection. Periodic shipboard inspections and surveys are required to verify compliance with ABS rules and USCG regulations. Those ships not certified by the USCG (Table 3.1), shall be maintained to ABS and USCG standards except as specifically authorized by COMSC.

b. The Administrative Area Commander shall:

(1) Comply with the requirements for USCG inspections and ABS surveys.

(2) Attend ship scheduling conferences to ensure that adequate time to meet USCG and ABS requirements is allowed in ship's schedules.

(3) Plan USCG inspections and ABS surveys during inport periods and within ship turnaround times, as practical.

## 3.1 AMERICAN BUREAU OF SHIPPING CLASSIFICATION

a. The American Bureau of Shipping Rules for Building and Classing Steel Vessels establishes hull and machinery design, construction and installation standards for MSC and merchant ships. For those ships complying with these rules, the American Bureau of Shipping provides classification documents verifying the ships' structural and mechanical fitness for particular use or service. The classification documents are issued to the ship at construction and require annual, intermediate and special surveys to remain valid.

b. Hull classification documents verify that the hull, deck machinery, bulkheads, hull piping, cargo systems, tanks and voids meet ABS requirements.

c. Machinery classification documents verify that machinery, machinery components, electrical equipment (including motors), fire extinguishing apparatus, steering gear and control systems meet ABS requirements.

d. The Chief Engineer and Administrative Area Commander shall maintain accurate and up-to-date records of all classification documents and endorsements for equipment and machinery under the Engine Department's cognizance. Special endorsements and additional surveys are required for the following items:

(1) Tail shafts, including shaft, bearings and seals.

(2) Boilers, including firesides, watersides, economizers, superheaters, all mountings and safety valves.

(3) Refrigeration plant, including machinery, piping, battens, insulation, temperatures and pressures.

(4) Inert gas systems, including all associated fans, valves, valve indicators, piping seals, operation records, maintenance records and pumps.

(5) Automation and remote control systems.

(6) Engines and turbines.

(7) Electrical equipment.

### 3.1.1 EQUIPMENT CLASSIFICATION CERTIFICATES

Equipment classification certificates are issued by ABS for individual pieces of major installed equipment. This equipment is usually surveyed during construction, and the classification certificate accompanies it when delivered for installation. The certificate verifies that the equipment was designed and constructed in accordance with ABS rules. The Chief Engineer and Administrative Area Commander shall maintain accurate and up-to-date records of all classification certificates for equipment and machinery under the Engine Department's cognizance. Equipment certificates are issued for each of the following types of equipment or machinery:

a. Anchors, anchor chains, connecting links and shackles.

b. Cable and wire rope.

c. Main propulsion diesels, turbines and motors.

d. Main generators.

e. Auxiliary generators, diesels and turbines.

f. Control and automation equipment.

g. Steering gear.

h. Deck machinery, booms, cranes and frames.

i. Propellers and propulsion shafting.

j. Fire extinguishing equipment.

k. Refrigeration machinery and insulation for refrigerated cargo spaces.

**3.1.2 EQUIPMENT SURVEYED AT THE MANUFACTURER'S FACILITY**

To certify certain lower powered pieces of equipment or machinery, ABS surveys the manufacturer's facility, manufacturing processes and equipment or machinery performance at the facility. Upon satisfying ABS requirements, the manufacturer is authorized to provide a certificate of test for all like equipment and machinery obtained from the facility. The Chief Engineer and the Administrative Area Commander shall verify that all new or replacement equipment installed on board is ABS classed. The Chief Engineer shall maintain on board all classification certificates for equipment and machinery under the Engine Department's cognizance.

**3.1.3 LOADLINE CERTIFICATES**

All ships shall possess a loadline certificate. These certificates are issued by ABS for five year periods. To remain valid, ABS must endorse the certificate annually during the 5-year period.

**3.1.4 SURVEYS AFTER CONSTRUCTION**

The Chief Engineer shall be familiar with the requirements for ABS surveys after construction as stated in Section 45 of the ABS Rules for Building and Classing Steel Vessels. These surveys shall be accomplished as indicated below to ensure maintenance of ABS classification.

**3.1.4.1 SURVEY CYCLES**

Most MSC ships are on a Continuous Survey Cycle. Ships on a Continuous Survey Cycle accomplish Special Survey requirements in rotation to complete all survey requirements within 5 years.

**3.1.4.1.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall maintain each ship's ABS classification and shall track survey requirements. The Administrative Area Commander shall coordinate survey schedules for each classed ship with ABS to coincide with planned availabilities when the ship may be examined for a segment of the Continuous Survey. When surveys are due, when machinery is available for "open and inspect" credit, or when hull and machinery damage requiring ABS survey of repairs (paragraph 6.2) is sustained, the Administrative Area Commander shall arrange for surveyor attendance. If it is advantageous for certain ships to remain under ABS Special Survey rules, the Administrative Area Commander shall request a waiver from the Continuous Survey requirement from COMSC.

**3.1.4.1.2 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall maintain complete and accurate records of all surveys accomplished and due dates for upcoming surveys. The Shipboard Automated Maintenance Management (SAMM) System (paragraph 7.3) provides a means of tracking, recording and posting survey dates.

**3.1.4.1.2.1 SURVEYS BETWEEN CYCLES**

When machinery is opened for maintenance or repair, the Chief Engineer shall request that the Administrative Area Commander arrange for an ABS surveyor to inspect the machinery or equipment for survey credit. When machinery is opened during the "open and inspect" phase of an INSURV inspection (paragraph 3.3), the Chief Engineer shall request that the INSURV senior inspector permit an ABS surveyor to attend in order to obtain ABS survey credit.

**3.1.4.2 CREDIT FOR SHIPBOARD AUTOMATED MAINTENANCE MANAGEMENT SYSTEM AND CONDITION MONITORING PROGRAM RECORDS**

MSC uses a Shipboard Automated Maintenance Management (SAMM) system and is implementing a Condition Monitoring Program (CMP) to provide fleetwide predictive and preventive maintenance management (chapter 7). Credit for Special Continuous Survey requirements may be obtained by presenting SAMM and CMP records to the ABS surveyor (paragraph 7.3.3).

**3.1.5 AUTOMATIC CONTROL SYSTEM FOR UNATTENDED ENGINE ROOM (ACCU)**

The automated control systems of ships which are classed by the ABS as Automatic Control System for Unattended Engine Room (ACCU) or Automatic Bridge Control System for Unattended Engine Room (ABCU) permit engineers to perform maintenance and repair work during normal working hours. The rules outlined in Section 41 of the ABS Rules for Building and Classing Steel Vessels establish design, testing and maintenance requirements for equipment and machinery in engineering spaces. The Administrative Area Commander shall ensure compliance with the rules of this section to ensure retention of ACCU or ABCU classification.

## 3.2 USCG CERTIFICATION

U.S. Coast Guard regulations are contained in Titles 33 and 46 of the U.S. Code of Federal Regulations. These regulations establish condition, operating, design and maintenance requirements for hull and machinery items. The USCG inspects MSC ships for compliance with these regulations. When a ship is found to be in compliance with USCG regulations, the USCG Officer in Charge of Marine Inspection (OCMI) issues a Certificate of Inspection (COI) to the ship. The USCG forwards the original COI to MSC Headquarters, who shall retain a copy and forward the original to the Administrative Area Commander. The Administrative Area Commander shall forward the original COI to the ship and retain copies for distribution throughout the Area Commands and MSC Offices, as necessary. Except for those ships listed in Table 3.1, all MSC ships will be certified by the USCG. Those ships exempted from USCG inspection and certification shall be maintained and operated in accordance with USCG standards, except as authorized by COMSC.

### 3.2.1 CERTIFICATES OF INSPECTION

The USCG COI lists information related to certification of the ship including manning requirements, operating area, ship characteristics, safety equipment, boiler and machinery data, drydocking information, date of previous inspection and date of certificate expiration. Ships certified by the USCG must display on board at all times a valid COI or USCG authorized Permit to Proceed (paragraph 3.2.2) in order to sail.

### 3.2.2 PERMITS TO PROCEED

a. If a ship will arrive in port with an expired or nearly expired COI, the Administrative Area Commander shall inform the OCMI of the ship's projected schedule for offloading cargo and proceeding to a port for repairs and reinspection. If the OCMI determines that the ship may safely complete its voyage, the OCMI may issue a Permit to Proceed (CG-948). Permits to Proceed replace the COI as authority to sail and shall be posted aboard.

b. If a ship must offload cargo before undergoing emergency repairs or must proceed to a repair port to undergo emergency repairs (chapter 6), the Administrative Area Commander shall inform the OCMI of the ship's projected schedule. As above, the OCMI may issue a Permit to Proceed.

### 3.2.3 SCHEDULE FOR USCG INSPECTIONS

The Administrative Area Commander shall comply with the schedule for USCG inspections for recertification, reinspection and hull inspections as required by USCG regulations.

**3.2.3.1 SCHEDULE FOR RECERTIFICATION AND REINSPECTION**

USCG regulations require that a ship undergo inspection for recertification every 2 years. Upon successful completion of this inspection, a new COI, valid for an additional 2 years is issued. Between the 10th and 14th month following the date of the COI, the USCG conducts a reinspection, which is often referred to as a midterm inspection. This inspection may cover all items previously inspected for recertification. Usually, a reinspection is substantially less extensive unless the inspector determines that the condition of the ship has deteriorated significantly since the last inspection, or finds that some major change has affected the seaworthiness of the ship.

**3.2.3.2 SCHEDULE FOR HULL INSPECTIONS**

a. Each ship shall be drydocked at least twice during a 5-year period, but the time between any two consecutive drydockings shall not exceed 3 years. For ships which are less than 15 years old and are specially outfitted and configured, an underwater inspection may replace a drydocking. Two underwater inspections may not be accomplished consecutively, however. For instance, if an underwater inspection is accomplished 2 years after the drydocking, the next hull inspection shall be accomplished by drydocking the ship not later than 3 years following the underwater hull inspection.

b. The USCG requires that the OCMI be notified whenever any ship is drydocked regardless of whether or not the drydocking is intended to satisfy inspection requirements. The Administrative Area Commander shall notify the appropriate USCG OCMI of all scheduled drydockings (paragraph 3.2.4) and all unscheduled or emergency drydockings (paragraph 6.2).

A) **3.2.3.2.1 SPECIAL MISSION SHIPS**

Special mission ships will be scheduled for drydocking once every 2 years and only when required by Memoranda of Agreement with the sponsor (paragraph 14.1). With sponsor, ABS and USCG concurrence, drydocking intervals shall be extended to the maximum possible.

A) **3.2.3.2.2 T-AO 187 CLASS OILERS**

The T-AO 187 Class oilers (all series) meet USCG requirements for the underwater hull inspection program. These ships will be scheduled for drydockings every 5 years and will be scheduled for an underwater hull inspection at the midperiod of the 5-year cycle.

**3.2.4 PREPARING FOR USCG INSPECTIONS**

a. Preparation is the key to successful inspections. When a ship is scheduled for recertification, reinspection or hull inspection, the Administrative Area Commander shall notify the USCG in writing 30 to 60 calendar days prior to the start of the availability or inport period during which the inspection is required. This notice shall be sent to the OCMI of the port where the inspection will be performed.

b. Prior to a USCG inspection and as feasible, the ship's Master, Chief Engineer and Port Engineer shall test the items identified in paragraph 3.2.6, so that when USCG inspections and tests are accomplished, they will be conducted efficiently and effectively. The Chief Engineer shall ensure that all SAMM records are up-to-date.

**3.2.5 PRE-INSPECTION MEETING**

Before a USCG inspection, the ship's Master, Chief Engineer and Port Engineer shall meet with the USCG inspectors to discuss the upcoming inspection. The Administrative Area Commander, the ship's Master and Chief Engineer shall provide the USCG inspectors facilities and support to complete their inspections efficiently and expeditiously.

**3.2.6 TESTS DURING INSPECTIONS**

The ship's Master, Chief Engineer and Port Engineer shall be prepared to conduct tests and inspections of the following equipment, machinery and systems for USCG recertification inspections:

a. <u>Lifesaving Equipment, including Lifeboats, Davits and Winches</u>

(1) The lifeboats shall be swung out and lowered, and all moving parts, brakes and falls inspected.

(2) All life preservers including Personnel Flotation Device (PFD) lights, exposure suits and ring buoys shall be stacked in one location and examined.

(3) Inflatable liferafts and hydraulic releases shall be checked for annual servicing and the servicing certificates shall be made available for inspection.

(4) The operation and condition of the Emergency Position Indicating Radio Beacon (EPIRB) shall be checked.

b. Fire Protection Equipment

(1) CO2 extinguishers shall have a hydrostatic test date not older than five years after the date stamped on the neck. If older, the extinguisher shall be serviced.

(2) Fixed CO2 extinguishing systems shall undergo a total system hydrostatic test every twelve years.

(3) Foam analysis reports, where applicable, shall be made available for USCG review.

(4) Fire hoses shall be laid out for inspection and shall be pressure tested as required.

(5) The firemain system shall be operated and pressure checked at the most remote and highest outlet of the ship.

(6) Firemen's outfits shall be inspected and stored properly.

A) (7) Fixed halon systems shall undergo a total system hydro every 12 years.

c. Hull Equipment. Watertight and weathertight doors, closures, hatches, gaskets, remote closure devices, shall be in working order.

d. Electrical Engineering Equipment

(1) Tests shall be conducted in accordance with Title 46 CFR 110-113 to determine mechanical and electrical condition and performance of all alarms, shutdowns and controls.

(2) Auto start of the emergency generator and ship's service generators, as applicable, hand transferring of loads, reverse power relays, emergency lighting and power systems, communication and alarm systems including fire detecting and alarms, general alarms and sound powered phone stations shall be tested.

e. Main Boilers including Superheaters, Reheaters, Economizers, Auxiliary Boilers and Low Pressure Heating Boilers. Manhole and handhole plates and washout plugs shall be removed as required for inspection.

(1) Furnace and combustion chambers shall be thoroughly cooled and cleaned.

(2) The overspeed trips on feed pumps shall be checked.

(3) Boiler drum, superheater and reheater safety valves shall be tested. Boiler mountings shall be opened if due (accomplished quadrennially), mounting studs and bolts shall be examined (accomplished every 8 years).

(4) Hydrostatic tests shall be accomplished in accordance with Title 46 CFR 61.

f. Automation Check-off List Tests. Engine room automation shall be checked in accordance with the USCG approved automation checkoff list.

g. Pressure Vessels. Relief valves shall be tested and internals inspected (if a pressure vessel is not fitted with inspection plates, a hydrostatic test of 1 1/4 MAWP shall be conducted).

h. Cargo Piping. Remote and local operation of all valves shall be tested, and a hydrostatic test of 1 1/2 MAWP shall be conducted.

i. Steering Gear. A complete inspection of the system including controllers, control linkages, rams, alarms and rudder angle indicators shall be conducted. Steering gear operation in all modes shall be tested.

j. Inert Gas Systems (where installed). System operation, shutdown and alarms shall be tested.

**3.2.6.1 TESTS OF UNATTENDED MACHINERY SPACES**

a. Title 46 CFR 46 provides guidance for designing, testing and maintaining equipment and machinery in engineering spaces designed for operation with reduced manning or no watchstanding. Compliance with the provisions of these regulations is required on those ships with reduced manning or no watchstanding.

b. The Chief Engineer shall be familiar with the requirements of these regulations. A key requirement is a fully documented preventive maintenance plan, the SAMM system (paragraph 7.3), which the Chief Engineer shall make available at any time for USCG review. A USCG approved test procedure used to evaluate the reliability of all engine room and machinery space automation also is required. This test plan shall be kept on board each ship. The Chief Engineer shall conduct the automation test prior to demonstrating it to the USCG inspector. This test will identify repairs or adjustments required to ensure a successful demonstration for the USCG.

### 3.2.7 NOTICE OF MERCHANT MARINE INSPECTION REQUIREMENTS (CG-835)

When a condition on board a ship is not in compliance with USCG regulations, the OCMI may issue a Notice of Merchant Marine Inspection Requirements (CG-835). If the deficiency is minor, the OCMI may provide a COI to the ship with notice that the cited deficiency shall be corrected prior to the date noted on the CG-835. In this case, the Port Engineer if in attendance, Master or Chief Engineer shall inform the Administrative Area Commander of the deficiency and take action to correct it.

#### 3.2.7.1 CG-835s WHICH RESTRICT SAILING

If the OCMI issues a CG-835 which restricts the ship's movement in any way, the Port Engineer if in attendance, Master or Chief Engineer shall immediately inform the Administrative Area Commander of the deficiency. The Administrative Area Commander shall immediately apply for a Permit to Proceed and inform MSC Headquarters of the deficiency, reporting the reasons for noncompliance, urgency of the voyage, the date by which the deficiency can be corrected and other pertinent details. If the OCMI does not provide a Permit to Proceed, COMSC shall direct the Administrative Area Commander to retain the ship in port to correct the deficiency or inform the Administrative Area Commander of intent to apply for a waiver. Only COMSC is authorized to apply to the USCG for a waiver (paragraph 3.2.7.3).

#### 3.2.7.2 CG-835 APPEALS

If any USCG cited deficiency is considered to be unreasonable, the Administrative Area Commander shall appeal the matter to the local OCMI. If the OCMI denies the appeal, the Administrative Area Commander shall request authorization from COMSC to appeal the matter to the appropriate District Commander, USCG. If the appeal is again denied, the Administrative Area Commander shall request authorization from COMSC to appeal the matter to the Commandant, USCG. The Administrative Area Commander shall appeal to the Commandant, USCG only with authorization from COMSC. Copies of all correspondence and supporting documentation shall be sent to COMSC (Code N7).

#### 3.2.7.3 APPLYING FOR WAIVERS

An application for a waiver from USCG regulations may be necessary when compliance with these regulations is not possible, cost-effective, time-efficient or, because of unique circumstances, beneficial to the ship or ship's force. When a waiver is needed, the Administrative Area Commander shall provide to MSC Headquarters technical information to support the application. Only COMSC has the authority to apply for a waiver to the OCMI. If granted, the

USCG waiver shall be posted on board with the COI. If not granted, COMSC may follow the appeals process through the District Commander and Commandant. Waivers and appeals shall not substitute for poor management which results in failure to comply with regulations.

### 3.2.8 DAMAGE CONTROL PLANS

USCG regulations require that each ship post at least two general arrangement plans for each deck and at least one tube containing a full set of general arrangement plans on the main deck level, port and starboard sides. These plans are to be used by boarding parties rendering emergency assistance to the ship and shall show the sections enclosed by fire retardant bulkheads, the location and type of various heat, smoke and fire detectors, types of fire extinguishing equipment in each space, the location of fire doors, the location of vent ducts and dampers, fans serving each section and means of entry into each compartment. The Administrative Area Commander shall verify compliance with this regulation.

## 3.3 INSURV

The Naval Board of Inspection and Survey (INSURV) conducts Acceptance Trials and Final Contract Trials of newly constructed MSC ships during their introduction into the MSC fleet. Additionally, INSURV conducts Triennial Material Inspections of those ships identified in Table 3.1 and surveys of all MSC ships prior to their deactivation. Specific requirements for INSURV inspections are outlined in INSURVINST 9080.2 (Trials and Inspections of Surface Ships).

### 3.3.1 ACCEPTANCE TRIALS

a. When construction of a ship is completed, INSURV witnesses Acceptance Trials. Acceptance Trials are conducted by the shipyard contractor with a licensed Master, Chief Engineer and other personnel provided by the shipyard to assist in demonstrating equipment and systems. Acceptance Trials demonstrate to the Supervisor of Shipbuilding (SUPSHIP) and the MSC Construction Representative (CONREP) that the ship was constructed and is capable of operating in accordance with contract requirements. Acceptance of the ship by SUPSHIP is contingent upon successful completion of the Acceptance Trials. When the ship is accepted by SUPSHIP, its operational and administrative control is transferred to Military Sealift Command.

b. MSC duties and responsibilities during Acceptance Trials are limited. The SUPSHIP representatives and the CONREP staff shall advise the shipyard contractor on the preparation of the ship for INSURV. The MSC CONREP, Master and Chief Engineer assigned to the ship attend the entire Acceptance Trial as observers. They and other designated Department Heads shall attend the screening conference (paragraph 3.3.1.2) and advise the shipyard contractor on the preparation of the ship for the INSURV inspection.

### 3.3.1.1 CONDUCTING ACCEPTANCE TRIALS

Acceptance Trials are conducted in three parts: first, the pre-underway inspection, followed by the underway material demonstration (sea trial), and the equipment "open and inspect" phase. Based on the results of the underway demonstration, INSURV and SUPSHIP designate items to be opened for inspection. The Chief Engineer shall advise the CONREP of additional items which should be opened for inspection. Following the "open and inspect" phase, the shipyard contractor shall correct deficiencies and make equipment ready for service. The MSC Chief Engineer shall witness retesting of equipment made ready for service.

### 3.3.1.2 SCREENING AND TRACKING INSURV DEFICIENCIES

After Acceptance Trials, a screening conference is held with SUPSHIP, Naval Sea Systems Command (NAVSEASYSCOM), MSC Headquarters, Administrative Area Commander, ship's force, shipyard contractor and sponsor representatives in attendance. This conference reviews the 2 KILO cards written during the INSURV inspection and assigns responsibility for correction. SUPSHIP maintains a record of INSURV deficiencies with assigned responsibilities for correction. As INSURV deficiencies are corrected, the Chief Engineer shall inform SUPSHIP (paragraph 10.2.3). SUPSHIP will incorporate these status changes into INSURV deficiency updates and forward the updates for official incorporation into the Chief Engineer's record.

### 3.3.2 FINAL CONTRACT TRIALS

The Administrative Area Commander presents newly constructed ships to INSURV at Final Contract Trials. Final Contract Trials are conducted after Acceptance Trials and before the end of the guarantee period.

### 3.3.2.1 PREPARATION BY THE ADMINISTRATIVE AREA COMMANDER

The Administrative Area Commander shall:

a. Ensure continuity of key personnel (i.e. Master, First Officer, Chief Engineer, First Assistant Engineer) before and during Final Contract Trials. For at least four months prior to and during the INSURV inspection, the Administrative Area Commander shall not permit rotation of these key personnel except in extreme emergencies.

b. Coordinate with MSC Headquarters time within the ship's schedule to provide a 2- or 3-week availability to correct items identified in paragraph 3.3.2.2. Work conducted during the availability shall be scheduled for optimum productivity so that the ship is in the best possible operational and material condition. At the end of the availability, time shall be allowed for equipment checks, general maintenance and thorough housekeeping just prior to the Final Contract Trial.

c. Ensure the Master and Chief Engineer designate appropriate INSURV team work space outfitted with sufficient furniture and office supplies. Flashlights, coveralls and hard hats shall be made available to the INSURV team, if needed.

d. Provide a copying machine and clerical services on board dedicated to the administrative work of the INSURV inspection.

e. Furnish parking spaces and transportation to and from the ship to the INSURV team and provide adequate steward services to ensure comfortable berthing and feeding of the INSURV team.

f. Ensure that technical representatives for major pieces of equipment and machinery are available for the underway and "open and inspect" portions of the INSURV inspection.

g. Arrange for industrial assistance to open the machinery required for the "open and inspect" phase of the inspection.

h. Arrange for ABS surveyors to attend the "open and inspect" phase so that ABS credit can be obtained for the machinery that is opened (paragraph 3.1.4.1.2.1).

**3.3.2.2 PREPARATION BY THE CHIEF ENGINEER**

The Chief Engineer shall:

a. Maintain an up-to-date work list of outstanding Voyage Repair Requests (VRRs, paragraph 5.2.2), Guarantee Item Reports (GIRs, paragraph 10.2.3) and Acceptance Trial INSURV deficiencies (paragraph 3.3.1.2) which must be completed prior to the Final Contract Trial.

b. Complete an INSURV Form 4790/2K (referred to as 2 KILO form) or 4790/2Q (referred to as a 2 QUEBEC form) for all outstanding deficiencies. INSURVINST 4730.11 (Preparation of Deficiency Forms) explains how to prepare and interpret these forms.

c. Complete and bring up-to-date all SAMM (paragraph 7.3) and administrative records.

**3.3.2.3 CONDUCTING FINAL CONTRACT TRIALS**

The Final Contract Trial is conducted in three parts: first, the pre-underway inspection, followed by the underway demonstration (sea trial) and the equipment "open and inspect phase. After the underway demonstration, INSURV will provide to the Administrative Area Commander's Port Engineer a list of machinery which will be opened for inspection upon return from the underway demonstration.

**3.3.2.4 SCREENING AND TRACKING FINAL CONTRACT TRIAL DEFICIENCIES**

After each Final Contract Trial, SUPSHIP, NAVSEASYSCOM, MSC Headquarters, Administrative Area Commander, designated ship's force, shipyard contractor and sponsor representatives attend a screening conference. This conference reviews the 2 KILO cards written during the INSURV inspection and assigns responsibility for correction.

**3.3.3 TRIENNIAL MATERIAL INSPECTIONS**

Those ships identified in Table 3.1 as subject to inspection by INSURV will undergo INSURV material inspections on a triennial basis. The Administrative Area Commander presents the ship to INSURV. The INSURV inspection team examines the physical condition of all equipment and spaces, witnesses the operation of machinery and systems and examines operating records. Prior to a Triennial Inspection, a Material Readiness Evaluation (paragraph 8.1) and a Command Inspection (paragraph 8.2) are conducted by the Administrative Area Commander to provide early identification and correction of deficiencies.

**3.3.3.1 PREPARATION BY THE ADMINISTRATIVE AREA COMMANDER**

The Administrative Area Commander shall:

a. Ensure continuity of key personnel (i.e., Master, First Officer, Chief Engineer, First Assistant Engineer) before and during Triennial Material Inspections. For at least 4 months prior to and during the INSURV inspection, the Administrative Area Commander shall not permit rotation of these key personnel except in extreme emergencies.

b. Coordinate with MSC Headquarters time within the ship's schedule to provide a 2- or 3-week availability to correct items identified in paragraph 3.3.3.2. Work conducted during the availability shall be scheduled for optimum productivity so that the ship is in the best possible operational and material condition. At the end of the availability, time shall be allowed for equipment checks, general maintenance and thorough housekeeping just before the Triennial Material Inspection.

c. Coordinate with the Master and Chief Engineer to designate appropriate INSURV team work space outfitted with sufficient furniture and office supplies. Flashlights, coveralls and hard hats shall be made available to the INSURV team, if needed.

d. Provide a copying machine and clerical services on board dedicated to the administrative work of the INSURV inspection.

e. Furnish parking spaces and transportation to and from the ship to the INSURV team and provide adequate steward services to ensure comfortable berthing and feeding of the INSURV team.

f. Coordinate with manufacturers' technical representatives for major pieces of equipment and machinery so that they will be available for the underway and "open and inspect" portions of the INSURV inspection.

g. Arrange for industrial assistance to open the machinery required for the "open and inspect" phase of the inspection.

h. Arrange for ABS surveyors to attend the "open and inspect" phase so that ABS credit can be obtained for the machinery that is opened (paragraph 3.1.4.1.2.1).

**3.3.3.2 PREPARATION BY THE CHIEF ENGINEER**

The Chief Engineer shall:

a. Maintain an up-to-date work list of outstanding Voyage Repair Requests (VRRs, paragraph 5.2.2) which must be completed prior to the INSURV trial.

b. Complete an INSURV Form 4790/2K (referred to as 2 KILO form) or 4790/2Q (referred to as a 2 QUEBEC form) for all outstanding deficiencies. INSURVINST 4730.11 explains how to prepare and interpret these forms.

c. Complete and bring up-to-date all SAMM system (paragraph 7.3) and administrative records.

### 3.3.3.3 CONDUCTING TRIENNIAL MATERIAL INSPECTIONS

The INSURV inspection is conducted in three parts: first, the pre-underway inspection, followed by the underway demonstration (sea trial) and the equipment "open and inspect phase. After the underway demonstration, INSURV will provide to the Administrative Area Commander's Port Engineer a list of machinery which will be opened for inspection upon return from the underway demonstration.

### 3.3.3.4 SCREENING AND TRACKING INSURV DEFICIENCIES

After each INSURV inspection, a screening conference of Administrative Area Commander and sponsor representatives reviews the 2 KILO cards written during the INSURV inspection and assigns responsibility for correction. The Administrative Area Commander shall maintain a list of INSURV deficiencies with assigned responsibilities for correction. The Administrative Area Commander shall submit this list to MSC Headquarters within 14 days after completion of the INSURV inspection and submit quarterly updates thereafter to show the status of all outstanding deficiencies.

### 3.3.4 SURVEY PRIOR TO DEACTIVATION

When the Chief of Naval Operations designates an MSC ship for deactivation, the Administrative Area Commander shall inform INSURV of the deactivation at least 6 months prior to its occurrence. The Administrative Area Commander shall schedule and manage the INSURV inspection in the same manner as a Triennial Inspection (paragraph 3.3.3). In special circumstances, INSURV may designate MSC to conduct the inspection, however this is considered on a case-by-case basis.

## 3.4 SHIPS NOT SUBJECT TO USCG, ABS OR INSURV INSPECTION

The Administrative Area Commander shall conduct a material inspection equivalent to that accomplished by ABS and USCG on those ships identified in Table 3.1 as not subject to inspection by the USCG, ABS and INSURV. Special US Navy equipment will also be checked for overall condition and operational readiness. The frequency of these inspections shall be comparable to USCG inspection schedules (paragraph 3.2.3). The Administrative Area Commander shall assign personnel to conduct these inspections who are technically qualified, know and understand USCG regulations and ABS rules and have experience in conducting inspections and evaluating material condition and machinery operation. The Administrative Area Commander shall record and maintain the results of these inspections using a procedure similar to that used to screen and track INSURV inspections (paragraph 3.3.3.4). The Administrative Area Commander shall submit to COMSC a letter attesting to the material condition and seaworthiness of the inspected ship, along with a copy of the inspection results.

**TABLE 3.1**

**SHIPS WITHOUT USCG CERTIFICATION** (R

* USNS KILAUEA (T-AE 26)
* USNS MARS (T-AFS 1)
* USNS SYLVANIA (T-AFS 2)
* USNS NIAGARA FALLS (T-AFS 3)
* USNS WHITE PLAINS (T-AFS 4)
* USNS CONCORD (T-AFS 5)
* USNS SAN DIEGO (T-AFS 6)
* USNS SAN JOSE (T-AFS 7)
** USNS SATURN (T-AFS 10)
** USNS SIRIUS (T-AFS 8)
** USNS SPICA (T-AFS 9)

* Subject to INSURV Inspection

** Subject to Inspection by MSC

# CHAPTER 4

## AVAILABILITY MANAGEMENT

### 4.0 AVAILABILITY MANAGEMENT

MSC ships require industrial assistance to accomplish some maintenance and repair actions and to assist with certain regulatory inspections and surveys. To facilitate availability planning, the ship's force and the Administrative Area Commander shall be aware of all items requiring industrial assistance.

### 4.1 AVAILABILITIES IN FOREIGN PORTS

a. Section 7309 of Title 10(c)(1), United States Code, states that "A naval vessel (or any other vessel under the jurisdiction of the Secretary of Navy) the homeport of which is in the United States may not be overhauled, repaired or maintained in a shipyard outside the United States." This law does not preclude emergency repairs (chapter 6), voyage repairs (chapter 5) or cleaning work specifically approved by the cognizant Administrative Area Commander. Because MSC does not designate homeports, the following criteria determine the applicability of this law to specific ships:

(1) Those ships which return to the United States at least once within a 2-year period will be considered to be homeported in the United States.

(2) Those ships which remain overseas for periods exceeding 2 years will be considered to be homeported overseas, as designated by the Assistant Secretary of the Navy for Shipbuilding and Logistics.

b. If a ship is homeported overseas and is scheduled to return to the United States within 1 year of the scheduled date of an availability, the availability shall be delayed and accomplished in the United States.

### 4.2 PREPARING FOR MAJOR AVAILABILITIES

In preparing for major availabilities, the Administrative Area Commander shall comply with the planning milestones in COMSCINST 4700.14 (Material Readiness Evaluations (MREs) and Planning for Major Availabilities). This instruction allows for professional discretion in complying with identified actions and milestones. Accordingly, the Administrative Area Commander shall be responsible for effective and thorough availability planning.

**4.2.1 PREPARING WORK PACKAGES**

The Port Engineer shall adhere to the requirements of the following instructions in preparing work packages:

a. COMSCINST 4700.2F (Administrative Procedures for the Alteration and Repair of MSC Ships).

b. COMSCINST 4750.2C (Preservation Instructions for MSC Ships) and chapter 12 (provide direction for determining the use, type and application of coatings approved for use by COMSC).

c. COMSCINST 4700.10A (Standardization of MSC Work Packages).

d. COMSCINST 4330.21C (Contract Procedures for Use in Procurement of Ship Maintenance, Repair and Alterations).

e. Paragraph 16.4, Underwater Hull and Propeller Maintenance.

**4.2.1.1 INCORPORATING VOYAGE REPAIR REQUESTS INTO THE WORK PACKAGE**

a. The Chief Engineer shall maintain up-to-date lists of Voyage Repair Requests (VRRs, paragraph 5.2.2) for incorporation into the availability work package and for identifying work requiring technical representative assistance. On ships equipped with the Shipboard Automated Maintenance Management (SAMM) system (paragraph 7.3), these records are contained in the Corrective Maintenance Module. On those ships not equipped with SAMM or if the SAMM system is not functioning, the Chief Engineer shall maintain hardcopy Voyage Repair Requests for required industrial assistance.

b. The Port Engineer shall review the ship's records to identify:

(1) VRRs which require industrial assistance.

(2) VRRs which require specialized assistance (technical representative or other assistance obtained through service orders).

(3) VRRs which can be deferred.

(4) VRRs which can be accomplished by the ship's force.

(5) VRRs which require configuration changes (chapter 9).

(6) Material Readiness Evaluation (paragraph 8.1) deficiencies and Command Inspection deficiencies (paragraph 8.2) which require correction during the availability.

#### 4.2.1.2 INCORPORATING SCHEDULED ACTIONS INTO THE WORK PACKAGE

The Port Engineer shall review the ship's records to identify the following maintenance actions which shall be incorporated into the work package:

a. Alterations scheduled for accomplishment (chapter 9).

b. Preventive maintenance actions requiring industrial assistance.

c. Regulatory requirements (chapter 3).

d. Other required recurring maintenance actions such as gage calibration and installation or replacement of flange shields (paragraph 13.2.3.1).

### 4.2.2 IDENTIFYING GOVERNMENT FURNISHED EQUIPMENT

The Port Engineer shall identify all Government Furnished Equipment (GFE) and Government Furnished Material (GFM) required to accomplish all work items and shall ensure that it is ordered promptly. The Port Engineer shall develop a contingency plan for obtaining GFE/GFM which is not delivered to the shipyard contractor's facility and shall track the delivery of GFE/GFM to the shipyard contractor's facility (paragraph 4.3.3).

### 4.2.3 RETAINING THE SHIP'S FORCE

The Chief Engineer and Master shall recommend to the Administrative Area Commander retention of those members of the ship's force who can contribute most effectively to the accomplishment of the availability. The length of the availability, specific work items to be accomplished, regulatory inspections and surveys required and work to be performed by the ship's force shall be considered when choosing those members of the ship's force who will be retained.

## 4.3 CONDUCTING THE AVAILABILITY

The Administrative Area Commander shall evaluate the complexity of the availability and assign a team of Port Engineer(s) and contracting personnel to provide on-site management and administration of the availability. The Port Engineer shall:

a. Monitor the ongoing shipboard work.

b. Anticipate problems and develop plans to resolve them.

c. Communicate effectively with the shipyard contractor, the retained ship's force and the Administrative Area Commander.

d. Develop cost estimates for growth and additional work.

e. Develop and keep current complete and accurate documentation for the availability.

**4.3.1 ARRIVAL CONFERENCE**

At the start of an availability, the Port Engineer shall chair a conference of the Chief Engineer, Master and shipyard contractor's production supervisor to discuss and establish:

a. Adequate telephones, ship services, parking spaces, gate security procedures and other facility support.

b. Requirements for maintaining ship cleanliness.

c. The locations of fire alarm boxes, availability of emergency firefighting water, fire watch procedures, safety inspections, precautions against freezing (if necessary) and gas freeing of tanks, voids and spaces.

d. The authority of the MSC Contracting Officer or his authorized representative to agree to additional work items or any changes in work item scope.

e. Weekly progress meeting schedules and procedures.

f. Production schedules of work to be accomplished.

g. Shipboard special tool and drawing sign-out procedures.

**4.3.2 SUPERVISING MAINTENANCE AND REPAIR ACTIONS**

The Port Engineer shall monitor maintenance and repair actions performed by the shipyard contractor. The Port Engineer shall meet regularly with the shipyard contractor's production supervisor to coordinate ongoing and planned actions and to resolve interferences, conflicting directions or other problems.

**4.3.3 TRACKING GFE/GFM DELIVERY**

The Port Engineer shall track the delivery of all GFE/GFM to the shipyard contractor's facility. The Port Engineer shall inform the Administrative Area Commander of all GFE/GFM which has not arrived at the shipyard contractor's facility by the start of the availability and continue to report the status of all outstanding GFE/GFM.

#### 4.3.4 WEEKLY PROGRESS REPORTS

For any availability in excess of 15 calendar days, the Port Engineer shall submit Weekly Status Reports (RCS MSC 4700-15) to the Administrative Area Commander (Info: COMSC WASHINGTON,DC) in accordance with Table 4.1. The Chief Engineer and Master shall provide input to this report. If a ship's departure from an availability extends more than 24 hours beyond the scheduled departure date or if any problems require more frequent reporting, the Port Engineer shall submit special Situation Reports in the same format as the Weekly Status Report in Table 4.1. These special Situation Reports shall be submitted every 24 hours until the ship departs or the problems are resolved.

#### 4.3.5 CHIEF ENGINEER'S DUTIES

The Chief Engineer shall be responsible for the operation of all machinery and systems in the engineering spaces. The Chief Engineer or his designated representative shall witness testing of machinery and systems which have been maintained or repaired.

##### 4.3.5.1 TECHNICAL REPRESENTATIVES

a. The Chief Engineer and Port Engineer shall establish procedures for the check in, review of work and departure of all technical representatives. This includes:

(1) Describing required work to the technical representative.

(2) Reviewing the technical representative's service report to make sure that it accurately reflects the work accomplished and the time spent on the job.

(3) Obtaining a copy of the technical representative's service report for retention in shipboard files and for submission to the Administrative Area Commander.

b. The Chief Engineer shall assign at least one engineering member of the ship's force to work with the technical representative so that the ship's force will benefit from the representative's knowledge and expertise.

##### 4.3.5.2 PREPARING FOR REGULATORY INSPECTIONS

The Chief Engineer shall prepare for regulatory inspections in accordance with chapter 3. The Chief Engineer shall accompany regulatory authorities in inspections and surveys of engineering spaces. The Chief Engineer shall ensure that licensed engineering personnel are available to operate and test machinery and assist regulatory authorities.

## 4.4 DRYDOCKING

Ships require drydocking to complete regulatory requirements, to accomplish underwater hull maintenance and to accomplish emergency repairs.

### 4.4.1 ADMINISTRATIVE AREA COMMANDER'S PRE-DRYDOCKING DUTIES

a. USCG regulations require that the Officer in Charge of Marine Inspection of the port in which any drydocking is to be accomplished be notified of the impending drydocking. The Administrative Area Commander shall provide this notification of all scheduled and unscheduled drydockings. Notification of scheduled drydockings shall comply with paragraph 3.2.4. Notification of unscheduled (emergency) drydockings (chapter 6) shall be provided as soon as the need for the drydocking is established by the Administrative Area Commander. The Administrative Area Commander shall ensure that the drydock and dockmasters are certified as safe and qualified by a recognized independent drydocking authority such as Crandall, Triple A, ABS or Lloyds. Conformance with MIL-STD-1625C, Safety Certification Program for Drydocking Facilities and Shipbuilding Ways for U.S. Navy Ships.

b. Before a ship enters a drydock, the Port Engineer shall confer with the dockmaster, Port Engineer, Master and Chief Engineer. This conference shall establish the following:

(1) Time and date of docking.

(2) Tugs and pilot to be used.

(3) Position of drydock blocks (before and after fleeting, if applicable).

(4) Whether bow or stern will enter drydock first.

(5) Required list and trim of ship.

(6) Line handling.

(7) Required tank levels.

(8) Requirements for tank level records.

(9) Gangways to be used.

(10) Ship services required (i.e., electric power, steam and water).

(11) Ship sanitary services to be provided.

(12) Garbage and refuse services.

(13) Means of providing firefighting water and location of fire alarm boxes.

(14) Machinery required to be on-line during docking.

**4.4.1.1 CHIEF ENGINEER'S PRE-DRYDOCKING DUTIES**

Before a ship enters a drydock, the Chief Engineer shall:

a. Verify that the fluid level in each fuel, lube, potable water and slop tank coincides with the docking plan or specific directions of the dockmaster.

b. Direct that no liquid will be transferred out of or into these tanks without coordinating the transfer with the Port Engineer, Master and production supervisor.

c. Clean and dry bilges and pump off slops.

d. Prepare the sewage treatment system/holding tank for shoreside hook-up.

e. Pump all bilges and cofferdams dry.

f. Verify the supply of fuel for the emergency diesel generator and top off the emergency diesel day tank.

g. Prepare reefer and air conditioning systems for shoreside cooling water.

**4.4.2 ACTIONS WHEN ENTERING DRYDOCK**

When a ship is entering drydock, the Chief Engineer shall secure the propellers in the docking position and the rudders amidships. When the dock is dry, the dockmaster, production supervisor, Port Engineer and the Master and Chief Engineer shall inspect the blocking arrangement and ship's position. The Port Engineer shall inform the dockmaster or shipyard production supervisor of his concurrence or disapproval of the blocking arrangement.

**4.4.3 DUTIES WHILE IN DRYDOCK**

a. The Port Engineer, Chief Engineer and Master shall inspect the underwater portion of the hull to determine whether any repairs not covered by the work package are required. The Port Engineer shall accompany ABS and USCG representatives in surveying the underwater portion of the hull. The Port Engineer and Chief Engineer shall witness repair work on and testing of sea valves, hardening up of the propeller nut and shaft coupling bolts, shaft alignment, installation of tailshaft, tailshaft and rudder clearance measurements, propeller fits and tailshaft packing installation. The Chief Engineer shall enter the results of this work and ABS and USCG inspections in the Engine Room Log.

b. In addition, the Port Engineer shall direct that:

(1) If discharge of any flammable or hazardous liquid is absolutely necessary, it shall be accomplished only under the supervision of the shipyard contractor and that it shall be pumped into containers provided by the shipyard contractor.

(2) In cold or freezing weather, water shall be drained from valves or fittings attached to the shell to prevent freezing and possible cracking of the fittings. Water tanks on the shell of the ship shall be kept empty.

(3) The ship's force shall be made aware of special safety procedures while in drydock, including the restriction on working over the side and throwing things over the side of the ship.

(4) Debris and flammables shall not be maintained aboard.

(5) Doors, ventilation and air intakes shall be secured as much as possible during sandblasting operations.

(6) Surface preparation and painting of the underwater hull shall be accomplished in accordance with COMSCINST 4750.2C and chapter 12.

(7) Underwater hull and propeller maintenance shall be accomplished in accordance with paragraph 16.4.

#### 4.4.4 RESPONSIBILITIES PRIOR TO REFLOODING DRYDOCK

Before the drydock is reflooded, the Chief Engineer and Port Engineer shall:

a. Inspect the hull to make sure that all sea chest blanks are removed, sea chests are free of debris and all sea valves, double bottom manhole covers and docking plugs are reinstalled.

b. Verify that all sea valves are closed.

c. Take a set of tank soundings and compare them to soundings taken prior to drydocking. If discrepancies are found, the cause shall be determined and levels corrected as required.

d. Direct the removal of the stack cover if the propulsion plant is to be lit off upon undocking.

e. Verify the supply of lube oil to the shaft bearings and stern tube (if applicable).

f. Verify that cathodic protection (CAPAC) and zinc anode masking has been removed.

g. Verify that the bow thruster tunnel (if installed) is free of debris.

**4.4.5 ACTIONS WHILE REFLOODING THE DRYDOCK**

While the drydock is being reflooded, the Chief Engineer and Port Engineer shall:

a. Station personnel at each sea valve to observe tightness.

b. Check stern gland for tightness, where applicable.

c. Check rudder stock gland for tightness.

d. Check bow thruster glands for tightness.

e. Check double bottom manhole covers and tank drain plugs for tightness.

**4.4.6 FLEETING OF SHIPS**

COMSCINST 4750.2C provides the criteria for determining when a ship in drydock shall be fleeted. The Administrative Area Commander shall comply with this directive to ensure complete hull coverage.

**4.5 AVAILABILITY CLOSEOUT**

At the end of each major availability, the Port Engineer shall accomplish the following actions:

a. Conduct dock and sea trials.

b. Complete the scrap and salvage report.

c. Resolve to the best of his/her ability the final bill from the shipyard contractor for the availability.

d. Conduct the overhaul closeout conference (paragraph 4.5.4).

e. Verify that Provisioning Technical Documentation (PTD) has been provided for all new equipment and machinery installed during the availability.

f. Obtain from the shipyard contractor drawing changes to show configuration changes accomplished by the shipyard contractor and verify that these drawings reflect regulatory approval where required.

**4.5.1 DOCK AND SEA TRIALS**

The Administrative Area Commander shall include in work packages for major availabilities a requirement for dock and sea trials. These trials provide for evaluation of maintenance, repair, calibration and alteration work performed during the availability. Dock trials are performed first to demonstrate the ability of the ship to get underway, to demonstrate machinery which can be tested effectively at pierside and to demonstrate proper operation of safety devices. Sea trials are conducted underway to demonstrate the proper operation of ship propulsion, steering, propulsion control, anchor windlass and electrical systems. Post-availability dock and sea trials shall be performed with the Master and Chief Engineer aboard and with additional personnel required by the USCG to conduct the trials. The Chief Engineer shall witness all machinery and systems tests accomplished during the dock and sea trials paying particular attention to the performance of equipment which was maintained and repaired during the availability and the operation of safety devices.

**4.5.2 SCRAP AND SALVAGE REPORT**

The Port Engineer shall submit to the Administrative Area Commander a scrap and salvage report for Government material left over at the end of the availability in accordance with COMSCINST 4000.2 (Military Sealift Command Supply Procedures Manual).

**4.5.3 RESOLVING THE SHIPYARD BILL**

The Port Engineer shall provide technical input to assist the Contracting Officer or his authorized representative in resolving charges for growth work items, additional work items, canceled work items and credits against work items. At the completion of the availability, and before departing from the shipyard contractor's facility, the Port Engineer shall ensure that all input needed to resolve the bill from the shipyard is provided to the Contracting Officer or his authorized representative.

**4.5.4 OVERHAUL CLOSEOUT CONFERENCE**

a. The Port Engineer shall conduct the Overhaul Closeout Conference (OCC) attended by the Master, Chief Engineer and Contracting Officer or his authorized representative. This conference shall review the amount and type of growth work and additional work required during the availability, decisions made, management techniques used and the type and amount of work deferred. The Chief Engineer shall provide operational and technical input as needed for a complete and accurate review. A closeout report shall delineate work package changes made and identify whether they were due to growth work, canceled work or additional work, whether they originated from sponsor or MSC work items and whether changes resulted from:

(1) Regulatory inspections.

(2) "Open and inspect" deficiencies.

(3) Late GFE/GFM.

(4) Failure to identify required work.

(5) Deficient work items.

(6) Weak contract clauses.

(7) Emergent work which could not have been previously identified by the last addendum to the solicitation.

(8) New work.

(9) "B" items issued to the shipyard as defined by COMSCINST 4330.21C.

b. The Port Engineer shall provide this report to MSC Headquarters and the Administrative Area Commander no later than 60 days after completion of the shipyard contract. This report shall list the dollar and percentage value of each of the above categories, final contract price, original price, percentage growth (over the total value of Category "A" and "B" items, as defined by COMSCINST 4330.21C), lessons learned and future actions required.

**TABLE 4.1**

**STATUS REPORT FOR SHIPS IN REGULAR OVERHAUL, MID-TERM AVAILABILITY AND EXTENDED MAINTENANCE PERIODS**

| Message Paragraph No. | Title/Brief |
|---|---|
| 1 | Status of work: by (name and location of shipyard contractor); at (location of ship if not at shipyard contractor's facility); for week ending (date); contract start (date); contract completion (date); revised completion (date), if applicable; estimated completion (date). |
| 1A | Percentage of total work completed by the shipyard contractor vs. percentage of total time expended in the availability. |
| 1B | Status of work items (providing listing of work package section numbers, i.e., 100 series, 200 series, 300 series, etc., in one column and overall percent completion for each work package section); status of work completed by the ship's force shall be included as the last line item in this paragraph. |
| 1C | Status of key milestones displayed in four columns. Column 1: Milestone; Column 2: Originally scheduled completion date; Column 3: Revised completion date, if applicable; Column 4: Estimated completion date, if applicable. |
| 2 | Status of change orders to shipyard contract: total number of additional work items issued; total number of growth work items issued; total number of canceled work items or credits issued; total number of change orders negotiated and settled; total number of change orders not yet negotiated; present growth percent to contract. (Growth shall be calculated by dividing the net increase/decrease in contract value by the original contract value. Original contract value includes Additional Government Requirements options, spare and repair parts pools and material pools.) |
| 3 | GFE/GFM status, indicating delays in delivery and actions taken to track late items. |
| 4 | Quality of work performed by shipyard contractor, including number of quality deficiency reports issued. |

| Message Paragraph No. | Title/Brief |
|---|---|
| 5 | Job manning status: indicate if manning is adequate, whether manning is lacking in specific trades, impact of deficient manning on certain work items (if applicable). Comments on adequacy of sub-contractor manning shall also be provided. |
| 6 | Problem areas: provide listing and description. |
| 7 | Master's comments. (Note 1) |
| 8 | Port Engineer's comments. (Note 2) |

Note 1:

Master's comments shall:

1. Reflect opinion on ship's ability to accomplish mission after the availability.
2. Address crewing problems and crew phase-up problems and shortages.
3. Address in general terms work package execution.

Note 2:

The Port Engineer shall:

1. Make explanations brief and to the point, yet sufficiently detailed to describe the facts.
2. Ensure report's clarity by evaluating it from the viewpoint of the receiver.
3. Indicate "Not applicable" or "No response" only in those paragraphs for which no information is available.
4. Render opinions as objectively as possible.
5. Address concerns with the manner and schedule in which the contractor/SRF executes the work package.
6. Address deficient job manning and contractor financial difficulties.
7. Address problems with the Government supply system, work package quality, late identified new work and slow negotiation of changes.
8. Not restate the Master's comments.

# CHAPTER 5

# MANAGEMENT OF ROUTINE CORRECTIVE MAINTENANCE

## 5.0 MANAGEMENT OF ROUTINE CORRECTIVE MAINTENANCE

The Chief Engineer is responsible for providing management oversight to accomplish all shipboard maintenance and repair. This includes managing, supervising and establishing priorities for corrective and preventive maintenance (chapter 7). All maintenance and repair shall be accomplished to ABS and USCG standards except for those specific systems and equipments which these standards do not address (e.g., Underway Replenishment Systems, Helicopter Decks and Electro-Magnetic Interference Installations).

## 5.1 TYPES OF CORRECTIVE MAINTENANCE

General repairs which can be accomplished without requiring a change in the ship's schedule are voyage repairs. Repairs needed for the ship to accomplish its assigned mission or to remain in a seaworthy condition or repairs to ensure the safety of the ship's force are emergency repairs (chapter 6).

## 5.2 REPORTING CORRECTIVE MAINTENANCE REQUIREMENTS

The Chief Engineer shall ensure that corrective maintenance requirements are reported using:

a. Casualty Reports (paragraph 5.2.1).

b. Voyage Repair Requests (paragraph 5.2.2).

### 5.2.1 CASUALTY REPORTS (R

The Chief Engineer shall prepare Casualty Reports (CASREPs) for corrective maintenance resulting from equipment malfunctions or deficiencies that may affect the safety of the ship's force, or the ship or limit the ship's ability to accomplish its mission. COMSCINST 3121.9 (Standard Operating Manual) and Naval Warfare Publication (NWP) 10-1-10 (Operational Reports) provide guidelines and requirements for submitting CASREPs.

a. In accordance with 46 CFR Part 4, the following types of casualties must be reported to the nearest Coast Guard Marine Safety Office or Marine Inspection Office:

(1) Groundings which create a hazard to navigation, the environment or the safety of the ship.

(2) Loss of main propulsion of primary steering or associated component which reduces the ship's maneuvering capabilities.

(3) Any occurrence which adversely affects the ship's seaworthiness, including but not limited to, fire, flooding damage to fixed fire extinguishing systems, lifesaving equipment, auxiliary power equipment or bilge pumping equipment.

(4) Loss of life.

(5) Injury which requires professional medical treatment beyond first aid, rendering the person unfit to perform further duties.

(6) Any occurrence which results in damage to ship's property, machinery or equipment, the cost of which to restore to its service condition is estimated to exceed $25,000.

(7) Casualties to standby generators, emergency generators and emergency fire pumps.

b. For those casualties reported under 5.2.1a, a follow-up copy of a Vessel Casualty Report (CG 2692) must be provided to the local USCG Marine Safety Office and the casualty reported to ABS within 12 hours of arrival in port.

c. Determination of the impact of casualties on ship safety and mission readiness is always at the discretion of the Master. Unless the Master determines otherwise, casualties to standby generators, emergency generators and emergency fire pumps shall be reported as C-3 casualties when underway and as C-4 casualties in port according to COMSCINST 3121.9 and NWP 10-1-10. When arriving in port, casualties to standby generators, emergency generators or emergency fire pumps shall be dowgraded to C-4.

d. The rating of these casualties is consistent with USCG and ABS requirements and the immediate repair directed under the provisions of these regulations. These and other "no sail" requirements are of prime importance and must be adhered to in the letter and spirit of the regulations.

R) **5.2.2 VOYAGE REPAIR REQUESTS**

a. The Chief Engineer shall prepare Voyage Repair Requests (VRRs) to request shipboard maintenance and repair requiring industrial assistance or technical representative assistance. VRRs shall be prepared in the format shown on Table 5.1 and submitted by cc:mail or Navy message.

b. The Chief Engineer will use the SAMM system to track and record VRRs (paragraph 7.3.1). The Chief Engineer shall ensure that CASREPs (paragraph 5.2.1) are submitted only for those VRRs which indicate equipment malfunctions or deficiencies that may affect the safety of the ship's force, or the ship or limit the ship's ability to accomplish its mission. CASREPs shall not be submitted for repair or adjustment of nonessential equipment, i.e., the ship's copier or ice machine. Such repair requirements shall be submitted as VRRs.

**5.3 VOYAGE REPAIRS**

Voyage repairs may be accomplished by:

a. The ship's force.

b. Industrial assistance contractors.

c. Technical representatives.

or a combination of any of these while in port, at sea, at an anchorage, in a shipyard or in drydock.

**5.3.1 VOYAGE REPAIRS BY THE SHIP'S FORCE**

To minimize reliance on outside industrial assistance contractors and technical representatives, the Chief Engineer shall direct shipboard engineering personnel in performing any maintenance and repair which can reasonably be accomplished without industrial or technical representative assistance. Table 5.2 shows (R
typical jobs which COMSC considers to be within the capability of the ship's force. The Chief Engineer shall manage ship's force accomplishment of Table 5.2 actions and other actions of similar complexity and technical difficulty. In addition, the Chief Engineer shall task watchstanding personnel to perform limited maintenance and repair while on watch. This maintenance and repair action shall not interfere with primary watchstanding responsibilities (paragraph 2.1.1).

**5.3.2 VOYAGE REPAIRS REQUIRING INDUSTRIAL ASSISTANCE**

a. The Chief Engineer shall identify voyage repairs requiring industrial assistance to the Administrative Area Commander so that work can be done during an inport period or voyage turnaround.

b. The Port Engineer shall manage the voyage repairs and maintain liaison with the command to which he/she is assigned. The Chief Engineer shall witness and attest to the satisfactory operation of all machinery and equipment repaired, maintained or modified. When repairs are limited and the availability or inport location is not local to the Administrative Area Commander, the Administrative Area Commander may require that the Chief Engineer supervise voyage repairs. In these cases, the Chief Engineer shall report to the Administrative Area Commander the status of ongoing work and the satisfactory completion of work.

### 5.3.3 VOYAGE REPAIRS REQUIRING TECHNICAL REPRESENTATIVE ASSISTANCE

The Administrative Area Commander shall ensure that all technical representatives are manufacturer's technical representatives or authorized manufacturer's technical representatives. Manufacturer's technical representatives are employed directly by the manufacturer of the equipment or machinery being serviced. Authorized manufacturer's technical representatives are not employed by the manufacturer, but have been recognized by the manufacturer as qualified to perform service work on their equipment or machinery.

#### 5.3.3.1 CHIEF ENGINEER'S DUTIES

a. The Chief Engineer, as directed by the Administrative Area Commander, shall establish procedures for the check in, review of work and departure of all technical representatives. This will include:

(1) Describing required work to the technical representative.

(2) Reviewing the technical representative's service report to make sure that it accurately reflects the work accomplished and the time spent on the job.

(3) Obtaining a copy of the technical representative's service report.

b. The Chief Engineer shall coordinate the scheduling of technical representative assistance with the Administrative Area Commander. The Chief Engineer shall assign an engineering member of the ship's force to work with the technical representative so that the ship's force will benefit from the technical representative's experience and expertise. The Chief Engineer shall retain a copy of service reports in shipboard files.

# VOYAGE REPAIR REQUEST

TABLE 5.1

COMSCINST 3540.6 (A

| | | |
|---|---|---|
| 1. Ship Name: | A2. Hull Number: | A3. Date: |

| | | |
|---|---|---|
| A4. VRR No.: | A5. Priority: *(Check One)* ☐ A ☐ B ☐ C | A6. Title: |

A7. Department: *(Check One)* ☐ Engine ☐ Deck ☐ Supply ☐ Sponsor ☐ Medical ☐ Other

A8. Category: *(Check as applicable)*

☐ Drydock Required
☐ Within SF Capability
☐ TRANSALT Required
☐ Cold Plant Required
☐ Result of CM/PM Program
☐ Configuration Change
☐ Hot Plant Required
☐ Result of MRE Program

B1. Abstract:

B2. References:

B3. Item Location/Description:

B3.1 Location:

B3.2 Item Description/MFG Data:

B3.3 Parts/Material Required:

B4. Not used:

B5. Notes:

B6. Quality Assurance Requirements:

B7. Statement of Work:

MSC 3120/37 (1-94)

TABLE 5.1 (Cont'd)

INSTRUCTIONS FOR COMPLETING VOYAGE REPAIR REQUEST (VRR) FORM

VRRs submitted via cc:mail or Navy message must show the alphnumeric designator for each field. The following fields must be completed for each VRR:

**A1** - Ship Name:

**A2** - Hull Number:

**A3** - Date:

**A4** - VRR Number: The voyage repair item number is five digits long. It starts with the three-digit sequential number and ends with the year. For example, 00493 indicates the fourth VRR written in 1993.

**A5** - Priority: The priority of the repair indicated in the VRR form must comply with the following:

Priority A: Mandatory repairs which must be accomplished to enable the ship to meet operational requirements. CASREPs are required for Priority A VRRs.
Priority B: Repairs which do not require CASREPs but which must be accomplished to maintain material readiness or a safe environment.
Priority C: Repairs which are desirable, but which may be deferred without degrading shipboard material readiness.

**A6** - Title: Brief identification of nature of VRR.

**A7** - Department: Indicate appropriate department (Engine, Deck, Supply, Sponsor, Medical, Other).

**A8** - Category: Indicate appropriate category:

TRANSALT Required: Indicate if accomplishment of the VRR requires a TRANSALT.
Configuration Change: Indicate if the work descried by the VRR either modifies the equipment configuration or changes COSAL parts support.
Drydock Required: Indicate if the ship must be drydocked to accomplish the VRR.
Cold Plant Required: Indicate if a cold plant is required to accomplish the VRR.
Hot Work Required: Indicate if hot work is required to accomplish the VRR.
Within Ship's Force Capability: Indicate if work described by the VRR is within the capability of the ship's force.

Result of CM/PM Program: Indicate if work described by the VRR is a result of or initiated by a condition monitoring or preventive maintenance program (SAMM or CMP). Result of MRE Program: Indicate if work described by VRR is a result of a deficiency identified during a Material Readiness Evaluation (paragraph 8.1).

**B1** - Abstract: Provide a brief overview of required work, identifying the purpose of the VRR.

**B2** - References: List the primary drawings specifications, manuals and other documents necessary for the performance of the work.

**B3.1** - Location: Identify the location where the work will be performed.

**B3.2** - Item Description/Manufacturer's Data: Provide the following pertinent nameplate and technical data to describe the equipment (nomenclature, manufacturer, model number, APL, quantity).

**B3.3** - Parts/Material Required: Describe in detail all material, type and quantity required to perform the repair. If parts are required, identify nomenclatures and quantities of each part required to perform the repair. If parts are required, identify nomenclatures and quantities of each part. This data must be in the same format as the 1PARTS and 1STRIP data sets mused in a CASREP. NWP 10-1-10 has information on this data.

**B4** - Not Used: Do not complete this field on VRRs. This field is reserved for DGM/GFS/GFE work item information.

**B5** - Notes: Provide any explanatory information that does not lend itself to Field B7.

**B6** - Quality Assurance Requirements: Specify requirements for certification of material and workmanship required in Field B7. Identify safety inspections and tests required. Identify personnel qualification requirements for accomplishing VRR.

**B7** - Statement of Work Required: Describe work to be accomplished to accomplish the VRR.

## TABLE 5.2

## SHIP'S FORCE CAPABLE REPAIRS/WORK

The items identified below are examples of the type and complexity of work determined to be within the capability of the ship's force. This is not a comprehensive list, but rather is a representative sampling of ship's force capable work. Only under unusual circumstances should industrial assistance be requested to accomplish the type of work identified herein.

1. Painting: preparing and painting interior and machinery areas; preparing and painting exterior areas, except underwater portions of hull and those areas requiring blasting to ensure effective repainting.

2. Valves: repairing and replacing all valves four inches and under except skin valves below the waterline. VRRs for all other valves requiring industrial assistance shall indicate the type, size, extent of repairs, location and service of each valve listed.

3. Watertight doors: maintaining dogs, wedges, gaskets, knife edges and all operating gear, inspecting door for structural defects.

4. Air ports: maintaining gaskets, hinges, knife edges, glass and bolts.

5. Ventilation systems: cleaning coils and ducting, freeing dampers, repairing holes, repairing screens and installing inspection plates.

6. Nameplates: replacing machinery nameplates and damage control equipment markings.

7. Hooks, brackets: installing hooks, padeyes and brackets, except those requiring load test.

8. Galvanizing work: removal of items which must be galvanized ashore.

9. Bilges and voids: touch-up preparing and painting bilges and voids.

10. Boats: performing minor engine repairs which can be accomplished without removal of engine from boat.

11. Running rigging: replacing running rigging (industrial assistance contractor to perform load tests).

12. Inspections and tests: performing routine checks and inspections of all machinery to determine extent of required repairs, periodically testing machinery as required by SAMM (or in maintenance plan), performing and witnessing all machinery tests required by regulatory authorities.

13. Piping: renewing gaskets and performing simple piping repairs and replacements.

14. Diesel engines: performing maintenance as prescribed in SAMM (or in maintenance plan).

15. Boilers: cleaning of firesides and watersides, performing minor brickwork and casing repairs and performing hydrostatic tests.

16. Auxiliary machinery: routine maintenance and repair of auxiliary machinery.

17. Firemain: testing, inspecting and repairing firemains as required.

18. Air compressors: overhauling and repairing air compressors.

19. Refrigeration compressors: overhauling and repairing refrigeration compressors in accordance with EPA regulations. (R

20. Distillers, condensers, coolers: mechanical and chemical cleaning, replacing of zincs and gaskets, plugging leaking tubes.

21. Gages, thermometers and meters: replacing pressure gages, thermometers and meters.

22. Relief valves: performing and witnessing tests, as required.

23. Safety guards: fabricating and installing safety guards.

24. Shaft and bearing clearances: measuring shaft and bearing clearances.

25. Motors: maintaining interior and exterior surfaces clean and free of dirt, water, lint, oil, etc.

26. Motor bearings: inspecting, cleaning, lubricating and replacement of auxiliary motor bearings.

27. Motor electrical connections: inspecting and repairing of motor electrical connections.

28. Megger readings: taking and recording electrical insulation resistance readings.

29. Motor brushes: fitting of new brushes on motors.

30. Switchboards and control equipment: maintaining and cleaning interior of switchboards, filters and power supplies, inspecting switchboard electrical connections.

31. Minor electrical repairs: locating shorts, grounds, open circuits, renewing defective cable where practical, replacing thermostats, switches, heating elements, relays, solenoids, controllers.

32. Antennas: lubricating and cleaning of all antennas, replacing of wire antennas.

33. Electronic equipment: routine cleaning to maintain equipment dust and moisture free, troubleshooting, calibrating and adjusting equipment.

34. Cables and waveguides: checking for bending, shielding and proper connections, replacing cable on short cable runs.

35. Phones and jacks: repairing and replacing phones and jacks.

# CHAPTER 6

# EMERGENCY REPAIRS

## 6.0 EMERGENCY REPAIRS

When structural or equipment failure or malfunction threatens the seaworthiness of the ship, the safety of the ship's force or the ship's schedule, the Master of the ship shall inform the Administrative Area Commander of the situation by immediately filing a Casualty Report (CASREP, paragraph 5.2.1). COMSCINST 3121.9 (Standard Operating Manual) and Naval Warfare Publication 10-1-10 (Operational Reports) provide guidelines and requirements for submitting CASREPs. In addition to the routine information required by CASREPs, this report also shall indicate the need for at sea assistance (e.g., tow or helo drop of parts) and, if appropriate, recommend a repair port.

## 6.1 INDUSTRIAL ASSISTANCE FOR EMERGENCY REPAIRS

The Administrative Area Commander shall take action necessary to provide immediate assistance to ship's force to ensure their safety and the mission. If necessary, the Administrative Area Commander will direct the ship to proceed to an assigned port for industrial assistance.

## 6.2 REGULATORY NOTIFICATION

ABS surveys and USCG inspections are required when a ship sustains damage or casualties requiring emergency repair. As soon as the Administrative Area Commander decides the port where emergency repairs will be accomplished, the Port Engineer shall inform the USCG Officer in Charge of Marine Inspection (OCMI) for that port and the local ABS office. If any other surveys or inspections (chapter 3) can be made concurrently with damage surveys and inspections, the Administrative Area Commander shall ensure that they are accomplished. For instance, if repair of hull damage requires drydocking, the Administrative Area Commander shall ensure that appropriate inspections are made and that drydocking credit is obtained from the ABS and USCG.

### 6.2.1 SPECIAL USCG REQUIREMENTS

The Administrative Area Commander shall notify the OCMI of any emergency repairs. USCG regulations require:

a. An inspection every time an accident occurs or defect is discovered which affects the safety of the ship, its stability, the completeness of lifesaving appliances or firefighting equipment or whenever important repairs or renewals are required.

b. Informing the OCMI of any scheduled or unscheduled drydocking of a ship.

c. An inspection whenever repairs affect the stability of the ship.

**6.3 MANAGING EMERGENCY REPAIRS**

Emergency repair management shall be in accordance with the applicable portions of chapter 4, Availability Management.

# CHAPTER 7

# PREVENTIVE AND PREDICTIVE MAINTENANCE

## 7.0 PREVENTIVE AND PREDICTIVE MAINTENANCE (R

The Military Sealift Command Engineering Office manages the maintenance, repair, alteration and modification of all MSC ships. A major part of this management effort is implementing and using preventive and predictive maintenance tools to improve machinery reliability, reduce maintenance costs and improve documentation of shipboard machinery maintenance and monitoring actions. These tools are included in the Shipboard Automated Maintenance Management (SAMM) system which schedules and documents all preventive and predictive maintenance. The SAMM system is installed on a microcomputer onboard all MSC ships.

## 7.1 PREVENTIVE MAINTENANCE (PM) (R

Preventive maintenance (PM) is the maintenance required on a periodic basis to prevent machinery casualties and maintain machinery operational readiness.

## 7.2 PREDICTIVE MAINTENANCE (R

The predictive maintenance program applies predictive maintenance indicators such as vibration, temperature and pressure measurements and lubricant analyses to detect problems in equipment before they become casualties.

## 7.3 SAMM SYSTEM (R

a. The SAMM system is a fleetwide shipboard program for preventive maintenance. The SAMM system performs the following functions.

(1) Maintains material readiness.

(2) Develops and publishes standards for shipboard maintenance.

(3) Tracks and documents shipboard maintenance actions and machinery history.

(4) Establishes and schedules required maintenance actions.

(5) Improve equipment operating performance.

(6) Reduces equipment downtime and repair costs.

b. The SAMM system provides a schedule of required maintenance tasks for each piece of maintainable equipment. Maintainable equipment in the SAMM system includes components of the main propulsion system, auxiliary systems, cargo handling and deck machinery systems, UNREP/VERTREP systems, hotel services systems, firefighting and safety systems, damage control systems, navigational electronics and sponsor related systems for which MSC bears the maintenance responsibility. The SAMM system does not include sponsor equipment for which MSC does not bear the maintenance responsibility and electronic equipment which is maintained by the ship's Military Detachment. SAMM does not include normal watchstanding maintenance requirements.

R) **7.3.1 SAMM SYSTEM MODULES**

a. The Machinery History Module of SAMM provides access to equipment nameplate and ratings information, maintenance actions assignment and machinery history and parts information.

b. The Shipboard Maintenance Module provides the monthly Maintenance Schedule. This module assists with the daily management of shipboard maintenance activities by providing a list of maintenance actions that are currently scheduled. This list can be sorted by billet, job number or assigned equipment. The shipboard user can either document maintenance actions as complete or defer the action to a future date. All actions not completed or deferred will remain on the maintenance schedule. The Regulatory Body Inspection Requirements tracking list is also contained in this module.

c. The Corrective Maintenance Module enables the Chief Engineer to create and update Voyage Repairs Requests (paragraph 5.2.2), write and process CASREPs (paragraph 5.2.1) maintain Standard Voyage Repairs and write and assign the Ship's Force Worklist. The Ship's Force Worklist provides a means to review, schedule and document maintenance actions performed by ship's force.

d. The Parts Module permits the Chief Engineer to review the repair parts for each piece of equipment in SAMM that has been assigned an allowance parts list (APL). The parts information is loaded shoreside directly from the COSAL information. This module also provides a means to generate and track part requisitions. SAMM will eventually link directly into the Configuration Logistics Improvement Program (CLIP) for parts information.

e. The System Manager Module allows the Chief Engineer to tailor the SAMM system to specific ship needs, complete backups and run feedback update diskettes.

### 7.3.2 RESPONSIBILITY FOR INCORPORATING AND MAINTAINING THE SAMM SYSTEM

Using and maintaining the SAMM system requires the interaction and mutual support of individuals on board MSC ships, in the Administrative Area Commands and at MSC Headquarters.

#### 7.3.2.1 MSC HEADQUARTERS RESPONSIBILITIES

MSC Headquarters Engineering Director (N7) shall manage the installation, maintenance and modification of the SAMM system for all MSC ships. This includes:

a. Maintaining the current master database for all ships.

b. Developing and monitoring fleet and class-wide maintenance requirements.

c. Approving SAMM system software revisions.

d. Coordinating SAMM system development, SAMM upgrades and SAMM installation for all ships.

e. Maintaining ABS approval of the SAMM system.

f. Providing quarterly updates and responses to all feedback generated by shipboard personnel.

g. Reviewing SAMM system and individual ship performance.

#### 7.3.2.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES

Administrative Area Commanders shall evaluate and verify shipboard use of the SAMM system for all ships under their cognizance. This includes:

a. Verifying that ships perform and document maintenance scheduled in the SAMM system and provide monthly reports on work accomplished under SAMM system control.

b. Providing input to MSC Headquarters on individual ship maintenance plans.

c. Reviewing all monthly SAMM system reports and feedback comments and forwarding them to MSC Headquarters with recommendations for appropriate action.

d. Inspecting shipboard maintenance management performance and use of the SAMM system during Command Inspections (paragraph 8.2) and at other times as necessary.

e. Informing MSC Headquarters when new, replacement or additional equipment is installed so that an appropriate maintenance plan may be developed.

R) f. Designating a SAMM system coordinator within the Administrative Area Commander's Engineering Office. This coordinator will:

(1) Prepare a monthly SAMM Report for the Director and Deputy Director of Engineering, which identifies the number of outstanding PM actions, percent of scheduled PM actions completed, percent of scheduled PM actions deferred, new Voyage Repair Requests (VRRs) (paragraph 5.2.2) and Casualty Reports (CASREPs) (paragraph 5.2.1) written, Configuration/Nameplate changes, additional independent Machinery History entries and repeat or chronic deferrals of maintenance items.

(2) Assess the overall SAMM usage rate per ship on a monthly basis, based on the month's data entries, completions, deferrals, etc. Prepare a SAMM Usage Report and assign a grade according to the following rating scale:

| | |
|---|---|
| **Outstanding:** | Far exceeds expectations for SAMM system usage. |
| **Excellent:** | Exceeds expectations for SAMM system usage. |
| **Good:** | Meets expectations for SAMM system usage. |
| **Satisfactory:** | Barely meets expectations for SAMM system usage. |
| **Unsatisfactory:** | Does not meet expectations for SAMM system usage. |

(3) Present the monthly SAMM Usage Report to the Director and Deputy Director of Engineering, cognizant Type Desk Port Engineer and Port Chief Engineer.

(4) Act as the primary point of contact for the Administrative Area Commander on all SAMM related matters, including ship's force training and interfacing with MSC Headquarters.

g. Training all Chief and First Assistant Engineers in the use of the SAMM system before their assignment to a ship. Other members of the ship's force also may be trained.

**7.3.2.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Prepare a monthly Preventive Maintenance (PM) schedule. Supporting "Billet Worksheets" will be produced as necessary to identify each person, watch or department responsible for completion of each maintenance action. "PM Job Tickets" will also be produced to provide detailed information for each PM action.

b. Record all completed maintenance actions in the SAMM system. The completion date, action, title and PM code number are automatically recorded on the Machinery History card and, if applicable, megger readings also are automatically posted to the Megger Card.

c. Schedule, perform, track, document and report planned maintenance actions in accordance with the SAMM system.

d. Verify that all information entered into the SAMM system is accurate and current.

e. Provide to the Administrative Area Commander information and comments on SAMM system maintenance requirements, system performance and maintenance schedules.

f. Report changes to equipment and ship configuration which will require the addition or deletion of SAMM system preventive maintenance data.

g. Provide monthly reports to the Administrative Area Commander on SAMM system maintenance accomplishment and performance.

h. Backup SAMM system files on disk at least once at (R
least once per week and maintain two updated back-up disks at all times.

i. Configure SAMM system operating parameters to reflect the ship's current operational status and billet assignments.

j. Generate Voyage Repair Requests (paragraph 5.2.2) from the Corrective Maintenance Module.

k. Verify that the nameplate data, serial numbers, (A
model numbers, etc. contained in SAMM are accurate. This is to be accomplished on an ongoing basis. For instance, if repairs to the #1 Vacuum Pump are being entered in Machinery History, this data shall be verified at that time.

A) 1. Initiate assistant engineers in the fundamentals of SAMM, conceptually and functionally. Ensure that assistant engineers, once trained, make PM Maintenance and Machinery History item entries.

A) **7.3.2.4 CONSTRUCTION REPRESENTATIVE'S (CONREP'S) DUTIES**

On a new construction or conversion program, the CONREP shall enter machinery history data into SAMM before the Chief Engineer arrives. Typical machinery history entries include machinery and equipment test results, inspections and repairs.

R) **7.3.3 ABS APPROVAL OF MSC's SAMM SYSTEM**

MSC has submitted Planned Maintenance Booklets for Preventative[1/] Maintenance to the ABS for each ship that has SAMM installed. ABS has approved the planned maintenance system presented therein for compliance with the ABS Guide for Survey Based on Preventative Maintenance Techniques. Adhering to the planned maintenance system which conforms with these guidelines will reduce the number of "open and inspect" actions performed specifically for ABS surveys.

1/ NOTE: ABS uses the term "preventative" maintenance. MSC uses the more current term "preventive." The definition of both words is the same.

**7.3.3.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall ensure that ABS surveyors complete the Annual Survey of Preventative Maintenance concurrently with the Annual Survey of Machinery. The Annual Survey of Preventative Maintenance requires the Surveyor to survey and report on any machinery opened at the time of the visit, generally examine all machinery, witness functional tests as appropriate, review the ship's periodical condition monitoring data and record of maintenance and repairs and report on the continued effectiveness of the SAMM system.

R) **7.3.3.2 CHIEF ENGINEER'S DUTIES**

When the Annual Survey of Preventative Maintenance is accomplished, machinery maintained by the SAMM system may be credited with meeting Special Continuous Survey requirements at the surveyor's discretion. To obtain Continuous Survey credit for a particular piece of equipment, the Chief Engineer shall present to the attending surveyor a copy of the SAMM system ABS approval letter (retained on board the ship) and a printout of the machinery history for the previous year. The Chief Engineer shall request from the attending surveyor a copy of the preventive maintenance report for ABS credit and documentation.

## 7.4 CONDITION MONITORING PROGRAM (CMP) (R

The CMP applies predictive maintenance indicators such as vibration, temperature and pressure measurements and used oil analyses to detect problems in equipment before they become casualties. When effectively interpreted using SAMM CMP software, predictive maintenance data can reduce unscheduled downtime, reduce repair time, extend machinery life and avoid catastrophic failures. Analyses of the CMP predictive maintenance indicators will be recorded in the SAMM system databases.

### 7.4.1 ELEMENTS OF THE CMP

a. Primary elements of the CMP are the:

(1) Vibration Monitoring System

(2) Lube Oil Monitoring and Analysis Program

(3) Hydraulic Oil Monitoring and Analysis Program

(4) Insulation Resistance Measurement Program

(5) Thermographic Analysis Program

(6) Boiler Water and Feedwater Testing and Treatment Program

(7) Diesel Engine Cooling Water Analysis Program

b. Additional elements are being researched and will be added to the CMP when development is complete.

### 7.4.2 CMP GOALS

The CMP seeks to improve the overall material readiness and operating efficiency of the MSC fleet. This will be achieved by:

a. Providing a basis for improving existing machinery maintenance strategy. As the CMP generates data regarding actual machinery condition on board MSC ships, the frequency of maintenance actions directed by the SAMM system (paragraph 7.3) can be modified based upon CMP data.

b. Reducing repair costs and equipment downtime by providing an indication of required maintenance before equipment failure.

c. Reducing costs associated with ABS survey requirements.

d. Providing quality assurance for repair work. The CMP's Vibration Monitoring Program provides a means to accomplish quality assurance of repair work performed on equipment. Identification of potential problems before accepting repair work will assist in preventing machinery casualties and erroneous acceptance of work.

e. Standardizing maintenance of ship's machinery. A consistent methodical approach to accomplishing maintenance actions and equipment checks eliminates subjectivity and inconsistencies that may result from crew changes. In addition, this approach ensures that data used in trend analysis is consistently obtained and immediately available for interpretation.

f. Ensuring consistency of maintenance decisions. Basing maintenance decisions on data from the CMP will result in making similar maintenance decisions under similar conditions.

g. Providing a way to manage shipboard engineering information elements consistent with the method used by shoreside management.

R) **7.4.3 VIBRATION MONITORING SYSTEM (VMS)**

Vibration of rotating machinery accelerates machinery wear. Vibrating machinery elements such as bearing housings, are usually accessible from the outside of the machine so that the resulting vibration can be measured. MSC uses VMS to measure and analyze machinery vibration. Vibration measurements can diagnose problems for shipboard rotating machinery without opening the machinery for inspection. The vibration frequency spectrum of machinery gives a characteristic shape (vibration signature) when the machinery is in good condition. When faults begin to develop, the vibration signature changes. The change in the signature determines the developing fault with the machine.

R) **7.4.3.1 VMS OBJECTIVES**

The objectives of the VMS are to increase operational readiness, improve equipment performance and reduce ship maintenance costs. These objectives will be met when the following criteria have been met.

a. The ship's force is familiar with shipboard machinery behavior.

b. The need for unnecessary time based overhauls is reduced.

c. Repairs can be scheduled in an advanced organized fashion.

d. Machinery requiring repair can be identified before it fails.

e. A determination of required machinery maintenance can be made based upon the manufacturers' recommendations, its operational requirements and vibration data.

f. The number of C-3/C-4 CASREPs (paragraph 5.2.1) is reduced.

g. Machinery open and inspect requirements are reduced.

**7.4.3.1.1 VMS METHODOLOGY** (A

The shipboard VMS uses a vibration data collector, a microcomputer software package and an expert automated diagnostic system (EADS). The VMS allows the ship's force to obtain vibration data and analyze them without extensive shoreside support. The VMS provides the operator with a summarized list of potential machinery faults. The following sequence of events is typical.

a. The operator carries the data collector to each piece of machinery and attaches a vibration transducer to a predetermined data point(s) on each monitored machine.

b. Vibration data is collected and stored in the portable data collector for each piece of machinery. Collection of vibration data will occur at least quarterly.

c. Collected data is loaded to the VMS shipboard personal microcomputer.

d. The analysis software processes the vibration readings for each data point and provides analyses, including trending and diagnostic reports.

**7.4.3.1.2 EXPERT AUTOMATED DIAGNOSTIC SYSTEM (EADS)** (A

An EADS is included in the software to aid in interpreting machinery vibration data and to diagnose machinery faults. The system contains data such as machinery running speed, number of gear teeth, number of pump vanes, bearing type, etc. This data and the collected vibration data at specific frequencies for each piece of machinery enables it to diagnose machinery problems and their magnitude (slight, moderate, severe, extreme) to identify machinery vibration trends, predict failure and provide repair recommendations to the engineer.

A) **7.4.3.1.2.1 INTERPRETING EADS REPORTS**

Table 7.1 provides a sample EADS report and interprets the results. For questions about EADS repair recommendations, the individual data files for that machinery shall be sent (via cc:mail) to the Administrative Area Commander or MSC Headquarters for manual analysis.

A) **7.4.3.1.2.2 ACTING ON EADS REPORTS**

Based upon VMS results, the ship's force shall do the following:

a. Accomplish the repair to bring the machinery vibration levels within safe parameters.

b. Issue a VRR (paragraph 5.2.2) if the repair cannot be accomplished by the ship's force. Parts availability shall be verified if industrial assistance or technical representative assistance is necessary.

c. Issue a CASREP (paragraph 5.2.1) if EADS recommends that machinery operation be discontinued and if discontinued operation degrades ship's mission capabilities.

d. Request further analysis of EADS recommendations according to paragraph 7.4.3.1.2.1.

R) **7.4.3.2 RESPONSIBILITY FOR INCORPORATING AND MAINTAINING THE VMS SYSTEM**

Using and maintaining the VMS requires the interaction and mutual support of individuals onboard MSC ships, in the Administrative Area Commands and at MSC Headquarters.

A) **7.4.3.2.1 MSC HEADQUARTERS RESPONSIBILITIES**

MSC Headquarters shall manage the installation, maintenance and modification of the VMS for all MSC ships. This includes:

a. Managing the maintenance of the master databases for all ships.

b. Approving VMS software revisions.

c. Coordinating VMS development, upgrades and installations for all ships.

d. Maintaining ABS approval of the VMS.

e. Coordinating and providing analysis support for vibration EADS reports submitted from any shipboard VMS.

f. Reviewing VMS data and individual ship performance.

g. Providing EADS reports to MSCHQ type desks for machinery fault tracking and correction.

**7.4.3.2.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES** (A

Administrative Area Commanders shall evaluate and verify shipboard use of the VMS for all ships under their cognizance. This includes:

a. Verifying that ships collect vibration data for monitored machinery on a quarterly basis at a minimum.

b. Reviewing all monthly EADS reports and provide fault documentation to appropriate type desks for tracking and correction.

c. Inspecting VMS use during Command Inspections (paragraph 8.2) and at other times as necessary.

d. Designating a VMS coordinator with the Administrative Area Commander's Engineering Office.

e. Training all Chief and First Assistant Engineers in the use of the VMS before their assignment to a ship. Other members of the ship's force may also be trained.

**7.4.3.2.3 CHIEF ENGINEER'S DUTIES** (A

The Chief Engineer shall ensure that the following are accomplished.

a. Collect vibration data on all machines as scheduled by the SAMM system.

b. Run EADS on all collected vibration spectra for fault detection and repair recommendations.

c. Review and analyze EADS reports (see Table 7.1 for additional details).

d. Act on EADS report recommendations according to paragraph 7.4.3.1.2.2.

e. Record completion of vibration data survey for each machine in the SAMM system.

f. Provide to the Administrative Area Commander information and comments on the VMS performance.

g. Report changes to equipment and ship configuration which will require the addition or deletion of vibration survey requirements in the VMS.

h. Provide monthly data submittals to the Administrative Area Commander of monthly vibration data collected.

i. Backup VMS files on disk on least once a week.

A) **7.4.3.3 ABS APPROVAL OF MSC'S VMS**

MSC has submitted the Vibration Test Analysis Guides (VTAGs) to ABS. ABS has approved the VMS for compliance with the ABS Guide for Survey Based on Preventative Maintenance Techniques. Vibration data collection of monitored machinery each quarter as a minimum will reduce the number of "open and inspect" actions performed specifically for ABS surveys.

R) **7.4.4 LUBE OIL MONITORING AND ANALYSIS PROGRAM**

a. Frequent monitoring of lubricants for water content, alkalinity reserve and viscosity changes by use of onboard test kits and visual examination can prevent most catastrophic oil related machinery failures. Onboard testing combined with routine laboratory analysis can reduce equipment failures and extend equipment overhaul intervals.

b. MSC's Lube Oil Monitoring and Analysis Program consists of onboard physical oil characteristic testing, off ship physical and wear metal analysis and the fleetwide Graphical Lube Oil Analysis System (GLAS). The monitoring the physical lubricant characteristics is of paramount importance in controlling accelerated machinery component wear. Using the onboard test kits, the ship's force shall conduct the simple tests described in the following paragraphs to determine lube oil quality, take corrective action, if needed and thereby minimize the effects of degraded oil on operating machinery.

**NOTE: Lube oil sample storage racks shall no longer be used. Onboard lubricant sample testing logs shall be used in accordance with paragraph 7.4.4.3.**

A) **7.4.4.1 MSC HEADQUARTERS RESPONSIBILITIES**

MSC Headquarters shall issue and keep current a contract for commercial procurement of bulk and package lube and hydraulic oils, lube and hydraulic oil analysis, shipboard test equipment and provide technical service calls as required. MSC Headquarters shall also promulgate Lube Oil Monitoring and Analysis Program policy and issue modifications to the Worldwide Lube Oil Contract Onboard Handbook.

**7.4.4.2 LUBE OIL MONITORING AND ANALYSIS DESCRIPTION**

The lube oil supply, monitoring and analysis contract provides:

a. Bulk and package lubricating and hydraulic oils.

b. Shipboard used oil analysis test equipment. (R

c. Service calls to review lube oil test logs and analysis data, inventory sampling kits and review lube chart and equipment registration sheets. (R

d. Training in the use of proper oils for equipment and machinery.

e. Training in sampling procedures and use of lube charts and equipment registration sheets. (R

f. Training in interpretation of analysis data.

g. Automated lube and hydraulic oil analysis.

h. A separate analysis report for each piece of equipment from which a sample was drawn.

i. Recommendations for consolidating lube oils in order to minimize the number of different oils required.

j. Graphical Lube Oil Analysis System (GLAS) software for the SAMM system computer to plot analysis results and thereby identify trends.

**7.4.4.3 LUBE OIL ANALYSIS PROGRAM** (A

a. Collecting Samples

(1) Lube oil samples shall be collected from machinery and sent to the lube oil contractor's lab for analysis at frequencies specified in the SAMM system. If sampling frequencies have not been established and incorporated into SAMM, sampling frequencies can be determined using the GLAS lubrication chart provided in the GLAS system.

(2) Main propulsion machinery and auxiliary generators shall be sampled daily when in operation, and all other operating machinery shall be sampled weekly. Collected samples shall be tested using the onboard test kit. Idle machinery shall be sampled and tested using the test kit before being placed in service. Testing of the sampled oil shall be performed as soon after taking the sample as possible. All tests shall be recorded in the Onboard Lubricant Test Log.

(3) If visual and onboard testing confirm severe oil degradation, the equipment shall be secured, the cause identified, the oil shall be drained and the equipment refilled with oil specified by the lube oil contractor's Lubrication Chart. Authorization for the use of oil other than that specified by the lube oil contractor must be obtained from the MSC Technical Program Manager at MSC.

(4) Lube oil samples shall be taken from the machinery sumps at the lowest practical point, or from the oil discharge line; however, no installed oil line, flange or fitting has been in circulation; therefore samples shall not be drawn from gage lines. To minimize possibilities for variances in test results, the same sampling point shall be used each time a specific equipment sample is drawn.

b. Shipboard Sampling and Testing. Onboard testing of lube oils shall be accomplished using the onboard test kit. Shipboard testing for water alkalinity and viscosity shall be recorded in the Onboard Lubricant Test Log provided by the lubricant contractor. Copies shall be mailed monthly as indicated on the log sheets.

(1) Water. Steam driven equipment and equipment using independent lube oil coolers are a prime candidates for water contamination. The presence of water in turbine and hydraulic oils is indicated by a cloudy appearance in the oil. A milky color indicates an unacceptably high water content and requires that the machinery be shut down as soon as possible, the cause determined and the oil purified or replaced. If the amount of water in the sampled oil reaches or exceeds 0.3% for engine oils and 0.2% for non-engine oils, the water shall be removed from the oil by purifying. If the water content in the oil reaches 2% by volume, severe damage to operating machinery may occur and a more positive method used to remove the water from the oil. In all cases, the source of water contamination must be eliminated. The maximum allowable water content is 0.5% in main engines, turbo generators and diesel engines; 1.0% in auxiliary steam turbines; 2.0% in stern tubes, 0.05% in hydraulic systems.

(2) Contaminants and Insolubles. Contaminants and insolubles are most often found in diesel engines, but may also appear in machinery which has been exposed to the weather or which has been idle for prolonged periods. These contaminants or

insolubles can be removed from the oil with the lube oil purifier. Examples of contaminants and insolubles are carbon, metal particles, rust, grease and other suspended particles introduced or formed in the oil during machinery operation. The maximum insoluble level for all diesel engines is 1.0. Corrective action must be taken when insolubles exceed this limit.

(3) Acids. As oil deteriorates or breaks down, it tends to become acidic in character, which promotes corrosion of machinery parts. Oil purification will not remove the acids. The oil shall be replaced, or at the very least new oil shall be added until complete oil replacement is possible. The alkalinity test performed with the onboard test kit will reflect the acid content in the oil sample by a change in the Total Base Number (TBN) of the oil. The maximum low limit for diesel engines is 6 for all engines (except EMDs whose lower limit is 7, and Pielstick 4.2s whose lower limit is 8).

(4) Viscosity. Viscosity shall be measured using the onboard test kit flow stick which compares the flow rate of the sample of used oil to that of a sample of unused oil of the same type. Failure of viscosity to meet criteria of the flow stick test indicates a possible fuel oil dilution of greater than 3% or oxidation levels which are causing accelerated liner and ring wear.

(5) Fuel Dilution. Fuel dilution in diesel engines is detected as a decrease in lube oil viscosity when distillate fuels are used. Fuel dilution of 3% is the maximum allowable amount to maintain an acceptable quality level of lubrication. Fuel dilution which exceeds 3% will break down the oil film in the bearings and pistons causing rapid wear, hot spots and machinery failure. An even greater danger exists of a possible crankcase explosion which often results in severe machinery damage, personnel injury and engineroom fire. Fuel dilution which exceeds 3% requires that the engine be shut down immediately, the cause determined and corrected and the oil replaced. The flow stick in the onboard test kit can detect fuel dilution up to 3%.

c. Shoreside Lube Oil Analysis. Collected samples shall be sent to the lube oil contractor's laboratory. Express mail shall be used to send samples to the laboratory from overseas ports. Samples sent out for analysis shall be labeled with the following information.

(1) Equipment registration number

(2) Ship's name

(3) Oil in use (name of oil being sampled, e.g., Mobilgard 412)

(4) Gallons used/24-hour period

(5) Sampling point (sampling point must be consistently from the same location)

(6) Oil hours (number of running hours on oil being tested)

(7) Date sampled: year/month/day

(8) Date landed: year/month/day (date sent to laboratory)

The lube oil contractor will provide analysis results for all samples received, provided that samples are labeled correctly. Incomplete labeling can result in samples being discarded. The number of samples sent for analysis shall be included in the Weekly Operational Summary (OPSUM) message under paragraph Echo. MSC shall forward GLAS electronic reports to the ships equipped with cc:Mail. Otherwise sample results shall be forwarded to the ship via hard copy. A message shall be sent to the ships for all samples that exceed the threshold limits and will contain recommendations for corrective action. Samples found to be satisfactory shall also be delineated.

d. Service Calls

(1) Lube oil contractor service engineers will perform two service calls yearly at 6-month intervals on those ships without GLAS and yearly on those ships with GLAS. Other service calls will be made on an as-needed basis. Periodic service calls will include training in sampling techniques, inventory of chemicals and test reagents, updating of lubricant and registration sheets and the Onboard Handbook and delivery services.

(2) The service engineer will complete a Ship's Service Report to provide a written record of the service call results. The Ship's Service Report will be signed by the Chief Engineer of the ship. Copies shall be forwarded to MSC and the cognizant Administrative Area Commander.

(3) Service calls shall be scheduled as far in advance as possible to give ample time for the service engineer to attend the ship and allow the Chief Engineer to schedule time to discuss lubricant related topics with the service engineer.

e. Graphical Lube Oil Analysis (GLAS). The GLAS Program provides complete database management of all data related to used oil samples submitted to the lube oil contractor. The intent of GLAS is to provide the shipboard engineer an easily managed system to retrieve used sample data for fault diagnostics. The shipboard GLAS accepts test sample data electronically from either diskette of cc:Mail. The GLAS data contain all the information for each equipment such as manufacturer, model and oil product in use for that equipment. The user can review all test results for current and historical samples. Various reports are available to th e user to print GLAS specific reports. GLAS provides three types of graphs that can be used for comparison and review of the different tests conducted on the used oil samples. The first graph is a sample graph that depicts the selected tests based on a sample interval, while the time graph depicts the selected tests by time interval between samples. A third graph, correlation graph, produces a correlation between selected tests and a single selected test. This allows the user to determine if iron is increasing or decreasing in conjunction with another test such as viscosity or insolubles. The following data will be available through GLAS.

(1) Sample Data. The results of the oil analysis on each sample including the date sampled, date received, date tested, test results for each test and comments appended by MSC and lube oil contractor engineering personnel.

(2) Wear Metals. The wear metals that can be detected in the oil sample. The possible metals that are in the oil path for each equipment.

(3) Thresholds. The alarm thresholds for each piece of equipment for high borderline, low borderline and low alarm limits.

(4) Lube Chart. The list of equipment with assigned registration numbers, sampling frequencies and type of lubricant to be used in the equipment.

**7.4.4.4 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall:

a. Ensure that required shipboard lube oils are ordered through the Contract Ordering Tracking System (COTS). (R

b. Monitor program implementation on each ship to ensure adherence to program requirements.

c. Arrange for a contractor service representative to visit each ship as required to review lube oil test logs, analyze data, replace sampling kits, provide training in proper sampling procedures and evaluate lubricant related problems.

d. Ensure that all licensed engineers are proficient in proper sampling procedures and know program requirements.

e. Include in Command Inspections a review of lube oil test logs, test kits, testing procedures and shipboard personnel training records.

f. Assign a staff engineer with the expertise needed to assist shipboard engineers in the Lube Oil Monitoring and Analysis Program.

R) g. Ensure that ships use only those lube oils listed on the onboard lube chart provided by the contractor or GLAS.

**7.4.4.5 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall comply with the direction promulgated in the Worldwide Lube Oil Contract Handbook/Reference Guide. The guide requires that the Chief Engineer:

a. Take lube oil samples as scheduled by the SAMM system.

b. Mail lube oil samples for analysis upon arrival in port.

c. Review the analysis information received.

d. Request a contractor service representative visit the ship as required to review lube oil test logs, analyze data, replace sampling kits, provide training in proper sampling procedures and evaluate lubricant related problems.

e. Ensure that all licensed engineers are proficient in proper sampling procedures and are familiar with program requirements.

R) f. Order required shipboard lube oils through the MSC worldwide lube oil contractor via the Area Commander designated representative.

g. Use only those lube oils listed on the lube chart by the lube oil contractor.

A) **7.4.4.6 EQUIPMENT SAMPLING FREQUENCIES**

Equipment samples shall be drawn according to the following schedule unless GLAS requires more frequent sampling.

**7.4.4.6.1 OFF SHIP SAMPLING**

Samples shall be drawn on the following equipment and machinery and sent to the lube oil contractor's laboratory for analysis according to the following schedule.

| EQUIPMENT NAME | SAMPLING FREQUENCY |
|---|---|
| Main Propulsion Diesels | Monthly |
| Diesel Engine Generators | Monthly |
| Auxiliary Diesels | Quarterly |
| Emergency Diesel | Quarterly |
| Main Turbine/Reduction gear (Steam) | Quarterly |
| Auxiliary Turbines | Monthly |
| Main Reduction Gears (Diesel) | Semi-annually |
| Lube/Fuel Oil Purifier | Semi-annually |
| Steering Gear | Semi-annually |
| Anchor Windlass Hydraulic | Quarterly |
| Anchor Windlass Gear Sump | Quarterly |
| Navy Standard Transmission (NST) | Yearly |
| UnRep Reduction Gears | Semi-annually |
| Auxiliary Hydraulic systems | Quarterly |
| Cargo Handling Hydraulic | Quarterly |
| Cargo Handling Diesel | Monthly |
| Capstans/Winches | Semi-annually |
| Crane Gearboxes | Semi-annually |
| Lifeboat Engines | Quarterly |
| Rescue Boat Engines | Monthly |
| Boat Winches | Semi-annually |
| Elevator Hydraulic | Quarterly |
| Cargo Elevator Gearbox | Semi-annually |
| Stern Tube Lubrication System | Quarterly |
| Controllable Pitch Propellers | Semi-annually |
| Line Shaft Bearings | Quarterly |
| Hydraulic Ramp Hydraulics | Semi-annually |
| Accommodation Ladder Hydraulics | Semi-annually |
| Hydraulic Door Systems | When directed |
| Ship's Service Air Compressors | Monthly |
| High Pressure Air Compressors | Quarterly |
| Start Air Compressors | Monthly |
| Air Conditioning Compressors | Semi-annually |
| Idle Machinery (ROS) | Semi-annually |
| Idle Machinery (ROS) | Transition to FOS |

#### 7.4.4.6.2 ONBOARD TESTING WHEN EQUIPMENT IS IN OPERATION

Samples shall be drawn on the following equipment and machinery when the equipment is in operation.

| EQUIPMENT NAME | TYPE TEST | FREQUENCY |
|---|---|---|
| Propulsion Diesel Engine | TBN/Water/Viscosity | Daily |
| Diesel Generator | TBN/Water/Viscosity | Daily |
| NM Turbine/Reduction Gear | Water | Daily |
| Auxiliary Diesels | TBN/Water/Viscosity | Daily |
| Auxiliary Turbines | Water | Daily |
| Hydraulic Systems | Water | Monthly |
| Reduction Gear (Diesel) | Water | Monthly |

| EQUIPMENT NAME | TYPE TEST | FREQUENCY |
|---|---|---|
| Auxiliary Reduction Gears | Water | Monthly |
| Hydraulic Door Sumps | Water | Semi-annually |
| Anchor Windlass Gearbox | Water | Monthly |
| Air Compressors (HP/LP) | Water | Weekly |

**7.4.4.6.3 ONBOARD TESTING FOR IDLE MACHINERY IN REDUCED OPERATIONAL STATUS (ROS)**

Samples shall be drawn on the following equipment and machinery on idle machinery in ROS.

| EQUIPMENT NAME | TYPE TEST | FREQUENCY |
|---|---|---|
| Main Turbine/Reduction Gear | Water | Weekly |
| Main Diesel Engine | TBN/Water | Monthly |
| Auxiliary Diesel | TBN/Water | Quarterly |
| Diesel Generators | TBN/Water | Monthly |
| Auxiliary Turbines | Water | Monthly |
| Auxiliary Reduction Gears | Water | Quarterly |
| Main Reduction Gears (Diesel) | Water | Monthly |
| Hydraulic Systems | Water | Semi-annually |

**7.4.5 HYDRAULIC OIL MONITORING AND ANALYSIS PROGRAM**

Hydraulically operated equipment and machinery is common on MSC ships. Hydraulic systems require high quality maintenance to ensure long term and trouble free operation. Problems with hydraulically operated equipment and machinery usually are caused by improper installation or inadequate maintenance and repair. Through a worldwide lubricating oil contract (paragraph 7.4.4), ships receive hydraulic fluids selected specifically for each piece of hydraulic equipment and machinery.

**7.4.5.1 MSC HEADQUARTERS RESPONSIBILITIES**

MSC Headquarters shall issue and keep current a contract for commercial procurement of bulk and package lube and hydraulic oils, lube and hydraulic oil analysis, shipboard test equipment and sample bottles and service calls as required. MSC Headquarters shall also promulgate Lube Oil Monitoring and Analysis Program policy and issue modifications to the <u>Worldwide Lube Oil Contract Handbook/Reference Guide</u>.

**7.4.5.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall:

a. Ensure that required shipboard hydraulic oils are ordered through the MSC worldwide lube oil contractor.

b. Monitor program implementation on each ship to ensure adherence to program requirements.

c. Arrange for a contractor service representative to visit each ship as required to review oil test logs, analyze data, replace sampling kits, provide training in proper sampling procedures and evaluate hydraulic problems.

d. Ensure that all licensed engineers are proficient in proper sampling procedures and know program requirements.

e. Include in Command Inspections a review of hydraulic oil test logs, test cabinets, testing procedures and shipboard personnel training records.

f. Assign a staff engineer with the expertise needed to assist shipboard engineers in the Hydraulic Oil Monitoring and Analysis Program.

g. Ensure that ships use only those hydraulic oils listed on the lube chart by the lube oil contractor.

h. Establish shipboard procedures for maintenance of hydraulic systems. The types of equipment and machinery covered by these procedures shall include, but not be limited to anchor windlasses, mooring winches, oceanographic winches, U and A Frame systems, steering gear, hatch cover operators, UNREP winches, sliding watertight doors, ram tensioners and telemotors. These procedures shall include the following elements:

(1) After initial installation or repair of hydraulic equipment, hydraulic systems shall be flushed in accordance with manufacturer's procedures.

(2) Filter buggies shall be used when filling equipment sumps from storage tanks or barrels.

(3) One filter buggy shall be used for each type of hydraulic fluid used on the ship. If it is necessary to use the same filter buggy for more than one type of fluid, the buggy shall be flushed with the type of oil in the equipment sump before it is used.

(4) Filter buggies shall be used for periodic removal of water and particulate contamination from equipment sumps. Two different filter cartridges are needed, one for water and one for particulates. Filter buggies with 1/3 HP motors require that the filter elements be alternated for both water and particulate removal. Filter buggies with 1 and 1-1/2 HP motors can be upgraded to accommodate simultaneously both types of filter elements. Upgrade kits are available from the buggy manufacturer. Filter elements are available from the buggy manufacturer and the Navy supply system.

(5) Filter buggy procurements shall be for the dual filter type.

(6) Filter buggies shall not be used for purifying sumps of closed loop systems such as the Navy Standard Transmission UNREP winches. Rather, the hydraulic oil shall be changed with new oil when the oil condition warrants.

(7) When excessive contamination is found, the sump and piping system shall be manually flushed. Before refilling the sump, it shall be cleaned and dried with lint-free cloths and the system shall be flushed in accordance with manufacturer's recommendations.

(8) Purifying, filtering and cleaning hydraulic systems shall be recorded in the Machinery History Module of the SAMM system.

(9) Sample analyses shall be recorded in the Machinery History Module of the SAMM system and periodically reviewed to identify trends.

**7.4.5.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall comply with the direction promulgated in the Worldwide Lube Oil Contract Handbook/Reference Guide. The Guide requires that the Chief Engineer:

a. Take hydraulic oil samples as scheduled by the SAMM system.

b. Mail samples for analysis upon arrival in port.

c. Request a contractor service representative visit the ship as required to review test logs, analyze data, replace sampling kits, provide training in proper sampling procedures and evaluate hydraulic problems.

d. Ensure that all licensed engineers are proficient in proper sampling procedures and are familiar with program requirements.

e. Order required shipboard hydraulic oils through the MSC worldwide lube oil contractor.

f. Use only those hydraulic oils listed on the lube chart by the lube oil contractor.

g. Comply with the shipboard procedures for maintenance of hydraulic systems established by the Administrative Area Commander.

### 7.4.6 INSULATION RESISTANCE MEASUREMENT PROGRAM

a. Shipboard electrical equipment is constantly exposed to heat, humidity and the highly corrosive effects of seawater. The environment contributes to electrical insulation breakdown which can lead to equipment failure. In order to determine the condition of electrical insulation and take corrective action before equipment failure, regular testing of electrical equipment insulation resistance is required.

b. Insulation resistance tests are accomplished with a megohmmeter (megger). The piece of equipment to be tested shall be de-energized and the breaker tagged out (paragraph 15.2.2). The megger test shall be accomplished in accordance with manufacturer's recommendations and MSC approved procedures. The ambient temperature shall be measured during megger tests and the readings corrected to 40 degrees Centigrade. Megger readings shall be reviewed to identify trends. A continued downward trend in megger readings indicates insulation deterioration.

c. The SAMM Machinery History Module contains a megger card file. When megger readings are taken and recorded in this file, that information is automatically posted to the appropriate machinery history card to facilitate trend identification. The megger card file displays megger readings for the previous 30 months.

#### 7.4.6.1 MSC HEADQUARTERS RESPONSIBILITIES

MSC Headquarters shall include megger test requirements in the SAMM system.

#### 7.4.6.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES

The Administrative Area Commander shall:

a. Verify that each ship has the proper equipment to take readings required by the Insulation Resistance Measurement Program.

b. Monitor program implementation on each ship to ensure that program requirements are met.

c. Ensure that all licensed engineers are familiar with program requirements.

d. Include a review of megger cards in each Command Inspection.

e. Assign a staff engineer with the expertise necessary to assist shipboard engineers in accomplishing the Insulation Resistance Measurement Program.

**7.4.6.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Ensure that each licensed engineer is familiar with program requirements.

b. Take regular insulation resistance ("megger") readings as scheduled by the SAMM system.

c. Correct megger readings to 40 degrees Centigrade.

d. Record all megger readings in the SAMM system.

e. Identify equipment with megger readings indicating deteriorating insulation.

**7.4.7 THERMOGRAPHIC ANALYSIS PROGRAM**

Thermographic surveys of electrical equipment shall be conducted during Material Readiness Evaluations (paragraph 8.1) to identify equipment and machinery related problems for work package preparation. The Administrative Area Commander shall ensure that thermographic survey equipment is provided to the MRE team.

**7.4.8 SHIPBOARD CHEMICALS CONTRACT**

MSC Headquarters shall execute and keep current a contract with a Commercial Chemical Treatment Program (CCTP) contractor to provide chemicals and technical expertise for treatment of boiler water and feedwater, diesel engine cooling water, sewage, fuel oil, ballast, evaporators and for cleaning of bilges.

**7.4.8.1 BOILER WATER AND FEEDWATER TESTING AND TREATMENT PROGRAM**

a. Maintenance of boiler water chemistry is essential for safe and efficient operation of main and auxiliary boilers. The conditions developing inside a steaming boiler can only be determined by chemical testing of boiler water. All MSC ships equipped with boilers are required to maintain an effective Boiler Water and Feedwater Analysis and Treatment Program to ensure correct boiler chemistry.

b. The goal of a shipboard water treatment program is to maintain boiler water which contains low concentrations of alkaline based dissolved solids and no dissolved oxygen. Adding chemicals and conducting surface and bottom blowdowns are basic water treatment actions. Understanding the purpose of these procedures and their proper application will help prevent casualties to steam generating equipment.

c. Feedwater entering the boiler contains dissolved metallic particles. Chemicals added to the boiler water convert the dissolved solids to suspended solids which settle and accumulate in the lower elements of the headers and water drum. With continued steaming, sludge accumulates and the conductivity of the water increases.

d. On steaming boilers, periodic surface blowdowns normally are effective in controlling the boiler chloride, light suspended solids, scum and lubricating oil. On boilers which have been secured, a series of bottom blowdowns is effective in removing sludge from the water drum and waterwall headers.

**7.4.8.1.1 BOILER WATER AND FEEDWATER TESTING AND TREATMENT PROGRAM UNDER DIFFERENT CONDITIONS**

a. Low Speed Steaming (FSS boilers only). Chemical concentrations in boilers operating at 10% load or less must be precisely maintained, according to Table 7.2, since boiler and deaerater corrosion is accelerated by the decreased circulation rate. Reduced firing rates disrupt the temperature gradients across all boiler sections. Generating tubes which are normally risers may become downcomers or their circulation may become stagnant. Stagnant circulation permits steam blanketing and overheating in high heat areas, concentrating dissolved solids at the metal water interfaces. Therefore, under low load conditions, if operational conditions permit, one boiler will be put in standby to permit operation of the online boiler at a greater load. Two boilers will not be operated in port unless preparing to get underway.

b. Standby and Idle Boilers. Boiler water chemical levels must comply with Table 7.2. When a boiler is offline for more than 24 hours, layup procedures will comply with paragraph 7.4.8.1.1c.

c. Layup Procedures. The two primary types of layup are wet and dry. Since dry layup is the most difficult to accomplish, it will be used when layup will extend beyond 120 days. Wet layup is the preferred method and will be accomplished for all other boiler offline conditions. Layup procedures for boilers in wet layup and not under a steam blanket must require that hydrazine be added in high concentrations (for Amerzine at 15% hydrazine concentration: .65-1.0 liters/ton of water) to prevent corrosion. The boiler shall be operated at sufficient load to circulate and uniformly distribute the oxygen scavenger (hydrazine) throughout the boiler for 2 hours before securing the boiler. After the fires are secured, the boiler will be filled/topped off until water is visible through the superheater vent using the chemical injection pump.

**NOTE:** Filling a boiler through the normal feed line until water is seen coming from the superheater vent line will cause carryover of boiler chemicals to the superheater, decreasing the lifespan of the superheater and potentially causing chemical plating of main or auxiliary turbine blading. Due to this moderate chemical contamination, proper blowdown must be accomplished.

d. External Water Washing of Boiler Tubes. External water washing shall only be accomplished with alkaline buffered water. Boilers shall be lit off within 24 hours of boiler tube external water washing. If this requirement is not complied with, the rate of external boiler tube corrosion will be accelerated. The Administrative Area Commander and COMSC (N7) will be notified by naval message any time this requirement cannot be met.

**7.4.8.1.2 MSC HEADQUARTERS RESPONSIBILITIES**

MSC Headquarters will issue and keep current boiler operating and boiler water and feedwater testing procedures.

**7.4.8.1.3 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander will ensure that Boiler Water/Feedwater Testing and Treatment Programs are established and implemented on all ships equipped with main or auxiliary boilers. The Administrative Area Commander will:

a. Maintain liaison between ships and the CCTP contractor regarding the boiler water treatment program, training schedules, ship visits and related technical requirements.

b. Act as the point of contact for ships ordering boiler chemicals, reagents and personnel training. Arrange for a CCTP contractor service engineer to make semi-annual visits to all ships for:

(1) On-the-job training of shipboard engineering personnel.

(2) Reviewing treatment procedures and logs.

(3) Checking boiler water/feedwater treatment to ensure that sufficient chemicals are onboard and that chemicals can be used within expiration dates.

c. Coordinate with MSC a shipboard training program for licensed engineers to maintain proficiency in proper boiler water/feedwater testing and treatment procedures.

d. Verify that the Assistant Engineer (usually Second Assistant) is fully qualified in boiler water and feedwater management practices and has been trained by a CCTP contractor service engineer within the last 2 years.

e. Require that ships submit monthly boiler logs to the CCTP contractor and Administrative Area Commander, and review logs to:

(1) Verify that chemical tests are being performed, that chemical dosing/treatment is being maintained within limits in Table 7.2 and that proper routine and corrective actions have been performed.

(2) Verify that ships report by immediate message to the Administrative Area Commander and COMSC, boiler water test results which indicate severe contamination as indicated in Table 7.3 and report to the Administrative Area Commander and COMSC, boiler water test results which indicate moderate contamination lasting more than 48 hours as indicated in Table 7.3.

(3) Verify that routine surface and bottom blowdowns are being performed.

(4) Provide status on the water treatment program to the Commander via Command Inspection reports.

(5) Identify difficulties encountered with the CCTP contractor.

f. Periodically check that equipment, such as deaerating feed tanks, condensate pumps, salinity alarm systems, reserve feed tanks and evaporator dump valves are functioning correctly and do not contribute to boiler water/feedwater contamination.

g. Include in Command Inspections a review of boiler logs, evaporator logs, boiler water/feedwater test cabinets and testing procedures and shipboard personnel boiler water/feedwater training records.

h. Inspect propulsion boiler internals as ship schedule permits but at least as frequently as every 2 years to determine the effectiveness of the Boiler Water/Feedwater Treatment Program.

i. Arrange for regulatory attendance at boiler inspections.

j. Assign a staff engineer with the expertise necessary to assist shipboard engineers in accomplishing the Boiler Water/ Feedwater Treatment Program.

k. Establish ships' procedures for reporting by immediate message to the Administrative Area Commander and COMSC, boiler water test results which indicate severe contamination as indicated in Table 7.3 and for reporting to the Administrative Area Commander and COMSC, boiler water test results which indicate moderate contamination lasting more than 48 hours as indicated in Table 7.3.

l. Establish ships' procedures for testing evaporator feedwater and condensate systems which will minimize the possibility of contaminating boiler feedwater with chlorides. Examples of such procedures are:

(1) Before dumping evaporator feedwater from the holding tank to the feed bottom tanks, the feedwater will be tested for chlorides.

(2) Before lighting off steam driven equipment equipped with a main or auxiliary condenser, the salinity cell will be read to ensure that the cell is functioning properly. Also, the cell will be checked to ensure that the condensate is within specified limits before aligning the unit to the condensate system.

(3) Chloride tests will be conducted on any feed bottom tank prior to placing it on makeup except in an emergency.

m. Ensure that Chief and Port Engineers comply with the procedures of paragraph 7.4.8.1.1 and Tables 7.2 and 7.3.

**7.4.8.1.4 FAST SEALIFT SQUADRON ONE'S (FSRON ONE'S) DUTIES**

The FSRON Commander will ensure that boiler water and feedwater testing and treatment programs are established and implemented on all ships equipped with main or auxiliary boilers. The FSRON Commander will:

a. Maintain liaison between ships and MSC regarding the boiler water treatment program, training schedules, ship visits and related technical requirements.

b. Act as primary point of contact for ships requiring personnel training. Arrange for a CCTP contractor service engineer to make semi-annual visits to all ships for:

(1) On-the-job training of shipboard engineering personnel.

(2) Reviewing treatment procedures and logs.

(3) Checking boiler water/feedwater treatment to ensure that sufficient chemicals are onboard and that chemicals can be used within expiration dates.

c. Coordinate with MSC a shipboard training program for licensed engineers to maintain proficiency in proper boiler water/ feedwater testing and treatment procedures.

d. Verify that the designated Assistant Engineer (usually Second Assistant) is fully qualified in boiler water and feedwater management practices and has attended formal training by a CCTP contractor service engineer within the last 2 years.

e. Ensure that ships submit monthly boiler logs to the CCTP contractor and Squadron Commander and review logs to:

(1) Verify that chemical tests are being performed, that chemical dosing/treatment is being maintained within limits in Table 7.2 and that proper routine and corrective actions have been performed.

(2) Verify that ships report by immediate message to the Administrative Area Commander and COMSC, boiler water test results which indicate severe contamination as indicated in Table 7.3 and report to the Administrative Area Command and COMSC, boiler water test results which indicate moderate contamination lasting more than 48 hours as indicated in Table 7.3.

(3) Verify that routine surface and bottom blowdowns are being performed.

(4) Provide status of the water treatment program in the FSRON contract performance evaluation.

(5) Identify difficulties encountered with the CCTP contractor.

f. Periodically check the equipment, such as deaerating feed tanks, condensate pumps, salinity alarm systems, reserve feed tanks and evaporator dump valves are functioning correctly and do not contribute to boiler water/feedwater contamination.

g. Include in FSRON contract performance evaluations, a review of boiler logs, evaporator logs, boiler water/feedwater test cabinets and testing procedures and shipboard personnel boiler water/feedwater training records.

h. Inspect propulsion boiler internals as ship schedule permits but at least as frequently as every 2 years to determine the effectiveness of the boiler water/feedwater treatment program.

i. Arrange for regulatory attendance at boiler inspections.

j. Establish ships' procedures for reporting by immediate message to the Administrative Area Commander and COMSC, boiler water test results which indicate severe contamination as indicated in Table 7.3 and reporting to the Administrative Area Commander and COMSC, boiler water test results which indicate moderate contamination lasting more than 48 hours as indicated in Table 7.3.

k. Verify that ships have established procedures for testing evaporator distillate and condensate systems to minimize the possibility of contaminating boiler feedwater with chlorides. Examples of such procedures are:

(1) Before dumping evaporator feedwater from the holding tank to the feed bottom tanks, the feedwater will be tested for chlorides.

(2) Before lighting off steam driven equipment equipped with a main or auxiliary condenser, the salinity cell will be read to ensure that the cell is functioning properly. Also, the cell will be checked to ensure that the condensate is within specified limits before aligning the unit to the condensate system.

(3) Chloride tests will be conducted on any feed bottom tank prior to placing it on makeup except in an emergency.

**7.4.8.1.5 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Operate and maintain boilers according to paragraphs 7.4.8.1, 7.4.8.1.1, 7.4.8.1.4, 7.4.8.1.5 and Tables 7.2 and 7.3.

b. Verify that boiler water/feedwater tests are accomplished.

(1) Twice daily both in port and at sea for main propulsion boilers and once daily for auxiliary boilers.

(2) When any part of the system has been drained or refilled.

(3) After a propulsion boiler has been placed on line.

(4) Just before securing the boiler to ensure that dosing is not required before securing.

(5) After bottom blowdown to determine whether chemical treatment will be required before lightoff.

(6) Before and after surface blowdown when the surface blowdown is used to control severe boiler contamination as defined in Table 7.3.

(7) Before lightoff on boilers that have been placed on steam blanket or when chemical levels are unknown.

c. Personally test boiler water and condensate samples from propulsion and auxiliary boilers once per week.

d. Ensure that the following minimum procedures are followed to avoid contaminating the boilers with chlorides. These procedures include:

(1) Before dumping evaporator feedwater from the holding tank to the feed bottom tanks, the feedwater will be tested for chlorides (only if holding tanks are installed).

(2) Before lighting off main or auxiliary condensers, the salinity cell will be read to ensure that the cell is functioning properly. Also, the cell will be checked to ensure that the condensate is within specified limits (specified in Table 7.2) before aligning the unit to the condensate system.

(3) Chloride tests will be conducted on any feed bottom tank before placing it on makeup except in an emergency.

e. Periodically check that equipment, such as deaerating feed tanks (DFT), condensate pumps, salinity alarm systems, reserve feed tanks and evaporator dump valves are functioning correctly and do not contribute to boiler water/feedwater contamination. The temperature difference between the DFT top steam space and bottom water space must not exceed $2^{o}F$ for more than 24 hours, the Chief Engineer will report this condition to the Administrative Area Commander. The Chief Engineer will take immediate action to isolate the source of the problem and ensure that adequate hydrazine levels are maintained in the boiler.

f. Reduce boiler load to minimum load when boiler water control limits in Tables 7.2 and 7.3 are exceeded and perform immediate procedures to bring boiler and feedwater chemistry within acceptable range.

g. Report my immediate message to the Administrative Area Commander and COMSC, boiler water test results which indicate severe contamination as indicated in Table 7.3. Report to the Administrative Area Commander and COMSC, boiler water test results which indicate moderate contamination lasting more than 48 hours as indicated in Table 7.3.

h. Ensure that boilers are not steamed under moderate or severe contamination conditions indicated in Table 7.3, unless the ship's safety is in jeopardy.

i. Perform boiler bottom flash blowdown of water drums and water wall headers weekly at sea on propulsion boilers and whenever maximum limits in Table 7.2 are approached. When at sea, the Chief Engineer will obtain permission from the Bridge to secure propulsion boilers for blowdown. The engineer on watch will record any occurrences of denied permission.

j. Perform surface blows on steaming boilers as required to control severe boiler contamination (Table 7.3) and to control oil contamination.

k. For boiler layup, comply with paragraph 7.4.8.1.1 and:

(1) Test water weekly if on a hydrazine (Amerzine) layup to ensure that the minimum hydrazine residual complies with the CCTP contractor's recommendations.

(2) Check water daily to ensure that the water level is maintained in the head tank and above the steam drum.

(3) Record hydrazine test results in parts per million (ppm) in the CCTP boiler log.

l. When the CCTP contractor service engineer visits the ship, check to ensure that he/she conducts on the job training of shipboard engineering personnel, reviews treatment procedures, checks for out-of-date boiler water/feedwater treatment supplies, reviews water treatment logs and provides recommendations for treatment.

m. Ensure that all licensed engineers are trained in boiler water/feedwater testing and treatment procedures and that the designated engineer in charge of water treatment (usually the Second Assistant Engineer) is proficient in water treatment management. If engineers are lacking in training or skills, the Chief Engineer will arrange for on-the-training by the CCTP contractor through the Administrative Area Commander.

n. Submit monthly boiler logs to the CCTP contractor and Administrative Area Commander.

o. Inspect boilers as the ship schedule permits to determine the effectiveness of the Boiler Water/Feedwater Treatment Program.

p. Arrange through the Administrative Area Commander for a service engineers to overhaul, calibrate and adjust critical propulsion plant meters according to paragraph 7.5.

q. Ensure that safety precautions are followed, including wearing eye protection and rubber gloves when testing and treating boiler and feedwater.

**7.4.8.2 SHIPBOARD COOLING WATER ANALYSIS PROGRAM**

a. Advances in diesel engine technology continue to improve diesel engine performance ratings. Improvements have led to higher temperatures, pressures and heat transfer rates. Higher temperatures have resulted in an increased rate of accumulation of mineral deposits on the waterside. It is therefore necessary to use treated distilled water as a coolant and provide high quality makeup water to reduce the corrosive effects and total dissolved solids of the cooling water. Untreated distilled water can be more corrosive to metals than raw water. This is especially true at the elevated temperatures in newer engines.

b. Scale can form in untreated engine cooling systems. Continued buildup of scale can block the water passages, impair heat transfer and ultimately lead to stress cracking or warping of cylinder liners and the engine block.

c. Corrosion is caused by low pH and dissolved oxygen in the distilled water. Oxygen can enter the cooling water through the expansion tank which is vented to the atmosphere, through leaking seals or in water added to the system. Corrosion inhibitors provide a thin protective film on metal surfaces and buffer the pH of the cooling water.

**7.4.8.2.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander will ensure that a shipboard cooling water treatment program is maintained on all ships equipped with air conditioning plants, and main, auxiliary or emergency diesel engines. The Administrative Area Commander will:

a. Ensure that shipboard cooling systems are tested weekly for reserve.

b. Ensure that bacteria and fungus tests are conducted monthly on all cooling water systems.

c. Direct that the following cooling water system corrosion inhibitors or equivalents be used:

(1) High speed diesels: Maxiguard or the chemical equivalent

(2) Medium speed diesels:

(a) Jacket Water: Liquidewt or the chemical equivalent

(b) Injector Cooling: Maxigard or the chemical equivalent

(3) Low speed diesels: Liquidewt or the chemical equivalent

(4) Large air conditioning chilled water systems: Liquidewt or the chemical equivalent

(5) Central cooling water systems: Liquidewt or the chemical equivalent

(6) High/low pressure air compressors fresh water cooling systems: Maxigard or the chemical equivalent

(7) Cooling systems with dissimilar metals: Maxigard or the chemical equivalent

d. Direct that ships which use jacket water as a preheater for evaporators not use ethylene glycol in cooling water systems. Ethylene glycol is volatile and may carryover to the distillate if coolant leaks at the feed heater.

e. Ensure that during Command Inspections, cooling water system logs, chemical testing equipment, testing procedures and shipboard personnel cooling water system training records are inspected.

f. Direct a vigorous shipboard training program for all licensed engineers so that they become proficient in proper cooling water testing and treatment.

g. Assign a staff engineer with the expertise necessary to assist with shipboard engineers in accomplishing the cooling water testing and treatment.

h. Ensure that the designated Assistant Engineer (usually Second Assistant) is fully qualified in cooling water treatment and has attended formal training by a CCTP contractor service engineer within the last 2 years.

**7.4.8.2.2 FAST SEALIFT SQUADRON ONE'S (FSRON ONE'S) DUTIES**

The FSRON Commander will ensure that a shipboard cooling water treatment program is maintained on all ships equipped with air conditioning plants, and main, auxiliary or emergency diesel engines. The FSRON Commander will:

a. Ensure that shipboard cooling systems are tested weekly for reserve.

b. Ensure that bacteria and fungus tests are conducted monthly on all cooling water systems.

c. Direct that the following cooling water system corrosion inhibitors be used:

(1) High speed diesels: Maxiguard or the chemical equivalent

(2) Medium speed diesels:

(a) Jacket Water: Liquidewt or the chemical equivalent

(b) Injector Cooling: Maxigard or the chemical equivalent

(3) Low speed diesels: Liquidewt or the chemical equivalent

(4) Large air conditioning chilled water systems: Liquidewt or the chemical equivalent

(5) Central cooling water systems: Liquidewt or the chemical equivalent

(6) High/low pressure air compressors fresh water cooling systems: Maxigard or the chemical equivalent

(7) Cooling systems with dissimilar metals: Maxigard or the chemical equivalent

d. Ensure that during contract performance evaluations, cooling water system logs, chemical testing equipment, testing procedures and shipboard personnel cooling water system training records are inspected.

e. Direct a vigorous shipboard training program for all licensed engineers so that they become proficient in proper cooling water testing and treatment.

f. Ensure that the designated Assistant Engineer (usually Second Assistant) is fully qualified in cooling water treatment.

**7.4.8.2.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall establish and maintain a shipboard cooling water treatment program on all ships equipped with air conditioning plants, and main, auxiliary or emergency diesel engines. The Chief Engineer shall:

a. Direct that ship's force follow established procedures for testing cooling water for ppm of corrosive inhibitor, chloride content, pH and bacteria and fungus using assay slides.

b. Verify that the following cooling water system corrosion inhibitors or equivalents are used:

(1) High speed diesels: Maxiguard or the chemical equivalent

(2) Medium speed diesels:

(a) Jacket Water: Liquidewt or the chemical equivalent

(b) Injector Cooling: Maxigard or the chemical equivalent

(3) Low speed diesels: Liquidewt or the chemical equivalent

(4) Large air conditioning chilled water systems: Liquidewt or the chemical equivalent

(5) Central cooling water systems: Liquidewt or the chemical equivalent

(6) High/low pressure air compressors fresh water cooling systems: Maxigard or the chemical equivalent

(7) Cooling systems with dissimilar metals: Maxigard or the chemical equivalent

c. Consult the CCTP contractor representative to ensure that the treatment chemicals used are compatible with the cooling water in those diesel engines which require the addition of antifreeze to the cooling water.

d. Ensure that all licensed engineers are proficient in proper cooling water testing and treatment and have attended CCTP contractor in the past 2 years.

e. Log all cooling water test results and chemical treatments in the shipboard cooling water system log.

f. Verify that ethylene glycol is not used in cooling water systems where jacket water is used as a preheater for evaporators.

g. Check to be sure that adequate test equipment and a minimum of 3 months supply of treatment chemicals is on board. Ensure that chemicals are properly stored and handled and that they are replaced when product shelf life is exceeded.

h. Drain and clean cooling systems when scale buildup is detected or suspected. The Chief Engineer will consult the CCTP contractor representative for advice on the best cleaning procedure.

i. Zincs to control corrosion will not be used in conjunction with cooling system treatment. Using zincs with certain treatment chemicals can aggravate corrosion of ferrous metal when the solution is heated and will result in sludge formation of zinc oxides.

j. Make sure that diesel engine expansion tank water levels are checked daily and that distilled water is added as needed to ensure a proper supply of coolant.

k. Direct and monitor procedures for identifying and repairing leaks from cooling water pump packing glands and cooling water system valves, lines and connections.

**7.4.8.3 EVAPORATOR ACID CLEANING AND SCALE PREVENTION**

Routine Saf-Acid cleaning of evaporators will not be used as the primary method to prevent scale formation within the evaporator's salt water circuit. Acid cleaning causes metal to leach away from the evaporator shell, resulting in thin walling and diminished distillate quality. To maintain a scale free system, Ameroyal must be injected into the saltwater circuit upstream of the feedheater on flash type evaporators and upstream of the source of preheat on all other evaporators. Ameroyal must be continuously fed while the evaporator is online, and its minimum dosage rate will comply with Table 7.4. The Ameroyal dosage rate must be increased as the salinity (surface tension) of the feedwater increases. When operating in the Persian Gulf or Red Sea, the high concentration of total dissolved solids requires that the Ameroyal dosage be increased by approximately 1.5 to 2.0 times the dosage in Table 7.4. Table 7.5 provides information on the expected Total Dissolved Solids and associated Ameroyal dosage in the Persian Gulf and the Red Sea. In any location, when feedwater salinity exceeds the normal worldwide salinity shown in Table 7.5, the actual Ameroyal dosage rate must be proportionally increased.

**7.4.8.3.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander will establish an evaporator maintenance program incorporating the direction in paragraph 7.4.8.3. The Administrative Area Commander will:

a. Ensure that Ameroyal is being regularly introduced into the evaporator salt water circuit according to Tables 7.4 and 7.5.

b. Include in Command Inspections a review of evaporator logs.

c. Ensure a shipboard training program for all licensed engineers so that they become proficient in proper evaporator maintenance and operation and water testing and treatment.

d. Assign a staff engineer with the expertise necessary to assist with shipboard engineers in accomplishing the evaporator maintenance.

**7.4.8.3.2 CHIEF ENGINEER'S DUTIES**

The Chief Engineer will establish and maintain an evaporator maintenance program on all ships. The Chief Engineer will:

a. Direct that ship's force follow established procedures for testing and treating evaporator feedwater according to paragraph 7.4.8.3 and testing distillate output for chlorides.

b. Ensure that all licensed engineers are proficient in evaporator maintenance and evaporator feedwater treatment.

**7.5 TESTING AND CALIBRATING SHIPBOARD METERS AND GAGES**

Testing and calibrating shipboard meters and gages will improve machinery monitoring and will reduce the possibility of casualties.

**7.5.1 TWO YEAR SCHEDULE FOR METER AND GAGE CALIBRATION**

The following meters and gages will be calibrated every 2 years at all locations.

a. Main and auxiliary diesels (lube oil pressure and temperature, cooling water pressure and temperature, exhaust temperature, fuel oil pressure and temperature, starting air pressure, RPM indicators)

b. Main and auxiliary switchboard (voltmeter, amperage meter, watt meter, power factor meter)

c. Main boilers (steam pressure and temperature, superheater pressure and temperature, desuperheater pressure and temperature, fuel oil pressure and temperature, windbox and furnace pressure, feedwater pressure and temperature)

d. Main propulsion turbines and turbine generators (throttle box pressure, first stage pressure, condenser vacuum, hotwell temperature, lube oil pressure and temperature, extraction steam pressure and temperature)

e. Auxiliary turbines (steam pressure, lube oil pressure and temperature)

f. Auxiliary boilers (pressure and temperature)

g. Firefighting systems (pressure)

h. Fuel, lube and cargo oil systems (pressure and temperature)

i. Steering gear (pressure)

j. Hydraulic crane and cargo gear (pressure and temperature)

k. Air conditioning and reefer systems (temperature, suction and discharge pressure)

l. Cargo and ship stores reefer boxes (temperature)

m. Shaft horsepower meters

n. High pressure air systems (pressure)

o. Evaporator (temperature)

p. Evaporator feedheater saltwater (temperature)

q. Evaporator feedheater steam supply (temperature)

r. Salinity system (conductivity)

**7.5.2 FIVE YEAR SCHEDULE FOR METER AND GAGE CALIBRATION**

All other gages not listed in paragraph 7.5.1 will be calibrated every 5 years at all locations.

**7.5.3 CALIBRATION EXCEPTIONS**

Direct reading fluid thermometers and control gages on pneumatic regulators will be replaced and not be calibrated.

R)

**TABLE 7.1**
**VMS-EADS REPORT INTERPRETATION**

Below is a sample EADS report. **(NOTE: "<==={X}," is included for reference only.)**

```
17 MARCH 1993       EXPERT SYSTEM REPORT          5:00:00 PM

COMPLETE REPORT

SHIP:  USS TAPIOCA  AS-1

CIRCULATING WATER PUMP #101           FOM = 186 <=={a}

Acquired: 03-17-1993  15:52:49

         Speed: 1XM = 1751 RPM    Avgs. = 6<=={c}
                ^=={b}

PRIORITY DES: BALANCE PUMP ROTOR <==={d}
     Maximum Level is 123 (+4) Vdb   [1T] at 1.00xM<==={e}

          MODERATE PUMP BALANCE <==={f}
          is indicated by 118 (+7) Vdb[2A] at 1.00xP<==={g}
                          114 (+4) Vdb[2R] at 1.00xP<==={g}
                          123 (+7) Vdb[2T] at 1.00xP<==={g}
```

**a. The Figure of Merit (FOM)**

(1) FOM {a} is used for two purposes:

(a) A "quick look" indicator of the overall machinery condition.

(b) Normalization double check.

(2) As a quick look indicator of the overall machinery condition, the FOM numbers shall be interpreted as follows:

| | |
|---|---|
| Healthy Machines | FOM: 0 to 100 |
| Slight Problems | FOM: 50 to 150 |
| Moderate Problems | FOM: 100 to 300 |
| Serious Problems | FOM: 200 to 600 |
| Extreme Problems | FOM: >500 |

NOTE: FOM values overlap categories

(3) For a correct normalization double check, the FOM shall be compared to Fault ID {f}. In the sample report, the FOM is 186 and the fault ID {f} is MODERATE. An FOM of 300 or greater, may indicate that the data was not correctly analyzed and that the Repair Recommendation (d) was incorrect. It is possible for machinery with an extreme problem to have only one data peak and for all other peaks to be below alarm. This would yield a low FOM. It is necessary to examine ALL of the EADS results and review the spectrum.

**b. Date, Time and Machine Running Speed.** Date, Time and Running Speed {b} indicates the date and time of the data collection that EADS has analyzed. It also indicates the machinery running speed. Running speed is detected by EADS for the reference shaft of this machine. If the machine running speed is incorrect, then the expert system cannot analyze the data correctly for the machine. For instance, if the pump has a 1200 RPM motor and the expert system determines that the pump running speed is 1800 RPM, then the system incorrectly analyzed the data for this machine.

**c. Number of Averages.** The Number of Averages {c} is the number of spectral measurements used to generate the "average file." The average file is the baseline from which machinery deterioration is determined. The following numbers are used to interpret baseline data accuracy and indicate the degree of confidence that should be attached to the diagnosis and repair recommendation.

| | |
|---|---|
| Avgs = 0-2 | Base line is MIL-STD-167B*. A poor baseline. Repair recommendations must be reviewed critically for validity. ALL VMS data for that piece of machinery must be examined to determine most likely source of vibration and most practical repair. |
| Avgs = 3-6 | Baseline is better than above but additional data still needed. Recommendations are taken more seriously than above. |
| Avgs = 6-16 | Baseline is acceptable. Recommendations likely have validity. |
| Avgs = 16+ | Baseline as sound basis. Repair recommendations are consistent and should be taken seriously. |

*MIL-STD-167B is the military standard for mechanical vibrations of shipboard equipment; for both environmentally and internally excited conditions.

**d. Repair Recommendations.** The Repair Recommendation {d} is the EADS determination of machinery repairs required to restore it to the baseline condition. The following interpretation of the Repair Recommendation shall be used to determine severity of problem and whether downtime is required to correct it:

MAN (Mandatory)
(Equipment failure or breakdown is imminent.)
Check equipment for indicated problem ASAP.
(NOTE: If EADS has machinery listed as critical, a MAN recommendation may be made even though only a moderate fault has been identified.

IMP (Important)
(High probability of failure or breakdown.)
Increase data collection frequency to monitor for increasing vibration trend. Check equipment for indicated problem at earliest convenience.

DES (Desirable)
(A specific problem has been identified, yet has a low severity and has low, or no, priority for repairs.)
Perform normal data collection and monitor for increasing vibration trend. No other action required.

No Recommendation
(No problems of significant severity have been identified.)
No action required.

**e. Maximum Level.** The Maximum Level {e} identifies the maximum vibration level identified on the machinery. The format is illustrated below.

```
123 (+4)Vdb [1T] at 1.00xM
{1}      {2}  {3}     {4}
```

{1} This is the amplitude of the MAXIMUM peak identified in Vdb (velocity decibels).
{2} This is the amount that the amplitude differs from the average plus one standard deviation value at this frequency. This will be a positive value if the peak is higher then the "normal" level, and negative if it is below.
{3} This identifies the location and orientation where the maximum level was identified.
{4} This identifies the frequency at which the peak was identified. The frequency is represented as a multiple of a shaft rate (e.g., 1.00xM equates to one times the motor shaft rate).

**f. Fault Identification.** The Fault Identification {f} identifies the fault found by EADS. Preceding the description of the fault is a severity indication. The following guidelines are provided for EADS identified faults.

EXTREME: Problems require urgent attention. Avoid operating the affected equipment. Review data for accuracy before making maintenance plans.

SERIOUS: Problems require close attention. Affected equipment shall be either monitored on a much more frequent basis (i.e., weekly or biweekly) or secured depending on its importance in the plant's service or operational requirements.

MODERATE: Problems require that monitoring frequency be increased (biweekly or monthly) to discern increases in vibration levels via trend analysis. Judgment, on the part of the EADS operator, is required based on the affected equipment and its importance in plant function, service or operational requirements.

SLIGHT: Indicates early evidence of a fault. It is highly unlikely that any service or monitoring action need be taken. Continue with normal data collection and use trend analysis to observe the affected equipment.

g. **Fault Data.** Fault Data (g) lists the vibration spectra peaks that EADS uses to identify the faults. Peaks will always be represented in the same form as the Maximum Level outline:

```
123(+4)Vdb [1T] at 1.00xM
 (1)   (2) (3)     (4)
```

(1) This is he amplitude of the peak identified (in Vdb).
(2) This is the amount that the amplitude differs from the average plus one standard deviation value at the frequency. If no average file exists, this will be the difference from MIL-STD-167B (107 Vdb at most frequencies). This will be a positive value if the peak is higher than the "normal" level, and negative if it is below.
(3) This identifies the location and orientation at which the level was satisfied.
(4) This identifies the frequency at which the peak was identified. The frequency is represented as a multiple of a shaft rate (for example, 1.00xM equates to one times the motor shaft rate).

R)

## TABLE 7.2
## BOILER WATER CHEMICAL LEVELS

Boiler water chemical levels of hydrazine, phenolphthalein alkalinity, total alkalinity, chlorides, phosphates, conductivity and condensate pH must maintained daily during plant operation and weekly during boiler plant layup. Treatment practices must follow those in the Shipboard Water Treatment Manual.

1. The following control limits apply for boiler water and condensate:

a. 950 psi (FSS, SL-7, COMFORT, MERCY, MERCURY) boilers, operated by MSC):

(1) NORMAL OPERATING LIMITS (inport)

| BOILER WATER TEST | CONTROL LIMITS |
|---|---|
| Phosphate | 5 ppm minimum * |
| pH | 9-10.2 |
| Hydrazine 03-100 ppm | |
| Chloride | 36 ppm maximum |
| Conductivity | 180 umhos/cm |
| Silica | 2 ppm maximum |
| Condensate pH | 8.6-9.0 |
| Hydrazine Reserve Layup | 100 ppm maximum |

(2) NORMAL OPERATING LIMITS (after underway 48 hrs or more)

| BOILER WATER TEST | CONTROL LIMITS |
|---|---|
| Phosphate | 15-25 ppm maximum * |
| pH | 9.8-10.2 |
| Hydrazine | .03-.10 ppm |
| Chloride | 16 ppm maximum |
| Conductivity | 120 umhos/cm ** |
| Silica | 6 ppm maximum |
| Condensate pH | 8.6-9.0 |

(3) EVAPORATOR AND FEEDBOTTOM SALINITY UPPER LIMITS:

| SAMPLE LOCATION | PPM | CHLORIDES |
|---|---|---|
| Evaporator Distillate | 2 ppm | .05 epm *** |
| Feedbottoms | 4 ppm | .1 epm |

* ppm (parts/million)
** umhos/cm (micromhos/centimeter)
*** epm (equivalent/million)

b. 450-850 psi boilers:

| BOILER WATER TEST | CONTROL LIMITS |
|---|---|
| Phosphate | 20-40 ppm * |
| P Alk **** | 90-130 ppm |
| T Alk ***** | Less than 2 X P Alk |
| Hydrazine | .10-.15 ppm |

| | |
|---|---|
| Chloride | 36 ppm maximum |
| Conductivity | 700 umhos/cm ** |
| Condensate pH | 8.3-8.6 |

c. Standard Diesel Ship auxiliary boiler (waste heat or oil fired) pressure (0-449 psi): Use AGK-100 treatment. AGK-100 contains an oxygen scavenger that must be dosed continuously, 24 hours/day to prevent oxygen corrosion. Dosage rate is adjusted to provide the following control test results:

| HYD ALK * | DOSAGE | CONDUCTIVITY | BLOWDOWN |
|---|---|---|---|
| Below 40 ppm | Increase | Up to 700 | Weekly bottom blowdown to remove sludge |
| 40-65 ppm | No change | Above 700 | Increase frequency to lower conductivity |
| Above 65 ppm | Decrease | | |

d. Distillate, Make Up Feed and Condensate and Return Drain Salinity Upper Limits for Auxiliary Boilers: When distillate, make up feed and condensate and return drain salinity readings for auxiliary boilers exceed the upper limits in this paragraph, leaky condensers must be taken offline and contaminated distillate, drains and reserve feedwater must be dumped to the bilge.

| SAMPLE LOCATION | CONDUCTIVITY | CHLORIDES |
|---|---|---|
| Condensate and Drain Returns | 3.0 umhos/cm | .02 epm |
| Evaporator Distillate Discharge | 8.0 umhos/cm | .05 epm |
| Reserve Feedwater | 5.0 umhos/cm | .10 epm |

Since ship's systems indicate Total Dissolved Solids (TDS) in umhos/cm or chlorides in epm, ppm or grains/gallon (gpg) to following conversions must be used to determine if salinity is within allowable limits:

1 gpg = 17.1 ppm
1 epm = 35.5 ppm
For example: 25 ppm/35.5 ppm per epm = .70 epm

* ppm (parts/million)
** umhos/cm (micromhos/centimeter)
*** epm (equivalent/million)
**** P Alk (phenol-alkalinity)
***** T Alk (total alkalinity)

e. Salinity Upper Limit of Shore Steam and Condensed Shore Steam Used as Feedwater:

| CONSTITUENT OR PROPERTY | REQUIREMENT |
| --- | --- |
| pH | 8.0-9.5 |
| Conductivity | 25 umhos/cm maximum |
| Dissolved Silica | .2 ppm maximum |
| Hardness | .10 epm maximum |

(1) Feedwater produced by demineralization, reverse osmosis or any process other than steam condensation must meet the following requirements:

| CONSTITUENT OR PROPERTY | REQUIREMENT |
| --- | --- |
| Conductivity | 2.5 umhos/cm maximum |
| Dissolved Silica | .2 ppm maximum |

(2) Shore source feedwater shipments, batch delivery, must meet the following requirements:

| CONSTITUENT OR PROPERTY | REQUIREMENT |
| --- | --- |
| Hardness | .10 epm maximum |
| pH (condensate) | greater than 5.4 |
| pH (processed water) | between 5.4 and 8.2 |
| Silica (propulsion boilers) | .2 ppm maximum |
| Conductivity | less than 40 umhos/cm |

**TABLE 7.3**
**BOILER CONTAMINATION LEVELS** (A

**1. Severe Contamination**

a. Severe contamination in boilers exists with any of the following conditions:

(1) Carryover is occurring; foaming is visible in the sight glass.

(2) Conductivity exceeds 1.5 times the maximum allowable operating limit as established in Table 7.2.

(3) Oil is visible in the samples or gage glass.

b. Under severe contamination conditions, the Chief Engineer will reduce the firing rate to the minimum when the ship is not in a restricted maneuvering situation. The minimum rate will be established by the Chief Engineer, but will not exceed 5 knots or the speed necessary to maintain minimum steerageway, whichever is greater.

c. During restricted maneuvering situations such as coastal waterways, underway replenishment and sea and anchor details, the Chief Engineer and Master must establish a doctrine for plant casualty which provides clear and concise response directions to the watch engineer for different casualty scenarios.

**2. Moderate Contamination.** Moderate contamination or corrosion in boilers exists with any of the following conditions:

a. The water contains no residual hydrazine.

b. pH, conductivity and phosphate are below the free caustic range as follows:

(1) 850-1200 psi boilers:

pH > 9
Phosphate < 5 ppm or > 25 ppm
120 umhos < Conductivity < 150 umhos

(2) 450-850 psi boilers:
P-Alkalinity < 50 ppm
T-Alkalinity > twice P-Alkalinity
Phosphate < 5 ppm

(3) 0-225 psi boilers:
Phosphate < 5 ppm
H-Alkalinity < 40 ppm

A)

**TABLE 7.4**
**AMEROYAL DOSAGE CHART**
**(ATLANTIC, PACIFIC AND MEDITERRANEAN OCEANS)**
Average Total Dissolved Solids: 34,450 ppm

| EVAPORATOR DAILY RATED CAPACITY (TONS) | DAILY AMEROYAL DOSAGE RATE LITER/FLUID OUNCES |
|---|---|
| 5 | .15/5 |
| 10 | .30/10 |
| 15 | .45/15 |
| 20 | .60/20 |
| 25 | .75/25 |
| 30 | .90/30 |
| 40 | 1.20/40 |
| 50 | 1.50/50 |

(A

**TABLE 7.5**
**TOTAL DISSOLVED SOLIDS IN RED SEA AND PERSIAN GULF**

| | General Worldwide | Dubai/ Kuwait | Al Khobar |
|---|---|---|---|
| Total Dissolved Solids | 34,450 ppm | 43,300 ppm | 55,800 ppm |

**Dubai/Kuwait**

| EVAPORATOR DAILY RATED CAPACITY (TONS) | DAILY AMEROYAL DOSAGE RATE LITER/FLUID OUNCES |
|---|---|
| 5 | .19/6 |
| 10 | .38/13 |
| 15 | .57/19 |
| 20 | .75/25 |
| 25 | .94/31 |
| 30 | 1.13/38 |
| 40 | 1.51/50 |
| 50 | 1.89/63 |

**Al Khobar**

| EVAPORATOR DAILY RATED CAPACITY (TONS) | DAILY AMEROYAL DOSAGE RATE LITER/FLUID OUNCES |
|---|---|
| 5 | .24/8 |
| 10 | .49/16 |
| 15 | .73/24 |
| 20 | .97/32 |
| 25 | 1.21/40 |
| 30 | 1.46/49 |
| 40 | 1.94/65 |
| 50 | 2.43/81 |

**In any location, when feedwater salinity exceeds the normal worldwide salinity the actual Ameroyal dosage rate must be proportionally increased.**

# CHAPTER 8

# MSC TESTS, INSPECTIONS AND TRIALS

## 8.0 MSC TESTS, INSPECTIONS AND TRIALS

Military Sealift Command conducts tests, inspections and trials to identify shipboard material condition and to evaluate shipboard management techniques and administrative recordkeeping. These include, but are not limited to Material Readiness Evaluations, Command Inspections and full power trials.

## 8.1 MATERIAL READINESS EVALUATIONS

Material Readiness Evaluations assist in availability (paragraph 4.2) and INSURV (paragraph 3.3) preparation by identifying material and work needed to maintain ships in a high state of material and operational readiness. Properly conducted MREs identify machinery and equipment in need of maintenance or repair, in degraded operational condition or requiring adjustment or calibration. Requirements for industrial assistance are then incorporated into the work package for the availability.

### 8.1.1 PREPARING FOR AND CONDUCTING MATERIAL READINESS EVALUATIONS

COMSCINST 4700.14 (Material Readiness Evaluations (MREs) and Planning for Major Availabilities) establishes the procedures for preparing for and conducting MREs. The MRE is conducted approximately 6 months prior to the beginning of a major availability. It generally lasts one week, but may vary in length depending upon the ship's operational commitments and the size and complexity of the ship. It usually includes an underway evaluation period that will verify equipment and system operation or a full power trial (paragraph 8.3).

#### 8.1.1.1 MSC HEADQUARTERS RESPONSIBILITIES

MSC Headquarters shall supervise effective Administrative Area Commander management of the MRE program. MSC Headquarters shall monitor the Shipboard Automated Maintenance Management (SAMM) system (paragraph 7.3) system to ensure continued effectiveness in tracking Voyage Repair Requests (VRRs, paragraph 5.2.2) and other MRE deficiencies.

#### 8.1.1.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES

a. The Administrative Area Commander shall form an MRE team including the principal Port Engineer, an engineer from the Material Readiness Branch and other engineers/surveyors as necessary to conduct tests and inspections. At the beginning of the MRE, the team shall report to the Master and Chief Engineer and shall identify tests and inspections which will require assistance and compartments of the ship to which they must have access. Normally, opening of machinery is not required.

b. The Administrative Area Commander shall:

(1) Develop an MRE plan including ship systems, hull maintenance, machinery operation and thermographic surveys.

(2) Ensure that MREs are conducted in time to include the results in the work package for the availability.

(3) Ensure that the MRE team is trained to document deficiencies in the detail needed to incorporate them into the availability work package and is capable of conducting thermographic surveys (paragraph 7.4.7).

(4) Include MRE findings in the shipyard work identification process.

(5) Track all deficiencies.

(6) Conduct shipyard availability close-out reviews.

(7) Provide thermographic survey equipment (7.4.7) to the MRE team.

**8.1.1.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Provide support to the MRE team in conducting tests and accessing compartments.

b. Make available all outstanding VRRs for review by the MRE team and for incorporation into the work package.

c. Make all SAMM (paragraph 7.3) system data and Condition Monitoring Program (CMP) (paragraph 7.4) data available to the MRE team for review.

**8.2 COMMAND INSPECTIONS**

Command Inspections evaluate the administrative, management and recordkeeping procedures and programs aboard each ship. COMSCINST 5040.2C (MSC Command Inspection Program) describes the Command Inspection Program in detail. It addresses the Command Inspection responsibilities of MSC Headquarters and the Administrative Area Commander.

### 8.2.1 CHIEF ENGINEER'S DUTIES

Prior to a Command Inspection, the Chief Engineer shall make the following documents available for review:

a. Engineering ship's force personnel records (paragraph 2.0)

b. SAMM and CMP records (chapter 7)

c. Engine room operating procedures (chapter 11)

d. Status of recommended alterations (chapter 9)

e. Engine room safety procedures (chapter 15)

f. Status of outstanding Voyage Repair Requests (paragraph 5.2.2)

## 8.3 FULL POWER TRIALS

Full power trials are used to evaluate equipment and system operation for the preparation of work items and to evaluate the quality of work performed during an availability. Full power trials usually are conducted during MREs (paragraph 8.1), INSURV inspections (paragraph 3.3) and post-availability sea trials (paragraph 4.5.1).

### 8.3.1 MSC HEADQUARTERS RESPONSIBILITIES

MSC Headquarters shall monitor the management and conduct of all full power trials and review the Full Power Trial Report (MSC 9094/1).

### 8.3.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES

The Administrative Area Commander shall:

a. Schedule full power trials and inform MSC Headquarters of the schedule.

b. Supervise full power trials continuing for a minimum of 4 hours at the speeds listed in Table 8.1.

c. Ensure full power trials are accomplished in accordance with the procedures in paragraph 8.3.4.

d. Record all full power trial data on the Engineering Trial Report, MSC 9094/1, and submit the report to MSC Headquarters with supplemental data and observations pertinent to propulsion plant performance. RCS OPNAV 9094-1 is assigned this reporting requirement.

**8.3.3 CHIEF ENGINEER'S DUTIES**

a. Prior to full power trials, the Chief Engineer shall:

(1) Operate the propulsion plant at high partial load power level for a minimum of 2 hours to thoroughly warm up machinery and stabilize operating temperatures.

(2) Following warm-up, increase propulsion plant power output gradually until it reaches its maximum continuous full power rating and then operate the plant for 1 hour at full power to allow equipment and systems operation to stabilize before beginning data collection.

(3) Duplicate as closely as possible the operating conditions appearing on the design full power heat balance diagrams.

(4) Check propulsion plant machinery safety device settings against design settings and verify that they have been tested to meet regulatory requirements.

(5) List for the Full Power Trial Report those safety devices which are overdue for inspection or which have tested unsatisfactorily.

(6) Verify the calibration of critical instrumentation and prepare for the Full Power Trial Report a list of critical instruments, their location and their latest date of calibration.

b. During full power trials, the Chief Engineer shall:

(1) Direct the operation of all propulsion and auxiliary machinery necessary to support the full power trial.

(2) Note in the Engine Room Log all machinery not operating in accordance with design parameters.

(3) Verify that all machinery not operating in accordance with design parameters is noted in the Full Power Trial Report.

(4) Ensure that full power trials are accomplished in accordance with the procedures in paragraph 8.3.4.

(5) Maintain power output and auxiliary loads as steady as possible.

(6) Ensure that maximum continuous power ratings of propulsion and auxiliary machinery are not exceeded.

### 8.3.3.1 CHIEF ENGINEER'S DUTIES ON ELECTRIC DRIVE SHIPS

On electric drive ships, the Chief Engineer shall accomplish the foregoing tasks in addition to the following specific duties. The Chief Engineer shall:

a. Ascertain and record limiter settings for propulsion motor current limiters and/or propulsion generator KW/KVA limiters.

b. Determine the maximum power level which renders a steady state condition to prevent the hunting of propulsion controls and cycling of power output at limiter set points.

c. Determine the number of generators to be operated so that each is operating as close as possible to its full power rating for those ships equipped with multiple generators providing power to the ship's propulsion and auxiliary plant loads. The minimum number of generators shall be used. This will facilitate the calculation of specific fuel consumption in terms of shaft horsepower and engine brake horsepower.

### 8.3.4 CONDUCTING FULL POWER TRIALS

Full power trials shall be conducted in deep open water under minimum wind and wave conditions. The trial run shall be straight and rudder movement kept to a minimum. Collection of data shall begin after the propulsion plant is warmed up and stabilized. One complete data collection round shall be made each hour for a total of four hours. If the trial is interrupted for any reason, the trial run shall be regarded as unsatisfactory and the trial repeated.

### 8.3.5 CALCULATING FULL POWER

Power levels at which full power trials are to be conducted shall equal the total shaft horsepower rating of the ship. Total shaft horsepower ratings and full power performance data for MSC ships are listed in Table 8.1. Full power shall be determined using shaft horsepower meters. If these meters are not available, the procedures in Table 8.2 shall be followed. Under no circumstances shall shaft RPM alone be used to indicate propulsion plant power level.

### 8.3.5.1 STEAMSHIPS

Propulsion unit output shall be determined using turbine nomographs and performance indicators. Specific procedures for using turbine nomographs and performance curves vary with turbine manufacturers, but the basic method is the same. Turbine nomographs use first stage pressure (or steam chest pressure and nozzle arrangement), condenser vacuum and shaft speed to determine shaft horsepower. Many turbine nomographs correct for variations in design parameters. Those which do not provide correction for design parameters require the application of correction factors to the computed shaft horsepower value. These correction factors can be obtained from the turbine performance curves. For ships equipped with shaft horsepower meters, turbine nomographs can be used to verify meter accuracy. Table 8.3 compiles the turbine nomographs and performance curves for MSC steamships.

**8.3.5.2 MOTORSHIPS**

Shaft horsepower of motorships (either direct drive or diesel-geared design), can be closely approximated by duplicating the fuel rack or governor settings recorded during full power shop tests or sea trials. Whenever possible, indicator readings and firing pressures shall be taken on each engine cylinder to ensure a balanced loading condition. Readings from indicator cards shall be copied and appended to the Full Power Trial Report.

**8.3.5.3 TURBO ELECTRIC AND DIESEL-ELECTRIC DRIVE SHIPS**

Electric drive ships usually are provided with meters that measure electrical power delivered to the propulsion motors. These meters may be calibrated in either kilowatts or horsepower. If a ship does not have a power meter, it will have volt and ampere meters from which power may be calculated. In either case, these meters will not account for losses due to motor and gearing efficiency. To allow for this, power delivered to the motor is multiplied by motor and gear efficiencies to obtain an estimate of actual shaft horsepower, Where power delivered to the motor is measured in horsepower, the efficiency factors may be directly applied. When power is measured or calculated in kilowatts, a conversion factor for horsepower must also be applied. In accordance with this method, the formulas in Table 8.2 shall be used to determine shaft horsepower.

## TABLE 8.1
## FULL POWER RATINGS AND SHIP DATA FOR MSC SHIPS

| VESSEL NAME | SHIP TYPE | HULL NO. T- | DSPL TONS | PROP ARRG'T | ENGINE MFR | # SHFTS | TOTAL SHP | RPM | SHIP SPEED | SHIP SFC LB/SHP-HR | ENG BHP | # ENGS | ENG SFC LB/BHP-HR | MN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INVINCIBLE | OCEANOGRAPHIC | AGOS-10 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| AUDACIOUS | OCEANOGRAPHIC | AGOS-11 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| BOLD | OCEANOGRAPHIC | AGOS-12 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| ADVENTUROUS | OCEANOGRAPHIC | AGOS-13 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| WORTHY | OCEANOGRAPHIC | AGOS-14 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| TITAN | OCEANOGRAPHIC | AGOS-15 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| CAPABLE | OCEANOGRAPHIC | AGOS-16 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| TENACIOUS | OCEANOGRAPHIC | AGOS-17 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| RELENTLESS | OCEANOGRAPHIC | AGOS-18 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 6 |
| SILAS BENT | SURVEY | AGS-26 | 2580 | ELECTR | ALCO | 1 | 3000 | 200 | 16.0 | 0.320 | 1800 | | | |
| KANE | SURVEY | AGS-27 | 2580 | ELECTR | ALCO | 1 | 3000 | 200 | 16.0 | 0.320 | 1800 | | | |
| CHAUVENET | SURVEY | AGS-29 | 4200 | GEARED | ALCO | 1 | 3200 | 175 | 15.0 | | 1800 | 2 | | - |
| HARKNESS | SURVEY | AGS-32 | 4200 | GEARED | ALCO | 1 | 3200 | 175 | 15.0 | | 1800 | 2 | | - |
| WILKES | SURVEY | AGS-33 | 4725 | ELECTR | ALCO | 1 | 3100 | 200 | 15.5 | 0.350 | 1800 | | | |
| WYMAN | SURVEY | AGS-34 | 4725 | ELECTR | ALCO | 1 | 3100 | 200 | 15.5 | 0.350 | 1800 | | | |
| MAURY | SURVEY | AGS-39 | 15821 | GEARED | ENTRPRSE | 1 | 19600 | 140 | 21.0 | 0.335 | 12500 | 2 | 0.325 | - |
| TANNER | SURVEY | AGS-40 | 15821 | GEARED | ENTRPRSE | 1 | 19600 | 140 | 21.0 | 0.335 | 12500 | 2 | 0.325 | - |
| S/L PACIFIC | TRNSPT TANKER | AOT-168 | 32000 | GEARED | CLT-PIEL | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L ARAB SEA | TRNSPT TANKER | AOT-169 | 32000 | GEARED | CLT-PIEL | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L CHINA SEA | TRNSPT TANKER | AOT-170 | 32000 | GEARED | CLT-PIEL | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L IND OCEAN | TRNSPT TANKER | AOT-171 | 32000 | GEARED | CLT-PIEL | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L ATLANTIC | TRNSPT TANKER | AOT-172 | 32000 | GEARED | ENTRPRSE | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L MEDITERR. | TRNSPT TANKER | AOT-173 | 32000 | GEARED | ENTRPRSE | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L CARIBBEAN | TRNSPT TANKER | AOT-174 | 32000 | GEARED | ENTRPRSE | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L ARCTIC | TRNSPT TANKER | AOT-175 | 32000 | GEARED | ENTRPRSE | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |
| S/L ANTARCTIC | TRNSPT TANKER | AOT-176 | 32000 | GEARED | ENTRPRSE | 1 | 14000 | 90 | 17.1 | 0.353 | | | | - |

NOTES

1. FOR CONDUCTING FULL POWER TRIALS ABOARD T-AO 187 CLASS THE FOLLOWING SHALL BE USED: BHP OF EACH M.E. = (SHP + 300) + (PTO KW * 1.342 / 0.88) FULL POWER TRIALS SHALL BE ACCOMPLISHED IN MODE II. MAX CONTINUOUS RATING OF EACH PROPULSION ENGINE IS 16275 BHP AT 400 RPM.

FULL POWER RATINGS AND SHIP DATA FOR MSC MOTORSHIPS

TABLE 8.1

FULL POWER RATINGS AND SHIP DATA FOR MSC SHIPS

| VESSEL NAME | SHIP TYPE | HULL NO. T- | DSPL TONS | PROP ARRG'T | ENGINE MFR | # SHFTS | TOTAL SHP | RPM | SHIP SPEED | SHIP SFC LB/SHP-HR | ENG BHP | # ENGS | ENG SFC LB/BHP-HR | MN GEN KW | PROP TYPE | PROP BLDS | PROP DIAM | PROP PITCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIRIUS | RFRG STORES | AFS-8 | 16792 | DIRECT | SULZER | 1 | 12800 | 122 | 18.0 | 0.324 | 12800 | 1 | 0.324 | ---- | FPP | 4 | 19'-0' | 16.00' |
| SPICA | RFRG STORES | AFS-9 | 16792 | DIRECT | SULZER | 1 | 12800 | 122 | 18.0 | 0.324 | 12800 | 1 | 0.324 | ---- | FPP | 4 | 19'-0' | 16.00' |
| SATURN | RFRG STORES | AFS-10 | 16792 | DIRECT | SULZER | 1 | 12800 | 122 | 18.0 | 0.324 | 12800 | 1 | 0.324 | ---- | FPP | 4 | 19'-0' | 16.00' |
| NEPTUNE | CABLE | ARC-2 | 8500 | ELECTR | GE | 2 | 4000 | 94 | 14.0 | 0.534 | 2830 | 3 | 0.345 | 2000 | FPP | 4 | 17'-2' | 13.75' |
| A.J. MYER | CABLE | ARC-6 | 8500 | ELECTR | GE | 2 | 4000 | 94 | 14.0 | 0.534 | 2830 | 3 | 0.345 | 2000 | FPP | 4 | 17'-2' | 13.75' |
| ZEUS | CABLE | ARC-7 | 14250 | ELECTR | EMD | 2 | 10000 | 145 | 15.0 | | 3600 | 5 | 0.352 | 2500 | FPP | 4 | 13'-0' | |
| POWHATAN | FLEET TUG | ATF-166 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.369 | ---- | CPP | 4 | 09'-0' | 09 08' |
| NARRAGANSETT | FLEET TUG | ATF-167 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.352 | ---- | CPP | 4 | 09'-0' | 09.08' |
| CATAWBA | FLEET TUG | ATF-168 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.369 | ---- | CPP | 4 | 09'-0' | 09.08' |
| NAVAJO | FLEET TUG | ATF-169 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.369 | ---- | CPP | 4 | 09'-0' | 09.08' |
| MOHAWK | FLEET TUG | ATF-170 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.369 | ---- | CPP | 4 | 09'-0' | 09.08' |
| SIOUX | FLEET TUG | ATF-171 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.369 | ---- | CPP | 4 | 09'-0' | 09.08' |
| APACHE | FLEET TUG | ATF-172 | 2260 | GEARED | EMD | 2 | 7200 | 227 | 15.3 | | 3600 | 2 | 0.369 | ---- | CPP | 4 | 09'-0' | 09.08' |
| H. J. KAISER | OILER | AO-187 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| J. HUMPHREYS | OILER | AO-188 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| J. LENTHALL | OILER | AO-189 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| A. HIGGINS | OILER | AO-190 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| B. ISHERWOOD | OILER | AO-191 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| H. ECKFORD | OILER | AO-192 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| W. DIEHL | OILER | AO-193 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| J. ERICSSON | OILER | AO-194 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| L. GRUMMAN | OILER | AO-195 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| KANAWA | OILER | AO-196 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| PECOS | OILER | AO-197 | 42382 | GEARED | CLT-PIEL | 2 | NOTE 1 | 95 | 22.0 | | 16275 | 2 | 0.293 | ---- | CRP | 4 | 21'-0' | 27.86' |
| LYNCH | OCEANOGRAPHIC | AGOR-7 | 1409 | ELECTR | CAT | 1 | 1000 | 200 | 13.5 | | 593 | | | | FPP | 3 | 09'-0' | 07.67' |
| DESTEIGER | OCEANOGRAPHIC | AGOR-12 | 1339 | ELECTR | CAT | 1 | 1000 | 200 | 13.5 | | 593 | | | | FPP | 5 | 7'-11' | 07.36' |
| BARTLETT | OCEANOGRAPHIC | AGOR-13 | 1339 | ELECTR | CAT | 1 | 1000 | 200 | 13.5 | | 593 | | | | FPP | 5 | 7'-11' | 07.36' |
| HAYES | OCEANOGRAPHIC | AGOR-16 | 3166 | GEARED | EMD | 2 | 2640 | 140 | 14.0 | | 2700 | | 0.385 | ---- | CRP | 4 | 12'-0' | 13.64' |
| STALWART | OCEANOGRAPHIC | AGOS-1 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| CONTENDER | OCEANOGRAPHIC | AGOS-2 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| VINDICATOR | OCEANOGRAPHIC | AGOS-3 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| TRIUMPH | OCEANOGRAPHIC | AGOS-4 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| ASSURANCE | OCEANOGRAPHIC | AGOS-5 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| PERSISTENT | OCEANOGRAPHIC | AGOS-6 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| INDOMITABLE | OCEANOGRAPHIC | AGOS-7 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| PREVAIL | OCEANOGRAPHIC | AGOS-8 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0.420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |
| ASSERTIVE | OCEANOGRAPHIC | AGOS-9 | 2285 | ELECTR | CAT | 2 | 1600 | 185 | 11.5 | 0 420 | 850 | 4 | | 600 | FPP | 4 | 08'-0' | |

FULL POWER HEAT BALANCE RATINGS A[illegible] [illegible]IP DATA FOR MSC STEAMSHIPS

| VESSEL NAME | SHIP TYPE | HULL NO. T- | DSPL TONS | PROP ARRG'T | BLR MFR | NO. BLRS | BLR PRESS | TURB MFR | # SHFTS | TOTAL SHP | RPM | SHIP SPEED | S/S KW LD | EVAP GAL/HR | SHIP SFC LB/SHP-HR | PROP TYPE | PROP BLDS | PROP DIAM | PROP PITCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KILAUEA | AMMUNITION | AE-26 | 20500 | GR'D TURB | F-W | 3 | 600 | GE | 1 | 22000 | 115 | 21.5 | 1495 | 734.7 | 0.606 | FPP | 6 | 22'-0" | 22.16' |
| MERCY | HOSPITAL | AH-19 | 69360 | GR'D TURB | F-W | 2 | 860 | GE | 1 | 24500 | 92 | 17.5 | 715 | 9697.9 | 0.580 | FPP | 5 | | |
| COMFORT | HOSPITAL | AH-20 | 69360 | GR'D TURB | F-W | 2 | 860 | GE | 1 | 24500 | 92 | 17.5 | 715 | 9697.9 | 0.580 | FPP | 5 | | |
| MISPILLION | OILER | AO-105 | 35000 | GR'D TURB | B & W | 4 | 450 | WEST'HSE | 2 | 15000 | 100 | 17.3 | 715 | 415.0 | 0.664 | FPP | 4 | 17'-6" | 22.19' |
| NAVASOTA | OILER | AO-106 | 35000 | GR'D TURB | B & W | 4 | 450 | WEST'HSE | 2 | 15000 | 100 | 17.3 | 715 | 415.0 | 0.664 | FPP | 4 | 17'-6" | 22.19' |
| PASSUMPSIC | OILER | AO-107 | 35000 | GR'D TURB | B & W | 4 | 450 | WEST'HSE | 2 | 15000 | 100 | 17.3 | 715 | 415.0 | 0.664 | FPP | 4 | 17'-6" | 22.19' |
| PAWCATUCK | OILER | AO-108 | 35000 | GR'D TURB | B & W | 4 | 450 | WEST'HSE | 2 | 15000 | 100 | 17.3 | 715 | 415.0 | 0.664 | FPP | 4 | 17'-6" | 22.19' |
| WACCAMAW | OILER | AO-109 | 35000 | GR'D TURB | B & W | 4 | 450 | WEST'HSE | 2 | 15000 | 100 | 17.3 | 715 | 415.0 | 0.664 | FPP | 4 | 17'-6" | 22.19' |
| NEOSHO | OILER | AO-143 | 44500 | GR'D TURB | B & W | 2 | 600 | GE | 2 | 28000 | 130 | 20.5 | 818 | 525.3 | 0.531 | FPP | 4 | 18'-0" | 18.83' |
| MISSISSINEWA | OILER | AO-144 | 44500 | GR'D TURB | B & W | 2 | 600 | GE | 2 | 28000 | 130 | 20.5 | 818 | 525.3 | 0.531 | FPP | 4 | 18'-0" | 18.83' |
| HASSAYAMPA | OILER | AO-145 | 44500 | GR'D TURB | B & W | 2 | 600 | GE | 2 | 28000 | 130 | 20.5 | 818 | 525.3 | 0.531 | FPP | 4 | 18'-0" | 18.83' |
| KAWISHIWI | OILER | AO-146 | 44500 | GR'D TURB | B & W | 2 | 600 | GE | 2 | 28000 | 130 | 20.5 | 818 | 525.3 | 0.531 | FPP | 4 | 18'-0" | 18.83' |
| TRUCKEE | OILER | AO-147 | 44500 | GR'D TURB | B & W | 2 | 600 | GE | 2 | 28000 | 130 | 20.5 | 818 | 525.3 | 0.531 | FPP | 4 | 18'-0" | 18.83' |
| PONCHATOULA | OILER | AO-148 | 44500 | GR'D TURB | B & W | 2 | 600 | GE | 2 | 28000 | 130 | 20.5 | 818 | 525.3 | 0.531 | FPP | 4 | 18'-0" | 18.83' |
| POINT LOMA | SUB SUPPORT | AGDS-2 | 10320 | GR'D TURB | F-W | 2 | 465 | WEST'HSE | 2 | 6000 | 180 | 15.0 | 500 | 332.0 | 0.706 | FPP | 3 | 11'-0" | 11.05' |
| OBSERV ISLE | TRACKING | AGM-23 | 17015 | GR'D TURB | F-W | 2 | 600 | GE | 1 | 19250 | 105 | 21.0 | 1902 | 437.5 | 0.557 | FPP | 4 | 22'-0" | 22.83' |
| MERCURY | RO/RO CARGO | AKR-10 | 45369 | GR'D TURB | B & W | 2 | 875 | GE | 1 | 37000 | 120 | 23.0 | 1807 | 388.1 | 0.551 | FPP | 6 | 22'-0" | 23.16' |
| RIGEL | RFRG STORES | AF-58 | 15540 | GR'D TURB | C-E | 2 | 600 | DELAVAL | 1 | 12500 | 90 | 20.0 | 500 | 588 | 0.532 | FPP | 6 | 22'-0" | 21 70' |
| VANGUARD | NAV RESEARCH | AG-194 | 21626 | TURB ELEC | B & W | 2 | | | 1 | 10000 | 106 | 16.3 | 1913 | | 0.813 | FPP | | | |
| REDSTONE | MSL RANGING | AGM-20 | 21626 | TURB ELEC | B & W | 2 | | | 1 | 10000 | 106 | 16.3 | 1913 | | 0.813 | FPP | | | |
| RNG SENTINEL | MSL RANGING | AGM-22 | 11860 | GR'D TURB | | 2 | | | 1 | 9350 | 93 | 16.5 | | | | FPP | 4 | 20'-6" | 22.92' |
| FURMAN | CABLE TRNSPT | AK-280 | 11150 | GR'D TURB | B & W | 2 | 450 | | 1 | 8500 | 85 | 16.5 | | | 0.600 | FPP | 4 | 20'-6" | 22.92' |
| MARSHFIELD | FBM CARGO | AK-282 | 11150 | GR'D TURB | B & W | 2 | 450 | | 1 | 8500 | 85 | 16.5 | | | 0.600 | FPP | 4 | 20'-6" | 22.92' |
| VEGA | FBM CARGO | AK-286 | 16400 | GR'D TURB | | 2 | | | 1 | 12100 | 96 | 18.0 | | | 0.573 | FPP | 4 | 21'-0" | 21.32' |
| BOWDITCH | SURVEY | AGS-21 | 13050 | GR'D TURB | | 2 | 450 | | 1 | 8500 | 85 | 16.5 | | | 0.597 | FPP | 4 | 20'-6" | 22.92' |
| H.H. HESS | SURVEY | AGS-38 | 17874 | GR'D TURB | F-W | 2 | 615 | GE | 1 | 19250 | 105 | 20.0 | | | 0.520 | FPP | 4 | 22'-0" | |
| ALGOL | RO/RO, CARGO | AKR-287 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |
| BELLATRIX | RO/RO, CARGO | AKR-288 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27 86' |
| DENEBOLA | RO/RO, CARGO | AKR-289 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |
| POLLUX | RO/RO, CARGO | AKR-290 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |
| ALTAIR | RO/RO, CARGO | AKR-291 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |
| REGULUS | RO/RO, CARGO | AKR-292 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |
| CAPELLA | RO/RO, CARGO | AKR-293 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |
| ANTARES | RO/RO, CARGO | AKR-294 | 51815 | GR'D TURB | | 2 | | GE | 2 | 120000 | 136 | 33.0 | | | 0.477 | FPP | 4 | 23'-0" | 27.86' |

## TABLE 8.2

## PROCEDURES FOR CALCULATING FULL POWER, TURBO ELECTRIC AND DIESEL-ELECTRIC DRIVE SHIPS

The following formulas shall be used for determining shaft horsepower for diesel-electric and turbo electric ships:

$$SHP = (HP)x(O_m)x(O_r)$$

$$SHP = (KW)x(O_m)x(O_r)x(1.341)$$

$$SHP = (V)x(I)x(O_m)x(O_r)x(M)x0.001341$$

where:

SHP = shaft horsepower
HP = motor horsepower
KW = motor kilowatts
$O_m$ = motor efficiency
$O_r$ = reduction gear efficiency
V = motor voltage (armature voltage for DC motors)
I = motor amperage (series loop for DC motors)
M = number of motor armatures (DC motors only)

Brake horsepower output of generator prime movers may be calculated by the following formulas:

$$BHP = (0.001341)x(KW)/O_g$$

$$BHP = (0.001341)x(V)x(I)/O_g \quad \text{(DC generators)}$$

$$BHP = (0.001341)x((V)x(I)x(PF))/O_g \quad \text{(AC generators)}$$

where:

BHP = prime mover brake horsepower
KW = generator kilowatts
V = generator voltage
I = generator amperage (series loop for DC machines)
$O_g$ = generator efficiency
PF = generator power factor (three phase, AC phase)

If the generator set is equipped with direct-connected propulsion motor exciters, the horsepower input to the exciter must also be calculated and added to the BHP calculated above in order to obtain the total BHP output of the prime mover.

Motor reduction gear, and generator efficiency curves are customarily found in manufacturer's technical manuals. Where full power motor, gear and generator efficiencies are not known, the following values[1] may be used:

**TABLE 8.2**

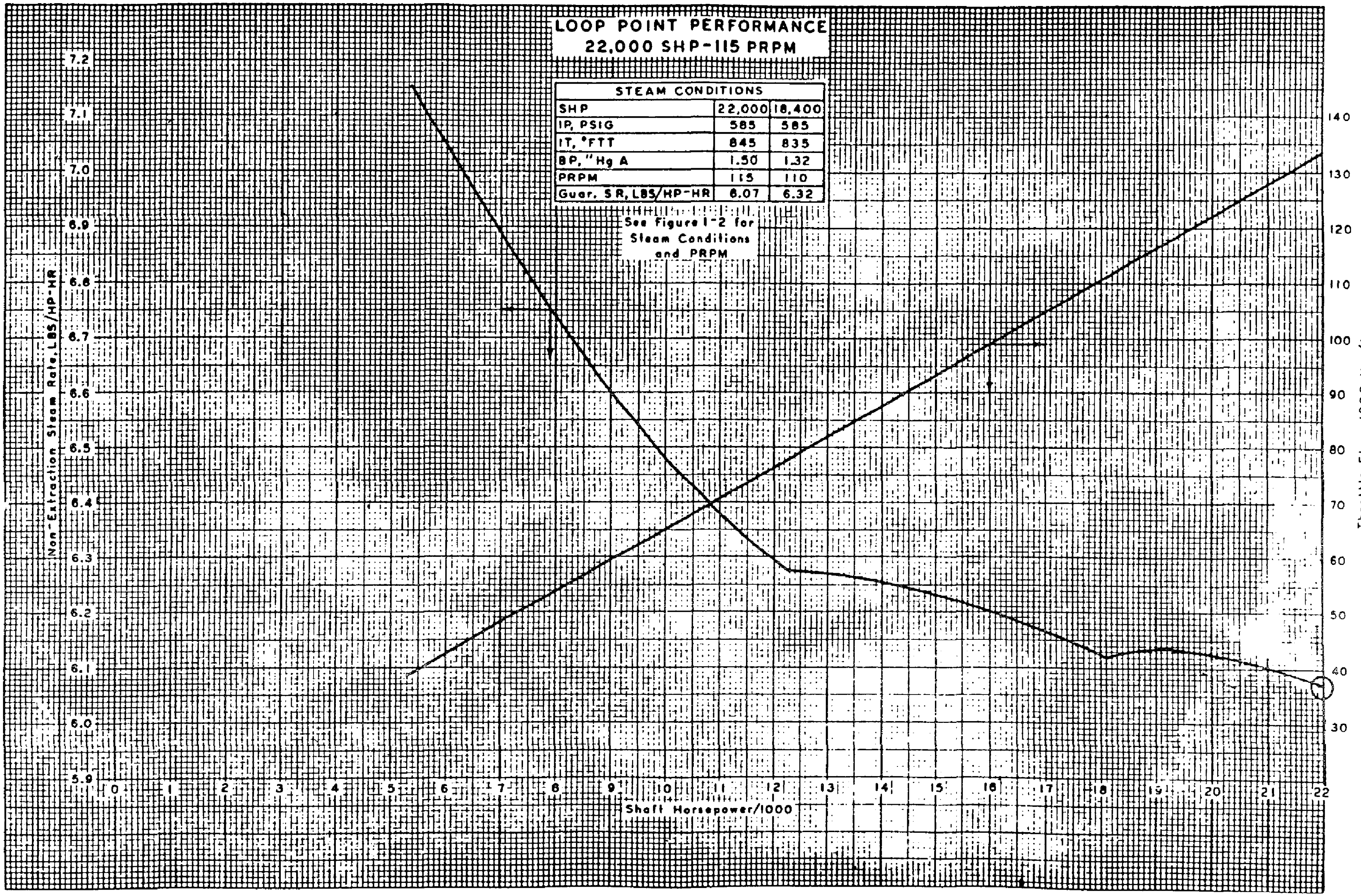
**PROCEDURES FOR CALCULATING FULL POWER, TURBO ELECTRIC AND DIESEL-ELECTRIC DRIVE SHIPS (CONT'D)**

| Unit | Rating | Efficiency |
|---|---|---|
| Generator | 1000 KVA | 0.94 |
| Generator | 2000 KVA | 0.96 |
| Generator | 10000 KVA | 0.97 |
| Motor | 1000 HP | 0.95 |
| Motor | 5000 HP | 0.96 |
| Motor | 10000 HP | 0.97 |
| Reduction Gear | All | 0.98 |

[1] Michael R. Lindeburg, Mechanical Engineering Review Manual, (7th Ed; San Carlos: Professional Publications, 1984), p. 74.

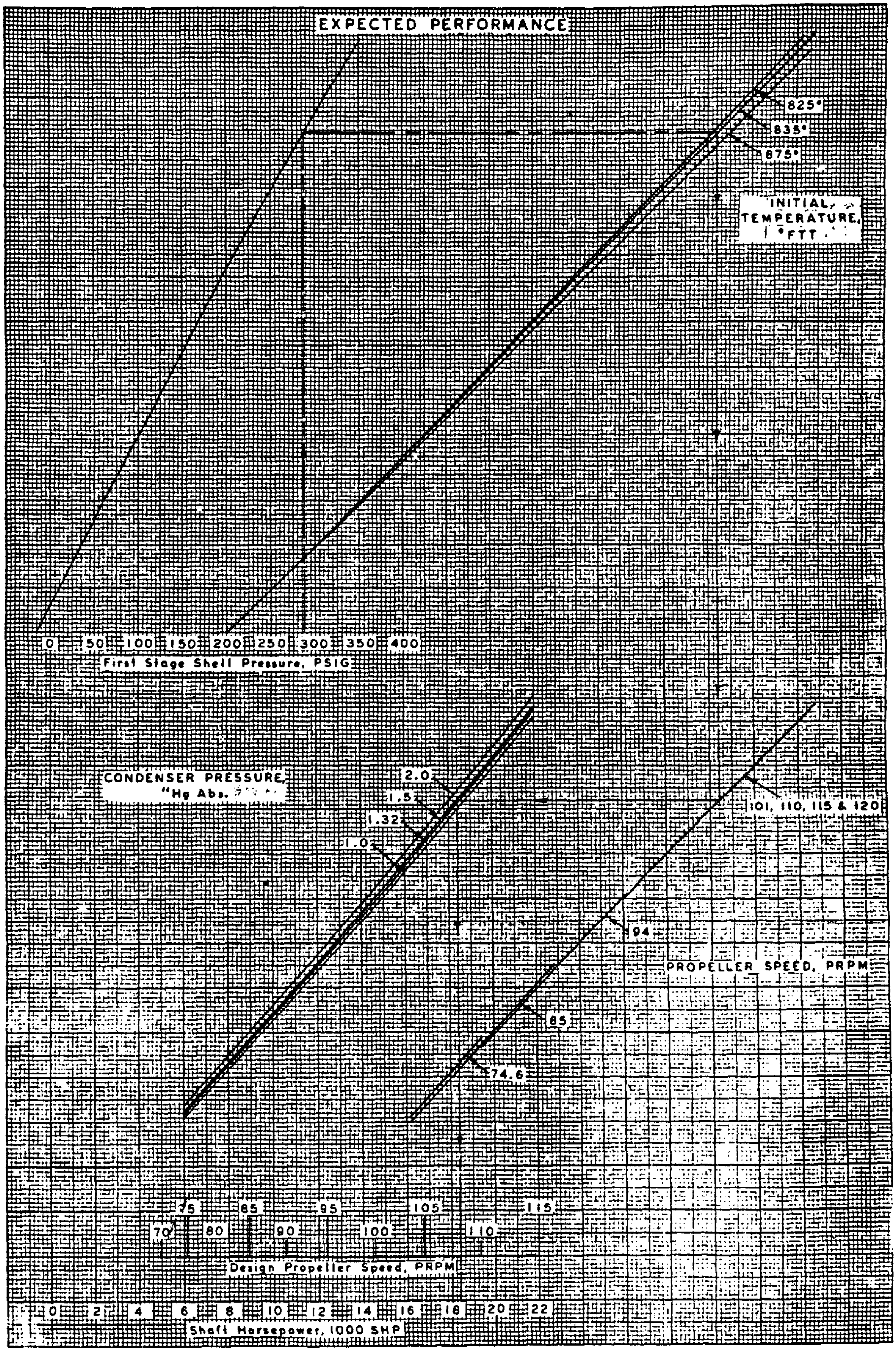
# TABLE 8.3

## TURBINE NOMOGRAPHS AND PERFORMANCE CURVES




# T-AE 26, USNS KILAUEA

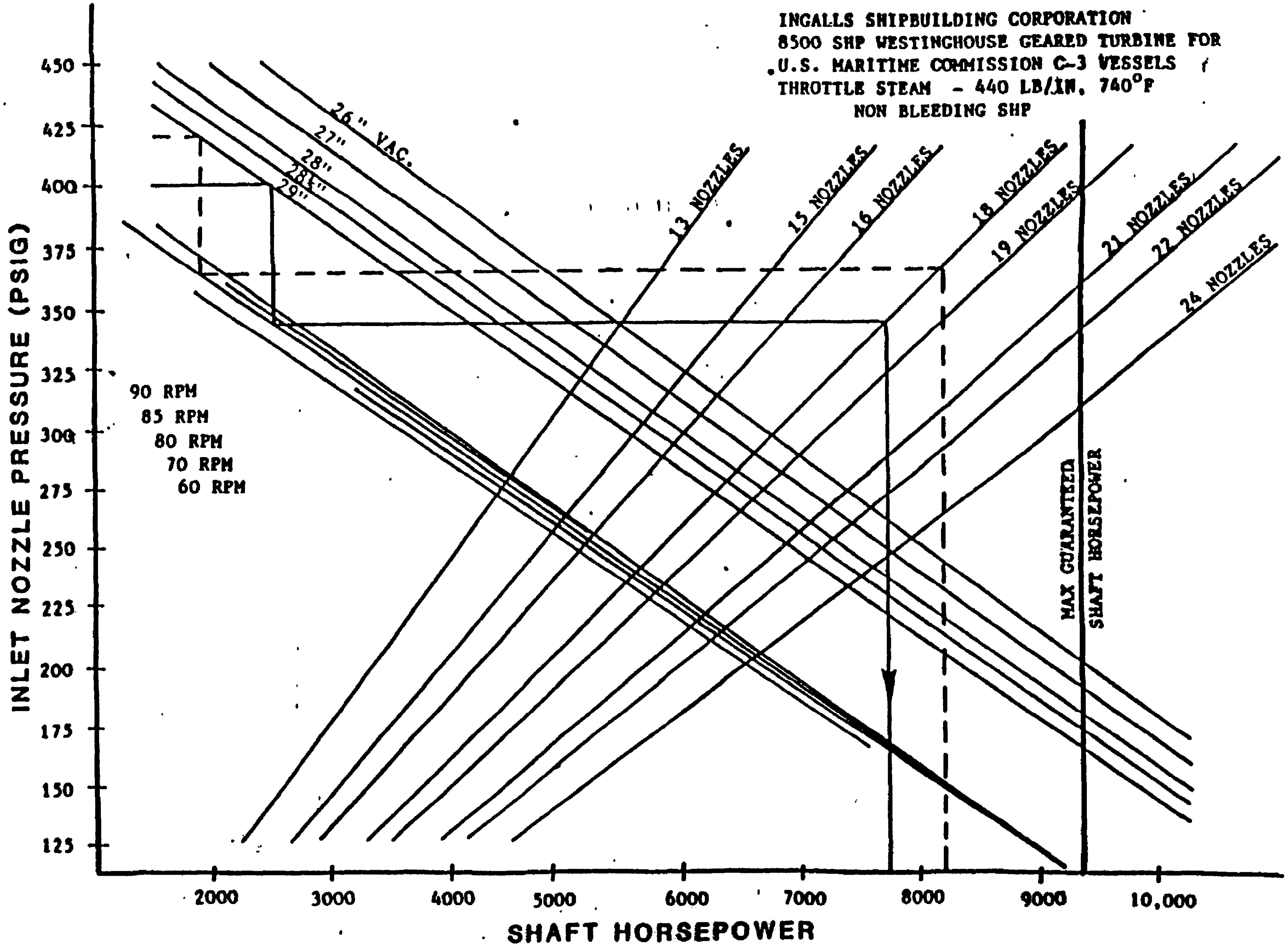
26 MAR 1992




T-AE 26, USNS KILAUEA

TABLE 8.3

# T-AK 280 CLASS TURBINE PERFORMANCE CURVE

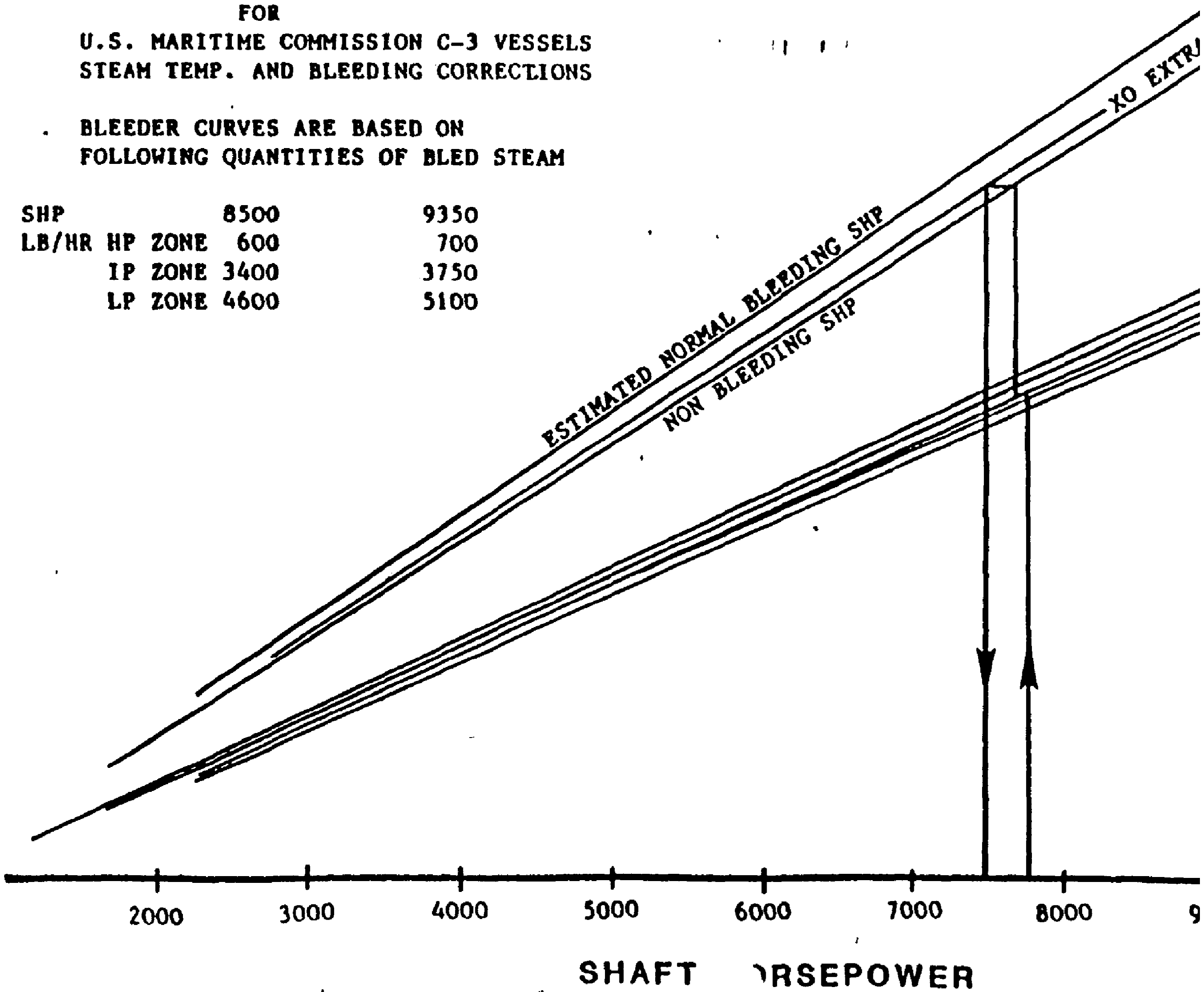


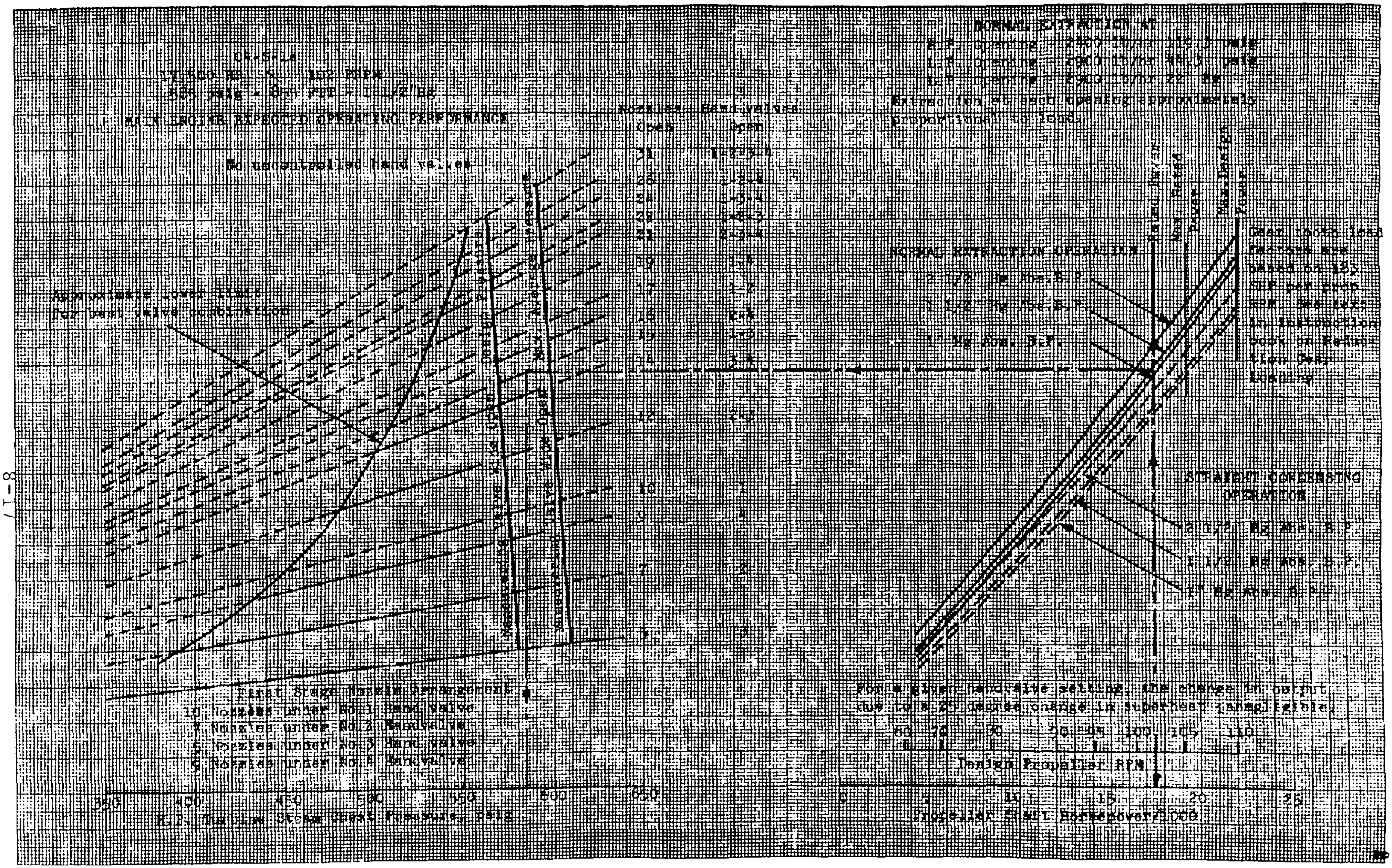
# T-AK 280 CLASS TURBINE PERFORMANCE C

INGALLS SHIPBUILDING CORPORATION
8500 SHP WESTINGHOUSE GEARED TURBINE
FOR
U.S. MARITIME COMMISSION C-3 VESSELS
STEAM TEMP. AND BLEEDING CORRECTIONS

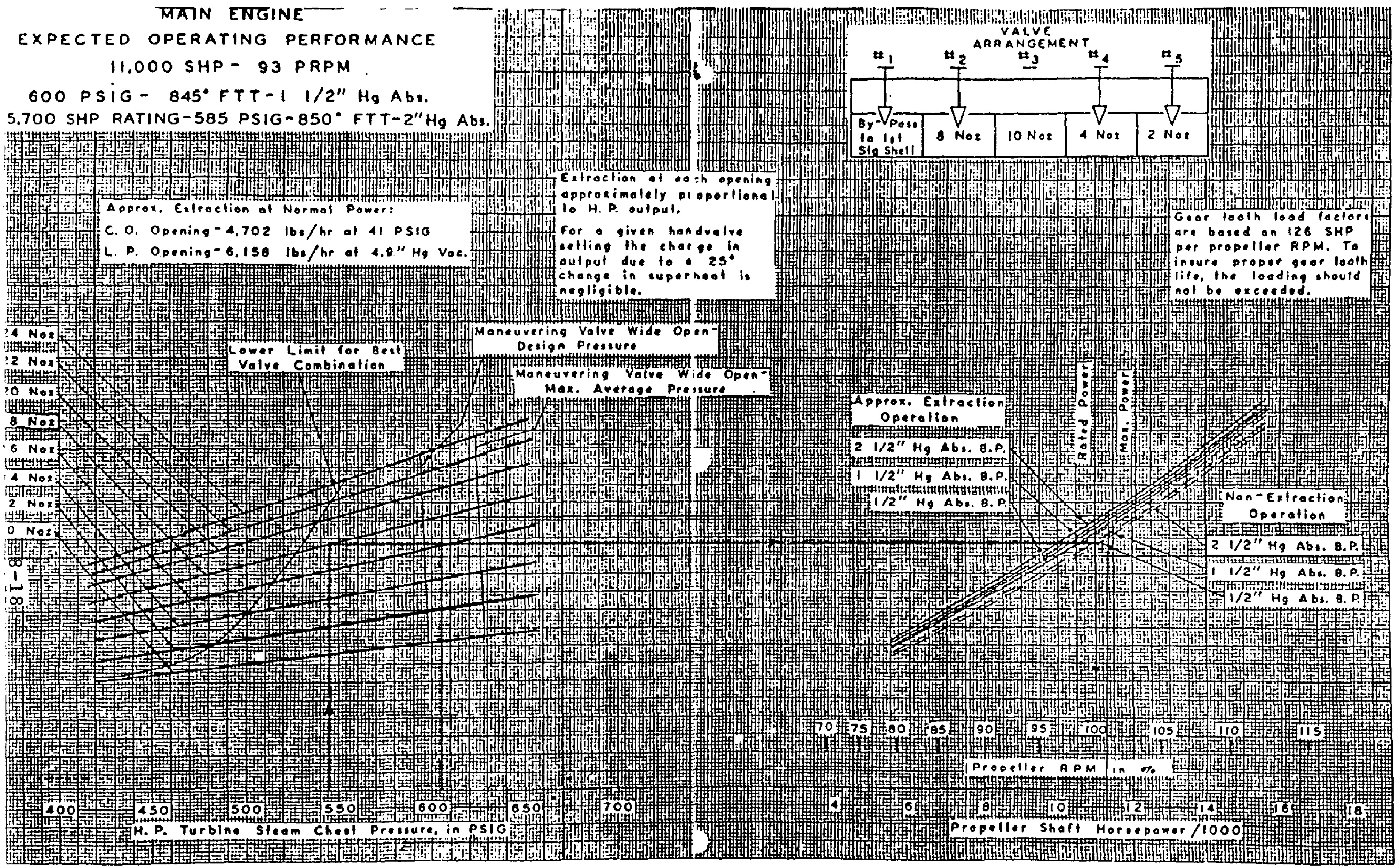
. BLEEDER CURVES ARE BASED ON
FOLLOWING QUANTITIES OF BLED STEAM

| | | |
|---|---|---|
| SHP | 8500 | 9350 |
| LB/HR HP ZONE | 600 | 700 |
| IP ZONE | 3400 | 3750 |
| LP ZONE | 4600 | 5100 |





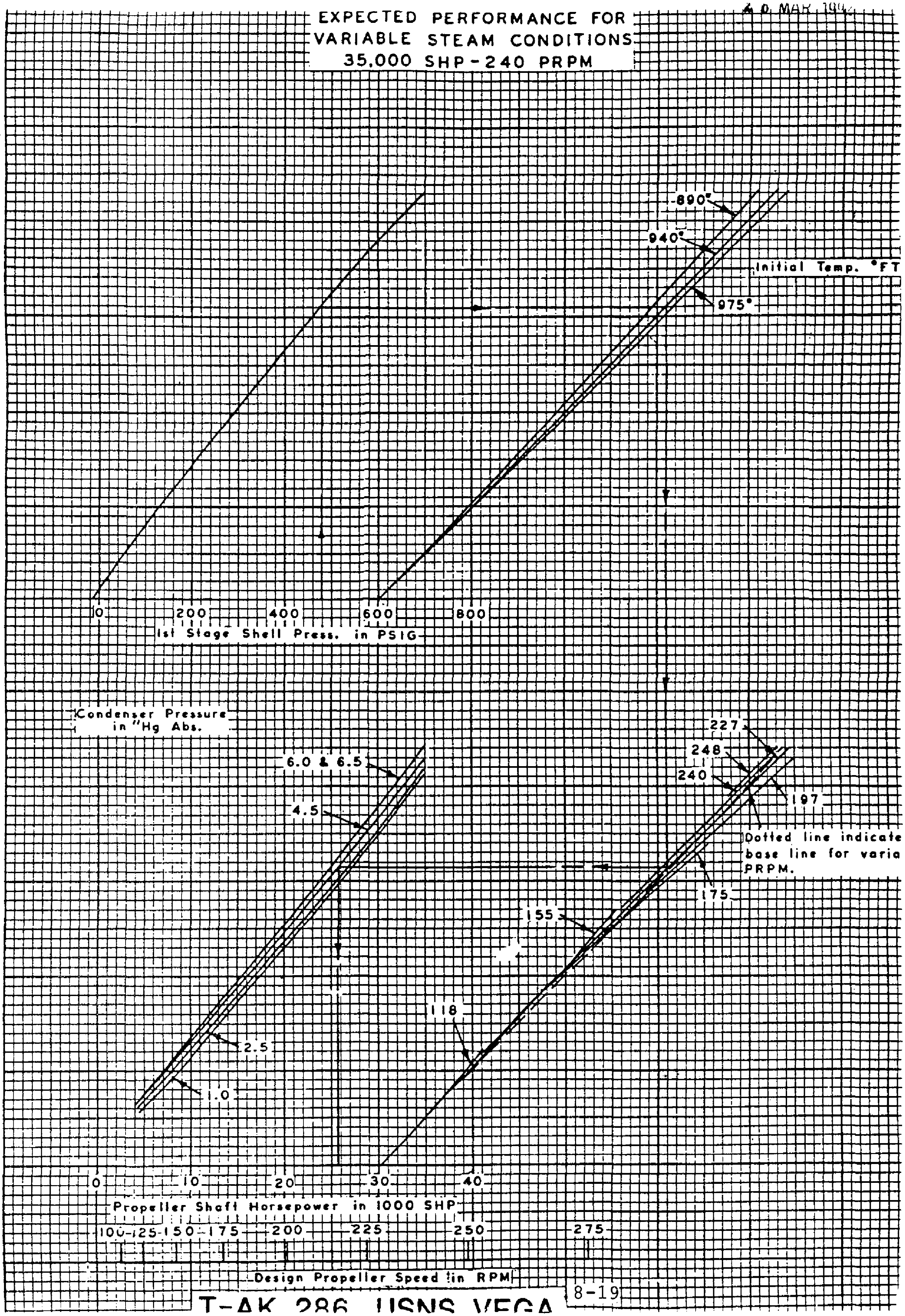

T-AGM 23, USNS OBSERVATION ISLAND AND T-AGS 38, USNS HESS




8-18

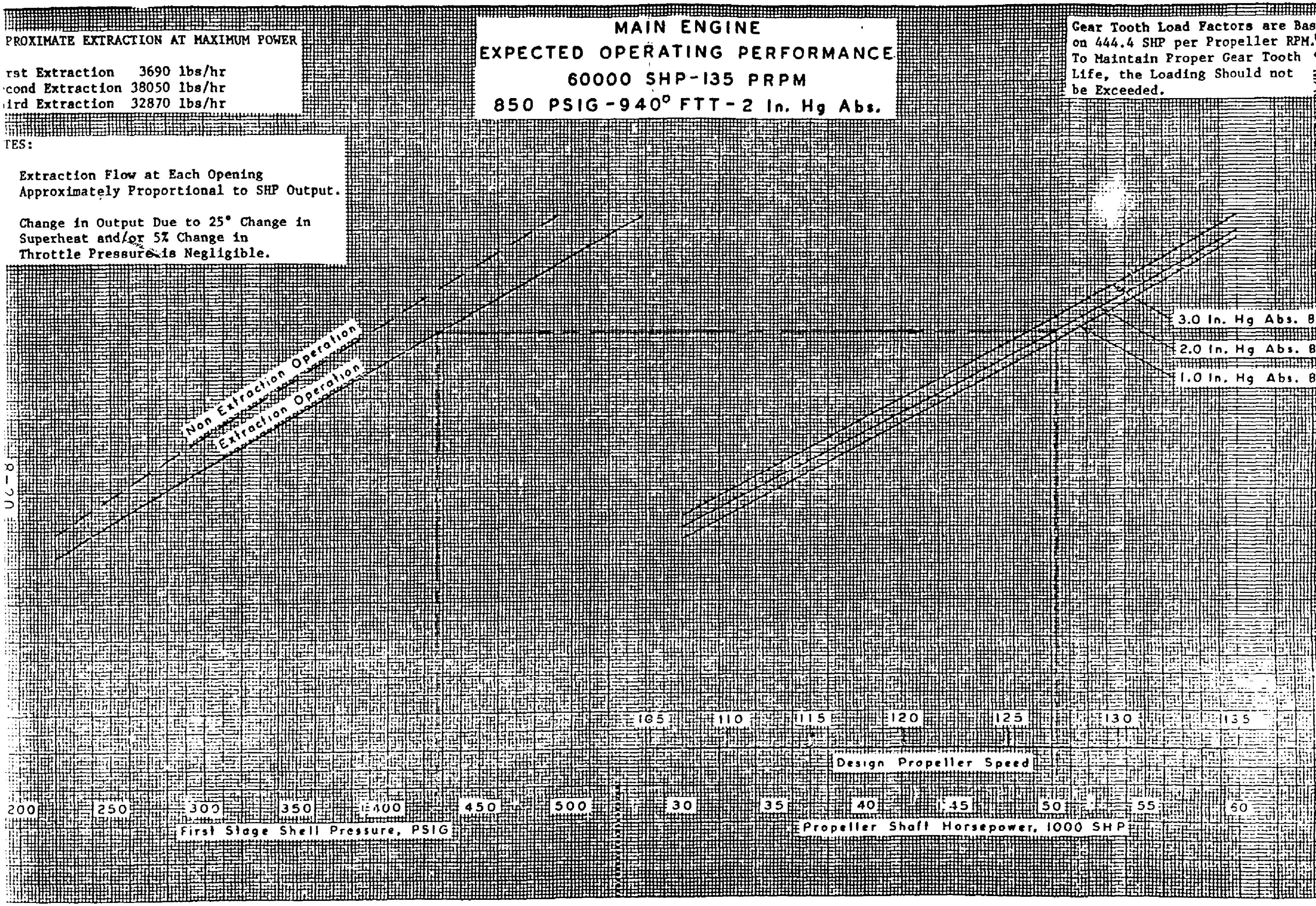
26 MAR 1992

# T-AK 286, USNS VEGA

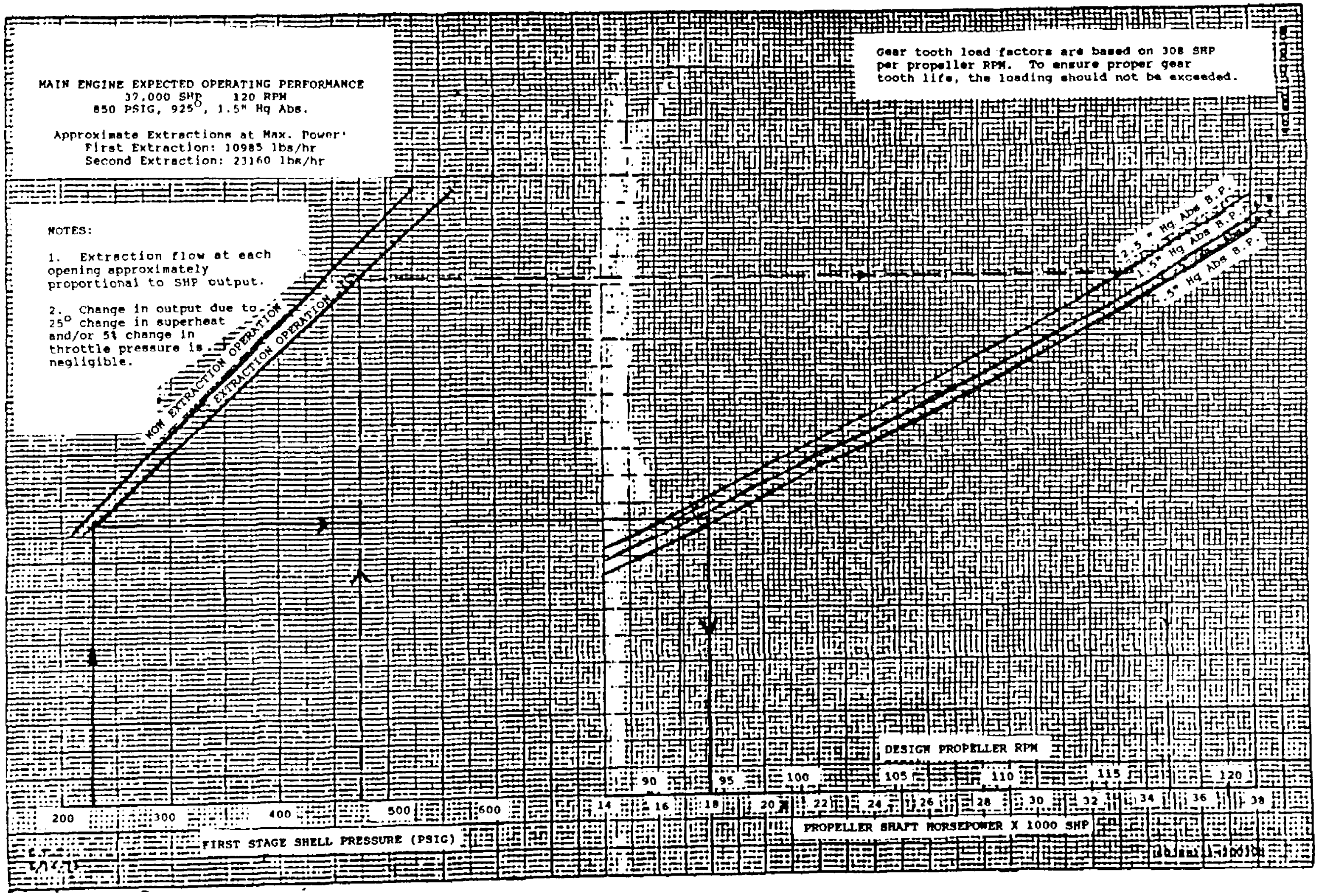





T-AK 286 USNS VEGA

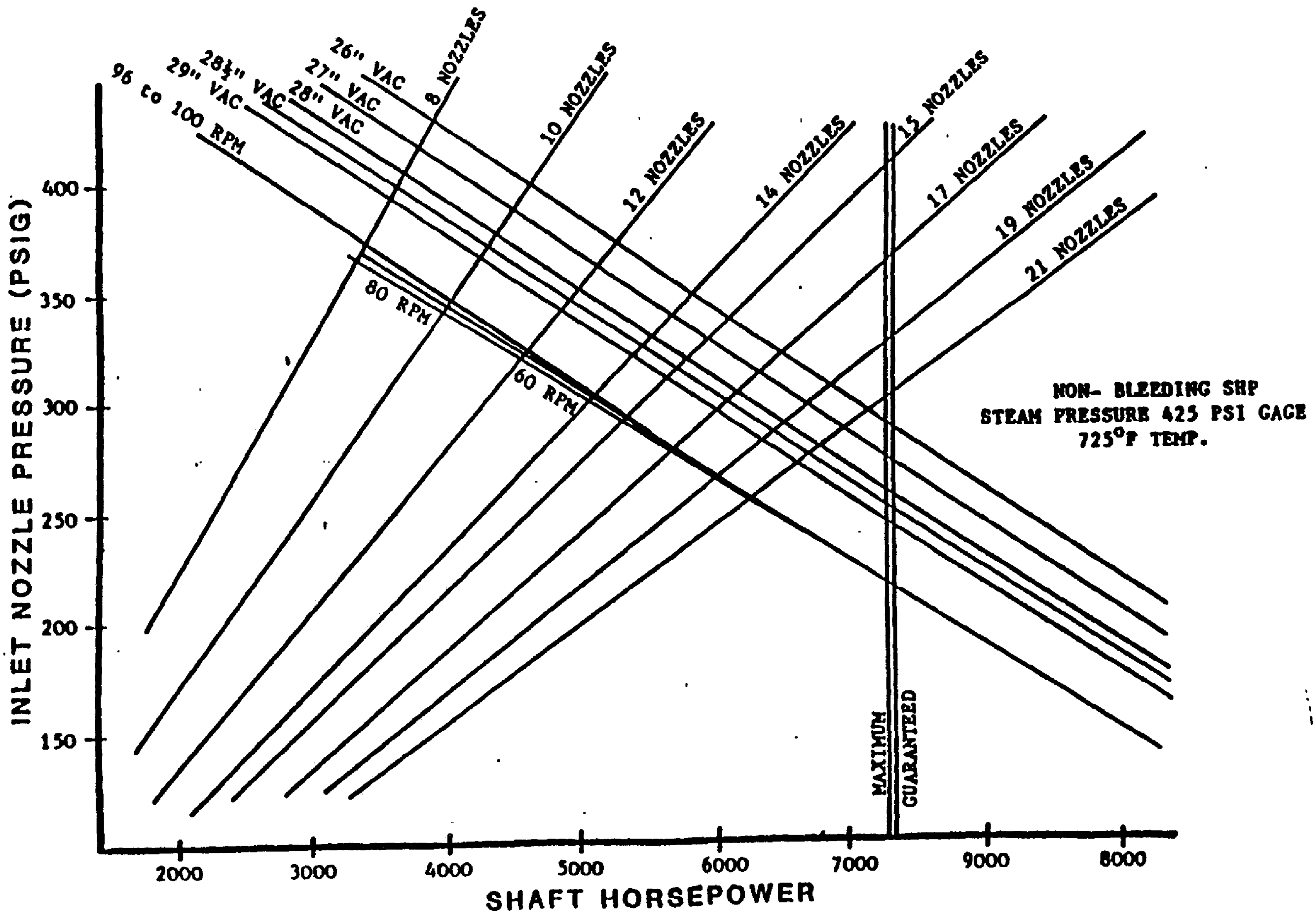



T-AKR 287 CLASS

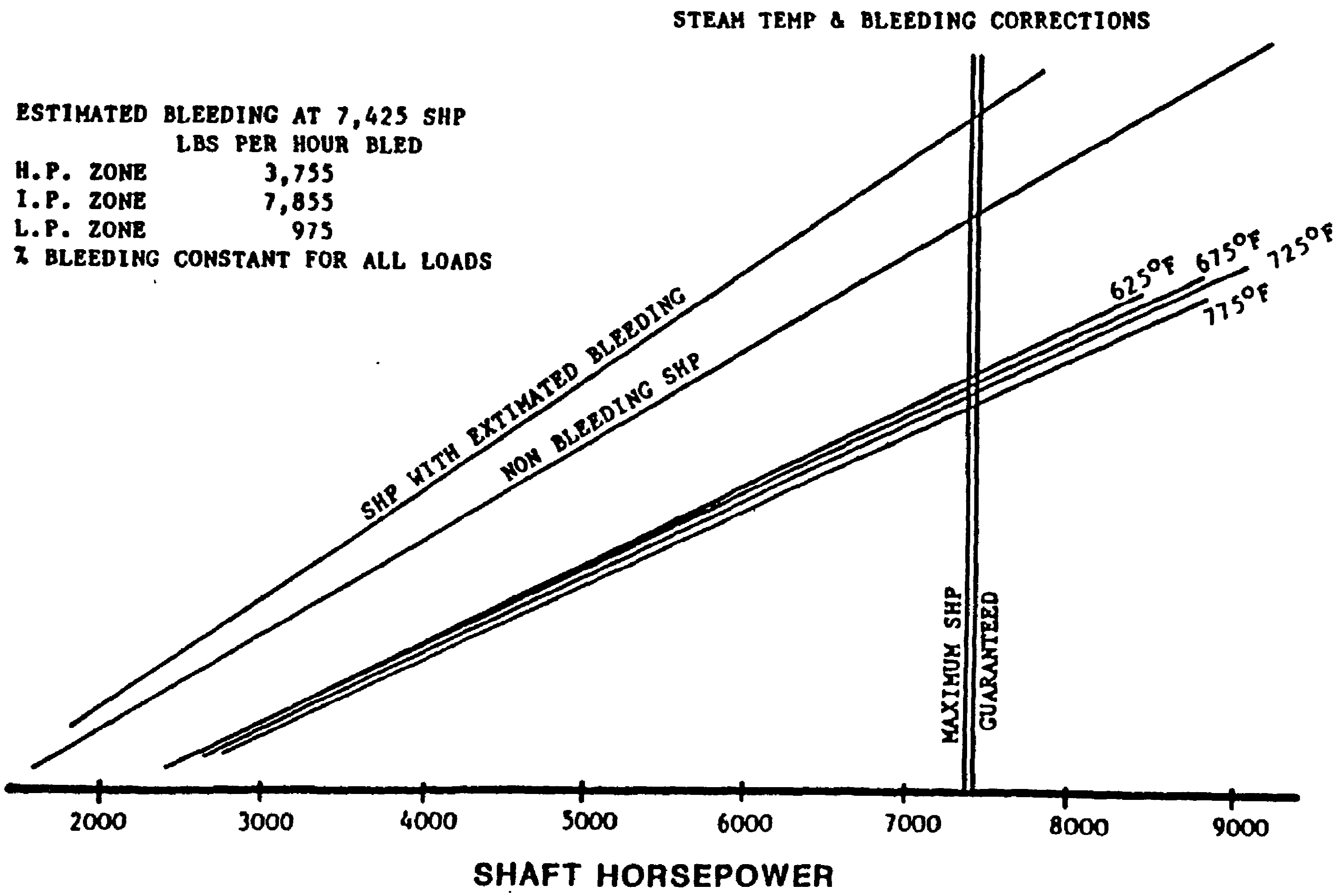


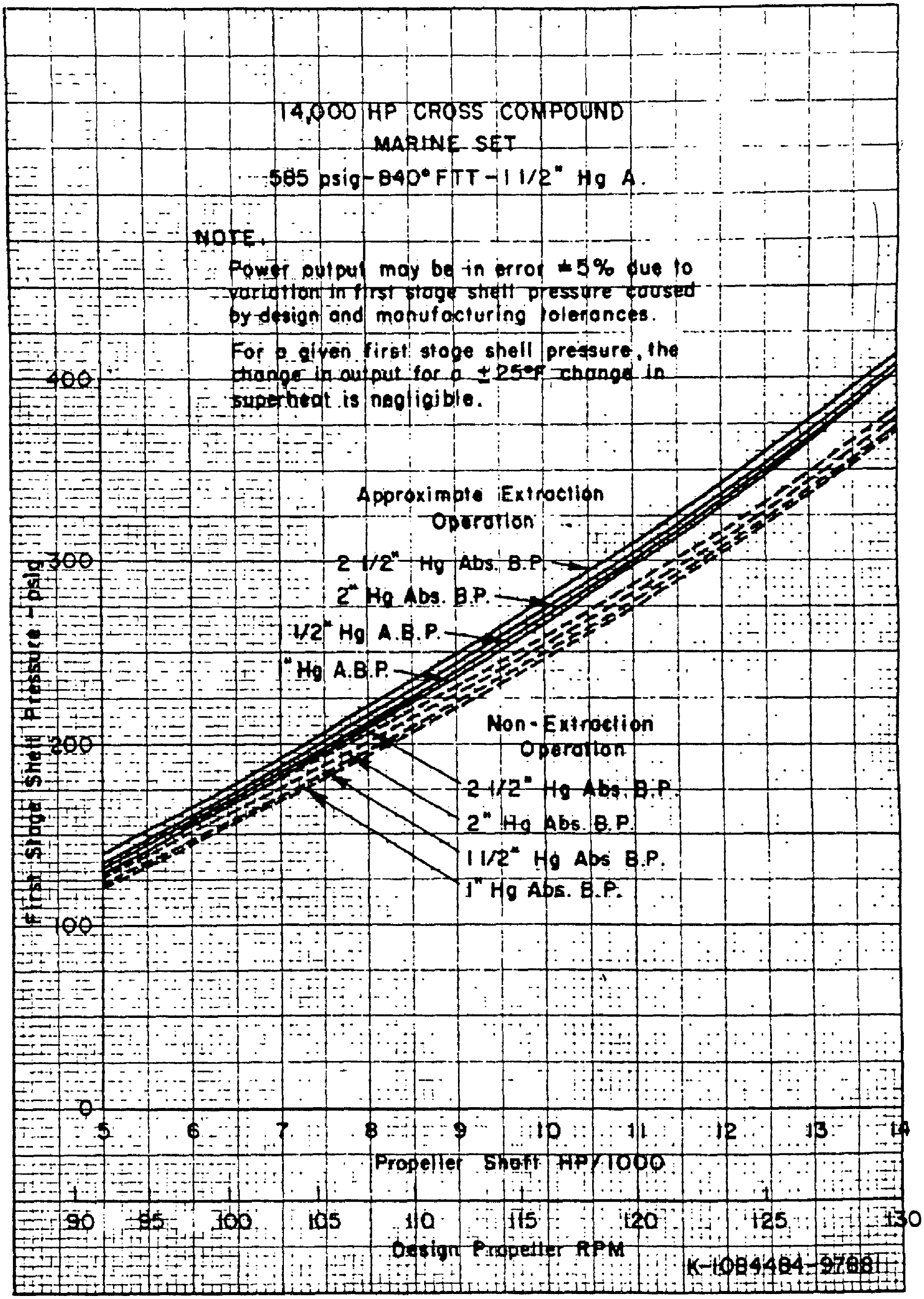

# T-AKR 10, USNS MERCURY

# T-AO 105 CLASS TURBINE PERFORMANCE CURVE



# T-AO 105 TURBINE PERFORMANCE CURVE

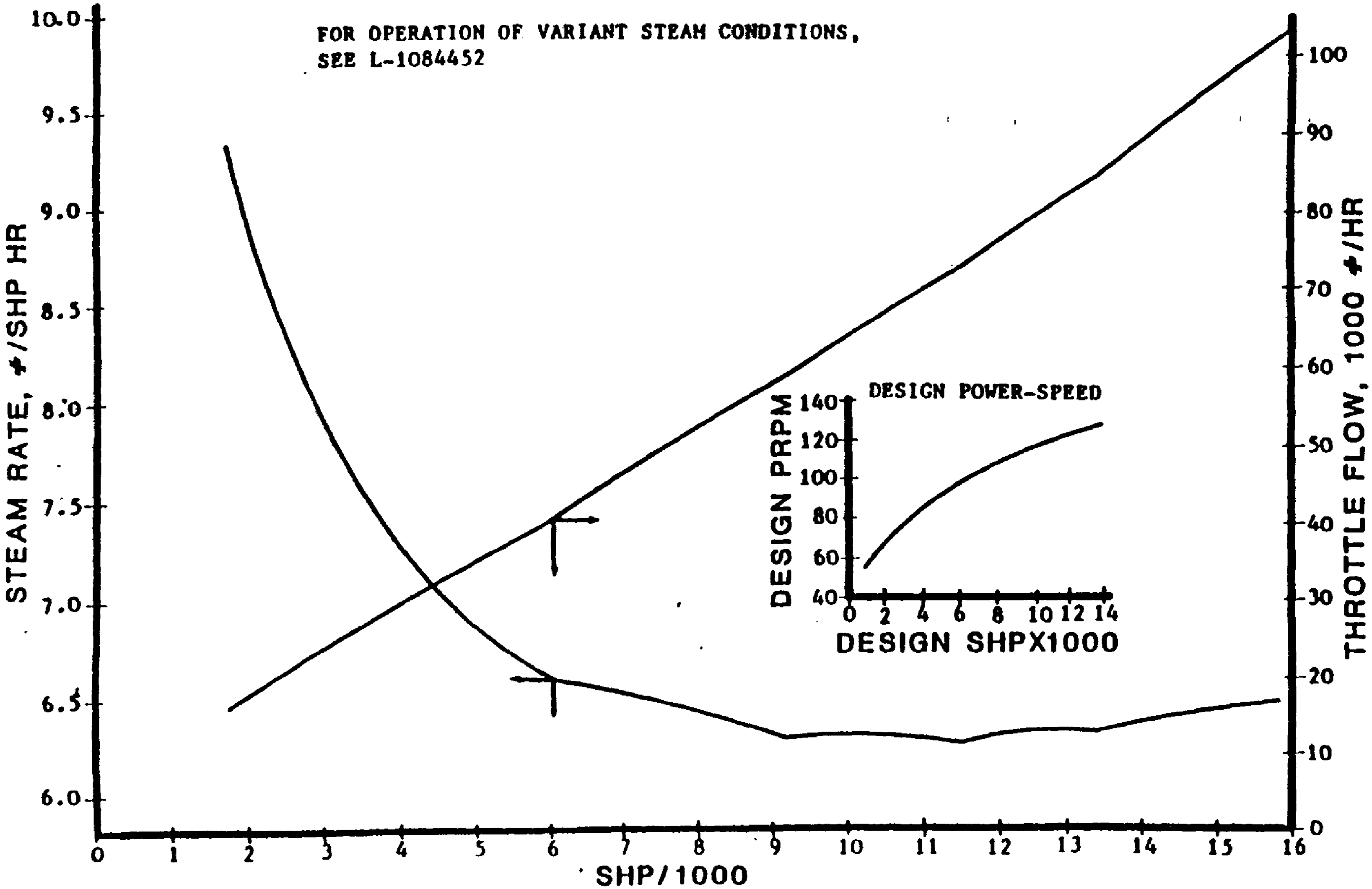




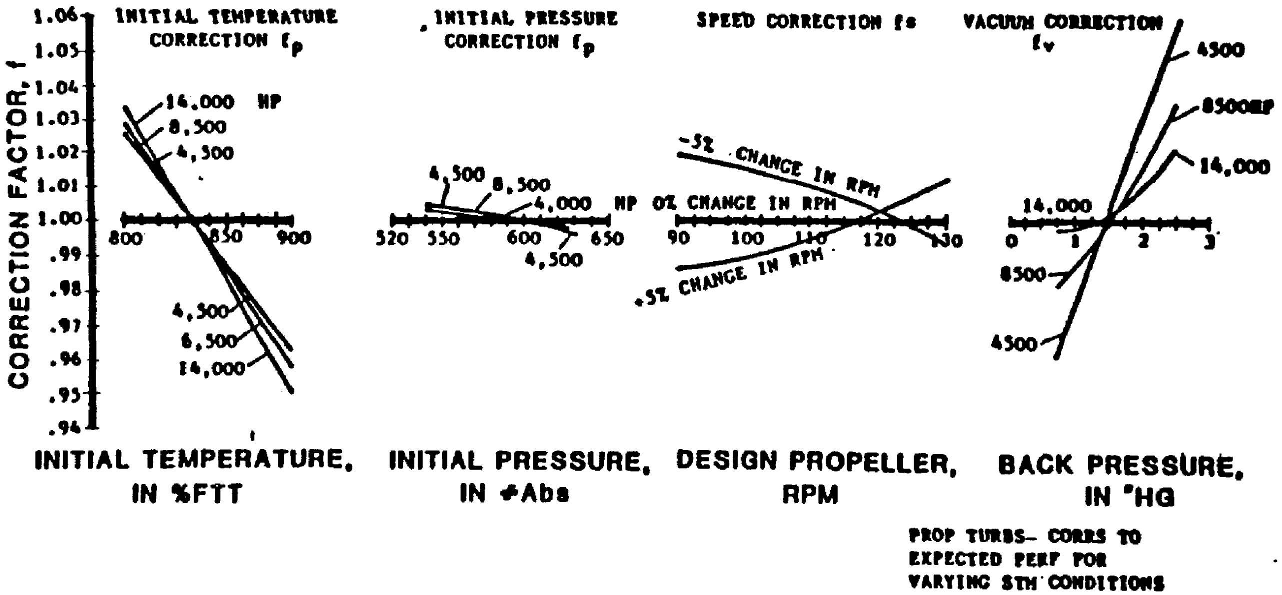



T-AO 143 CLASS

EXPECTED STRAIGHT CONDENSING PERFORMANCE
AO 143 CLASS VESSELS
14,000 SHP CROSS COMPOUND MARINE SET
585 psig-840° FTT-1½"Hg

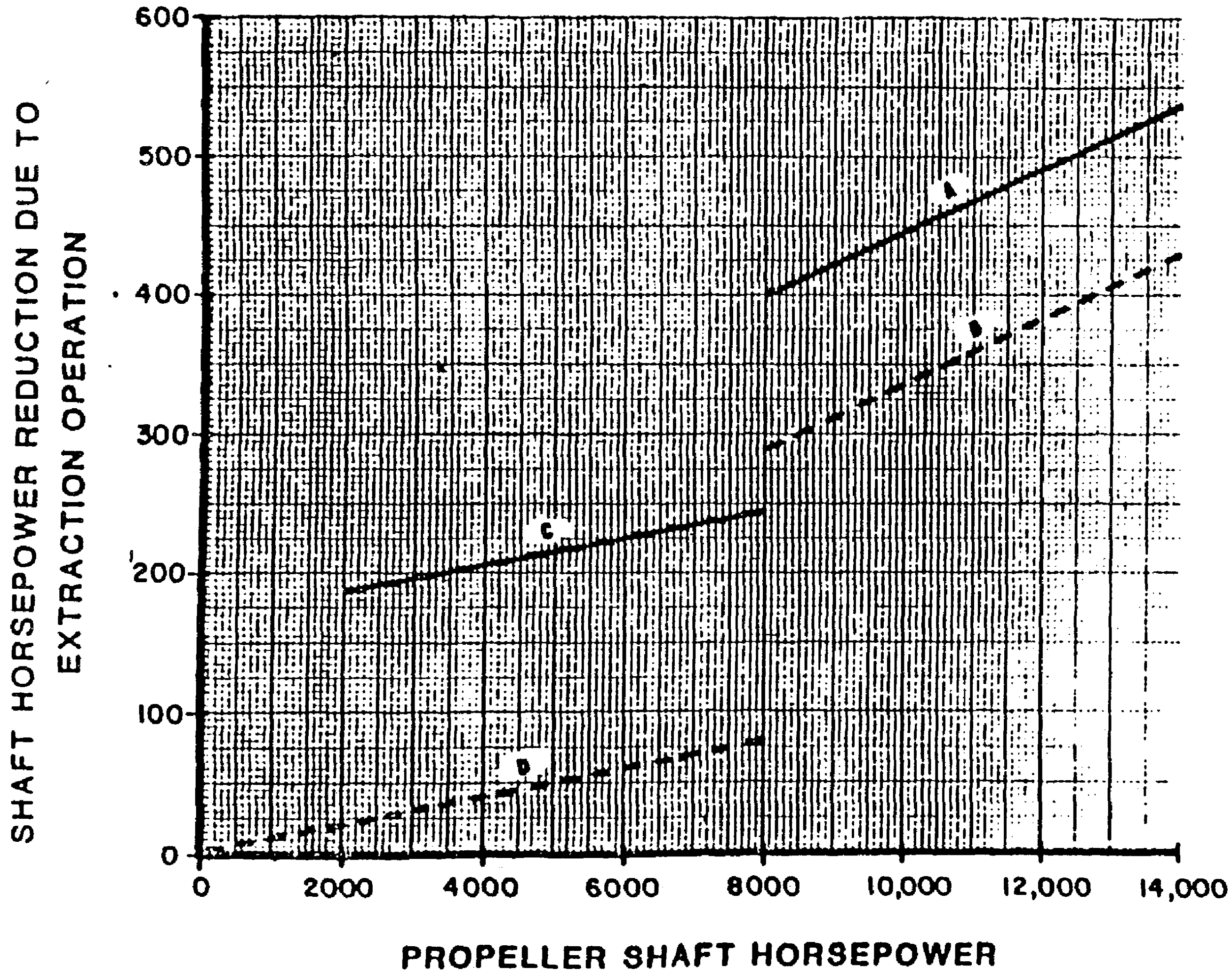



PROP TURBS- EXPECTED STRAIGHT
CONDENSING PERF




**AO 143 CLASS 14,000 HP CROSS COMPOUND**
**MARINE SET CORRECTION FACTORS**

# Estimated Shaft Horsepower Correction Curves For Turbine Extraction Operation



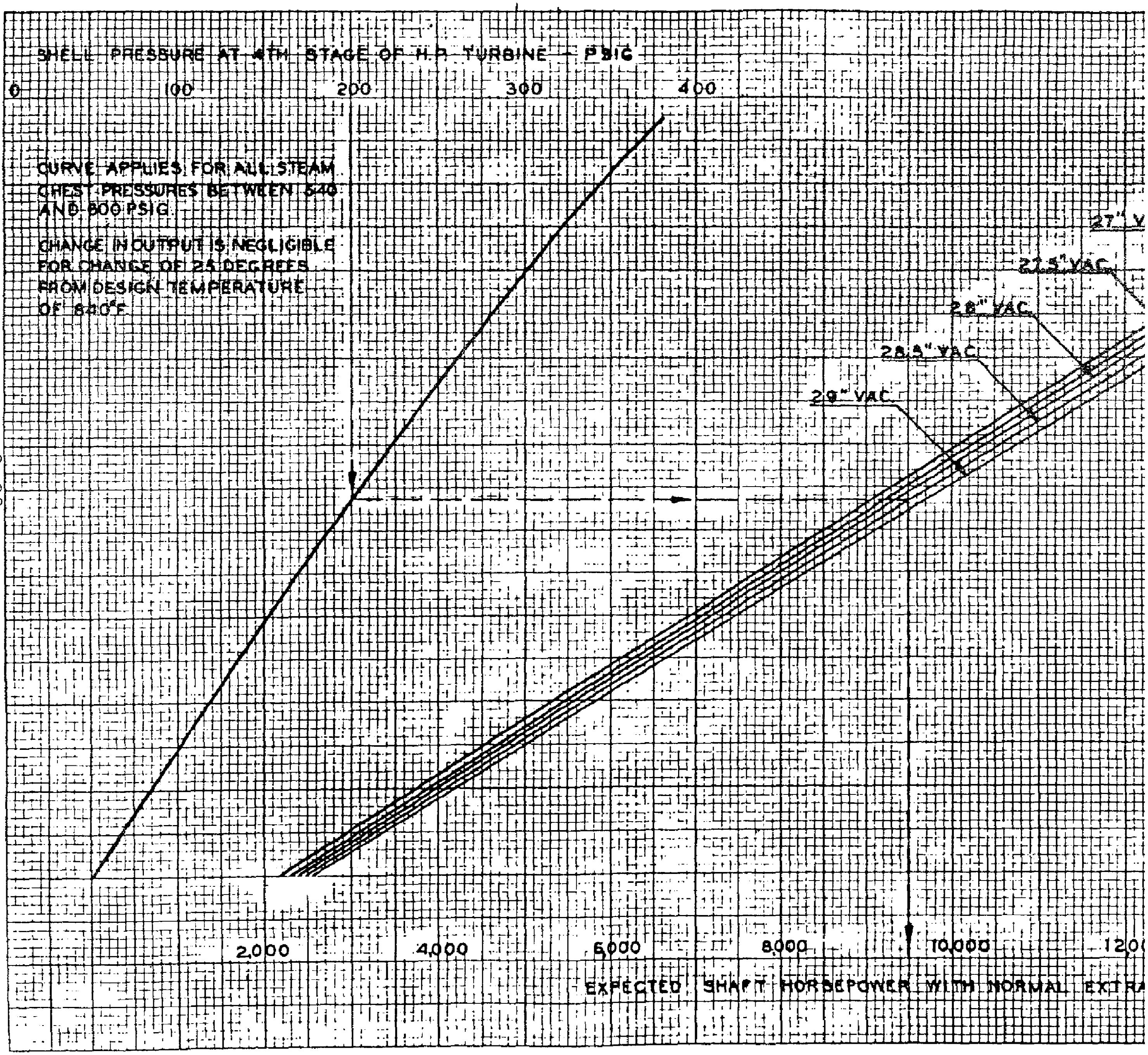

CURVE A, FULL EXTRACTION WITH LP BLEED TO DISTILLER* AND LP FEED HEATER AND CROSSOVER BLEED MAKING UP AUXILIARY EXHAUST

CURVE B, SAME AS CURVE A EXCEPT THAT THERE IS NO LP BLEED TO DISTILLER

CURVE C, PARTIAL EXTRACTION WITH LP BLEED TO LP FEED HEATER AND CROSSOVER BLEED TO DISTILLER*

CURVE D, SAME AS CURVE C EXCEPT THAT THERE IS NO BLEED FLOW TO DISTILLER

*DISTILLER FLOW - 12,000 GPD




T-AF 58, USNS RIGEL

# CHAPTER 9

## CONFIGURATION MANAGEMENT

### 9.0 CONFIGURATION MANAGEMENT

Configuration management applies technical and administrative direction to identify and document physical characteristics of the ship, control changes to those characteristics and record and report alteration processing and implementation status. COMSCINST 4700.2F (Administrative Procedures for the Alteration, Maintenance and Repair of MSC Ships) provides direction for requesting, reviewing and approving configuration changes for alterations which are identified and approved at any time during the ship's operation after expiration of a its Ship Construction Navy (SCN) funding period (paragraph 10.2).

### 9.1 SHIPS WITHIN THE SCN FUNDING PERIOD

a. The baseline item configuration control process shall be used to manage configuration changes which are identified and approved for ships within the SCN funding period. MSC Headquarters coordinates this program with Commander, Naval Sea Systems Command (COMNAVSEASYSCOM). Prior to ship delivery, any configuration change to the ship's hull, arrangements, machinery, systems or equipment which the Chief Engineer or any member of the ship's force recommends shall be submitted to the Construction Representative (CONREP).

b. After ship delivery, any change to the ship's hull, arrangements, machinery, systems or equipment which the Chief Engineer or any member of the ship's force recommends shall be submitted to the Administrative Area Commander in accordance with COMSCINST 4700.2F.

### 9.2 SHIPS AFTER THE SCN FUNDING PERIOD

Configuration changes identified and approved after expiration of the SCN funding period, shall comply with the TRANSALT process outlined in COMSCINST 4700.2F. Actions on configuration changes which have been identified as class baseline items and which apply to ships after the SCN funding period shall follow the TRANSALT process.

# CHAPTER 10

## INTRODUCTION OF NEW SHIPS

### 10.0 INTRODUCTION OF NEW SHIPS

The successful introduction of newly constructed or newly converted ships into the MSC fleet depends on the free exchange of detailed information among the ship's force; Construction Representative (CONREP); MSC Headquarters; the Administrative Area Commander; Regulatory Bodies; Commander, Naval Sea Systems Command (COMNAVSEASYSCOM); the Supervisor of Shipbuilding (SUPSHIP); the Naval Board of Inspection and Survey (INSURV) and many other parties.

### 10.1 ASSIGNMENT OF THE CHIEF ENGINEER

In accordance with the Fleet Introduction Manual for the ship type, the Area Commander shall assign a Chief Engineer to a ship under construction or conversion. The Chief Engineer will provide practical operational expertise to the CONREP staff and will gain knowledge of the ship's construction and operation.

### 10.2 CHIEF ENGINEER'S DUTIES DURING CONSTRUCTION OR CONVERSION AND DURING SCN FUNDING PERIOD

The Chief Engineer performs a wide range of duties during ship construction or conversion availabilities and through the SCN (Ship Construction Navy) Fund limiting date. This date, established by law, is the last day of the eleventh month after completion of fitting out. This is the last day that work funded by SCN can be authorized. The Chief Engineer shall perform routine shipboard duties in addition to accomplishing the following specific tasks.

a. Witnessing operational tests.

b. Identifying and reporting configuration changes.

c. Identifying and tracking deficiencies.

d. Establishing liaison with regulatory bodies.

e. Initiating SAMM system records (paragraph 7.3.2).

f. Identifying material deficiencies.

g. Assisting with Acceptance Trials and Final Contract Trials (paragraph 3.3).

h. Assisting with Post Shakedown Availability planning, accomplishment and closeout.

### 10.2.1 WITNESSING OPERATIONAL TESTS

The Chief Engineer shall witness all operational tests in the construction/conversion shipyard, including shipyard contractor and regulatory demonstrations. The Chief Engineer shall maintain a record of the tests performed, the date and time of the tests and the results.

### 10.2.2 IDENTIFYING AND REPORTING CONFIGURATION CHANGES

a. During the ship's construction or conversion and up to the ship's delivery date, the Chief Engineer shall identify and report to the CONREP any changes required to the ship's hull, arrangements, machinery, systems or equipment.

b. After delivery, the Chief Engineer shall report to the Administrative Area Commander any required changes to the ship's hull, arrangements, machinery, systems or equipment as directed by COMSCINST 4700.2F (Administrative Procedures for the Alteration, Maintenance and Repair of MSC Ships).

c. The Chief Engineer shall strive to identify and report required configuration changes to the ship's design or operation within the SCN funding period so that the deficiencies will be corrected using SCN funds. Any configuration changes requiring extensive redesign shall be immediately identified and reported to the CONREP or the Administrative Area Commander Port Engineer, as appropriate, to facilitate prompt action.

### 10.2.3 IDENTIFYING AND TRACKING DEFICIENCIES

a. The Chief Engineer shall become completely familiar with the ship construction/conversion contract so that he/she can effectively identify shipyard contractor failures to meet the requirements of the ship construction/conversion contract. As soon as the Chief Engineer reports to the ship and through the ship's guarantee period, stated in the construction/conversion contract, the Chief Engineer shall identify and track guarantee and INSURV deficiencies. These deficiencies also may be identified by ship's force, CONREP, MSC Headquarters, Administrative Area Commander, Regulatory Body, NAVSEASYSCOM, SUPSHIP and INSURV personnel. When deficiencies are identified, a Guarantee Item Report (GIR) or INSURV deficiency is generated. Deficiencies discovered by any person shall be forwarded to the Chief Engineer.

b. The Chief Engineer shall:

(1) Maintain a record of all deficiency reports. Separate records shall be maintained for GIR and INSURV deficiencies. These records shall indicate the date the deficiency was generated, a brief description of the deficiency, the number of the deficiency, whether the deficiency is opened or closed and brief comments.

(2) Review all deficiency forms to ensure that they provide sufficient detail, citing the contract requirement which has not been met. For deficiencies generated by the ship's force, the Chief Engineer shall direct the ship's force to troubleshoot the equipment breakdown and/or malfunction, fully document conditions found and identify material required to correct the deficiency.

(3) Review each new deficiency form to ensure that it does not describe existing reported deficiencies. If the deficiency duplicates one already recorded, the Chief Engineer shall add to the existing record, amplifying or clarifying information contained in the new deficiency form.

(4) Forward all GIRs to SUPSHIP. If deficiencies affect the operational capability of the ship, the Chief Engineer shall notify SUPSHIP by message and if possible, by phone. As soon as the ship arrives in port (or if the ship is already in port), the Chief Engineer shall forward two copies of the deficiency form to SUPSHIP by express mail or electronic transfer. If the shipyard contractor does not correct the deficiency within 48 hours of the ship's arrival in port (or reporting of the deficiency if reported while in port), the Chief Engineer shall notify the Administrative Area Commander. The Administrative Area Commander shall take whatever action is necessary to correct the deficiency, including contracting for industrial assistance. The Administrative Area Commander shall maintain cost records for labor and material used to correct the deficiency. The Administrative Area Commander shall forward all cost information to SUPSHIP and MSC Headquarters so that the shipyard contractor can be backcharged. For those deficiencies which do not affect the operational capability of the ship including material deficiencies (paragraph 10.2.6), the Chief Engineer shall forward copies of the deficiency forms to SUPSHIP by express mail or electronic transfer as soon as the ship arrives in port.

(5) Ensure that CASREPs, CASCORs and CAS-UPDATES (as required by COMSCINST 3121.9 (Standard Operating Manual) resulting from an INSURV deficiency or a GIR cite the deficiency number and include the appropriate SUPSHIP office as an addressee.

(6) Provide copies of all USCG 835s to the appropriate SUPSHIP office, NAVSEASYSCOM and MSC Headquarters and generate a GIR for the regulatory deficiency.

(7) Advise the appropriate SUPSHIP office of those GIRs/ INSURV deficiencies which have been closed since the previous report. As soon as the ship arrives in port, the Chief Engineer shall forward copies of closed GIRs to the appropriate SUPSHIP office by express mail or electronic transfer. If the ship is in port for more than 1 week, the Chief Engineer shall forward this information by express mail or electronic transfer each week.

(8) Keep GIRs open if the shipyard contractor has not provided the all of the required material including spare parts to clear the deficiencies. If on board spare parts were used to correct the deficiency, the Chief Engineer shall amend the original GIR to reflect correction of the deficiency, but shall show a requirement to replace spare parts.

(9) Close those GIRs which by SUPSHIP decision are not the responsibility of the shipyard contractor to correct. If the Chief Engineer has additional information which may warrant reconsideration of the shipyard contractor's responsibility for correction of the item, the Chief Engineer shall provide it to SUPSHIP.

(10) Close those GIRs which also are being tracked as INSURV deficiencies upon receiving notification from SUPSHIP that a duplicate record exists.

(11) Reopen GIRs for recurring failures of equipment covered by previously closed GIRs, provided the failure recurred within the guarantee period established by its original correction. This process may continue past the end of the guarantee period, provided documentation is provided to prove the failure recurred since the original guarantee period. For instance, if the guarantee period is 6 months, and a failure recurs 6 months after its original correction, the GIR may be reopened. This process may continue past the original 6-month guarantee period, if failures recur within the 6 month period following the most recent correction.

(12) Update Acceptance Trial deficiency reports, Final Contract Trial deficiency reports and Quality Deficiency Reports (QDRs) upon receipt of SUPSHIP's periodic status reports.

### 10.2.4 LIAISON WITH INSPECTORS AND SURVEYORS

The Chief Engineer shall establish and maintain liaison with regulatory inspectors and surveyors so that he/she is fully aware of all regulatory deficiencies and requirements. For ships built to Unattended Engine Room standards (paragraphs 3.1.5 and 3.2.6.1), the Chief Engineer shall maintain records needed for regulatory review before final approval.

### 10.2.5 INITIATING SAMM SYSTEM OPERATION

SAMM system records cover many aspects of shipboard operation and maintenance (paragraph 7.3). Upon delivery of the ship, or as soon thereafter as the SAMM system is installed, the Chief Engineer shall begin to maintain SAMM system records to establish an accurate machinery data baseline. The Chief Engineer shall advise MSC Headquarters of any errors in SAMM system information provided with the installation.

**10.2.6 IDENTIFYING AND CORRECTING PARTS AND TECHNICAL MANUAL DEFICIENCIES**

The Chief Engineer shall identify:

a. Spare parts deficiencies.

b. Manufacturer's technical manual deficiencies.

**10.2.6.1 SPARE PARTS DEFICIENCIES**

To correct spare parts deficiencies, the Chief Engineer shall provide to the ship's Supply Department the information needed to complete an Allowance Change Request (ACR). If the ship does not have a Supply Department, the Chief Engineer shall complete the ACR and submit it to the CONREP prior to delivery of the ship, or to the Administrative Area Commander after delivery of the ship. The Chief Engineer shall attempt to identify as many spare parts deficiencies as possible before the SCN funding period expires so that SCN funds will be used to correct them.

**10.2.6.2 MANUFACTURER'S TECHNICAL MANUAL DEFICIENCIES**

The Chief Engineer shall inventory manufacturer's technical manuals provided to the ship and shall review those manuals for accuracy. The Chief Engineer shall initiate a GIR to report missing or inaccurate manuals.

**10.2.7 ASSISTING WITH ACCEPTANCE TRIALS AND FINAL CONTRACT TRIALS**

The Chief Engineer shall assist in preparing for and conducting INSURV Acceptance Trials and Final Contract Trials as outlined in paragraph 3.3.

**10.2.8 ASSISTING WITH POST SHAKEDOWN AVAILABILITY ACTIONS**

The Post Shakedown Availability (PSA) is the final industrial period during which deficiencies are corrected and baseline items are completed using SCN funds. The Chief Engineer shall have the same responsibilities for availability planning, accomplishment and closeout as outlined chapter 4.

# CHAPTER 11

## MACHINERY OPERATION AND TESTING

### 11.0 MACHINERY OPERATION AND TESTING

The Administrative Area Commander and the Chief Engineer shall ensure that shipboard machinery is operated and tested in accordance with:

a. Regulatory requirements (chapter 3).

b. Shipboard Automated Maintenance Management (SAMM) system and Condition Monitoring Program (CMP) requirements (chapter 7).

c. Established watchstanding procedures (paragraph 2.1.3).

d. Standing orders and procedures (paragraph 11.1).

e. Material Readiness Evaluation (MRE) Program requirements (paragraph 8.1)

f. Full power trial requirements (paragraph 8.3).

g. Dock and sea trial requirements (paragraph 4.5.1).

### 11.1 POSTING ORDERS

The Chief Engineer shall post requirements for equipment, machinery and system tag out procedures (paragraph 15.2.2). The Chief Engineer shall establish and maintain a night order book instructing the watchstanding engineers in any special procedures to be followed during watches. The night order book shall provide engineering watch officers (including port relief watch officers) with the following information and orders:

a. Changes in normal machinery operation due to ongoing shipboard operations (such as cargo operations or repair work).

b. Precautions for machinery operation.

c. Engine room securing and evacuation procedures.

d. If in port, people to notify in the event of an emergency (i.e., port authority, deck watch officer and Chief Engineer) and their phone numbers.

e. The location and operation of engine room damage control equipment, machinery and systems.

f. Any specific orders.

A) g. If provided with an electronic Engine Room Log Book, the Chief Engineer may post orders electronically.

### 11.1.1 POSTING OPERATING PROCEDURES

The Chief Engineer shall post placards near vital machinery to instruct engineers in the proper procedures for starting, stopping and securing machinery and transferring machinery control. As a minimum, specific procedures shall be developed for each ship for the following machinery and systems if installed:

a. <u>Diesel Generator Sets</u>. Direction that the diesel generator sets not be operated in an unloaded or lightly loaded condition shall be posted. If special operations (such as UNREP) require the operation of an unloaded diesel generator set, this requirement shall be noted in the Engine Room Log. The operation of the unloaded set shall continue only for as long as the special operation requires. Also, procedures for start up and securing shall be posted.

b. <u>Boilers</u>. Light off procedures including use of purge tables, procedures for control of boiler smoking and procedures for boiler warm up and securing shall be posted.

c. <u>Turbines</u>. Procedures for start up, warm up and securing shall be posted.

d. <u>Main Propulsion Diesels</u>. Procedures for start up, warm up and securing shall be posted.

### 11.2 STEERING GEAR INSPECTION AND MAINTENANCE

The Administrative Area Commander shall develop and establish a steering gear maintenance and inspection program which meets regulatory requirements (chapter 3) and is consistent with SAMM and CMP requirements (chapter 7). The steering gear inspection and maintenance program shall require:

a. Exercising and inspecting the steering gear before the ship enters a potential maneuvering situation to demonstrate that:

(1) All main and auxiliary steering gear machinery and controls are operating correctly.

(2) All primary and alternate steering stations are operating correctly.

(3) All communications, alarm devices between the engine room, pilot house, steering gear room and alternate steering stations are functioning correctly.

b. Reviewing steering gear casualty control procedures and emergency drills.

c. Conducting a drill to test emergency procedures for shifting from main to auxiliary operation at least monthly and recording the drill in the Engine Room Log.

d. Inspecting the steering gear during each monthly drill, and recording inspection results in the Engine Room Log.

**11.3 TESTS AND INSPECTIONS OF SHIPBOARD ELEVATORS AND DUMBWAITERS**

Improper maintenance and operation of shipboard elevators and dumbwaiters can lead to serious personnel injury or death. To ensure personnel safety in the maintenance and operation of elevators and dumbwaiters, the Administrative Area Commander shall:

a. Use a service contract for corrective and preventive maintenance, inspection and certification of passenger elevator equipment.

b. Comply with applicable protective measures required by the American Standard Safety Code for Elevators, Dumbwaiters and Escalators.

c. Ensure that all ships with elevators and dumbwaiters have a complete file of required safety and inspection certificates.

d. Ensure that dumbwaiter safety control devices are located to prevent tampering and manipulation of the control devices while any dumbwaiter door is open.

e. Ensure that operating instructions for all elevators and dumbwaiters are posted at control stations. These instructions shall include all safety precautions and load limitations of equipment and shall prohibit the transportation of passengers on elevators designed for freight service only.

f. Ensure that elevators and dumbwaiters with inoperative safety devices are placed out of service and tagged out (paragraph 15.2.2) until repairs have been made.

g. Ensure that a suitable means of communication is provided between dumbwaiter stations.

A) **11.4 MARINE SANITATION SYSTEM MAINTENANCE AND OPERATION**

Proper operation and maintenance of marine sanitation systems is essential to its reliable operation. A COMSC notice in the 4730 series on this subject provides inspection criteria for marine sanitation systems. As a minimum, COMSCNOTE 4730 shall be used to inspect marine sanitation systems during Material Readiness Evaluations (MREs), paragraph 8.1. It may also be used for unscheduled inspections.

A) **11.4.1 MSC HEADQUARTERS RESPONSIBILITIES**

MSC Headquarters shall ensure that the SAMM system (paragraph 7.3) preventive maintenance requirements are sufficient to ensure safe and reliable operation of the marine sanitation device. MSC Headquarters shall inspect marine sanitation systems during shipboard visits. MSC Headquarters shall amend COMSCNOTE 4730 as needed.

A) **11.4.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall ensure that marine sanitation systems are inspected during shipboard visits. The inspections and tests in COMSCNOTE 4730 shall be included in each MRE.

A) **11.4.3 CHIEF ENGINEER'S DUTIES**

To ensure proper operation and maintenance of sewage systems, the Chief Engineer shall follow the following procedures.

a. Operate the marine sanitation device (MSDs) continuously, including those times when system shutdown and bypass is allowed by regulatory bodies.

b. Regularly perform the checks in COMSCNOTE 4730.

c. Establish corrective maintenance of sewage systems as a top priority.

d. Prohibit the disposal of disinfectants through the soil system.

A) **11.5 OILY WATER SEPARATOR AND OIL CONTENT MONITOR MAINTENANCE AND OPERATION**

Proper operation and maintenance of oily water separators and oil content monitors is essential to its reliable operation.

### 11.5.1 MSC HEADQUARTERS RESPONSIBILITIES (A

MSC Headquarters shall ensure that the SAMM system (paragraph 7.3) preventive maintenance requirements are sufficient to ensure safe and reliable operation of the oily water separator and oil content monitor.

### 11.5.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES (A

The Administrative Area Commander shall ensure that ships follow the SAMM preventive maintenance actions and correct cleaning procedures for oily water separators and oil content monitors.

### 11.5.3 CHIEF ENGINEER'S DUTIES (A

a. The Chief Engineer shall follow the SAMM preventive maintenance actions and correct cleaning procedures for oily water separators and oil content monitors. Improper cleaning agents can damage the units. The following agents are the only cleaners approved by the USCG for oily water separators and oil content monitors:

(1) Drew Ameroid Corporation - OWS

(2) Allied Chemical Corporation - Allied P-98

b. The Chief Engineer shall provide COGARD MSO with an information copy (INFO copy) of any Casualty Report (CASREP, paragraph 5.2.1), for oily water separators and oil content monitors.

## 11.6 LUBE OIL PURIFIER OPERATION (A

Proper use of lube oil purifiers can reduce lube oil costs and improve machinery operation and reliability. The following lube oil purifier operational procedures shall be followed.

a. Lube oil purifiers shall be run at least 12 hours per day on diesel engines when the engine(s) is secured.

b. A viscosity test shall be conducted daily when diesel engines are operating.

c. Lube oil purifiers shall be run continuously while machinery which they serve is operating.

d. Lube oil containing free water shall be immediately purified.

e. Corrective maintenance required on purifiers shall be reported through a Casualty Report (CASREP, paragraph 5.2.1).

f. Contaminated lube oil containing particulate matter shall be brought to the attention of the Chief Engineer.

A) **11.6.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

Administrative Area Commanders shall ensure that the procedures in paragraph 11.6 are implemented on each ship.

A) **11.6.2 CHIEF ENGINEER'S DUTIES**

Chief Engineers shall ensure that the procedures in paragraph 11.6 are implemented on each ship and that members of the Engineering Department are aware of proper lube oil management practices.

# CHAPTER 12

# PAINTING, PRESERVATION AND STANDARDS OF APPEARANCE

## 12.0 PAINTING, PRESERVATION AND STANDARDS OF APPEARANCE

The Administrative Area Commander shall make each member of the ship's force aware of the requirements established by COMSCINST 3120.16B (Standards of Appearance). The Administrative Area Commander shall also verify that all hull, machinery and system painting and preservation is accomplished in accordance with COMSCINST 4750.2C (Preservation Instructions for MSC Ships) and COMSCINST 9280.3D (Designation and Marking of Hull Structure on MSC Ships in Service (USNS)).

## 12.1 MSC PAINT SUPPLY CONTRACT

a. MSC Headquarters has issued a paint supply contract to provide paint to shipyards as Government Furnished Material (GFM). Underwater hull coatings (anticorrosive and antifoulant), topside and void coatings (inorganic zincs, epoxies and topcoats), tank coating epoxies for petroleum cargo tanks, ballast tanks, feedwater tanks, sanitation tanks and potable water tanks and non-skid coatings for helo decks, ro/ro decks and forklift corridors shall be purchased through this contract.

b. MSC Headquarters is in the process of developing procedures for the ordering and purchasing of paint under the MSC paint supply contract. These procedures will be in the form of a COMSC instruction. When promulgated, all action addressees shall comply with this instruction.

# CHAPTER 13

# DAMAGE CONTROL

## 13.0 DAMAGE CONTROL

MSC damage control policy and actions assure survival of the ship's force and ship. Ship survivability depends upon ship design and effective damage control. Ship design is based upon ABS and USCG requirements; damage control depends on the training, ability, initiative and desire of the ship's force to prevent, react to, contain and control shipboard damage. COMSCINST 3541.5C (Damage Control Manual) provides direction on MSC Damage Control and the following information shall be used to augment this instruction. Clearly, no written instruction can anticipate and address all occurrences when combatting or preventing a casualty. Flexibility and common sense must guide any damage control procedure. The objectives of damage control are:

a. Casualty prevention

b. Casualty control

c. Emergency restoration

d. Personnel protection

e. Crew readiness via training and drills

## 13.1 DAMAGE CONTROL OFFICER

The Master appoints a licensed member of the deck ship's force as the Damage Control Officer. This position usually is assigned to the First Officer, but the Master may appoint any licensed member of the deck force to fill this position based on his/her skills and training. The Damage Control Officer shall direct damage control training, coordinate training programs with Department Heads and make sure that equipment and personnel are ready for action to counter any casualties. During emergencies, the Damage Control Officer initially directs action from damage control central. The overall damage control organization and Department Head responsibilities are provided in COMSCINST 3541.5C.

## 13.2 CHIEF ENGINEER'S DUTIES

The Chief Engineer shall integrate damage control objectives into the Engine Department damage control policy, training and drills. The Chief Engineer shall direct the ship's force action to counter casualties in Engine Department spaces. In emergencies, the Chief Engineer or the Master shall advise the Damage Control Officer of the situation, coordinate actions with the Damage Control Officer and request assistance or advice as needed.

**13.2.1 DAMAGE PREVENTION**

Prevention is the most effective damage control measure. The Chief Engineer shall:

a. Prevent casualties to Engine Department equipment, machinery and systems.

b. Prevent flooding in Engine Department spaces.

c. Maintain Engine Department damage control equipment.

d. Direct engine room drills in accordance with COMSCINST 3121.9 (Standard Operating Manual) and COMSCINST 3541.6A (Engineering Casualty Exercises).

e. Maintain equipment, machinery and systems in accordance with the Shipboard Automated Maintenance Management (SAMM) System (paragraph 7.3) and operate equipment and machinery in accordance with manufacturers' technical manuals.

f. Prepare a night order book (paragraph 11.1) for in port and at sea watches.

**13.2.2 FLOODING PREVENTION**

The Chief Engineer shall:

a. Check proper maintenance of watertight door gaskets.

b. Periodically verify the proper operation of level alarms and remote valve operators.

c. Ensure that valves (particularly sea valves) are properly maintained and that flange, pipe and valve leaks are promptly repaired.

d. Verify that ship's force caps sounding tubes after use.

e. Direct proper valve line-up and operation when receiving, transferring or discharging liquids.

f. Check ship's force ability to operate eductors.

g. Make sure that emergency pumping equipment and machinery is properly maintained and periodically operated.

h. Verify that shoring is easily accessible at all times.

i. Ensure that the engineering members of the ship's force participate in flooding prevention training and drills conducted in accordance with COMSCINST 3120.2D (Administrative and Operating Procedures for MSC Ships) and COMSCINST 3541.5C.

j. Report the status of training to the Damage Control Officer.

**13.2.3 FIRE PREVENTION**

The Chief Engineer shall:

a. Verify that proper gas free/"safe for hot work" procedures are followed before any hot work in accordance with OPNAVINST 5100.19B, Navy Occupational Safety and Health Program for Forces Afloat and NSTM, Chapter 074, Volume 1.

b. Supervise proper disposition of oily rags and proper paint and other flammable materials stowage in accordance with OPNAVINST 5100.19B and NSTM, Chapter 074, Volume 1.

c. Direct prompt repair of fuel and oil leaks.

d. Ensure that no oil accumulates in bilges.

e. Verify that flange shields (paragraph 13.2.3.1) are installed on all pressurized fuel and oil piping connections.

f. Periodically check the proper operation of ventilation systems.

g. Periodically check the proper operation of ventilation fan and fuel oil pump/valves remote shutdowns.

h. Periodically check firefighting equipment. This check shall include fire pump valve alignment, maintenance and operation of fire and smoke detection systems and emergency lighting and maintenance and availability of Emergency Escape Breathing Devices (EEBDs), Self-contained Breathing Apparatuses (SCBAs) and Survival Support Devices (SSDs).

i. Verify that ship's force keeps escape trunks clear of obstructions.

j. Direct shipboard orientation and training in the location and operation of damage control equipment, machinery and systems and remote shutdown of vital machinery such as fuel pumps and ventilation fans. The Chief Engineer shall conduct drills in the Engine Department spaces to achieve and maintain proficiency in rigging hoses, maintaining fire and smoke boundaries, moving through the space in darkness, working as a team, rotating firefighting teams, space evacuation, using EEBDs, SCBAs, SSDs and communication. Drills shall be conducted more frequently when the turnover rate of engineering members of the ship's force is high. Guidance on conducting drills and training is contained in COMSCINST 3120.2D, COMSCINST 3121.9 and COMSCINST 3541.5C.

k. Report the content and format of the casualty prevention and damage control program to the Damage Control Officer.

**13.2.3.1 FLANGE SHIELDS**

The Administrative Area Commander shall verify that all ships have flange shields installed on piping flanges and bolted valve bonnet flanges in compliance with Title 46, CFR 50.50-60 and 56.50-65. Shield material shall meet the requirements of ASTM F1138 and NAVSEA Drawing 803-2145518. Shields shall be installed on:

a. Fuel lines in main and auxiliary machinery spaces where a source of ignition exists.

b. Lube and hydraulic oil piping if the flange is within 15 feet of electrical equipment, a hot surface or other source of ignition.

c. Flanges near any surface with a temperature exceeding 400°F.

d. Fuel and lube oil strainers subject to pump discharge pressure.

**13.2.3.1.1 WHERE FLANGE SHIELDS ARE NOT REQUIRED**

Flange shields are not required on:

a. Bilge piping flanges, including fuel, unless within 15 feet of an ignition source.

b. Suction or other piping not subject to pressurization.

c. Gage lines downsteam of root valves.

d. Joints located within other protective enclosures.

e. All union type fittings.

f. System where only contaminated water is pumped.

### 13.3 MAINTAINING DAMAGE CONTROL EQUIPMENT

The Chief Engineer shall ensure that damage control equipment and systems under Engine Department cognizance:

a. Are maintained.

b. Are supported with adequate spare parts.

c. Are marked in accordance with COMSCINST 9280.3D (Designation and Marking of Hull Structure on MSC Ships in Service).

d. Have operating instructions posted.

### 13.4 CONTROLLING AND COUNTERING CASUALTIES

To effectively control and counter casualties, the ship's force must be trained, prepared and capable of quick response. The Chief Engineer shall:

a. Verify that new engineering members of the ship's force know their Station Bill assignments as required by COMSCINST 3120.2D and COMSCINST 3541.5C.

b. Direct and train engineering members of the ship's force to take immediate action to counter any engineering casualty or ship emergency. This required action includes sounding the engineer's assistance needed alarm and notifying the Master immediately if the casualty degrades or can degrade ship handling, maneuvering or speed.

c. Train engineering members of the ship's force in damage control in accordance with COMSCINST 3120.2D and COMSCINST 3541.5C.

d. Include non-engineering members of the ship's force in engineering damage and casualty control drills so that they can assist Engine Department response to casualties, if needed.

e. Assume control of all repair parties in Engine Department spaces and areas. The Chief Engineer shall coordinate damage control response efforts with the Damage Control Officer.

f. Direct and verify that all engineering members of the ship's force know and understand the Main Space Fire Doctrine (paragraph 13.4.1).

#### 13.4.1 MAIN SPACE FIRE DOCTRINE

A main space fire is one of the most serious threats to the ship and ship's force. Immediate action is imperative because rapidly increasing heat and smoke can quickly make the space untenable and firefighting impossible. To provide direction for immediate action, the Chief Engineer shall develop, post in the space and amend as necessary a Main Space Fire Doctrine (MSFD). Some ships have been provided with specific MSFDs by the Administrative Area Commander. If one has not been developed and provided to the ship, the Chief Engineer shall develop one. The MSFD shall be based on NSTM, chapter 555 and COMSCINST 3541.5C. It shall address the duties of the Engine Department ship's force and others and include, as a minimum, the following direction:

a. Personnel within the space shall immediately on the discovery of a fire:

(1) Notify the engineering watch officer. The engineering watch officer will notify the deck watch officer who will notify the Damage Control Officer.

(2) Don a breathing apparatus (Air Pak or other) or obtain and carry an EEBD/SSD.

(3) Attack the fire with the most effective firefighting system available (halon, PKP bottles, CO2 hose reel and firehose).

(4) Establish negative ventilation in the main space to evacuate smoke and positive ventilation in other spaces to prevent the spread of smoke.

(5) Secure all sources of fuel oil by shutting valves and stopping pumps.

(6) Secure all equipment, machinery and systems except that required to support and provide firefighting, lighting and ventilation services.

(7) Establish communication with the Chief Engineer and advise him of the situation.

b. The deck watch officer will immediately sound the General Alarm and notify the Damage Control Officer who shall:

(1) Set fire and smoke boundaries.

(2) Isolate the space except for firefighting, lighting and ventilation services.

(3) Organize and man repair parties.

(4) Request that the ship be maneuvered to minimize smoke entering the ventilation intakes.

(5) Direct the starting of additional fire pumps as needed.

(6) Direct starting of the emergency generator to supply emergency electrical power to the fire pumps as needed.

c. The Chief Engineer shall:

(1) Direct firefighting efforts in the space.

(2) Ensure that the Damage Control Officer/On Scene Leader organize hose teams and other forces afloat to fight the fire and support firefighting in the space.

(3) Ensure that the Damage Control Officer/On Scene Leader supervises the replacement of expended chemicals or damaged equipment.

(4) Maintain contact with the Damage Control Officer to advise him/her of the situation and request needed support.

d. Engineering members of the ship's force shall take these initial actions to control a main space fire.

(1) Fight and extinguish the fire with available systems and agents using standard procedures and techniques.

(2) Wash spilled (unignited) oil into the bilges and cover the surface with foam.

(3) Relieve firefighting personnel as necessary and evacuate injured personnel.

(4) Maintain communications among personnel in the main space, the Chief Engineer, the Damage Control Officer and the bridge.

e. Main space fires can develop rapidly. If the firefighters in the space, the Chief Engineer or the Damage Control Officer decide that a fire cannot be controlled, the firefighter designated by the Master shall:

(1) Activate the Halon or CO2 systems and the foam system (bilge sprinkling systems), if installed.

(2) Notify space personnel that the fire is "out of control" and direct personnel to don EEBDs/SSDs and depart the space by the nearest safe exit.

(3) Advise the Chief Engineer and the Damage Control Officer that evacuation has been ordered.

(4) During evacuation secure all machinery and isolate the space. Verify that all ventilation is secured and close escape hatches after all personnel are out of the space.

(5) Outside the space, muster and account for all personnel who were in the space. Report to the Chief Engineer the status of the propulsion plant and the fire.

f. Because of the danger of reflash (reignition), the space must remain sealed for a sufficient amount of time to permit fuel and metal to cool below reignition temperature. During that time, the Damage Control Officer shall direct the ship's force to:

(1) Post a reflash watch.

(2) Inspect adjacent compartments for secondary fires and extinguish them.

(3) Use fire hoses to cool down bulkheads and decks in adjoining spaces.

(4) If cooling the space is critical and space arrangement permits, cut openings into the Main Space to insert applicators and spray low pressure fog into the space.

g. When it is certain that the fire is out, hose teams with protective equipment, clothing and breathing apparatus shall enter the space by the safest access. These firefighters shall:

(1) Report to the Damage Control Officer that the fire is extinguished or take appropriate action to fight the remaining fire.

(2) Apply a blanket of AFFF foam to protect against reflash.

h. When the fire is out, the Damage Control Officer shall direct the ship's force to dewater, deballast or counterflood, as necessary to maintain stability.

i. To restore operations in the space:

(1) Firefighters shall overhaul the space by breaking up and dousing smoldering lagging/combustibles and apply a complete unbroken layer of foam to all oil coated surfaces.

(2) The Damage Control Officer shall direct smoke removal, ventilation and dewatering, making sure that an AFFF blanket is maintained in the bilge.

(3) The Gas Free Engineer shall test the space and engine room voids for a safe atmosphere (paragraph 15.2.3).

(4) When the space is declared "safe for men," engineering members of the ship's force shall investigate the damage and survey requirements to restore operations.

**13.5 REPAIRING DAMAGE AND RESTORING OPERATIONS**

The Chief Engineer shall:

a. Direct and supervise emergency repairs to restore operations.

b. Isolate and tag out (paragraph 15.2.2) equipment which is damaged and cannot be operated safely.

c. Reenergize electrical equipment after inspection and testing of cableways, controllers and all electrical components of equipment, machinery and systems.

d. Stow damage control equipment and restock damage control lockers.

e. Interview ship's force present at the site of the casualty when it occurred and who responded to the casualty. Information obtained will support an investigation of the cause of the casualty and an evaluation of damage control effectiveness.

# CHAPTER 14

## SPECIAL REQUIREMENTS

### 14.0 SPECIAL REQUIREMENTS

MSC provides a wide range of specialized mission and sponsor support which includes supporting sponsor missions and personnel and maintaining shipboard helicopter facilities, refueling-at-sea facilities and degaussing systems.

### 14.1 MEMORANDUMS OF AGREEMENT

MSC Headquarters' Memorandums of Agreement (MOA) with its sponsors delineate responsibilities for mission support. The Shipboard Automated Maintenance Management (SAMM) system (paragraph 7.3) and the Condition Monitoring Program (CMP, paragraph 7.4) address routine preventive and predictive maintenance to be performed on mission related equipment which MSC is to maintain in accordance with the MOAs. The Chief Engineer shall ensure that required engineering support is provided.

### 14.2 MAINTAINING HELICOPTER FACILITIES

Many MSC ships have helicopter facilities. COMSCINST 3120.15C (Helicopter Certification Requirements for MSC-cognizant Air Capable Ships; policies and procedures concerning) establishes requirements to install, maintain and inspect helicopter facilities. All affected parties shall adhere to the provisions of this instruction.

### 14.3 MAINTAINING REFUELING-AT-SEA FACILITIES

MSC tankers and oilers are equipped to transfer cargo to Navy ships. COMSCINST 3180.2J (MSC Refueling-at-sea (RAS) Instructions) establishes requirements to maintain, inspect and test RAS installations. All affected parties shall adhere to the provisions of this instruction. Further, COMSC has executed MOA with the Naval Ship Systems Engineering Station (NAVSSES) and Naval Ship Weapon Systems Engineering Station (NSWSES) which address responsibilities for providing technical support in the maintenance, repair, operation and alteration of Underway Replenishment Systems. MSC Headquarters and the Administrative Area Commander shall be familiar with the provisions of these MOA.

### 14.4 MAINTAINING DEGAUSSING SYSTEMS

Some MSC ships have degaussing systems installed. COMSCINST 3121.9 (Standard Operating Manual) establishes requirements to maintain, inspect and test degaussing systems. All affected parties shall adhere to the provisions of this instruction.

# CHAPTER 15

# SAFETY AND OCCUPATIONAL HEALTH OF ENGINEERING PERSONNEL AND ENGINE ROOM SAFETY

## 15.0 SAFETY AND OCCUPATIONAL HEALTH OF ENGINEERING PERSONNEL AND ENGINE ROOM SAFETY

Operational readiness and mission accomplishment depends on continuing attention to safety and occupational health programs and procedures which will prevent shipboard accidents to personnel and machinery. MSC policy to ensure the occupational health of engineering personnel and engine room safety is based on:

a. Naval Occupational Safety and Health (NAVOSH) programs for safety and occupational health of personnel.

b. Safety procedures which apply to maintenance, repair, operation and alteration of engine room machinery and systems.

## 15.1 SAFETY AND OCCUPATIONAL HEALTH PROGRAMS

COMSCINST 5100.17A (MSC Safety Manual) provides a detailed description of MSC personnel safety and occupational health programs. The Chief Engineer shall be familiar with these programs and require that Engine Department personnel follow the personnel protection procedures outlined in this manual. This manual addresses:

a. Hazard abatement

b. Asbestos control

c. Heat stress

d. Hearing conservation

e. Sight conservation

f. Personal protective clothing and equipment

g. Respiratory protection

h. Safety council

i. Mishap investigation and reporting (additional information provided paragraph 15.3)

**15.1.1 SAFETY AND OCCUPATIONAL HEALTH TRAINING PROGRAMS**

Safety and health training programs available from the Area Command Safety Office include classroom training, on the job training and video tapes used to familiarize the ship's force with personal safety and health procedures. Training materials and video programs provided to each ship are identified in COMSCINST 5100.17A. The Chief Engineer shall verify that Engine Department personnel are familiar with shipboard information on safety and health and that they review it at least once during their tour.

**15.2 ENGINE ROOM SAFETY PROCEDURES**

The following Engine Department safety procedures will prevent most shipboard accidents. The Chief Engineer shall implement the following procedures and programs:

a. Electrical Safety Program (paragraph 15.2.1)

b. Tag out procedures (paragraph 15.2.2)

c. Gas free engineering (paragraph 15.2.3)

d. Hazardous material control and management (paragraph 15.2.4)

**15.2.1 ELECTRICAL SAFETY PROGRAM**

Electrical shock is a potential hazard aboard any ship. The combination of high humidity, salt water, metal structures, ship movement and high voltage increase the potential for electrical shock. Maintenance and repair work shall not be accomplished on energized equipment unless absolutely necessary to the continued safe operation of the ship. Before maintaining or repairing energized equipment, the Chief Engineer shall obtain the Master's approval to accomplish or direct this operation and shall log the Master's approval in the Engine Room Log.

**15.2.1.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall:

a. Verify that those members of the ship's force who maintain and repair shipboard electrical and electronic equipment and machinery, are trained as required by COMSCINST 5100.17A. This group includes chief electricians and electronic technicians, if embarked, and other engineering members of the ship's force who work on electrical and electronic equipment and machinery.

b. Ensure that ships have a supply of electrical equipment inspection tags, NAVSEA 5100/5 (NSN 0116-LF-051-0025), Table 15.1.

**15.2.1.2 CHIEF ENGINEER'S DUTIES**

The Chief Engineer administers the shipboard Electrical Safety Program. The Chief Engineer shall:

a. Assign a shipboard Electrical Safety Officer.

b. Supervise an inventory and inspection program for portable electrical equipment. Portable electrical equipment items are hand held tools and appliances which are plugged into an electrical power source. This equipment includes drills, grinders, sanders, ventilation blowers, deck buffers, circular saws, extension cords, drop lights, vacuum cleaners, coffee pots and soldering irons.

c. Supervise an inventory and inspection program for mobile electrical equipment. Mobile electrical equipment devices are not hard-wired, but are normally stationary, such as fans, adding machines, computers, toasters, welding machines, bench grinders, vending machines, refrigerators, ice makers and messroom coffee makers.

d. Maintain an inventory and inspection program for personal electrical and electronic equipment such as radios, stereos and hair dryers.

e. Verify that each member of the ship's force and manufacturer's technical representative is familiar with the tag out program (paragraph 15.2.2).

f. Require that each engineering member of the ship's force review the shipboard training material on MSC's Electrical Safety Program included in COMSCINST 5100.17A.

g. Periodically review the Electrical Equipment Inventory and Inspection Log (paragraph 15.2.1.3) to make sure that the Electrical Safety Program is being managed effectively.

**15.2.1.3 ELECTRICAL SAFETY OFFICER'S DUTIES**

The Chief Engineer shall designate an engineering member of the ship's force to serve as the Electrical Safety Officer. The Electrical Safety Officer shall implement the Electrical Safety Program. As part of his duties, the Electrical Safety Officer shall:

a. Ensure that each Department maintains a current Electrical Equipment Inventory and Inspection Log of portable electrical equipment and mobile electrical equipment in spaces under their cognizance. This log shall contain a full inventory of this equipment and indicate inspection dates and results. This log shall be a permanent inspection record and shall conform with the format in Table 15.2.

b. Verify that designated Department personnel inspect the condition of mobile electrical equipment cords and plugs at least as frequently as the monthly walk through inspections required by COMSCINST 5100.17A. Portable and mobile equipment inspection tags (paragraph 15.2.1.3.e) shall be checked. Survey results shall be recorded in the Department's Electrical Equipment Inventory and Inspection Log. Deficiencies found or untagged equipment shall be noted. Department Heads shall provide a copy of results to the Electrical Safety Officer.

c. Review Department Electrical Equipment Inventory and Inspection Logs to identify equipment requiring inspection, repair or servicing (paragraph 15.2.1.3.f).

d. Ensure that Department Heads direct new members of the ship's force to the Electrical Safety Officer for inventory and inspection of personal electrical and electronic equipment. The Electrical Safety Officer shall inspect and test this equipment in accordance with NSTM, chapter 300. The Electrical Safety Officer shall maintain a log of personal electrical and electronic equipment belonging to members of the ship's force. When the Electrical Safety Officer finds equipment safe for shipboard operation, he/she shall attach an inspection tag NAVSEA 5100/5 (NSN 0116-LF-051-0025), Table 15.1. The Electrical Safety Officer shall retain in a secure place any personal electrical equipment found to be unsafe for shipboard use. The Electrical Safety Officer shall return secured items to the owner when he/she departs the ship.

e. Inspect portable and mobile equipment and electrical receptacles annually (semi-annually for receptacles exposed to weather) in accordance with NSTM, chapter 300. The Electrical Safety Officer shall attach an inspection tag, NAVSEA 5100/5 (NSN 0116-LF-051-0025), Table 15.1, to all portable and mobile electrical equipment which has passed inspection. The results shall be logged in the Electrical Equipment Inventory and Inspection Log.

f. Inform the Chief Engineer of any inspection deficiency and recommend action to correct it (directing repair by the ship's force or preparing a Voyage Repair Request, paragraph 5.2.2). If the Electrical Safety Officer determines that continued operation of the faulty equipment may cause personal injury or result in further equipment casualty, the Electrical Safety Officer shall inform the Chief Engineer of the condition of the equipment, record this information in the Electrical Equipment Inventory and Inspection Log and recommend:

(1) Removing the equipment from its normal location and stowing it where it cannot be used until it is repaired or replaced or

(2) If the equipment cannot be easily moved, tagging out the equipment (paragraph 15.2.2) to prevent further casualty or personal injury until the equipment can be repaired or replaced.

**15.2.2 TAG OUT PROCEDURES**

When equipment, machinery or a system is isolated for maintenance, repair, alteration or any other reason, tags shall be affixed to all controls and other critical components to alert ship's force, manufacturer's technical representatives or industrial assistance contractors to the hazards of operating the tagged machinery or system while it is temporarily isolated. Standardized tag out procedures prevent personal injury and equipment, machinery or system damage resulting from improper operation. All members of the ship's force shall observe tag out instructions at all times. Violation of any tag instruction compromises the entire tag out procedure and could in itself have serious consequences. Equipment, machinery and systems shall be tagged out when:

a. The ship's force, technical representatives or any industrial assistance contractor performs any form of maintenance, repair or alteration to any equipment, machinery or system or

b. When any equipment, machinery or system has been damaged and is unsafe for operation.

**15.2.2.1 SUMMARY OF TAG OUT PROCEDURES**

The detailed Tag Out Procedures in Table 15.3 shall be followed when isolating equipment, machinery or systems from any energy source to perform testing, maintenance or repair. These procedures include the following steps:

a. After opening circuit breakers, switches, controllers, the individual performing the service shall prepare tags for all isolation points and make appropriate entries in the Tag Out Log.

b. After isolating the equipment, machinery or system, the individual performing the service shall request that the Authorizing Officer review the tags and the log entries. The Chief Engineer normally shall designate the engineering officer of the watch as the Authorizing Officer.

c. After opening circuit breakers, switches and controllers, the individual performing the service shall verify that the equipment, machinery or system has been isolated.

d. If the tags and log entries are complete and correct, the Authorizing Officer shall sign the tags and the Tag Out Log.

e. When service work is completed, the individual who attached the tags, shall remove them, enter appropriate information in the Tag Out Log and realign the equipment, machinery or system for service.

**15.2.2.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall:

a. Ensure that ship Department Heads are familiar with tag out procedures.

b. Verify shipboard compliance with tag out procedures during Command Inspections and during other ship visits.

c. Include tag out requirements in work packages and service orders for industrial assistance contractors and technical representatives.

**15.2.2.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Administer the tag out program.

b. Verify that all engineering members of the ship's force and Department Heads are familiar with tag out procedures.

c. Maintain the Tag Out Log at the Engine Room Log Desk.

d. Direct each engineering watch officer to serve as the Authorizing Officer during the course of his/her watch. For those ships operating with an unattended engine room (paragraph 2.2), the Chief Engineer shall authorize at least one licensed engineer to serve as the Authorizing Officer.

e. Verify, at least a bi-weekly, ship's force compliance with tag out procedures by checking tags and labels recorded in the Tag Out Log against the tags and labels attached to equipment, machinery, and systems. This check shall be recorded in the Engine Room Log.

**15.2.2.4 AUTHORIZING OFFICER'S DUTIES**

The Authorizing Officer shall:

a. Review the Tag Out Log before assuming each watch, and inform relieving watchstanders of any equipment, machinery or systems tagged out during the course of his/her watch.

b. Sign tags and labels to be issued or cleared.

c. Review with the individual performing the maintenance, repair or alteration the nature of the work being planned to ensure that it does not adversely impact ongoing engine room operations.

d. Verify that individuals performing tag outs are qualified to perform these procedures.

e. Review equipment, machinery or system isolation to make sure that it cannot be inadvertently started.

f. Verify and sign entries in the Tag Out Log.

g. Direct the individual performing the service to notify the appropriate Department Head if a tag out will affect systems or equipment operations in another department before performing the tag out.

h. Tag out equipment, machinery or systems which have been rendered inoperable due to casualty or malfunction, during his/her watch and record the action in the Tag Out Log.

i. When necessary, require a system line-up after maintenance, repair or alteration has been performed.

j. Destroy removed tags.

**15.2.2.5 TYPES OF TAGS**

a. The following types of tags (Table 15.4) shall be used for the Tag Out Program:

(1) CAUTION TAG (NAVSHIPS 9890/5)

(2) DANGER TAG (NAVSHIPS 9890/8)

(3) OUT-OF-COMMISSION LABEL (NAVSHIPS 9890/7)

b. When any component is tagged more than once, any DANGER tag takes precedence over all other tags. Under no circumstances shall equipment, machinery or systems be operated when DANGER tags are attached to a component. All DANGER tags must be removed and cleared before the equipment is tested or operated. Tags or labels shall not be used for any purpose other than that specified and shall not be laminated to permit repeated use. The use of tags or labels is not a substitute for other safety measures such as chaining or locking valves, removing fuses, tag out locking devices or racking out circuit breakers.

**15.2.2.6 TAG OUT LOG BOOK**

a. Each ship shall maintain a Tag Out Log Book as a record of authorization for each tag out action. The Tag Out Log shall be a green record book or 3-ring binder to record tag outs, to serve as a ready reference of existing tag outs and to ensure that serial numbers are sequentially issued. The Tag Out Log Book shall be in the format of Table 15.5. The Tag Out Log Book shall allow space for at least the following information:

(1) Date/Time of tag-out

(2) Tag-out Serial Number

(3) Type of tag-out

(4) Work requiring the tag-out

(5) Work necessary to clear tag-out

(6) Tag number

(7) Component tagged

(8) Position of component (open, shut, off, fuses removed, etc.)

(9) Name of person performing the tag-out

(10) Date and time the component was tagged

(11) Name and signature of the Authorizing Officer authorizing tags

(12) Date and time tags were removed

(13) Name of person removing and clearing the tags

(14) Name and signature of the Authorizing Officer authorizing tag removal

(15) Space for a manufacturer's technical representative or industrial assistance representative to indicate concurrence with the tag

b. A copy of the procedures in Table 15.3 and any amplifying directives for administering the system shall be included in the Tag Out Log Book. The names of the Authorizing Officers appointed by the Chief Engineer also shall be listed in the Tag Out Log Book.

**15.2.3 GAS FREE ENGINEERING**

Entry into, work in or work on confined or enclosed spaces may cause injury, illness, fires, explosions and death. Hazardous atmospheres encountered in confined or enclosed spaces are:

a. Flammable or explosive atmospheres containing:

(1) Flammable vapors from gasoline, light oil or volatile liquids.

(2) Hydrogen gas generated by an acid reacting with metal, such as sulfuric acid reacting with iron.

(3) Byproducts of work procedures that generate flammable conditions.

(4) Excessive oxygen (for instance, from a leaking cylinder of oxygen).

b. Toxic or asphyxiating atmospheres which lack sufficient oxygen:

(1) Oxygen deficiency resulting from consumption of oxygen during a chemical reaction, such as the formation of rust on the exposed surface of a confined or enclosed space.

(2) A toxic chemical atmosphere such as hydrogen sulfide which is a byproduct of marine sanitation devices and decaying organic matter.

(3) The byproducts of petroleum products which produce symptoms ranging from mild exhilaration, irritation of the eyes, headaches and unconsciousness which can lead to death.

**15.2.3.1 ENTERING CONFINED OR ENCLOSED SPACES**

The Chief Engineer shall not permit engineering members of the ship's force to enter confined or enclosed spaces (such as voids, tanks and cofferdams) at sea unless the entry is required to maintain operational readiness. If entry into a confined or enclosed space at sea is necessary, the Chief Engineer shall make sure that engineering members of the ship's force are aware of and adhere to the following requirements for confined or enclosed spaces:

a. Before entering a confined or enclosed space, the person to enter shall verify that the space has been tested (in accordance with NSTM, chapter 074, section 20) by the Gas-Free Engineer (GFE) appointed by the Master and the test results posted outside the space.

b. The individual entering the space shall comply with the requirements of the certificate or tag posted by the GFE at the entrance to the confined space.

c. If a change to the space ventilation or condition has occurred since the inspection, the individual requiring entry shall verify that the confined or enclosed space has been retested and recertified before reentering and performing any additional work.

d. Before any person enters a confined or enclosed space, all members of the ship's force who are to make or assist the entry shall attend a meeting with the Master or his designated representative to discuss:

(1) Signals for communication between the individuals in the space and those outside.

(2) Precautions to be followed to prevent falls.

(3) Proper footwear and protective clothing to be worn within the confined space.

(4) Availability and proper use of rescue and life support apparatus.

(5) Hazards that may be encountered within the confined space.

e. A member of the ship's force shall be stationed outside the confined or enclosed space for rescue purposes whenever personnel are within the space. This person shall be trained in confined or enclosed space entry and rescue procedures and shall maintain continuous communication with members of the ship's force in the confined or enclosed space to ensure their safety.

f. To make an emergency entry into a confined or enclosed space:

(1) Personnel shall wear a self contained breathing apparatus, a parachute-type safety harness to permit rescue from the space, a lifeline securely fastened to the safety harness and personal protective equipment as required by the GFE.

(2) Continuous communication shall be maintained between the individual entering the confined or enclosed space and the attendant outside the space.

(3) Additional rescue equipment shall be stationed immediately outside the entrance to the confined space.

**15.2.3.2 HOT WORK**

Anyone performing any job in or on the structure of a confined or enclosed space that requires hot work, shall ensure that the space has been tested and a certificate stating that the space is "Safe for Hot Work" has been posted in accordance with the procedures in paragraph 15.2.3.1. In addition, the following procedures shall be followed in accordance with NSTM, chapter 074, section 22:

a. Extraneous flammable or combustible materials such as scrap wood, paper, rope or rags shall be removed from the space. Combustible materials that cannot be removed shall be protected from heat and flame. Ventilation ducting shall be of non-combustible metal and free of combustible residues.

b. A fire watch with fire extinguishing equipment shall be posted.

c. Adjacent spaces above, below and on all sides shall be tested, cleaned, ventilated or inerted as appropriate.

d. Pipes, tubes and coils that service or run through the space shall be certified safe before hot work may begin in the confined or enclosed space.

e. Welding, cutting or burning, shall not be conducted on or near materials which give off hazardous byproducts when exposed to heat. This includes hydraulic fluids, freons, chlorinated solvents and halons.

f. Hot work in or near spaces containing magazines, ammunition, or explosives shall be accomplished only in compliance with NAVSEA OP-04, Ammunition Afloat.

**15.2.4 HAZARDOUS MATERIAL AND HAZARDOUS WASTE**

Hazardous materials (HM) because of their quantity, concentration or physical or chemical characteristics pose a substantial threat to human health or the environment if such materials are purposefully released or accidently spilled. Hazardous materials include flammables, combustibles, corrosives, toxics, oxidizers, aerosols and compressed gasses. Mishandling of HM can lead to injury and long term illness. HM related accidents most frequently involve material routinely used in the operation and maintenance of shipboard equipment, machinery and systems. Hazardous wastes (HW) are any HM (liquids, solids or gases) which require special disposal and/or are designated as hazardous waste by the Environmental Protection Agency or a State authority.

**15.2.4.1 ADMINISTRATIVE AREA COMMANDER'S DUTIES**

The Administrative Area Commander shall:

a. Arrange for maintaining and repairing pollution control and spill response equipment which is beyond the capability of the ship's force.

b. Verify that Port Engineers and Construction Representatives (CONREPs) are trained in hazardous waste disposal and hazardous material handling procedures with attention to the following:

(1) Laws and regulations governing controlling, handling, stowing and disposing of HW.

(2) Types of HW encountered in a shipboard environment, types of hazards, regulatory requirements and HW reference material.

(3) Methods and procedures for controlling, storing, handling and disposing of HW.

(4) Identification of amount and types of HW generated by ships.

(5) HW generator numbers.

(6) Responsibilities for HW handling and control in shipyards and industrial facilities.

(7) Incorporating HW control, handling and disposal requirements in work items and contract clauses.

(8) Methods of monitoring shipyard contractor compliance with HW requirements.

(9) Ship's force responsibilities for actions to control HW.

(10) Requirements to report actions taken to deal with HW.

**15.2.4.2 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Order and obtain all Hazardous Material from the ship's HM/HW Coordinator (usually the Supply Officer) who is appointed by the Master. If any Hazardous Material not listed in COMSCNOTE 5100

(Authorized Shipboard Hazardous Material Listing (SHML)) (issued annually) is required by the Engine Department, the Chief Engineer shall advise the HM/HW Coordinator of the need for an exception to policy.

b. Inform the Damage Control Officer (paragraph 13.1) of all HM spills so that an immediate and appropriate response may be made.

c. Verify that all HM received from the HM/HW Coordinator is properly labeled and that any HM repackaged after receipt from the HM/HW Coordinator is properly labeled.

d. Train engineering members of the ship's force in HM/HW requirements and related actions. The Chief Engineer shall obtain training materials from the HM/HW Coordinator and maintain records of training received by each engineering member of the ship's force.

e. Refer to the NSTM, chapter 670 as the primary source for information on the storage, use, disposal, spill response or transportation of HM products in the custody of the Engine Department and refer to the Material Safety Data Sheets (MSDS) of the Hazardous Materials Information System (HMIS) (available on microfiche and CD-ROM on each ship) for detailed and guidance beyond that furnished by the NSTM.

**15.3 MISHAP INVESTIGATION AND REPORTING**

a. The Chief Engineer shall furnish all technical information to the Master to conduct Mishap Investigations and file Mishap Reports submitted to the Naval Safety Center (with copies to MSC Headquarters and the Administrative Area Commander) as required by OPNAVINST 5100.21A (Afloat Safety Program). The scope and content of this instruction differs significantly from the previous version. The policy and procedures of this instruction provide for aggressive mishap prevention, investigation and reporting. The level of investigation and type of mishap reports required are summarized as follows:

(1) Class A Mishap (Formal Board - Detailed Report)
Damage = $1,000,000 or more
Death
Permanent Total Disability

(2) Class B Mishap (Investigated by Command with Mishap Report to NAVSAFECEN)
Damage = $200,000 TO $1,000,000
Hospitalization of 5 or more people
Permanent Partial Disability

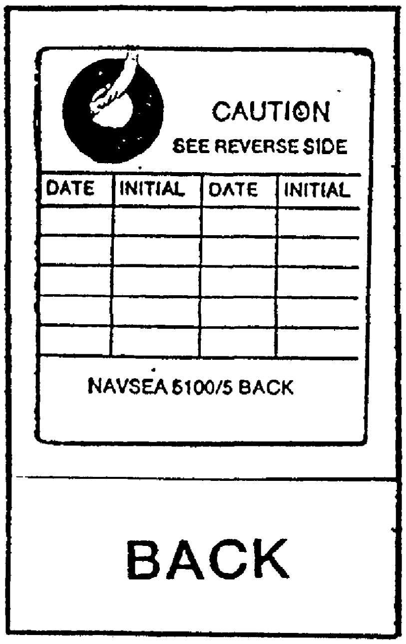
(3) Class C Mishap (Investigated by Command with Mishap Report to NAVSAFECEN)
Damage = $10,000 to $200,000
Injury = 5 lost work days

(4) Reportable Special Case Mishaps
People Falling Overboard
Collision
Grounding
Flooding
Explosion
Electric Shock
All Fires (except trash fires with no injury)
Hazardous Material, Chemical, Toxic Exposure Requiring Medical Attention
Cases of Oxygen Deficiency Requiring Medical Attention
Cases of Back Injury Requiring Medical Attention

b. The Chief Engineer shall make sure when an engineering member of the ship's force is injured, a Form CA-1, Federal Employee's Notice of Traumatic Injury and Claim for Continuation of Pay/Compensation or a Form CA-2, Federal Employee's Notice of Occupational Disease and Claim for Compensation, is filed in accordance with COMSCINST 12810.1 (Federal Employees' Compensation Program (FECP)), to obtain any authorized benefits for the injured person.

# TABLE 15.1

## INSPECTION TAG FOR ELECTRICAL SAFETY PROGRAM



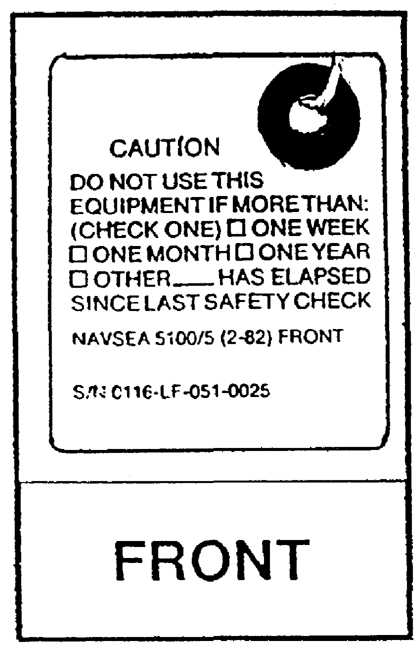



**TABLE 15.2**

**ELECTRICAL EQUIPMENT INSPECTION LOG**

USNS________________________________

ELECTRICAL EQUIPMENT INSPECTION LOG

CATEGORY (CHECK APPROPRIATE CATEGORY)

_____ MOBILE: ANNUALLY - DEPARTMENT________________________
_____ PORTABLE: QUARTERLY - DEPARTMENT_____________________
_____ PERSONAL: SEMI-ANNUALLY - NAME_______________________
_____ RECEPTACLES: ANNUALLY (SEMI-ANNUALLY FOR THOSE EXPOSED TO WEATHER)

| EQUIPMENT NAME | SERIAL NO. | LOCATION USED | DATE TESTED | TEST RESULTS |
|---|---|---|---|---|
| | | | | |

Testing done in accordance with NSTM, chapter 300.

**TABLE 15.3**

**TAG OUT PROCEDURES**

1. Danger Tags. Individuals performing maintenance, repair or testing shall isolate and de-energize the equipment, machinery or systems being serviced, attach DANGER tags and make entries in the Tag Out Log as indicated in these procedures.

a. When a tag out will affect systems or equipment operation in other departments, the individual performing the service shall notify the Department Head before performing the tag out. System tag outs which could affect other departments include certain ship's service electrical system, galley equipment and ventilation system tag-out actions. Systems tag-outs which could affect ships control or operations include certain ship's service electrical systems, systems affecting the ability to operate the propulsion system at full power, steering systems, radar systems and cargo handling equipment.

b. Circuit schematics or system diagrams shall be used to determine the adequacy of all tag out actions.

2. The individual performing the tag-out shall present the Tag-out Record Sheet and associated tags to the Authorizing Officer to obtain his/her concurrence. Upon review of the tags, Tag-out Record Sheet and isolation methods, the Authorizing Officer shall sign and date the tags, sign the Tag-out Record Sheet and enter the record sheet into the Tag-out Log.

a. Each tag required shall be entered on the Tag-out Record Sheet in the space for Work Requiring Tag-out. A separate record sheet shall be used for each tag-out action. Each record sheet shall be dated and assigned a sequential serial number. This serial number shall correspond to the serial number on the tag used. Entries shall be complete. Ditto marks, arrows or other such abbreviations shall not be used.

b. Log entries shall include references to any applicable documents for example: Shipboard Automated Maintenance Management System (SAMM) requirement (paragraph 7.3), Voyage Repair Request (VRR, paragraph 5.2.2), Casualty Report (CASREP, paragraph 5.2.1) or work item number. Requirements for clearing the tag and identification of individuals accomplishing the work also shall be entered.

3. The individual isolating the equipment and attaching tags shall verify that the equipment is isolated. After switches and circuit breakers have been opened, the circuits shall be tested to ensure

they are de-energized prior to commencing any work. Tags shall be attached to prevent operation from any station that could exercise control. Tags shall not be attached to breaker covers or valve caps which can be removed.

4. If a tag out is requested by a technical representative, or industrial assistance contractor, he/she shall sign the log indicating satisfaction with the completeness of the tag out. This will advise personnel removing tags that technical representative or industrial assistance contractor concurrence is required prior to removing the tag.

5. When tags for additional work are required on an existing tag out, the following procedures shall be followed:

a. Additional tags shall be completed to reflect the added work. The reason for the original tag out, amplifying instructions and work necessary to clear the original tag out shall be reviewed and updated on the Tag-Out Record Sheet, if necessary, to ensure they reflect the new work being added to the log. The Authorizing Officer shall sign the Tag-out Record Sheet after a complete review, to verify that the proposed new tags together with the original tags, provide complete tag out protection for the total amount of work to be accomplished. Each tag added to the original tag out shall be numbered sequentially on the tag series for the original tag out.

b. Additional work on a component, equipment or system by a separate individual will require a second tag-out. This tag-out shall provide sufficient protection to the individual and the component, equipment or system exclusive of the first tag-out.

6. When tags are missing or lost after they have been recorded in the Tag Out Log, the Authorizing Officer shall reissue additional tags as necessary but with a letter suffix indicating number of replacements (i.e., "A" if it's the first replacement, "B" if it's the second replacement,etc.). The Authorizing Officer shall indicate in the Tag Out Log that the tag was missing or damaged and that a replacement tag was issued. The Authorizing Officer shall sign the Tag Out Record Sheet to authorize clearing damaged or missing tags and to authorize the replacement tag.

7. Clearing tag out actions shall be accomplished in accordance with the following procedures:

a. When an individual has completed a maintenance, repair or alteration action which ends the need for that equipment, machinery or system to be tagged out, he/she shall:

(1) Request permission from the Authorizing Officer to remove the tags or labels.

(2) Line up the equipment, machinery or system as directed by the Authorizing Officer.

(3) Return all tags and labels to the Authorizing Officer.

(4) Test run the equipment, machinery or system as directed by the Authorizing Officer.

(5) Clear the tag out action from the Tag Out Record Sheet by signing off and dating the tag out action. When an industrial assistance activity or manufacturers' technical representative has participated in the maintenance, repair or alteration action, their authorized representative also shall sign off and date the tag out action.

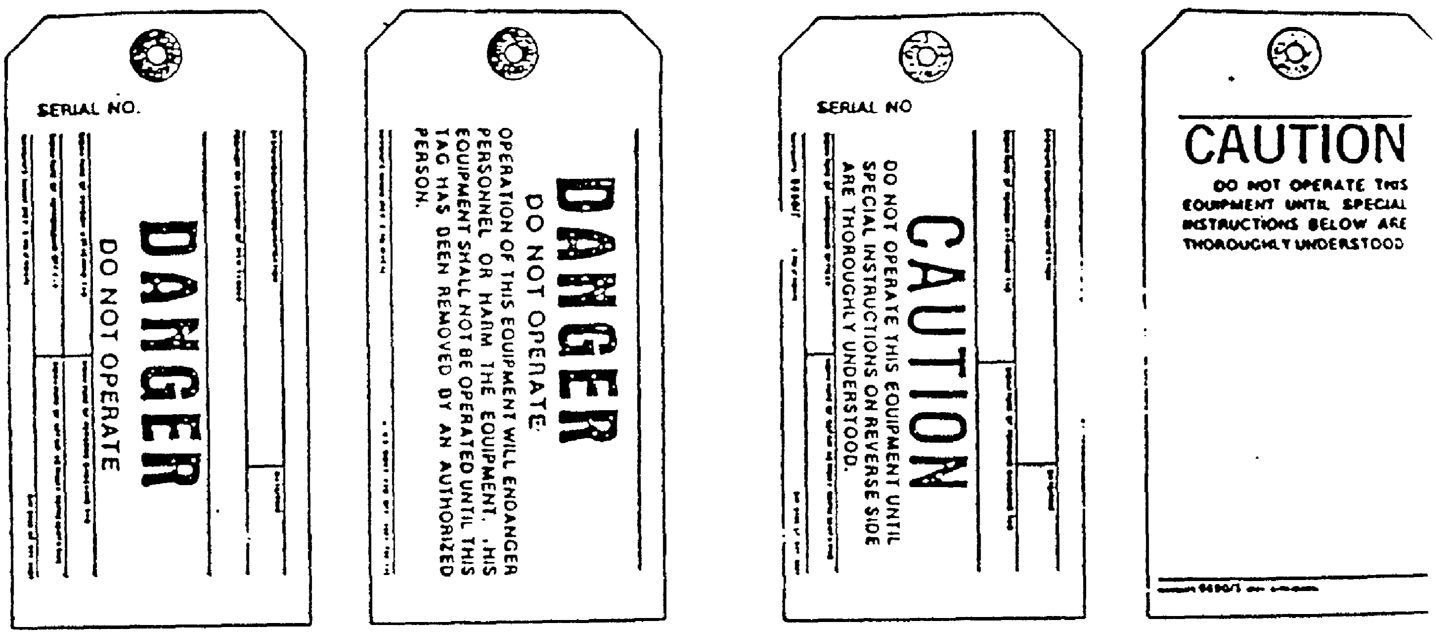
b. When equipment, machinery or systems have multiple tag out actions, no tag out action will be cleared and no tag removed until all tag out actions can be cleared unless the Authorizing Officer is ensured that the remaining tags provide adequate protection for personnel and machinery.

8. Caution Tags. CAUTION tag installation and removal procedures shall be the same as for DANGER tags with the exception that the Authorizing Officer may assign any qualified mariner to clear the tag, not necessarily the person who installed the tag. The individual making out the tag shall indicate, on the back of the tag, the instructions under which the machinery, system or component may be operated.

9. Out of Commission Labels. Upon determining that a gage, meter or other instrument is not operating correctly, a mariner shall fill out an OUT OF COMMISSION label indicating the instrument name, the individual's name and the date and time of initiating the labeling action. The label will be taken to the Authorizing Officer who will make an entry onto the Instrument Log Sheet, assign a sequential serial number to the label and sign the label. The label will then be installed on the meter/gage face and action will be taken to correct the condition as soon as possible. Once the condition has been corrected, the Authorizing Officer shall authorize the removal of the label and make an appropriate entry in the Instrument Log Sheet.

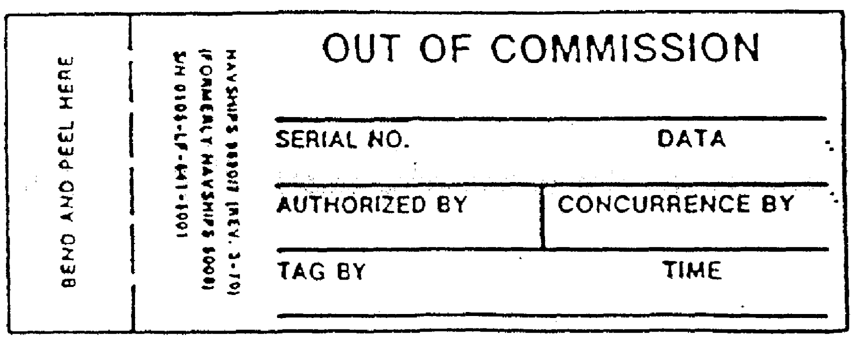
TABLE 15.4

EXAMPLES OF TAGS FOR TAG OUT PROGRAM




DANGER TAG, (NAVSHIPS 9890/8): A 6x3 inch RED tag used for prohibiting operation of equipment, machinery, or systems if operation could jeopardize personal safety or cause damage.

CAUTION TAG, (NAVSHIPS 9890/5): A 6x3 inch YELLOW tag used as a precautionary measure to provide temporary special instructions when operating equipment, machinery, or systems.




OUT-OF-COMMISSION LABEL, (NAVSHIPS 9890/7): RED label used to identify equipment, machinery, and systems that will not operate correctly because they have malfunctioned or are isolated from the system.

# TABLE 15.5
# TAG OUT LOG BOOK FORM

| TAG #/ TAG TYPE | EQUIP/SYS TAGGED OUT | POSITION OF TAGGED COMPONENT | TAG POSTED BY | DATE/TIME OF TAG OUT | NAME/SIGNATURE AUTHORIZING OFF | DATE/TIME TAGS CLEARED | TAGS CLEARED BY | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

Signature Block:________________________

# CHAPTER 16

# ENERGY CONSERVATION ON MSC SHIPS

## 16.0 ENERGY CONSERVATION ON MSC SHIPS

The greatest cost of operating MSC ships is the cost of fuel consumed; therefore, fuel conservation can significantly decrease the cost of ship operation. Shipboard operational procedures and practices have a great effect on fuel consumption. Efficient operational procedures which cost little or nothing can produce real savings in fuel burned.

## 16.1 MSC HEADQUARTERS RESPONSIBILITIES (R

MSC Headquarters shall comply with and keep current COMSCINST 9400.3, Ship Fuel Efficiency and Inventory Reporting. MSC Headquarters shall ensure that the Area Commanders establish programs for burning of waste oil.

## 16.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES

The Administrative Area Commander shall:

a. Evaluate the efficiency of each ship's power plant operation. This action shall include an observation of power plant operation at the time of the evaluation, review of ship's logs, review of ship's Shipboard Automated Maintenance Management (SAMM) system (paragraph 7.3) records, review of the Fuel Efficiency and Inventory Forms required by COMSCINST 9400.3 and review of posted operating procedures aimed toward reducing fuel consumption (paragraph 11.1.1).

b. Establish and continue a competitive awards program to recognize achievement in shipboard energy conservation.

c. As part of regular performance evaluation, evaluate the efforts and accomplishments of each ship's Master and Chief Engineer in maintaining an energy efficient operation. This evaluation shall be conducted at least once every 6 months.

d. Establish and maintain an underwater hull and propeller program (para. 16.4). (A

e. Establish and maintain a program to burn waste oil (para. 16.5). (A

f. Interview each Master and Chief Engineer to determine their familiarity with energy conservation regulations and procedures and their efforts toward energy efficient shipboard operation. During this interview, Masters and Chief Engineers shall be required to cite examples from the following Tables and to apply those examples to their ships:

(1) Diesel ships: Tables 16.1, 16.3, 16.4

(2) Steam ships: Tables 16.1, 16.2, 16.4

(3) Steam/Diesel ships: Tables 16.1, 16.2, 16.3, 16.4

**16.3 CHIEF ENGINEER'S DUTIES**

The Chief Engineer shall:

a. Evaluate power plant operating efficiency.

b. Post machinery operating procedures which will minimize fuel consumption (paragraph 11.1.1).

c. Familiarize Engine Department personnel with machinery operating procedures required for most efficient fuel consumption.

A) d. Establish and manage procedures for burning waste oil (para. 16.5).

e. Operate the power plant according to the following guidelines:

(1) Tables 16.1, 16.3, 16.4 for diesel ships

(2) Tables 16.1, 16.2, 16.4 for steam ships

(3) Tables 16.1, 16.2, 16.3, 16.4 for steam/diesel ships

f. Comply with COMSCINST 9400.3.

**16.4 UNDERWATER HULL AND PROPELLER MAINTENANCE**

Effective hull and propeller surface maintenance is essential to energy conservation. Table 16.5 outlines typical power penalties resulting from roughness and fouling of a ship's underwater hull and propeller. Whether underwater hull cleaning and propeller polishing is feasible or practical is determined by the ship's mission, operating profile and schedule, area of operation, drydocking intervals and the cost of hull and propeller surface maintenance.

**16.4.1 ELEMENTS OF UNDERWATER HULL MAINTENANCE**

Effective underwater hull maintenance programs shall include:

a. A pre-maintenance hull survey and analysis.

b. The hull maintenance and hull coating selection process.

c. Quality control and quality assurance procedures.

d. Post maintenance hull survey and analysis.

e. Interim surveys and hull cleanings.

**16.4.2 PROPELLER MAINTENANCE**

Effective propeller maintenance includes regular propeller inspection and polishing when the ship is both in and out of drydock.

**16.4.3 UNDERWATER HULL AND PROPELLER MAINTENANCE PROGRAM**

The Administrative Area Commander, to establish and maintain an underwater hull and propeller maintenance program, shall:

a. Before drydocking perform a pre-maintenance hull survey and analysis. This survey shall determine the condition of the underwater hull and obtain data needed to make informed and responsible decisions on maintenance and painting. The Administrative Area Commander shall assign the personnel who prepare the work package to perform the pre-maintenance hull survey and analysis. This survey and analysis shall be completed before developing the underwater maintenance work item. The pre-maintenance survey and analysis method shall be selected by evaluating available reliable procedures. These methods shall include:

(1) Reviewing the cathodic protection (CAPAC) system operating log.

(2) Visually inspecting underwater hull while waterborne.

(3) Reviewing the ship's speed loss over time for a given power.

(4) Accomplishing a diver's inspection.

(5) Conducting the pre-maintenance hull roughness survey and analysis described in Table 16.6.

b. Select hull coating and hull maintenance processes. The Administrative Area Commander shall evaluate each available hull maintenance method to determine its cost-effectiveness when compared to the price of excessive propulsion fuel consumed if the method is not used. This cost/benefit analysis may be based on the computer-based analysis model (SHIPSHAPE) described in Table 16.7. The Administrative Area Commander shall select the most cost effective hull maintenance process and shall develop a work item to implement this decision.

c. Implement quality control/quality assurance procedures. The work of preparing the underwater hull and applying the coating shall be of the highest quality so that projected cost benefits are not lost through poor workmanship. COMSCINST 4750.2C (Preservation Instructions for MSC Ships) includes techniques for inspecting and evaluating the painting and preservation of underwater hulls.

d. Perform post-maintenance hull survey and analyses. The Administrative Area Commander shall perform a post-maintenance hull survey and analysis while the ship is in drydock and after all underwater hull maintenance work has been completed. This post maintenance survey and analysis shall be accomplished by visual inspection or by a complete post maintenance hull roughness survey and analysis. The survey method shall be selected following a cost benefit analysis of methods of evaluating the hull maintenance techniques used. This survey shall evaluate the condition of the hull after maintenance and painting and provide data to assist in making decisions on overhaul maintenance planning. Table 16.8 describes a post-maintenance hull roughness survey and analysis.

e. Perform interim surveys and hull cleanings. Underwater hull cleaning can reduce fuel consumption. Table 16.9 provides a worksheet and guidance to assist the Port Engineer in determining the need for hull cleaning. The Administrative Area Commander shall ensure that any hull cleaning method used is compatible with the coating system on the hull. COMSC approval is required for underwater hull cleaning of ships with ablative or polishing types of coatings. Administrative Area Commander requests to clean ships with these coatings shall include sufficient background information to justify the action.

f. Supervise propeller maintenance procedures. Studies show that propeller roughness can impose a 5% power loss. Table 16.10 shows how to estimate the degree of propeller roughness. Six months after drydocking and at 6-month intervals thereafter (until 6 months before the next scheduled drydocking), the Chief Engineer shall request propeller cleaning by issuing a Voyage Repair Request (paragraph 5.2.2) prior to the ship's next inport period. During drydocking, the Administrative Area Commander shall ensure that propellers are polished and protected until undocking. Table 16.10 provides information on propeller polishing.

A) **16.5 BURNING OF WASTE OIL**

Fuel consumption and waste oil disposal costs can be reduced by burning waste oil. Administrative Area Commanders and Chief Engineers shall ensure that waste oil is burned by establishing a shipboard program that includes the following aspects.

a. On steam ships burning Bunker C, waste oil shall be collected, decanted and separated. Reclaimed oil shall be pumped into a fuel oil storage tank for diluting and then burned in the boilers. Waste oil shall not be reclaimed on steam ships burning diesel oil.

b. On diesel ships, crankcase oil can be mixed with its fuel supply, but the ratio of used oil to fuel must not exceed 5%. Gasoline crankcase oil, transmission oil, hydraulic oils, grease, cleaning solvents and crankcase oils mixed with antifreeze shall not be mixed with diesel fuel oil. The following procedures shall be followed when mixing crankcase oil with diesel fuel oil.

(1) Mix used and filtered crankcase oil with an equal amount of fuel.

(2) Filter or centrifuge mixture oil before putting it in fuel tank to prevent fuel filter plugging and accelerated wearing of fuel system components. This process should remove soot, dirt, metal and residue particles larger than 5 microns (0.000197 inch). Add mixed and filtered oil to fuel tank before new fuel added to the tank.

(3) Prevent introduction of any contaminants into the crankcase oil from outside sources when collecting, storing and transferring the used crankcase oil.

TABLE 16.1

# VESSEL OPERATION AND MANAGEMENT GUIDELINES

## 1. VOYAGE ECONOMICS

### a) Operate the vessel at the most economical speed

Obtain a fuel consumption per nautical mile curve for the vessel (Figure 1). Use it to identify the best possible speed for a voyage

Whenever possible, transits should be made as close to the vessel's most economical speed as possible The most economical speed is the bottom of the curve in Figure 1, 9 knots.

Continuous communication and cooperation between shipboard departments and shoreside staff are required for fuel efficient voyage planning and economical speed selection

Speed selection should be based on arrival at the final destination with a reasonable but not excessive time margin, taking into account operational requirements and weather

Slow steaming for best economical results should be accomplished such that while the at sea portion of a voyage may be longer, the total voyage time is unchanged This can be achieved by improved planning, management and conduct of in-port cargo operations which shorten required port times.

Average economical transit speed is best maintained with no, or a minimum, of speed (throttle) changes made during the passage.

Do not "hurry up and wait." If speed changes are required during the passage, they should occur as a result of increasing speed above the economical transit speed near the end of the passage in order to ensure a timely arrival.

***Example:** A 600 mile transit is required and the maximum transit time available is 60 hours The average required transit speed under ideal conditions is 10 0 knots. Referring to Figure 1, the fuel consumed under these conditions is:*

600 miles x 1 065 BBLS/mile = 639 Barrels

*If, however, the average 10 0 knot transit speed is maintained by steaming for 30 hours at 15 0 knots and 30 hours at 5 0 knots*

(30 Hrsx15 0 Knots)+(30 Hrsx5 0 Knots)=10 0 Knots Avg
60 Hrs

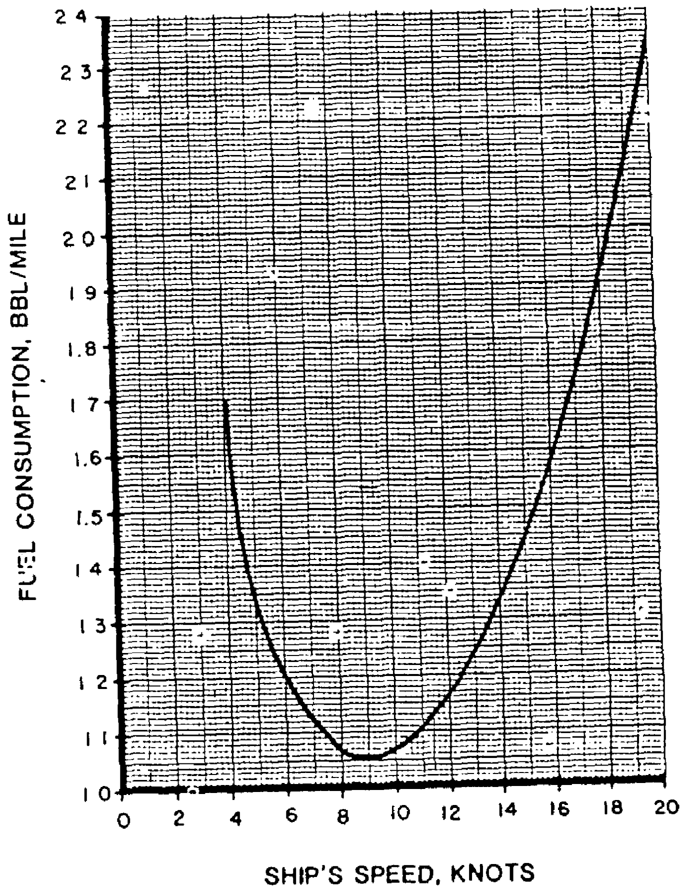
*The fuel consumption for the passage becomes*

(450 Miles x 1 45 BBL/Mile) + (150 Miles x 1 33 BBL/Mile)

= 852 Barrels

**Figure 1**

**Typical Vessel Most Economic Speed Curve**



## 2. NAVIGATION AND STEERING SYSTEMS

### a) Use proper ship handling

Every effort should be made to optimize steering system performance and auto pilot setting to minimize over-steering rudder drag and associated steering system electrical power consumption (Figure 2).

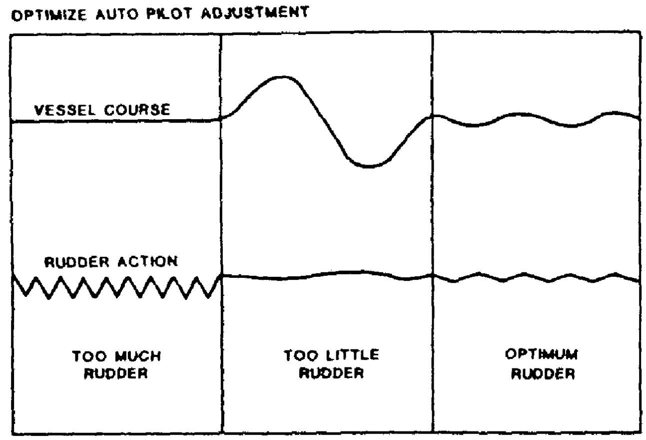
In an effort to eliminate excess steaming miles, the most accurate navigation systems installed should be utilized For most ships this will be the satellite navigation system

***Example:*** *Referring to Figure 1 for a transit of 3000 miles at 15 0 knots for which a reduction of 50 nautical miles steamed is achieved from the utilization of the most accurate navigation systems installed, the following savings can be obtained*

5 Nautical Miles x 1 45 BBLS/MM @ 15.0 Knots = 21 75 BBLS

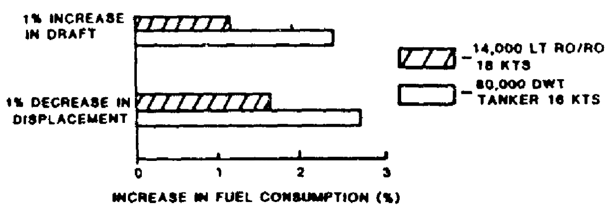
**Figure 2**

**Autopilot Adjustment**




## 3. DISPLACEMENT, TRIM, AND RELATED INFLUENCES (FIGURE 3)

**Typical Relationship Of Changes In Draft And Displacement And Fuel Consumption For A RO/RO Ship And A Tanker**




Use of additional saltwater ballast for excessive stability should be avoided

Guidelines regarding optimum trim to reduce powering and fuel consumption should be followed closely

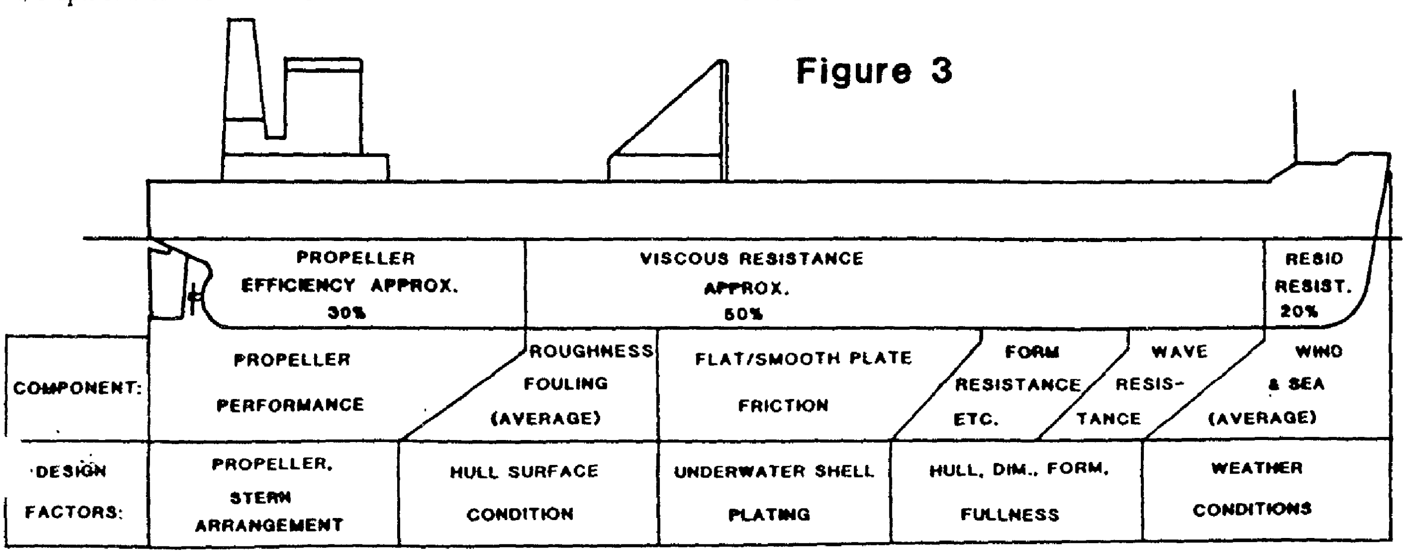
In adjusting for optimum trim by increasing displacement with saltwater ballast, there is a crossover point where the fuel consumption penalty for the increased displacement offsets the fuel consumption savings from optimum trim.

### a) Optimize vessel trim and displacement

Keep a record of vessel trim, displacement, and fuel consumption per nautical mile. Use this data to set the best trim/displacement combination.

An increase in displacement which increases power and fuel consumption for a given vessel speed should be the result of increased cargo deadweights and not saltwater ballast.

**Figure 3**



## 4. WEATHER AND ENVIRONMENTAL FACTORS

### a) Use weather and environmental factors to reduce fuel consumption

Weather and environmental conditions greatly influence powering requirements and fuel consumption. Care should be taken to utilize favorable wind, sea and currents and to minimize the influence of similar unfavorable conditions.

When available, all advanced weather data, especially weather routing, should be integrated into voyage planning as a method for maintaining minimum fuel consumption.

For larger high-power/speed vessels, the added resistance due to shallow water effects of "squat" remain, in effect, even in relatively deep waters Voyage operation's management and planning in coastal areas should consider this fuel consumption penalty by steaming outside this depth whenever practical The shallow water effect depth is a function of vessel draft, speed and length and can be estimated with the following formula:

$$\text{Depth} = (10)\,(V)\,(\text{Draft}/L^{1/2})$$

Where: V = Vessel Speed
L = Ship Length

***Example:*** *For a T-AO 143 Class oiler with a mean draft of 28'-0" transiting at 15 knots, the depth below which the shallow water effect can result in increased powering resistance is*

$$D = (10)\,(15)\,(28/655^{1/2})$$

$$= 164 \text{ feet or approximately 27 fathoms}$$

## 5. OPTIMIZE LIQUID CARGO OPERATIONS

### a) Operate liquid cargo equipment efficiently to reduce fuel consumption

Cargo (ballast) pumps should be operated so as to obtain a combination of the fewest, most highly loaded machines that can reliably perform such required service.

Pump performance should be checked periodically to identify maintenance requirements to keep up efficiency.

Advanced planning can minimize cargo and ballast pumping and stripping requirements and time.

Use unheated sea water for tank cleaning operations whenever possible. Plan cargo operations which minimize tank cleaning.

Heat cargo no higher than the minimum transit temperature required.

If cargo comes aboard heated, delay shipboard heating to allow for the build-up of a viscous, insulating layer on tank skin.

Set up and maintain detailed cargo heating records to ensure future minimum fuel consumption for cargo heating.

On other than tank vessels, cargo or other deck operations should be planned and managed to ensure minimal use of various deck machinery and systems, lighting and compressed air.

## 6. HULL AND PROPELLER ROUGHNESS EFFECTS

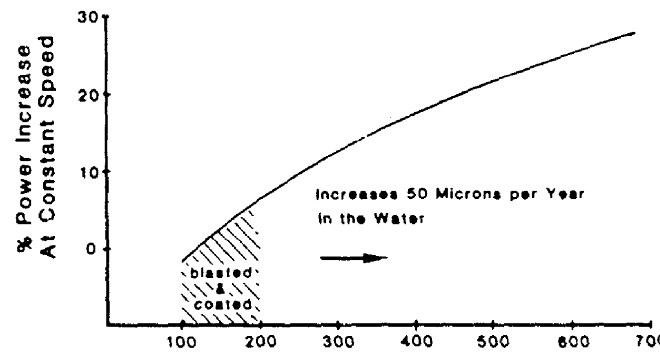
**a) Proper hull and propeller cleanliness will reduce vessel fuel consumption**

Hull and propeller roughness and fouling at a constant vessel speed can conservatively increase fuel consumption by up to 10.0% and 5.0%, respectively

Hull condition degradation can be monitored and trended over time, based on increased RPM, power, fuel consumption, apparent propeller slip, and time out of dock versus ship speed, assuming that displacement and weather influences will average out over a prolonged operating period. (Figure 4) Propeller degradation and its impact on fuel consumption are not as easily monitored and require actual periodic roughness measurements.

While obviously mission dependent, minimizing the time a vessel spends alongside or at anchor, especially in tropic waters, will reduce hull and propeller fouling

**Figure 4**
**Impact On Vessel Power Requirement Due To Hull Roughness**




## 7. TWIN SCREW VESSELS

**a) Eliminate excess rudder application to maintain course**

On larger twin screw vessels, one or two degrees of continuous corrective rudder application can result in a fuel consumption increase of from 0.5 to 1.0%

Twin shaft vessels should be operated during prolonged steady state transits with shaft lines at equal speeds and power outputs whenever possible to reduce the potential for continuous corrective rudder action and associated increased powering requirement due to added rudder drag

Shaft tachometers, rudder angle indicators and other steering and shaft output indicators and associated repeaters should be kept in close calibration to aid in twin shaft load balancing and shaft load imbalance detection

TABLE 16.2

# STEAM TURBINE PROPULSION PLANT

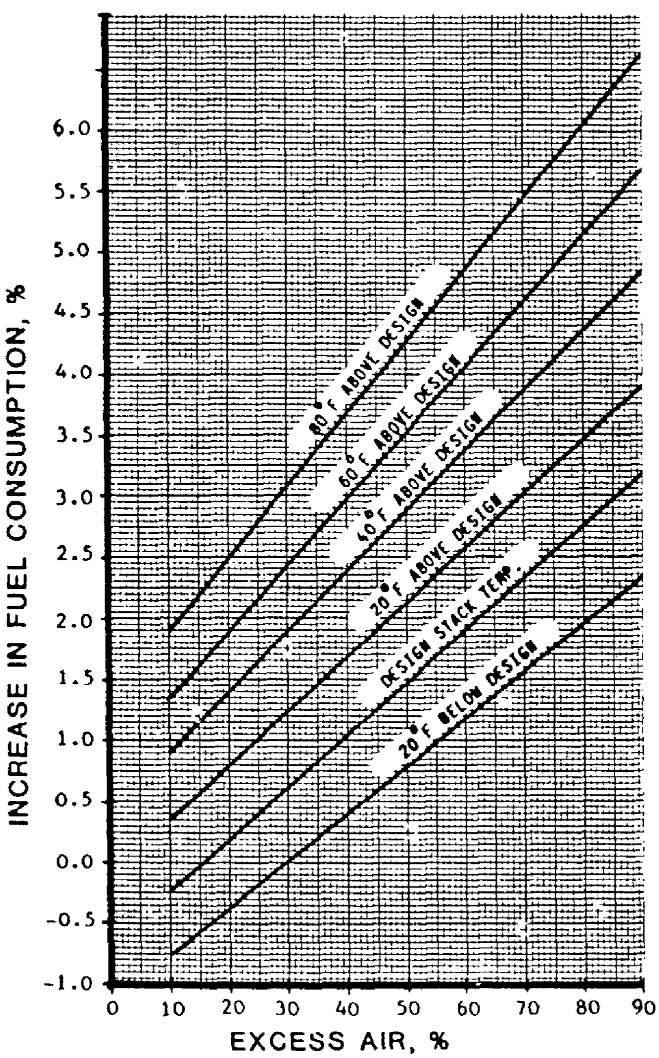
# ECONOMIC OPERATING GUIDELINES

## 1. BOILER OPERATION

### a) Reduce excess air and stack temperature

Use in-situ or portable oxygen analyzers to maintain maximum 3% $O_2$ (15% excess air) in flue gas Higher than design stack temperature usually indicates high excess air levels Figure 1 shows the effect of change in stack temperature and excess air levels on fuel consumption

**Figure 1**
**Increase In Fuel Consumption As A Function Of Stack Temperature And Excess Air**




### b) Service and adjust automatic combustion controls

Eliminate manual operation, control "hunting" and mechanical looseness Clean air lines, filters, and instruments regularly. Adjust set point frequently according to flue gas analysis and incipient stack smoking

### c) Improve fuel atomization and air mixing

Ensure burner tips are not worn Do not mix burner tip sizes. Operate with the minimum number of burners and highest burner header pressures for a given load Ensure atomizing steam is at the proper pressure and is dry or slightly superheated. Set up burners to manufacturer's dimensions When possible, ensure all fuel and steam valves and air registers are full open and not throttled Secure atomizing steam, and remove all unused burners from the boiler, close all unused air register doors

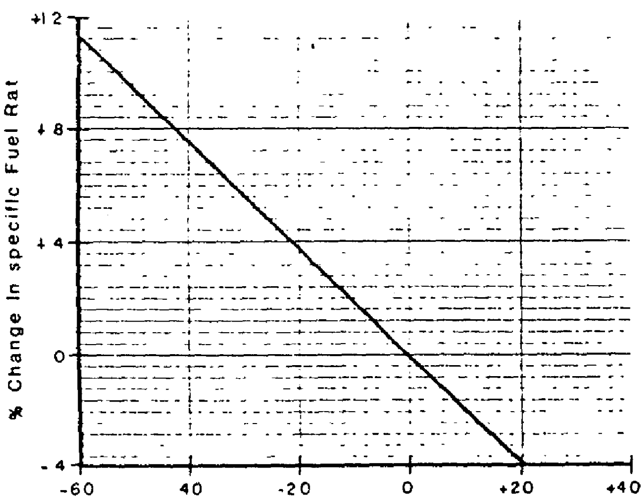
### d) Operate at lowest possible forced draft fan speed

Forced draft (FD) fan speed should be as slow as possible with the inlet vanes between 25% and 75% open If the vanes are less than 25% open, the next slower speed should be used; if the vanes are greater than 75%, the next higher speed should be used FD fan operation at the slowest speed possible for a given load reduces the ship's electrical load and enables the operator to more easily reduce the excess air level for greater boiler efficiency

**e) Superheater outlet pressure and temperature**

Maintain design superheater outlet temperature and pressure to ensure optimum plant efficiency by properly tuning and maintaining the outlet pressure control system and keeping boiler heating surfaces clean. Each 50° decrease in superheater outlet temperature increases fuel consumption by 1% while each 50 psi decrease in superheater outlet pressure increases fuel consumption by ½% An increase in stack temperature, along with a decrease in superheater outlet temperature, indicates the need to operate the soot blowers Figures 2 and 3 show the relationship of superheater outlet temperature and pressure on the ship's specific fuel consumption rate

**Figure 2**
**Relationship Of Superheater Outlet Temperature To Specific Fuel Consumption**

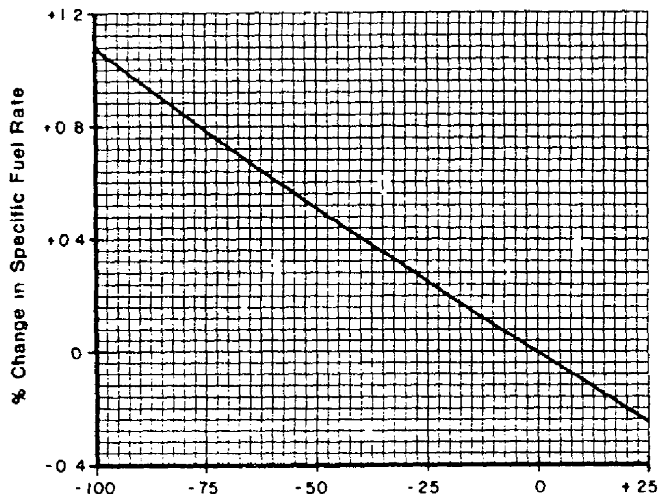



Change From Design Superheater Outlet Temp.-°F

**f) Boiler miscellaneous items**

Make any necessary repairs to any leaking valves, flanges, or packing glands. Also replace missing lagging and insulation blankets, as necessary

**Figure 3**
**Relationship Of Superheater Outlet Pressure To Specific Fuel Consumption**




Change from Design Superheater Outlet Press. PSIG

## 2. PROPULSION TURBINES

**a) Turbine extractions**

The turbine extractions (bleeds) should be wide open at full power and kept open to the lowest possible power level to take advantage of this available energy rather than using live steam make-up At one-half (½) power, utilization of bleed steam saves 4% Proper adjustment of the live steam make-up valve controller is essential to prevent premature live steam valve opening and thus closing of the bleeds

**b) Gland seal steam and turbine drains**

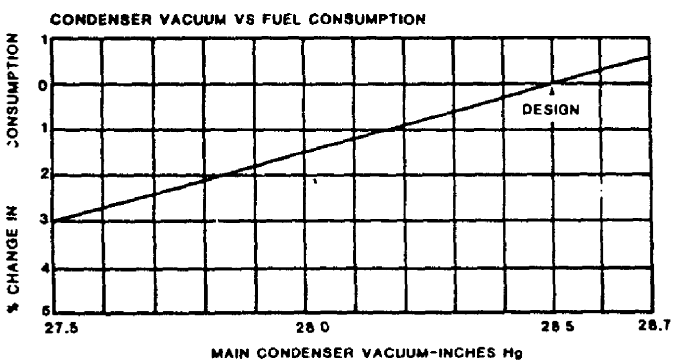
The gland seal steam pressure should be kept as low as possible (between 1.5 and 3.0 psi) while still maintaining main condenser vacuum A 4 5 psi setting rather than 1 5 psi increases fuel consumption by 0.2% Turbine drains and low point drains should be kept clear and drain valves operated as necessary. Steam blowing from the turbine glands is an indication of either too high a gland seal pressure or faulty low point drains resulting in water backing up into the glands and boiling

## 3. MAIN CONDENSER/SALT WATER CIRCULATING SYSTEM

### a) Main condenser vacuum

Operating the main condenser at the highest possible vacuum increases the amount of energy made available from the steam in the last stages of the low pressure turbine that would not be available if the turbine exhausted to a higher pressure. A one-inch decrease in condenser vacuum increases fuel consumption by 3%. Figure 4 shows the result on specific fuel consumption when operating at off-design main condenser vacuum.

**Figure 4**




### b) Maintain clean condenser

Ensure both the steam side and the saltwater side of the condenser are clean for good heat transfer. For a constant power level, fouling on the saltwater side decreases cooling water flow and is noted by a decrease in vacuum along with an increase in the temperature rise of the sea water. Fouling on the steam side or excessive air leakage is noted by a decrease in vacuum along with a decrease in the temperature rise of the sea water.

### c) Locate and stop vacuum leaks

Use pressure test, paint, tape, soap or other techniques to locate air leaks. Make sure turbine glands are in good condition and gland steam is effective.

### d) Use scoop injection

Make use of scoop injection down to as slow a speed as possible, as long as there is no reduction in vacuum. Securing the main circulating pump while using scoop injection reduces the KW load or steam consumption, depending on the circulating pump's prime mover

### e) Eliminate condensate sub-cooling

Excessive cooling of the condensate below the saturation temperature for a given vacuum can be eliminated by proper main circulation pump operation or cautious throttling of the overboard discharge valve. Care should be taken not to over pressurize the condenser water boxes 5°F of subcooling can increase fuel consumption by 0.3%.

### f) Minimize condenser loading

Check for leaking auxiliary exhaust dump valve by cautiously feeling discharge piping (hot piping indicates a leaking valve). Operate extractions at as low a power level as possible Check traps, drains and other discharges to the main condenser

## 4. AIR REMOVAL EQUIPMENT

### a) Inspect air ejectors

Routinely inspect air ejectors. Replace improperly sized or worn nozzles. Ensure motivating steam is slightly superheated dry steam to reduce nozzle erosion. Check air ejector inter-condenser loop seal to main condenser to ensure that it is full of water. Check after-condenser vent, a heavy steam plume indicates a flooded or fouled inter or after condenser section or a tube leak.

### b) Maintain vacuum pumps

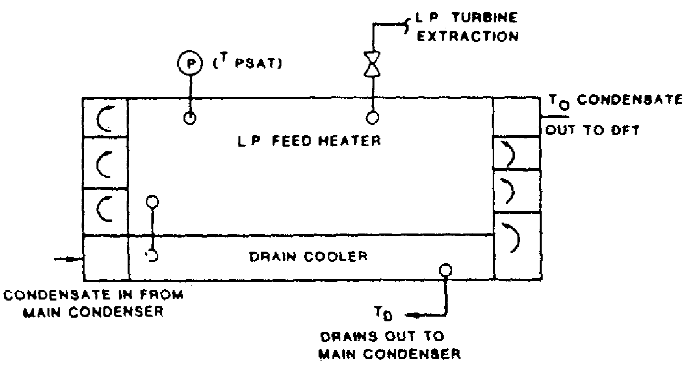
Keep vacuum pumps in good working order Maintain proper level in seal water tank Check that all connections to main condenser are tight.

## 5. FEED HEATERS

### a) Check L.P. heater operating temperatures and pressures

Frequently check the LP heater shell vacuum, condensate inlet and outlet temperatures and drain temperature (as shown in Figure 5) against design values for a given power level A 10°F Terminal Temperature Difference, (TTD), reduction increases fuel consumption by 0 15% while a 10°F Drain Cooler Temperature Difference, (DCTD), reduction increases fuel consumption by 0 04%

**Figure 5**
**Typical Low Pressure Feed Heater Performance Check Parameters**




$TTD = T_O - T_{PSAT} \approx 5^{\circ}C$

$DCTD = T_D - T_I = 5^{\circ}C$

### b) L.P. heater shell vacuum and venting

Proper venting of the low pressure heater shell to the main condenser is essential to maintain sufficient vacuum in the heater shell in order to ensure bleed steam flow to the heater. All valve packing and flanges should be kept tight to prevent vacuum leaks Every 100°F of feed heating by extraction (bleed) steam decreases fuel consumption by 1% By-passing the LP heater typically increases fuel consumption by 1 15%

### c) Proper L.P. heater drain temperature and level

Maintain the level controller in good working order to ensure proper drain levels (drain cooler flooded, one-half (½) to three-fourths (¾) level in gauge glass). Higher than design drain temperatures are caused by improper drain level control resulting in a fuel penalty since the heat of the drains is lost overboard in the main condenser rather than transferred to the condensate

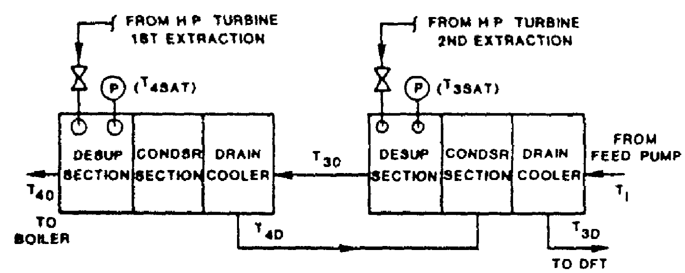
### d) Maintain proper DFT pressure

DFT shell pressure should be maintained at the design pressure and feed water discharge temperature A 25°F reduction in feed water temperature out of the heater will typically increase fuel consumption by 0 2% Ensure live steam make-up, crossover bleed make-up and auxiliary exhaust dump valve controllers are operating properly to hold desired pressure Avoid induction of large flows of cold water to DFT which can collapse shell pressure and cause feed pump difficulty Check vent valve and/or orifice to gland exhaust condenser to ensure adequate flow for proper DFT venting.

### e) Check H.P. heater operating temperatures and pressures

Frequently check the H P heater shell pressure, condensate inlet and outlet temperatures and drain temperature (as shown in Figure 6) against design values for a given power level A 10°F TTD reduction increases fuel consumption by 0 2% while a 10°F DCTD reduction increases fuel consumption by 0 02%

**Figure 6**
**Typical High Pressure Feed Heater Performance Check Parameters**




3rd STAGE HEATER:

$TTD = 0 = T_{3SAT} - T_{3O}$

$DCTD = 25^{\circ}F = T_{3D} - T_I$

4th STAGE HEATER:

$TTD = 0 = T_{4SAT} - T_{4O}$

$DCTD = 25^{\circ}F = T_{4D} - T_{3O}$

### f) H.P. heaters venting and draining

Ensure proper (flooded) drain cooler operation Ensure that condensing section is properly vented Keep both steam and condensate sides of tubes clean

## 6. FEED PUMPS

### a) Maintain proper discharge pressure

Keep main feed pump discharge pressure at 75-100 psi above drum pressure with feed regulator valves 50 to 60% open. Every 100 psi over recommended setting increases fuel consumption by .25%.

### b) Close recirculation valve

Keep feed pump recirculation valve open only at low plant outputs and maneuvering to ensure minimum flow through pump. Operating with recirculation valve open unnecessarily, increases fuel consumption by 0.2%.

### c) Close extra nozzles

Keep extra steam nozzles closed except when necessary for high feed flows at high powers. Operation with extra nozzles open unnecessarily typically increases fuel consumption by 0.2%.

### d) Secure idling feed pumps

Owing to the high reliability of most feed pumps, idling a stand-by pump is unnecessary. Idling a stand-by feed pump low powers in-port increases fuel consumption by 1.5%.

## 7. TURBINE GENERATOR/AUXILIARY CONDENSER

### a) Operate with minimum number of TG's for a given load

Turbogenerators are more efficient when highly loaded. Operate with the minimum number of TG's on line for a given load, up to 90% of machine's rating. Operating 3 TG's at one-third load rather than two machines at one-half load increases fuel consumption by 0.3% underway and 1.2% in port.

### b) Auxiliary condenser

Keep auxiliary condenser in good working order, similar to main condenser upkeep. When possible, cross TG exhaust to main condenser and secure auxiliary condenser, auxiliary circulating system, auxiliary vacuum equipment, and auxiliary condensate pumps.

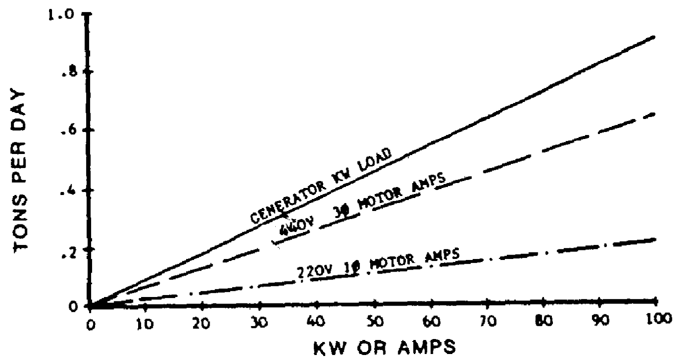
## 8. ELECTRICAL POWER DISTRIBUTION

### a) Shut down unnecessary electrical loads

Monitor kilowatt meter and look for ways to minimize load. Limit number and speeds of ventilation fans, service pumps, inert gas fans, forced draft fans, etc., in service. Secure water circulation to unused coolers and condensers. Figure 7 shows the effect of increasing electrical load on fuel consumption.

**Figure 7**

**Excess Electrical Power Consumed vs Fuel Burned Per Day**




### b) Reduce lighting load

Turn off lights when leaving quarters, storerooms, etc. Turn off outside lights at daybreak. Check to minimize number and wattage of lights.

### c) Heating and air conditioning

Keep thermostat settings to minimum. Keep outside doors and portholes closed when heat or air conditioning is on. Adjust systems to provide uniform temperature and ventilation to all quarters.

### d) Minimize Steward Department waste

Turn off galley ovens and stoves except when actually needed. Combine or save laundry for maximum washing machine loads. Eliminate or minimize use of fresh water for washing decks.

### e) Conserve potable or fresh water

Repair dripping faucets. Adjust pressure regulators to showers, sinks and toilets. Insulate hot water lines and clean systems to avoid excessive warm-up or flushing of faucets and showers.

## 9. DISTILLING PLANT

### a) Supply steam

Use bleed system, LP bleed or cascaded crossover bleed, as the heating supply steam whenever possible. Check for sufficient supply steam pressure ensuring proper steam flow to maximize heat transfer. Use of live steam versus bleed steam increases fuel consumption by 2.0%.

### b) Operational checks and procedures

Check operating pressures, vacuum, and temperatures with design diagrams frequently Keep heat transfer surfaces clean via chemical cleaning, as necessary

## 10. LOW PRESSURE DRAIN COLLECTING SYSTEM

### a) Check return lines to collecting tank

Inspect all drain lines to collecting tank and repair any leaks, as necessary. Ensure all steam traps are unlagged and operating properly, repair or replace as necessary. Boiling, or a sharp rise in tank temperature, normally indicates a faulty trap which can be located and corrected by isolating drains to the drain tank one at a time until faulty trap is located.

### b) Emptying the collecting tank

Whenever possible, the collecting tank should be emptied via a drain pump rather than vacuum dragging to the main condenser Ensure proper operation of tank level control to prevent cycling of the transfer pump Emptying the tank via vacuum drag vice transfer pump increases fuel consumption by 1 0%

## 11. AUXILIARY STEAM SYSTEM

### a) Steam driven auxiliaries

Keep steam drive auxiliaries in good working order, with all steam piping, valves and machinery lagged and drained as necessary. Eliminate unnecessary idling standby machinery. Maintain proper design steam inlet pressure and temperatures and design exhaust back pressure. Check all relief valves for proper operation.

### b) Auxiliary exhaust system

Maintain design auxiliary exhaust system pressure by ensuring proper operation of auxiliary exhaust dump, crossover bleed make-up and live steam make-up valves. Check that live steam make-up and auxiliary exhaust dump valves are never open at the same time, this increases fuel consumption by up to 3%. Check all by-pass valves on the above mentioned control valves for leakage, repair as necessary. Check control valve strainers for blockage. Check for leaking valves by cautiously feeling the discharge piping On a leaking valve this piping will be hot.

### c) Contaminated steam system

Whenever possible operate the contaminated steam generator on H.P. bleed steam rather than live steam. Operation of live steam versus H.P. bleed typically increases fuel consumption by 1.0% Ensure all steam piping is lagged and in good working order, repair any leaks, valves, etc. as necessary. Frequently inspect contaminated drain inspection tank. Check return lines for proper drain trap operation and repair any leaks, valves, etc. as necessary.

### d) Live auxiliary steam system

Ensure the live auxiliary steam (desuperheated steam) is at the design pressure and temperature. Off-design desuperheated steam temperature and pressure causes poor steam driven auxiliaries performance requiring an increase in steam flow The increase in steam flow results in an increased fuel rate.

TABLE 16.3

# DIESEL ENGINE PROPULSION PLANT ECONOMIC OPERATING GUIDELINES

## 1. PROPER ENGINE OPERATION

### a) Keep engines in top condition

Use P-V diagrams to check cylinder compression pressure and firing pressure against manufacturer's specifications. Frequently check cylinder exhaust temperatures and maintain within manufacturer's specifications The recommended allowable deviation in compression pressure between two cylinders is +/- 15 psi. The recommended allowable deviation in exhaust temperatures is +/- 20°F. Balance the power from each cylinder by making these measurements the same on each cylinder. Table 1 shows the relationship between various combinations of cylinder pressure and exhaust temperature and the resultant corresponding operating conditions Scheduled preventive maintenance will keep engine in top condition Keep track of the hours between maintenance jobs

**Table 1**
**ylinder Pressure, Exhaust Temperature And Operating Conditions**

| CYLINDER PRESSURE | EXHAUST TEMPERATURE | OPERATING CONDITIONS |
|---|---|---|
| Low Compression | Low | Mechanical clearance too great : compression ratio too low |
| | Normal | Air intake clogged or air delivery by blower insufficient |
| | High | Air-charge loss through leaky valves, piston rings or worn or scored liners |
| High Compression | Low | Mechanical clearance too small: high compression ratio |
| Low Firing | Low | Fuel rack too far out |
| | Normal | Air intake clogged or poor quality fuel |
| | High | Injection timing late, injection nozzle dirty or leaky: high back pressure |
| Normal Firing | Low | Light load |
| | High | Overload: high back pressure |
| High Firing | Low | Injection timing early |
| | Normal | Worn orifices in injection nozzle |
| | High | Fuel rack too far in |

### b) Maintain/calibrate fuel injection system to specifications

Each cylinder should require the same amount of fuel and produce the same pressures and temperatures. Use offset diagrams to check the setting of the injection timing. A one or two degree error in timing can cause a 2% increase in fuel consumption. Figure 1A shows the PV and offset diagram for a typical well running, four-stroke engine. Figures 1B and 1C are typical offset diagrams indicating late injection and poor quality fuels (fuel knock). Check the injector nozzle holes for size. 5/10,000 of an inch of wear can cause a 0.5% increase in fuel consumption.

**Figure 1A**
**Four-Stroke Airless-Injection Engine**

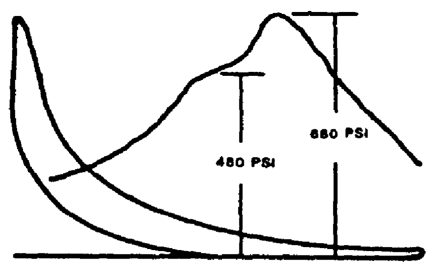



**Figure 1B**
**Late Injection**

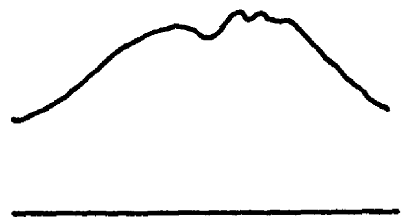
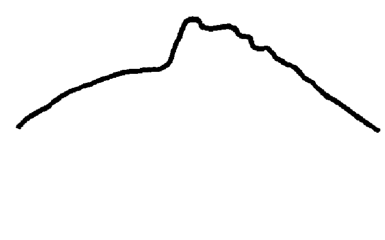


**Figure 1C**
**Low-Cetane Fuel, Fuel Knock**



**c) Clean the intake air system**

Keep the air intake filters clean If possible, measure the pressure drop across the air filter. Clean the charge air cooler air side with an approved chemical at regular intervals Proper charge air cooling reduces fuel consumption by 7.0% on a typical medium speed, four cycle engine

**d) Take proper care of the blower/turbocharger**

Clean the air side and gas side as recommended by the manufacturer Keep track of the temperature rise across the air side and temperature drop across the gas side of the turbocharger These values can give a good indication of the efficiency of the unit and alert the operator that cleaning is required. Record the back pressure in the exhaust at the outlet of the turbo If this increases, the engines will operate inefficiently. A 12 "$H_2O$ increase in back pressure will cause a 1% increase in fuel consumption

**e) Operate the engine cooling systems at the proper temperature and pressure**

Keep the cooling water inlet and outlet temperatures at the design value Running at low temperatures will be inefficient and will cause increased corrosion, while running hotter may cause the engine to overheat Maintaining a proper coolant treatment will limit corrosion and fouling, which can cause reduced coolant flow and wasted pump power On raw-water tems, clean the heat exchangers on a regular schedule or en the water pressure rises due to clogging Keep the lube oil clean by changing filters and centrifuging. Clean lube oil reduces friction more efficiently

**f) Use engine driven auxiliaries whenever possible**

Engine driven lube oil, jacket water and raw water pumps are more efficient than the elctric-driven type Engine driven pumps require 20% less power than electric drive units of the same capacity

**g) Operate shaft drive systems in the proper manner**

For direct drive diesels, keep the line shaft and stem tube bearings clean and well-lubricated On a geared drive, the gear lube oil should also be kept clean Periodically check the gear teeth for wear which shows misalignment and wasted power. Make sure clutch pads are not slipping Diesel-electric drives must be kept clean to operate efficiently Clean the electrical contacts and rotating equipment frequently Proper operation of a CP propeller drive requires good maintenance of the positioning systems Operating at the proper pitch/ speed combination can save 2% to 5% in fuel consumption Keep the actuating oil clean and the pitch transmitter calibrated Operate the engine/propeller at the proper speed/pitch combination according to the manufacturer's recommendations

## 2. FUEL OIL CONDITIONING/ TREATMENT SYSTEMS

**a) Maintain clean fuel filters**

Clean or replace filters regularly or when the pressure drop across them is above the limit.

**b) Operate purifiers properly**

For self-cleaning purifiers, make the time between cleanings as long as possible Too frequent cleanings waste good fuel. When two centrifuges are installed, operation in series as purifier/clarifier gives optimum particle removal results Reduce flow rate to purifier to 10% above engine consumption rate to allow for more efficient particle removal

**c) Keep proper fuel temperatures**

Drain settlers only as much as necessary Maintain the proper fuel temperature or viscosity Running hot or cool causes inefficient combustion. A 10°F change in fuel temperature may cause a 1.5% increase in fuel consumption.

## 3. LUBE OIL SYSTEMS

**a) Maintain clean lube oil filters**

Items discussed for fuel filters and purifiers also apply to lube oil filters and purifiers. Keep the lube oil clean. Clean lube oil reduces engine friction and reduces engine wear, roving engine efficiency

**b) Maintain proper lube oil temperature**

High temperature causes the oil to evaporate faster so that more is consumed Cool temperature causes increased friction and pumping power losses

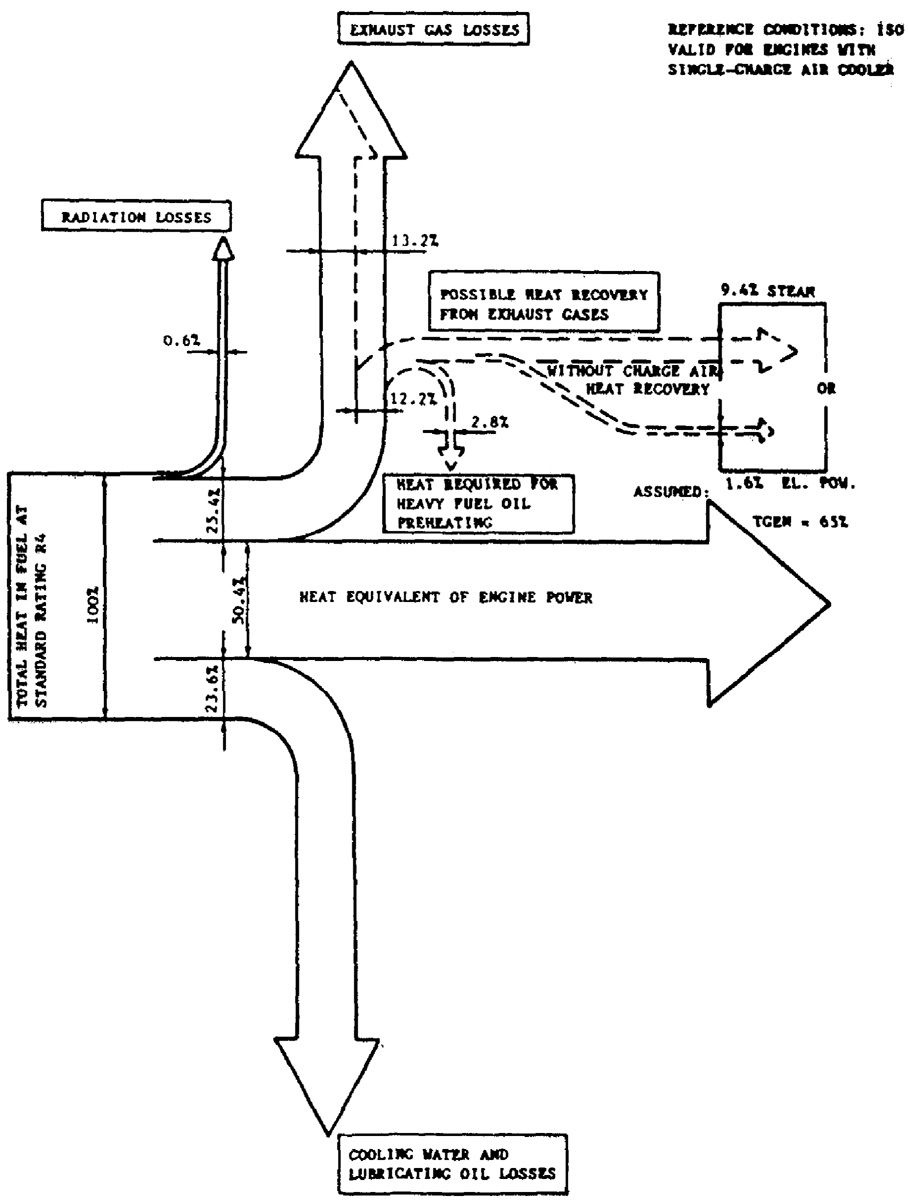
## 4. WASTE HEAT RECOVERY SYSTEM

### a) Utilize engine waste heat

Use engine exhaust gas boilers/heaters as much as possible (see Figure 2) Do not operate fired boilers when the exhaust gas boiler can supply sufficient steam. Operating a fired boiler when not required can increase overall fuel consumption by 25%

Utilize the jacket water distiller fully Clean the heater transfer surfaces when required Use the recommended chemical treatment to reduce tube fouling Do not operate above design capacity, as this will cause rapid fouling.

**Figure 2**
**Engine Heat Distribution Diagram**



## 5. AUXILIARY BOILER OPERATION

### a) Reduce excess air and stack temperature

Use in-situ or portable oxygen analyzers to maintain maximum 3% $O_2$ (15% excess air) in flue gas. Higher than design stack temperature usually indicates high excess air levels

### b) Service and adjust automatic combustion control

Eliminate manual operation, control "hunting" and mechanical looseness Clean air lines, filters, and instruments regularly. Adjust set point frequently according to flue gas analysis and incipient stack smoking.

### c) Improve fuel atomization and air mixing

Ensure burner tips are not worn. Do not mix burner tip sizes Operate with the minimum number of burners and highest burner header pressures for a given load. Ensure atomizing steam or air is at the proper pressure. Set up burners to manufacturer's dimensions. When possible, ensure all operating fuel and steam valves and air registers are full open and not throttled Secure atomizing steam, and remove all unused burners from the boiler. Close all unused air register doors

### d) Operate at lowest possible forced draft fan speed

Forced draft fan speed should be as slow as possible with the inlet vanes between 25% and 75% open. If the vanes are less than 25% open, the next slower speed should be used, if the vanes are greater than 75%, the next higher speed should be used. FD fan operation at the slowest speed possible for a given load reduces the ship's electrical load and enables the operator to more easily reduce the excess air level for greater boiler efficiency.

### e) Boiler miscellaneous items

Make any necessary repairs to any leaking valves, flanges or packing glands Also, replace lagging and insulation blankets, as necessary.

## 6. CONTROLLABLE PITCH PROPELLER OPERATION

### a) Select the most economical pitch/RPM combination

For vessels with a combined pitch/RPM control, simply select handle position to meet (and not exceed) current operating requirements. For vessels with separate RPM and pitch controls, try different combinations which meet the operating requirements, and monitor fuel consumption to determine which pitch/RPM selection is most economical.

### b) Select the most economical combination of engines and shaftlines in operation

For off design conditions, it is often more economical to run one engine at a higher power level than two engines at a lower power level, and a CPP allows the operator the flexibility to change the propulsion system characteristics. This principle can be applied to ships, single or twin screw, with two engines per shaftline, or to twin screw ships with one engine per shaftline.

TABLE 16.4

# MISCELLANEOUS SHIPBOARD ECONOMIC OPERATING GUIDELINES

## 1. INSTRUMENTATION

### a) Maintain the ship's instrumentation in proper working condition

Calibrate pressure gages, thermometers, and other instruments on a regular basis. Pressure gages are particularly sensitive to thermal and vibration-induced drift Tag the instruments with the date of most recent calibration. Accurate, repeatable instrumentation is the engineer's indication of an efficiently operating plant

## . TRAPS and DRAINS

### a) Maintain all steam traps and condensate drains in working condition

Check drain lines and traps by touch or with a contact thermometer The drain line downstream of a trap should be only warm The line upstream of the trap should be too hot to touch Ensure all drain traps are unlagged At low powers and in port, malfunctioning traps on a typical deck steam system increase fuel consumption by 4.0%

### b) Stop leakage

Renew leaking gaskets, valves, machinery packing and screwed fittings Excessive leaks result in extra make up feed requirements. Typically for low pressure distillers every 2000 gallons required above design increases fuel consumption by 0 15%

## 3. FUEL OIL TANKS

### a) Maintain fuel tanks at the proper temperature

Bunker and storage tanks should be kept at the minimum temperature for proper transfer pump operation. Settler (and day) tanks should be kept at the best temperature for separation Maintaining tanks too hot is inefficient When tanks are low, make sure that the oil level is above the thermometer well.

### b) Drain settlers only as necessary

Excess draining wastes fuel

### c) Secure the heat before stripping tanks

Heating during stripping can cause heavy oil to overheat and "crack" in the tank

## 4. HOTEL WASTAGE

### a) Minimize potable water wastage

Combine or save laundry for maximum washing machine loads. Eliminate or minimize use of fresh water for washing decks. Repair dripping faucets. Adjust pressure regulators to showers, sinks and toilets. Insulate hot water lines and clean pipe internals to avoid excessive warm-up or flushing of faucets and showers. Typically for low pressure distilling units every 2000 gallons above vessel design water consumption requirements increases fuel consumption by 0.15%.

### b) Reduce heating and air conditioning loads

Keep thermostat settings to minimum. Keep outside doors and portholes closed when heat or air conditioning is on. Adjust systems to provide uniform temperature and ventilation to all quarters. Secure unnecessary ventilation fans or reduce fan speed whenever possible.

## 5. INSULATION

### a) Maintain all steam piping and insulation in good condition

Replace all broken or torn insulation Renew lagging after repair or maintenance work is complete. Figures 1 and 2 show graphically the fuel losses for uninsulated steam lines and holes in steam piping

**Figure 1**
**Bare Line Loss**
**(Assumes 88% Boiler Efficiency)**

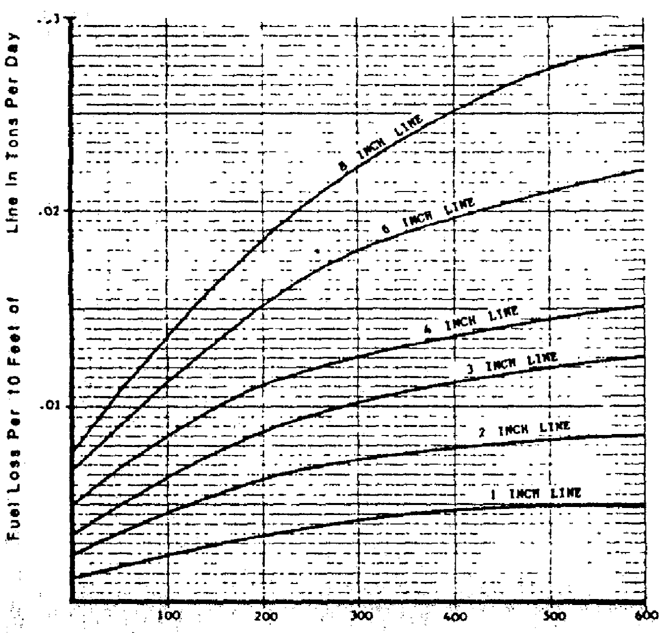
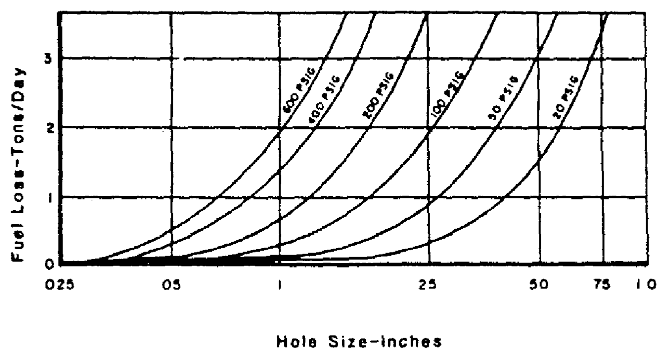



**Figure 2**
**Fuel Loss From Steam Leaks**



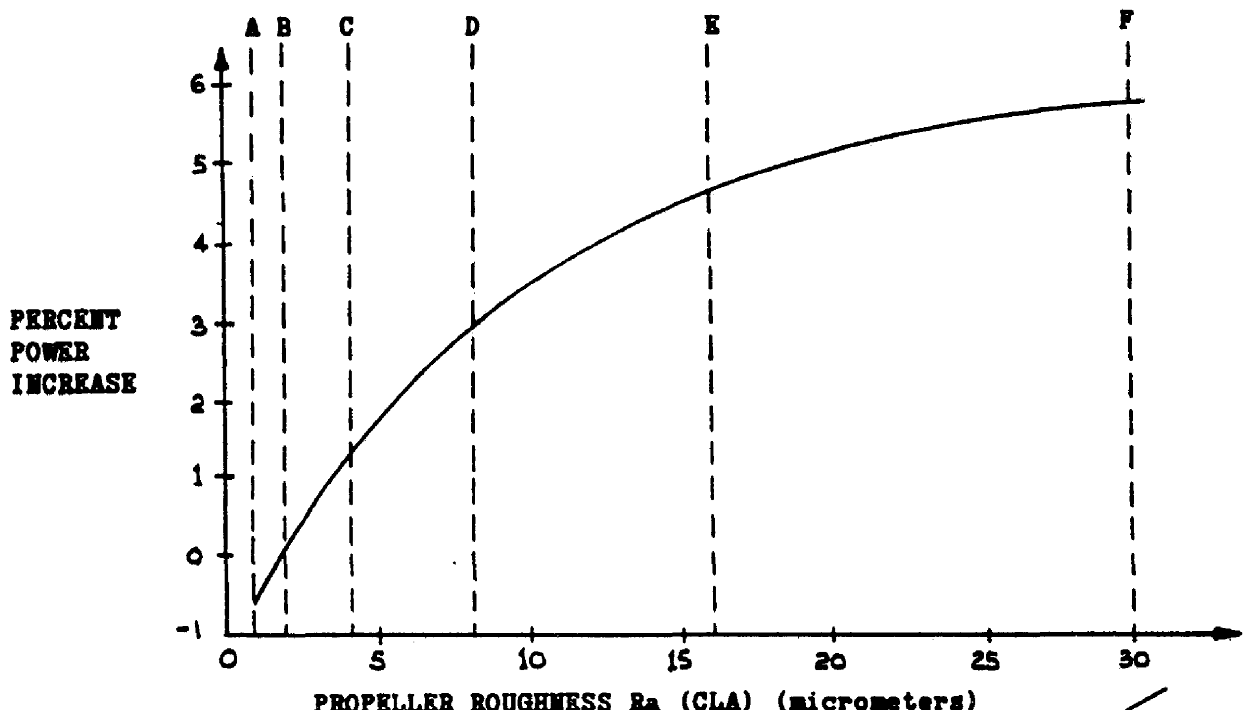

## 6. FUEL AND LUBE OIL PIPING

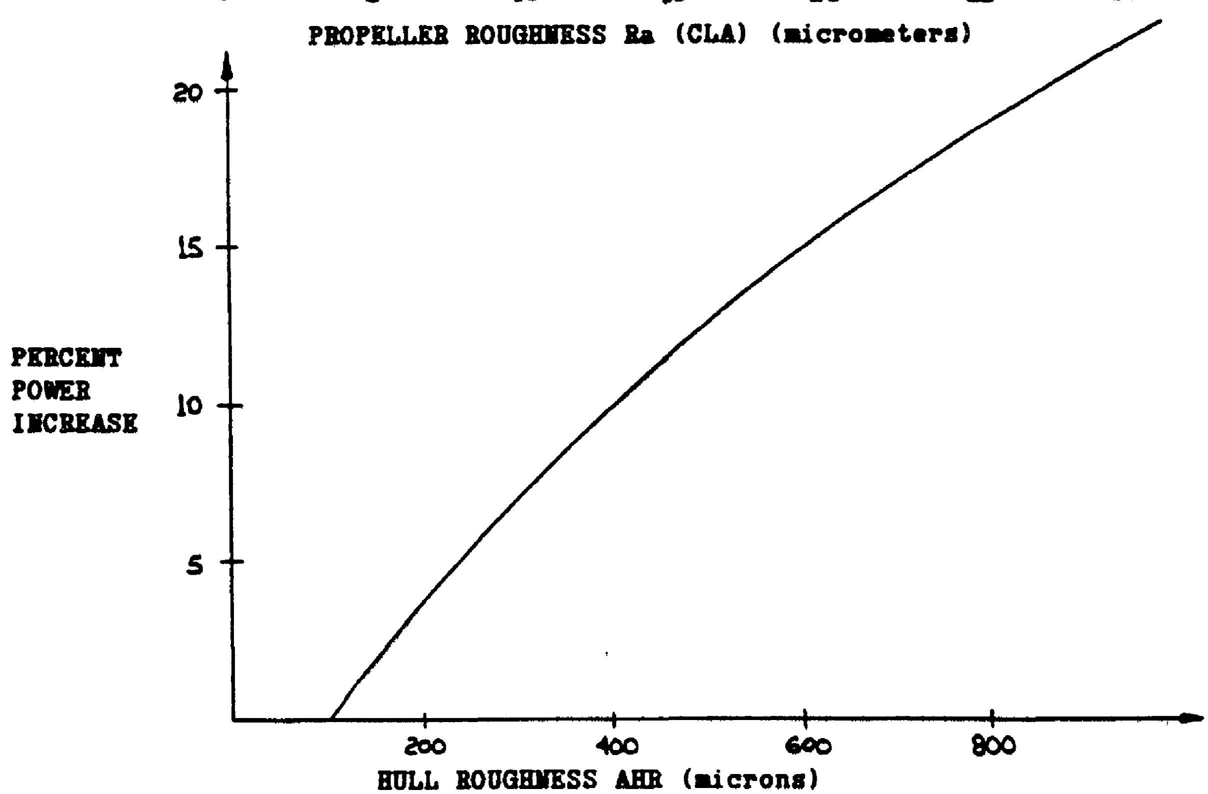
### a) Stop fuel and lube oil piping leaks

Repair all fuel oil and lube oil piping leaks Ensure all gasket and packing materials are in good shape and not leaking A fuel or lube leak of one drop per second (5800 drops per pound) wastes 2.5 tons per year.

TABLE 16.5

**TYPICAL POWER PENALTIES**
**FOR UNDERWATER HULL AND PROPELLER ROUGHNESS**



# TABLE 16.6

## DESCRIPTION OF PRE-MAINTENANCE HULL ROUGHNESS SURVEY AND ANALYSIS

1. Pre-maintenance hull roughness surveys shall be accomplished as follows:

a. Hull roughness data shall be taken with a BSRA hull roughness analyzer at a minimum of 100 locations (data points) evenly distributed over the ship's hull. To eliminate sample bias and to ensure a uniform survey, the location of data points shall be determined by dividing the ship length into ten equal sections and then specifying a minimum of ten locations appropriately spaced in each section.

b. Qualitative assessments of hull and paint condition shall be made at each location where hull roughness is taken.

c. An overall qualitative assessment of hull condition shall address hull fouling and hull and paint damage.

2. The pre-maintenance hull roughness survey and analysis report shall include:

a. Date and location of survey.

b. Ship characteristics, including information on previous drydocking and paint system.

c. Overall summary of results.

d. Description of how the survey was accomplished and location of data points.

e. Condition of the hull and roughness data for each data point.

f. Roughness histogram and average hull roughness values.

g. Detailed discussion of survey findings.

# TABLE 16.7

## COMPUTER BASED MODEL
## SHIPSHAPE

1. A computer based analysis model (SHIPSHAPE) can be used to compare alternative hull surface maintenance management systems on the basis of life cycle costs. The program requires the following data input.

   a. Ship age and remaining service life

   b. Speed

   c. Operating profile

   d. Fuel consumption characteristics

   e. Operating area of the ship

   f. Present hull condition

2. The model can be used to select coating types, application techniques, reconditioning techniques and quality control methods to predict life cycle costs. The model also provides estimates of potential fuel consumption and projected fuel savings.

## TABLE 16.8

## DESCRIPTION OF POST-MAINTENANCE HULL ROUGHNESS SURVEY AND ANALYSIS

1. Post-maintenance hull roughness surveys shall be accomplished as follows.

a. Hull roughness data shall be taken with a BSRA hull roughness analyzer at a minimum of 100 locations (data points) evenly distributed over the ship's hull. To eliminate sample bias and to ensure a uniform survey, the location of data points shall be determined by dividing the ship length into ten equal sections and then specifying a minimum of ten locations appropriately spaced in each section.

b. Qualitative assessments of hull and paint condition shall be made at each location where hull roughness is taken.

c. An overall qualitative assessment of hull condition shall address the quality of maintenance actions (such as water washing and sand or grit blasting) and the quality of coating application.

2. The post-maintenance hull roughness survey and analysis report shall include:

a. Date and location of survey.

b. Ship characteristics, including information on the current paint system.

c. Overall summary of results.

d. Description of how the survey was accomplished and location of data points.

e. Condition of the hull and roughness data for each data point.

f. Roughness histogram and average hull roughness values.

g. Detailed discussion of the results of maintenance actions and hull painting.

**TABLE 16.9**

**HULL CLEANING GUIDANCE**

1. The Fuel Conservation Worksheet provides a means to determine, at the earliest possible date, the need for underwater cleaning. The Chief Engineer shall collect data to complete the worksheet as soon as the ship has resumed normal operations after departing drydock.

2. It is assumed that hull cleaning will decrease fuel consumption by 5% unless additional information is available for a particular ship.

3. When actual speed at normal shaft horsepower decreases by 10% or shaft horsepower at normal speed increases by 10%, underwater hull cleaning is warranted if the cost of fuel saved will exceed the cost of underwater hull cleaning. Fuel savings can be calculated from the date of the fuel conservation study to the date of the next scheduled drydocking. When the factors in Part I of the worksheet exceed 10%, then underwater hull cleaning is warranted if the cost can be amortized per Part II.

**FUEL CONSERVATION WORKSHEET**

**PART I**

(A) Normal cruising speed at normal SHP: ________knots
(B) Actual speed made at normal SHP: ________knots.
(C) (A) - (B) = ________knots.
(D) (C)/(A) x (100) = ________knots.
(E) Normal SHP at normal cruising speed: ________SHP.
(F) Actual SHP at normal cruising speed: ________SHP.
(G) (F) - (E) = ________SHP.
(H) (G)/(E) x (100) = ________% increase.

---

Continue calculations for steam ships only:

(I) Normal HP steam chest pressure at cruising speed ________psi.
(J) HP steam chest pressure at cruising speed ________psi.
(K) (J) - (I) = ________psi.
(L) (J)/(K) x (100) = ________% increase.

If (D), (H) or (L) is greater than 10%, proceed to Part II.

## FUEL CONSERVATION WORKSHEET

## PART II

(A) Avg. price per barrel of fuel = $________.
(B) Avg. current underway fuel consumption/day = ________bbls.
(C) Cost of fuel/day (A) x (B) = $________.
(D) 5% fuel savings (C) x 0.05 = $________.
(E) Estimated number of days between projected hull cleaning and drydocking: ________.
(F) Money saved for accomplishing hull cleaning prior to drydocking: (D) x (E) = $________.
(G) Estimated cost of hull cleaning: $________.
(H) If (F) is greater than (G), hull cleaning is recommended at earliest opportunity.

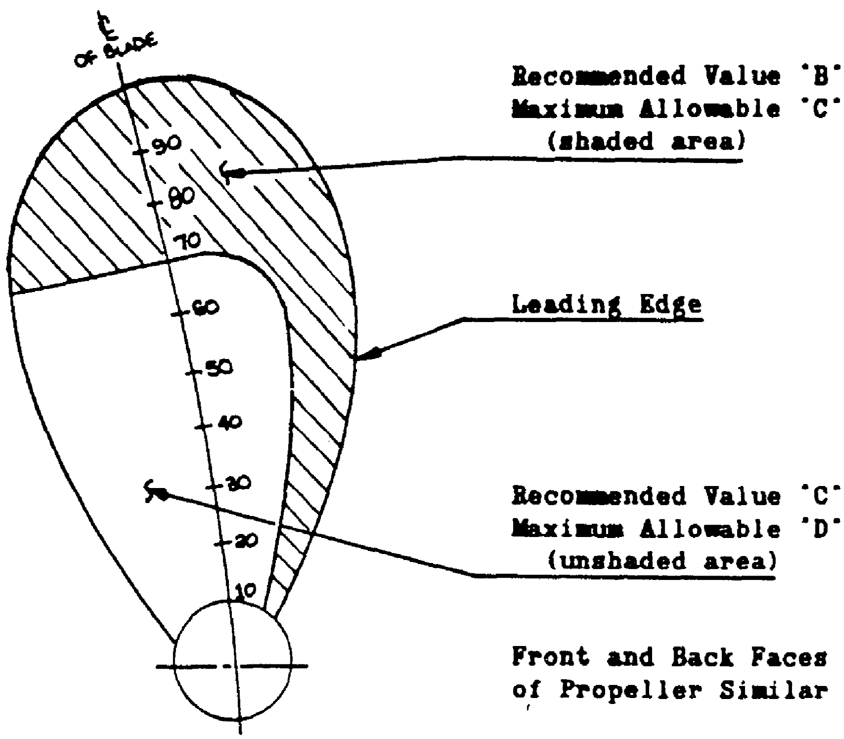
**TABLE 16.10**

**PROPELLER ROUGHNESS AND PROPELLER POLISHING**

1. Propeller Roughness. Significant ship's propulsion power losses may be caused by initial stages of roughening of the propeller between indices "B" and "E" on the Rupert Ships Propeller Roughness Comparator Gauge. This stage is usually reached within 6 months of polishing. When a propeller reaches "D" on the Rupert Ships Propeller Roughness Comparator Gauge, the Administrative Area Commander shall initiate propeller cleaning as soon as practical. This will normally occur within 6 months of undocking or the previous docking. Blades should, at this point, be restored to "B" condition on the Rupert Ships Propeller Roughness Comparator Gauge.

2. Propeller Polishing. Polishing shall include the forward and after surfaces of the propeller blade tips between .7 and 1.0 radius lines and the leading edge of the propeller blade over 0.2 of the blade width these areas shall be polished to a finish equal to the "B" condition of the Rupert Ships Propeller Roughness Comparator Gauge (a roughness average ($R_m$) of 76.8 microinch). The remainder of the propeller blades shall be polished to a finish equal to the "C" condition of the Rupert Ships Propeller Roughness Comparator Gauge (a roughness average of 188.0 microinch).

**RECOMMENDED LIMITS**
**FOR PROPELLER ROUGHNESS**
**(after removal of fouling)**




**NOMINAL ROUGHNESS (MICROMETRES)**

| Surface | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Ra | 1 | 2 | 4 | 8 | 16 | 30 |
| Rz | 6 | 12 | 24 | 48 | 96 | 180 |

(The above diagram is courtesy of Rupert & Co.)

# CHAPTER 17

## ENVIRONMENTAL PROTECTION

### 17.0 ENVIRONMENTAL PROTECTION

a. The Administrative Area Commander and the Chief Engineer shall comply with the provisions of COMSCINST 5090.2 (Disposal of Plastics, Medical and Other Waste in the Marine Environment), the USCG pollution control regulations contained in Title 33 of the CFR and OPNAVINST 5090.1A (Environmental Protection Program).

b. OPNAVINST 5090.2 (Management of Ozone Depleting Substances) requires that MSC promulgate policy for the management of shipboard ozone depleting substances. This policy is being developed and will be promulgated in the form of a COMSC instruction. Once promulgated, all action addressees shall comply with this instruction.

# CHAPTER 18 (R

## MAINTENANCE AND REPAIR (M&R) BUDGETING

### 18.0 MAINTENANCE AND REPAIR BUDGETING

a. Halfway through the fiscal year, the MSC Engineering Directors are required to update the current year M&R budget and revise or develop M&R budgets for future (budget) years. The years following the budget year consecutively are the budget year plus one and budget year plus two. During even numbered years, the Engineering Directors update the current year M&R budget and provide estimates for three budget years. During odd numbered years, the Engineering directorates update the current year M&R budget and provide estimates for the next two budget years.

b. The MSC Engineering Directors of COMSC, COMSCLANT and COMSCPAC are designated as funds administrators for the M&R budgets. This means that they provide management oversight and direction for M&R budget development, verifying the necessity and reasonableness of expenditures and monitoring expenditures against the budget.

### 18.1 MSC HEADQUARTERS RESPONSIBILITIES

MSC Headquarters Engineering Director will:

a. Act as funds administrator.

b. Designate an M&R Budget Coordinator responsible for liaison with the Comptroller (para. 18.3).

c. Update M&R budget preparation, managing and monitoring procedures.

d. Ensure that division directors and branch heads with budget preparation and management responsibilities, develop, update, revise and monitor M&R budgets and submit them to the M&R Budget Coordinator using Table 18.1 - Budget Justification Sheet Per Ship and Table 18.2 - Budget Justification Sheet Per Subprogram (paras. 18.4 and 18.6).

### 18.2 ADMINISTRATIVE AREA COMMANDER'S DUTIES

The COMSCLANT and COMSCPAC Engineering Director will:

a. Act as funds administrators.

b. Designate an M&R Budget Coordinator responsible for liaison with their command's Comptroller (para. 18.3).

c. Recommend revisions to M&R budget preparation, managing and monitoring procedures.

d. Ensure that division directors and branch heads prepare, update and revise M&R budgets and submit them to their M&R Budget Coordinator using Table 18.1 - Budget Justification Sheet Per Ship and Table 18.2 - Budget Justification Sheet Per Subprogram (paras. 18.4 and 18.6).

**18.3 M&R BUDGET COORDINATOR'S DUTIES**

The M&R Budget Coordinator will manage and coordinate the flow of M&R budget information between the funds administrator and the division directors and branch heads and between the Comptroller and the funds administrator. The M&R Budget Coordinator must route all correspondence and reports (paras. 18.4 and 18.6) to the Comptroller or outside M&R Budget Coordinator's command through the funds administrator.

**18.4 DEVELOPING AND REVISING M&R BUDGETS**

The COMSC, COMSCLANT and COMSCPAC Engineering division directors and branch heads will develop and revise M&R budgets as follows.

a. Obtain information for budget justification. Budget submissions require detailed supporting information. This is referred to as justification. Since historical M&R cost information provides a sound basis from which to project future M&R costs, division directors and branch heads will collect historical M&R cost information from at least the previous two fiscal years for each ship or class of ships. This information will be evaluated for applicability to the budget years and the cost (adjusted to current year dollars) used in budget justification. This information will include:

(1) Availability bid breakdowns

(2) Voyage repair availability cost information

(3) Service orders

(4) M&R material costs

(5) Shipboard M&R overtime records

b. Develop budget justification for Major Availabilities (Overhaul, Drydocking, Recertification and Midterm Availabilities), Accounts 6601 and 6602. Division directors and branch heads will use bid breakdowns for past major availabilities to estimate the cost of accomplishing recurring planned work items. Work items and their associated projected cost must be entered on Table 18.1, columns (7), (9) and (10), by the work item series number in the work package (i.e., 100 series, 200 series, 300 series, etc.).

c. Develop budget justification for Voyage Repairs, Account 6603. Division directors and branch heads will use cost information from past voyage repair availability work packages to estimate the cost of accomplishing future voyage repairs on Table 18.1, columns (7), (9) and (10). This estimate will include the cost for the recurring type of work which is identified in past voyage repair work packages and the cost for other M&R which will be accomplished through a work package.

d. Develop budget justification for Service Orders, Account 6630. Division directors and branch heads will use historical service order costs to project future costs on Table 18.1, columns (7), (9) and (10). Costs for the types of service orders which are not likely to be repeated will be omitted. Those service orders for which no historical cost data are available will be estimated, using past cost information from similar type service orders.

e. Develop budget justification for Material Requests, Account 6635. Division directors and branch heads will use historical material request costs to project future costs on Table 18.1, columns (7), (9) and (10). Costs for the types of material purchases which are not likely to be repeated will be omitted. Those material purchases for which no historical cost data are available will be estimated, using past cost information from similar type purchases.

f. Develop budget justification for Programmed Alterations, Account 6605. Division directors and branch heads will list each alteration and associated programmed funds on Table 18.1, columns (7), (9) and (10). Usually, the total of all programmed alterations does not exceed 20% of the amount reflected in Table 18.1, Accounts 6601 + 6602 + 6603. If alterations are anticipated to exceed this figure, explanation of their estimated cost and necessity will be attached to Table 18.1. Programmed alterations are defined in COMSCINST 4700.2F, Administrative Procedures for the Alteration, Maintenance and Repair of MSC Ships.

g. Develop budget justification for Unprogrammed Alterations, Account 6606. Division directors and branch heads will record the total cost of unprogrammed alterations on Table 18.1, columns (7), (9) and (10). Usually, the total does not exceed 2% of the amount reflected in Table 18.1, Accounts 6601 + 6602 + 6603. If, due to the nature of planned availabilities, the cost of emergent alterations is anticipated to exceed this figure, explanation of their estimated cost and necessity will be attached to Table 18.1. Unprogrammed alterations are defined in COMSCINST 4700.2F, Administrative Procedures for the Alteration, Maintenance and Repair of MSC Ships.

h. Develop budget justification for Shipboard M&R Overtime, Account 6142 or 6143. For those ships operated under the provisions of the Office of Management and Budget Circular No. A-76, Performance of Commercial Activities, division directors and branch heads will use historical records of past reimbursable overtime (Account 6142) to project future overtime costs on Table 18.1, columns (7), (9) and (10). For those ships which are not contract operated under the provisions of Circular A-76, division directors and branch heads will use historical records of past M&R overtime (Account 6143) to project future overtime costs on Table 18.1, columns (7), (9) and (10). The impact of manning scale changes, the ship's operating schedule and ship's force M&R requirements will be assessed when projecting overtime costs.

i. Update the current year M&R budget. Division directors and branch heads will use current year figures provided by the M&R Budget Coordinator to prepare Table 18.1, columns (2) through (4). Division directors and branch heads will prepare Table 18.1, column (5), identifying and estimating the expenses for the remainder of the fiscal year. Explanations will accompany midyear projected expenses which deviate from the budgeted amount by more than 10%. Division directors and branch heads will prepare Table 18.1, column (5) according to the procedures in paragraphs 18.4a through 18.4i with the following additional considerations.

(1) Accounts 6601, 6602, 6603, 6635 on Table 18.1, column (5), will identify that work which has not yet been accomplished and estimate work package addendums which are likely to be issued.

(2) Account 6605, Programmed Alterations, on Table 18.1, column (5), will identify alterations which have not yet been accomplished and their programmed funds.

(3) Account 6606, Unprogrammed Alterations, on Table 18.1, column (5), will reflect the low probability of accomplishing unprogrammed alterations for the remainder of the fiscal year since most current fiscal year work packages are either under development or complete.

(4) Account 6142 or 6143, Overtime, on Table 18.1, column (5), will project the cost for reimbursable or shipboard M&R overtime for the remainder of the fiscal year.

j. Calculate account totals. For each required submission, the division directors and branch heads will total all accounts per ship on Table 18.1. These totals will be added to the account totals for all ships within the same subprogram and entered on Table 18.2 for each ship covered under each subprogram.

## 18.5 FACTORS AFFECTING PROJECTED M&R COSTS

Division directors and branch heads will adjust historical cost data to reflect those factors which may impact future M&R costs. These factors include:

a. Anticipated competitive bidding for industrial assistance.

b. Alterations which impact maintenance requirements.

c. Changes in regulatory requirements.

d. Availability accomplishment in Ship Repair Facility (SRF) or commercial shipyard.

e. Inflation occurring from the time historical data was recorded until the current year.

f. Estimates for nonreimbursed M&R and alterations for contract operated ships and for ships operated under the provisions of the Office of Management and Budget Circular No. A-76, Performance of Commercial Activities.

## 18.6 MANAGING AND MONITORING M&R BUDGETS

Managing and monitoring M&R budgets require close coordination among the Comptroller and the Engineering directorate's funds administrator, M&R Budget Coordinator, division directors and branch heads. The M&R Budget Coordinator centralizes budget management. Budget management includes:

a. Preparing and distributing standard reports. These reports are summarized on Table 18.3 and include:

(1) Fiscal Year Approved Budget Report. At the beginning of each fiscal year, the M&R Budget Coordinator will provide approved budget figures for each subprogram and each ship to the funds administrators, division directors and branch heads. This information will be provided in the format of Tables 18.1 and 18.2.

(2) Expense Reports. By the twentieth day of each month, the M&R Budget Coordinator will prepare an Expense Report showing for the previous month on a per ship per account basis the amount:

(a) Budgeted for the year

(b) Budgeted for the month

(c) Expensed, obligated and committed during the past month

(d) Over or under budget for the month (in dollars and by percent)

(e) Budgeted, expensed, obligated and committed year to date

(f) Over or under budget for the year to date (in dollars and by percent)

The M&R Budget Coordinator will provide this report to the funds administrator, division directors and branch heads. Division directors and branch heads will verify the accuracy of the data on this report and will inform the M&R Budget Coordinator of any expenses or projected expenses which deviate or are planned to deviate from budgeted funds. Explanations will accompany midyear projected expenses which deviate from the budgeted amount by more than 10%. The COMSC M&R Budget Coordinator will obtain copies of the COMSCLANT and COMSCPAC Expense Reports from the Comptroller and submit them to the COMSC Engineering directorate's funds administrator to evaluate and verify the data provided.

(3) Midyear Review Reports. At the midyear budget review period (approximately 5 months into the current fiscal year), the M&R Budget Coordinator will obtain current and budget year data from the Comptroller and provide them to the funds administrator, division directors and branch heads. This information will be provided in the format of Tables 18.1 and 18.2. Division directors and branch heads will prepare Tables 18.1 and 18.2 according to paragraphs 18.4a through 18.4i and submit them to the M&R Budget Coordinator. The M&R Budget Coordinator will submit these reports to the Comptroller through the funds administrator.

(4) Major Month Report. At the midyear budget review period, division directors and branch heads will identify the major month during which major availabilities are scheduled or will be scheduled on the form (M&R Days Allocation by Ship by Month) provided in COMSCINST 7130.1K, MSC Budgeting Under the Navy Industrial Fund. If availabilities span more than 1 month, then the month when the availability begins will be identified as the major month. Division directors and branch heads will submit this form to their M&R Budget Coordinator who will forward it to the Comptroller through the funds administrator. The COMSC Comptroller will forward Area Command major month identification to the COMSC M&R Budget Coordinator for verification. COMSC division directors and branch heads will inform the M&R Budget Coordinator of changes

in availability start dates which deviate from the major month identified. The M&R Budget Coordinator will forward this information to the Comptroller through the funds administrator.

b. Monitoring budgets for overexpenditures and anticipated overexpenditures. Division directors and branch heads will check for funds availability before recommending their authorization for M&R expenditures. This can be accomplished by reviewing the monthly Expense Reports. If the division director or branch head cannot determine funds availability from this report, then the division director or branch head will request a determination from the M&R Budget Coordinator. If current or projected expenses exceed or are likely to exceed budgeted funds, the M&R Budget Coordinator will request through the funds administrator that the Comptroller reprogram funds within a subprogram. If funds are not available within the subprogram, the M&R Budget Coordinator will request that the COMSC Comptroller reprogram funds from outside the subprogram.

c. Submitting and reviewing reports. The M&R Budget Coordinator will submit the data contained in the Midyear Review Reports (paras. 18.6a(3) and 18.6a(4)) to the command's Comptroller. The COMSC M&R Budget Coordinator will obtain copies of the COMSCLANT and COMSCPAC Midyear Review Reports from the COMSC Comptroller and submit them to the COMSC Engineering directorate's funds administrator. If the COMSC Engineering Director disagrees with the reports' data, he will verify data accuracy and reasonableness with the Area Commander, inform the Area Commander of the discrepancy and change the report to reflect the new figure. The COMSC M&R Budget Coordinator will return the Area Commander's Midyear Review Reports with recommended changes to the COMSC Comptroller through the funds administrator.

# BUDGET JUSTIFICATION SHEET PER SHIP
## USNS ____________________

ESTIMATED IN THOUSANDS OF DOLLARS

| | CURRENT YR BUDGETED | CURRENT YR EXPENDED | CURRENT YR REMAINING | CURRENT YR PROJECTED | BUDGET YR PREV. REQ. | BUDGET YR REQUEST | BUDGET YR+1 PREV. REQ. | BUDGET YR+1 REQUEST | BUDGET YR+2 REQUEST |
|---|---|---|---|---|---|---|---|---|---|
| ACCT 6601 | | | | | | | | | |
| 000/GENERAL REQTS | | | | | | | | | |
| 100/HULL STRUCTURES | | | | | | | | | |
| 200/MACH'Y PROPULSION | | | | | | | | | |
| 300/ELECTRICAL | | | | | | | | | |
| 400/COMM., NAVAIDS | | | | | | | | | |
| 500/MACH'Y, AUX. | | | | | | | | | |
| 600/OUTFIT, HAB | | | | | | | | | |
| 800/HVAC | | | | | | | | | |
| 1000/UNREP | | | | | | | | | |
| TOTAL ACCT 6601 | | | | | | | | | |
| ACCT 6602 900/DRYDOCKING | | | | | | | | | |
| ACCT 6603 VOYAGE REPAIRS | | | | | | | | | |
| ACCT 6630 SERVICE ORDERS | | | | | | | | | |
| ACCT 6635 MAT'L REQUESTS | | | | | | | | | |
| ACCT TOTALS 6601+6602+6603+ 6630+6635 | | | | | | | | | |
| ACCT 6605 PROGRAMMED ALTS | | | | | | | | | |
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| | | | | | | | | | |
| TOTAL ACCT 6605 | | | | | | | | | |
| ACCT 6606 UNPROGRAMMED ALTS | | | | | | | | | |
| ACCT 6142 OR 6143 O.T. | | | | | | | | | |
| ACCT TOTALS 6601+6602+6603+ 6630+6635+6605 6606+6143 | | | | | | | | | |
| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 | COLUMN 9 | COLUMN 10 |

Effective Date ____________________

Table 18.1

# BUDGET JUSTIFICATION SHEET PER SUBPROGRAM
## SUBPROGRAM ______________________

ESTIMATED IN THOUSANDS OF DOLLARS

| ACCT TOTALS PER SHIP / SHIP NAME | CURRENT YR BUDGETED | CURRENT YR EXPENDED | CURRENT YR REMAINING | CURRENT YR PROJECTED | BUDGET YR PREV. REQ. | BUDGET YR REQUEST | BUDGET YR+1 PREV. REQ. | BUDGET YR+1 REQUEST | BUDGET YR+2 REQUEST |
|---|---|---|---|---|---|---|---|---|---|
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| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 | COLUMN 9 | COLUMN 10 |

Effective Date ______________

Table 18.2

**REPORT SUBMISSION**

| REPORT TITLE | WHEN SUBMITTED | PROVIDER/ PREPARER | RECEIVER |
|---|---|---|---|
| Fiscal Year Approved Budget Report | FY start | 1 | 2,3 |
| Expense Report | 20th day of month | 1 | 2,3 |
| Budget Justification Report/Ship | Midyear budget review period | 2 | 1,3 |
| Budget Justification Sheet/Subprogram | Midyear budget review period | 2 | 1,3 |
| Major Month Report | Midyear budget review period | 2 | 1,3 |

1 - M&R Budget Coordinator
2 - Division directors/branch heads
3 - Funds Administrator

**NOTE: The M&R Budget Coordinator must route all correspondence and reports to the Comptroller or outside the M&R Budget Coordinator's command through the funds administrator.**

**TABLE 18.3**

# CHAPTER 19 (A

## ENGINEERING READINESS

### 19.0 ENGINEERING READINESS

Engineering readiness (ENGREAD) messages will be issued periodically to keep the MSC Force current with changing engineering practices and safety procedures. ENGREADs will not focus on ship unique maintenance problems. ENGREADs will address class problems, fire fighting equipment engineering maintenance programs and EOMM updates.

### 19.1 ENGREAD FILING

ENGREADs are numbered sequentially in order of issuance. An index listing the date time group, subject and ENGREAD sequence number will be maintained on Table 19.1. ENGREADs issued after ENGREAD 024 will be recorded on the index and filed sequentially after the index.

### 19.2 MSC HEADQUARTERS RESPONSIBILITIES

MSC Headquarters will issue all ENGREADs.

### 19.3 ADMINISTRATIVE AREA COMMANDER'S DUTIES

The Administrative Area Commander will verify that each ship implements the procedures and programs prescribed by the ENGREADs and file all ENGREADs according to paragraph 19.1.

### 19.4 CHIEF ENGINEER'S DUTIES

The Chief Engineer will implement the procedures and programs prescribed by the ENGREADs and file all ENGREADs according to paragraph 19.1.

## ENGREAD INDEX

| DATE/TIME/GROUP | SUBJECT | ENGREAD NO |
|---|---|---|
| COMSC 101944ZAPR87 | EOMM, CH-31 | 001 |
| COMSC 301611ZAPR87 | LO/HYD OIL SAMPLG | 002 |
| COMSC 041814ZMAY87 | EMER CAS PWR SYS | 003 |
| COMSC 272002ZJUL87 | DEACTIV OF TAFES | 004 |
| COMSC 041915ZMAR88 | TAO 187 LO/HYD PROC | 005 |
| COMSC 192002ZMAY88 | IMPLEMENT SAMM | 006 |
| COMSC 092300ZJUN88 | LO PURIF OPER | 007 |
| COMSC 212135ZSEP88 | WESTFALIA PURIF | 008 |
| COMSC 180240ZNOV88 | BLR FDWTR MGMT | 009 |
| COMSC 212220ZNOV88 | NOAP LO MGMT | 010 |
| COMSC 152206ZJUN89 | MAR SANIT SYS | 011 |
| COMSC 021852ZJUN89 | OWS/OCM | 012 |
| COMSC 042018ZAUG89 | TAO FULL PWR TRIAL | 013 |
| COMSC 281228ZJUL89 | CABLE PENET | 014 |
| COMSC 302143ZAUG89 | PIPE/DUCT PENET | 015 |
| COMSC 241625ZJAN91 | DIES ENG FUEL INJ | 016 |
| COMSC 022325ZMAR90 | DIES ENG CRKSHFT | 017 |
| COMSC 291522ZMAY90 | TAO LO PURIF | 018 |
| COMSC 032010ZMAY91 | PORTABLE EXTING | 019 |
| COMSC 232227ZJUL91 | TAO RAS AIR FLASK | 020 |
| COMSC 221338ZJUL91 | FOAM SAMPLING | 021 |
| COMSC 271755ZFEB92 | PURGE DFM STM SHIP | 022 |
| COMSC 181507ZSEP92 | CALIB OF METERS | 023 |
| COMSC 061517ZJAN93 | EVAP OP/CLNING | 024 |

TABLE 19.1