

# **OIL SHIP WASTE OFFLOAD BARGE (SWOB)**

## **OPERATION & MAINTENANCE**

**NAVFAC MO-909  
AUGUST 1979**

**DEPARTMENT OF THE NAVY  
NAVAL FACILITIES ENGINEERING COMMAND  
200 STOVALL STREET  
ALEXANDRIA, VA. 22332**

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## ABSTRACT

OIL SWOBs numbered 1 through 42 are described in detail. Step-by-step instructions for loading and offloading oily waste cargoes are prescribed along with procedures for the operation of various subsystems such as level indicators and alarms. Preventive and corrective maintenance information includes warnings and helpful tips on unusual problems that can arise. An addendum to the manual features changes to all sections, as required, to extend its application to OIL SWOBs numbered 56 through 60.

## FOREWORD

The Oil SWOB has become a key element in the Navy's effort to eliminate overboard discharge of oily wastes. Routine shipboard procedures such as tank stripping, tank washing, deballasting and pumping bilges are all sources of oily waste and potential environmental problems because without alternate means of disposal, oily waste is usually pumped overboard. Although the quantities of oil may appear slight in some cases, the environmental effects are cumulative and the damage is often long-lasting, especially where ships are berthed.

The primary purpose of the Oil SWOB is to collect oily waste from U.S. Navy ships in port or at anchor and transfer the waste to a shoreside terminal for treatment, reclamation or disposal. The information contained in this manual will provide port managers and operators with indepth knowledge on the Oil SWOB's operation and maintenance characteristics, as well as provide guidelines for preventative and corrective maintenance procedures.

There are two classes of SWOBs barges now serving U.S. Navy ships: oil and sewage barges. This manual addresses only Oil SWOBs. At no time should Oil SWOBs be used to receive ships sewage.

Recommendations or suggestions for modification, or additional information that will improve the publication and motivate its use, are invited and should be submitted through appropriate channels to:

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This manual has been reviewed and approved in accordance with SecNavInst 5600.16A, and is certified as an official publication of this Command.



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## CONTENTS

	<u>Page</u>
Chapter 1. INTRODUCTION .....	1-1
1.1 MOTIVATION .....	1-1
1.2 PURPOSE OF THE SWOB .....	1-1
1.3 CARGO CARRYING LIMITATIONS .....	1-2
1.4 PURPOSE OF THE MANUAL .....	1-2
1.5 ADDENDUM TO MANUAL .....	1-2
Chapter 2. DESCRIPTION .....	2-1
2.1 GENERAL ARRANGEMENT .....	2-1
2.1.1 Hull Characteristics .....	2-1
2.1.2 Tank Configuration .....	2-1
2.1.3 Void Space Configuration .....	2-5
2.1.4 Deckhouse .....	2-5
2.1.5 Pump Room .....	2-5
2.1.6 Forward Storage Compartment .....	2-5
2.2 CARGO PIPING LAYOUT .....	2-5
2.2.1 Description of Loading .....	2-7
2.2.2 Description of Offloading .....	2-7
2.2.3 Effects of Inclination During Offloading .....	2-8
2.2.4 Description of Transfer Mode .....	2-8
2.3 CARGO HANDLING COMPONENTS .....	2-8
2.3.1 Cargo Pumps .....	2-8
2.3.2 Electrically Operated Cargo Valves .....	2-12
2.3.3 Filling/Discharge Station Valves .....	2-14
2.4 LEVEL INDICATOR, ALARM AND PUMP CUT-OFF SYSTEMS .....	2-14
2.4.1 Principle of Operation .....	2-14
2.4.2 Power Sources .....	2-19
2.4.3 Effects of Inclination and Waves .....	2-19
2.4.4 Other Means of Measurement .....	2-21
2.5 DESCRIPTION OF POWER SYSTEM .....	2-21
2.5.1 Power Distribution .....	2-21
2.5.2 120v AC System .....	2-22
2.5.3 24v DC System .....	2-22
2.5.4 Diesel Engine .....	2-22
2.5.5 Generator .....	2-23
2.6 DESCRIPTION OF SAFETY AND NAVIGATION EQUIPMENT .....	2-23

CONTENTS (Continued)

	<u>Page</u>
2.6.1 Lighting System .....	2-23
2.6.2 Navigation Lights .....	2-23
2.6.3 Blower .....	2-23
2.6.4 Sacrificial Anodes .....	2-23
2.6.5 Fendering .....	2-24
2.6.6 Spill Coaming .....	2-24
2.6.7 Fire Extinguishers .....	2-24
2.6.8 Life Rings .....	2-24
2.6.9 Bilge Pump .....	2-24
2.6.10 Warning Signals .....	2-24
 Chapter 3. OPERATION .....	 3-1
3.1 GENERAL OPERATING GUIDELINES .....	3-1
3.2 HANDLING PROCEDURES .....	3-3
3.2.1 Towing .....	3-3
3.2.2 Waterbody Restrictions .....	3-3
3.3 LOADING PROCEDURE .....	3-3
3.4 OFFLOADING PROCEDURE .....	3-7
3.5 OPERATION OF LEVEL INDICATORS AND LEVEL ALARM .....	3-9
3.5.1 Startup Procedure .....	3-9
3.5.2 Securing Procedure .....	3-10
3.6 POWER SYSTEM OPERATION .....	3-10
3.6.1 Generator Operation .....	3-10
3.6.2 Shore Power Operation .....	3-14
 Chapter 4. PREVENTIVE MAINTENANCE .....	 4-1
4.1 DIESEL GENERATOR .....	4-1
4.1.1 Engine Oil .....	4-1
4.1.2 Oil Filter .....	4-1
4.1.3 Coolant .....	4-1
4.1.4 Hoses .....	4-1
4.1.5 Radiator .....	4-1
4.1.6 Oil Drip Pan .....	4-3
4.1.7 Fuel Tank .....	4-3
4.1.8 Strainer and Filter .....	4-3
4.1.9 Air Cleaner .....	4-3
4.1.10 Air Box .....	4-3
4.1.11 Ventilation System .....	4-4
4.1.12 Blower Screen .....	4-4
4.1.13 Starting Motor .....	4-4
4.1.14 Batteries .....	4-4
4.1.15 Tachometer Drive .....	4-4
4.1.16 Linkages/Trip .....	4-4

CONTENTS (Continued)

	<u>Page</u>
4.1.17 Tune-Up .....	4-4
4.1.18 Drive Belts .....	4-4
4.1.19 Overspeed Governor .....	4-4
4.1.20 Shut-Down System .....	4-4
4.1.21 Generator Bearing .....	4-4
4.1.22 Insulation and Brushes .....	4-4
4.1.23 Ether System .....	4-5
4.1.24 Lagging .....	4-5
4.2 CARGO PUMPS .....	4-5
4.2.1 Pump and Motor Bearings .....	4-5
4.2.2 Pump Seal .....	4-5
4.2.3 Relief Valve .....	4-6
4.2.4 Pump Foundation .....	4-6
4.2.5 Pump, Motor, and Pipe Supports .....	4-6
4.2.6 Hose Couplings .....	4-6
4.2.7 Cargo Pump Drive Belt .....	4-6
4.2.8 Electrical Insulation .....	4-6
4.2.9 Strainer .....	4-6
4.3 CARGO VALVES .....	4-6
4.3.1 Valve Glands .....	4-6
4.3.2 Valve Operation, Manual/Auto .....	4-7
4.3.3 Hose Connector Lubrication .....	4-7
4.4 CONTROL SYSTEMS .....	4-7
4.4.1 Air Compressor and Filter Blowdown .....	4-7
4.4.2 Air Compressor Suction Filter .....	4-7
4.4.3 Calibration Check .....	4-7
4.4.4 Alarm Operation and Light Check .....	4-7
4.4.5 Nitrogen Bottle Check .....	4-7
4.4.6 Wiring .....	4-10
4.4.7 Power Panels and Interlock .....	4-10
4.4.8 Emergency Lantern .....	4-10
4.4.9 Battery Charge .....	4-10
4.5 MISCELLANEOUS .....	4-10
4.5.1 Blower .....	4-10
4.5.2 Safety Equipment Check .....	4-10
4.5.3 Deck Gear Lubrication .....	4-10
4.5.4 Tanks, Voids and Vents .....	4-10
4.5.5 Anode Protection .....	4-12
4.5.6 Paint Inspection .....	4-12
 Chapter 5. CORRECTIVE MAINTENANCE .....	 5-1
5.1 DIESEL ENGINE - WILL NOT START .....	5-1
5.1.1 Engine Will Not Rotate or Low Cranking Speed .....	5-1
5.1.2 No Fuel .....	5-1

CONTENTS (Continued)

	<u>Page</u>
5.1.3 Emergency Trip .....	5-1
5.1.4 Low Compression .....	5-1
5.2 DIESEL ENGINE - ABNORMAL OPERATION .....	5-4
5.2.1 Uneven Running or Frequent Stalling .....	5-4
5.2.2 Lack of Power .....	5-4
5.2.3 Detonation or Pre-Ignition .....	5-4
5.3 DIESEL ENGINE - LOW OIL PRESSURE .....	5-5
5.3.1 Lubricating Oil .....	5-5
5.3.2 Pressure Gauge .....	5-5
5.3.3 Poor Circulation .....	5-5
5.3.4 Oil Pump .....	5-5
5.4 DIESEL ENGINE - HIGH COOLANT TEMPERATURE .....	5-5
5.4.1 Coolant .....	5-5
5.4.2 Insufficient Heat Transfer .....	5-5
5.4.3 Poor Circulation .....	5-5
5.5 DIESEL ENGINE - LOW COOLANT TEMPERATURE .....	5-6
5.5.1 Improper Circulation .....	5-6
5.5.2 Leaking Thermostat Seal .....	5-6
5.6 DIESEL ENGINE - SMOKEY EXHAUST .....	5-6
5.6.1 Black or Gray Smoke .....	5-6
5.6.2 Blue Smoke .....	5-6
5.6.3 White Smoke .....	5-6
5.7 GENERATOR - IMPROPER OUTPUT VOLTAGE .....	5-7
5.7.1 No Voltage at No-Load .....	5-7
5.7.2 Low Voltage or Low Frequency at No-Load .....	5-7
5.7.3 Dropping Voltage with Load .....	5-7
5.8 GENERATOR - VIBRATION .....	5-7
5.8.1 Vibration with No Load .....	5-7
5.8.2 Vibration with Load .....	5-7
5.9 GENERATOR - OVERHEATING .....	5-7
5.9.1 Bearing Overheating .....	5-7
5.9.2 Stator Overheating .....	5-7
5.10 CARGO PUMPS - REDUCED DISCHARGE .....	5-7
5.10.1 Loss of Suction .....	5-7
5.10.2 Improper Operation .....	5-7
5.10.3 Pump Failure .....	5-8
5.10.4 Relief Valve .....	5-8
5.10.5 Incorrect Rotation or Electrical Output .....	5-8
5.10.6 Inclination .....	5-8
5.11 CARGO PUMPS - EXCESSIVE WEAR .....	5-8
5.11.1 Belt Wear .....	5-8
5.11.2 Seal Leakage .....	5-8
5.11.3 Vane Wear .....	5-8
5.12 CARGO PUMPS - NOISE AND VIBRATION .....	5-9
5.13 CARGO VALVE - JAMMED .....	5-11
5.13.1 Jammed Under Pressure .....	5-11



CONTENTS (Continued)

	<u>Page</u>
5.13.2 Valves Inoperable .....	5-11
5.14 CARGO VALVE - LEAKAGE .....	5-11
5.14.1 Valve Seat Leakage .....	5-11
5.14.2 Valve Gland Leakage .....	5-11
5.15 VALVE ACTUATOR - INOPERATIVE .....	5-12
5.15.1 Handwheel Position Incorrect .....	5-12
5.15.2 Improper Electrical Output .....	5-12
5.15.3 Safety Shut-Off Switch Inoperable .....	5-12
5.15.4 Improper Limit Switch Setting .....	5-12
5.16 VALVE ACTUATOR - HUMS OR STALLS .....	5-13
5.16.1 Excessive Torque .....	5-13
5.16.2 Improper Electrical Output .....	5-13
5.17 VALVE ACTUATOR - IMPROPER POSITION .....	5-13
5.17.1 Improper Limit Switch Setting .....	5-13
5.17.2 Jamming .....	5-13
5.18 LEVEL INDICATOR - INOPERATIVE .....	5-13
5.18.1 All Indicators Inoperative - Battery Mode (24v DC) .....	5-13
5.18.2 All Indicators Inoperative - Generator/Shore Power Mode (120v AC) .....	5-13
5.18.3 One or More Indicators Inoperative - Either Mode .....	5-14
5.19 LEVEL INDICATOR - INACCURATE .....	5-14
5.19.1 Indicates Higher Than Actual Tank Level .....	5-14
5.19.2 Indicates Lower Than Actual Tank Level .....	5-15
5.20 LEVEL ALARM - INOPERATIVE .....	5-15
5.20.1 Air and Electrical System .....	5-15
5.20.2 Pressure Switches - High Level Alarm .....	5-15
5.20.3 Pressure Switch - Low-Level Alarm .....	5-16
5.20.4 Electrical Control Circuit Fault (24v DC) ...	5-16
5.21 LEVEL ALARM - ERRATIC OPERATION .....	5-16
5.21.1 Intermittent Circuit .....	5-16
5.21.2 Low or Irregular Air Pressure .....	5-16
5.21.3 Waves or Listing .....	5-17
5.22 LOW-LEVEL PUMP CUTOFF - INOPERATIVE .....	5-17
5.22.1 Mode Switch .....	5-17
5.22.2 Air and Electrical System .....	5-17
5.22.3 Pressure Switch - Low-Level Pump Cutoff .....	5-17
5.22.4 Electrical Control Circuit Fault (120v AC) ..	5-17
5.23 PUMP-MOTOR - INOPERATIVE .....	5-17
5.24 SWOB BARGE DOCKING PLAN .....	5-18
ADDENDUM. OIL SWOB NUMBERS 56 THROUGH 60 .....	A-1

## FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
Figure 1-1	- Ships Waste Offload Barge (SWOB) Under Tow .....	1-1
2-1	- Layout of Ship Waste Offloading Barge (SWOB) .....	2-2
2-2	- Tank and Void Arrangement .....	2-3
2-3	- Tank Capacity Curves .....	2-4
2-4	- Piping Arrangement .....	2-6
2-5	- SWOB Loading Inclinations .....	2-9
2-6	- Cargo Pump and Motor - Starboard Side .	2-10
2-7	- Oil SWOB Pump Capacity Curves .....	2-11
2-8	- Tank Level Indicator and Cargo Valve Position Lights .....	2-13
2-9	- Level Indicator Principle .....	2-15
2-10	- Internal Control Panel Layout .....	2-16
2-11	- Block Diagram of Level Indicator, Alarm and Pump Cut-Off System .....	2-17
2-12	- Arrangement of Alarm Panel Lights .....	2-20
3-1	- Electrical Bonding Connection Between Vessel and Dock .....	3-5
3-2	- Emergency Shutoff Reset Cam for Diesel .....	3-11
4-1	- Cross Section of 3-Way Cargo Valve ....	4-8
4-2	- Cross Section of 2-Way Cargo Valve ....	4-8
4-3	- Location of Rotometers .....	4-9
4-4	- Location of Pressure Flask Gauge .....	4-11
4-5	- Anode Position or Starboard Skeg - Exposed by Ballasting .....	4-12
5-1	- Removing Pump Vane from the Cargo Pump .....	5-10
5-2	- Valve Actuator Cut-Off Switch for Manual Operation .....	5-12
5-3	- SWOB I Class (43 Series) Docking Plan .....	5-19
A-1	- Schematic Piping Arrangement .....	A-2
A-2	- Oily Waste Pump (STBD) .....	A-3
A-3	- Oily Waste Pump Wiring Diagram .....	A-5
A-4	- View of Cargo Manifold Valve in Pump Room .....	A-5
A-5	- Two Views of the Float Gauge System ...	A-6
A-6	- Tank Capacity Curves .....	A-7
A-7	- View of Fuel Gauge Panel (From Outside the Deckhouse) .....	A-8
A-8	- Typical Gauge Light Panel Conditions ..	A-13

TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
3-1	Classification of Common Petroleum Products .....	3-1
4-1	Preventive Maintenance Schedule .....	4-2
4-2	Painting Instructions .....	4-13
4-3	Solvent Chart .....	4-16
5-1	Trouble Shooting Guide .....	5-2
5-2	Major Component Index .....	5-3

## CHAPTER 1. INTRODUCTION

1.1 MOTIVATION. If you mention some recent catastrophies involving supertankers, most people think of oil-covered beaches or mammoth oil slicks. These disasters serve as vivid reminders to the awesome hazard of uncontrolled oil in our environment. While less spectacular than a cracked hull spewing oil in a heavy sea, ships engaged in everyday operations can create environmental hazards of equal proportion. Routine shipboard procedures such as tank stripping, tank washing, deballasting and pumping bilges are all large sources of oily waste and potential environmental problems because without alternate means of disposal, oily waste is usually pumped overboard. Although the quantities of oil may, in come cases, appear slight, the environmental effects are cumulative and the damage is often long-lasting, especially where ships are berthed. Eliminating overboard discharge of oily wastes is not a simple matter. The problem is not merely technical, other considerations such as logistics and economics figure in as well. However, despite the problems, the Navy, like other ship operators, must comply with recently enacted Federal laws prohibiting the discharge of oily waste upon navigable waters and the contiguous zone of the United States.

1.2 PURPOSE OF THE SWOB. A key element in the Navy's effort to eliminate overboard discharge of wastes is the Ships Waste Offloading Barge, or SWOB, shown in Figure 1-1. There are two types of SWOBs now servicing Navy activities, OIL SWOBs and SEWAGE SWOBs. The primary purpose of the OIL SWOB is to collect oily waste from U. S. Navy ships in port or at anchor and transfer the waste to a shoreside terminal for treatment, reclamation or disposal. In this way, ships entering or staying in port may dispose of their oily wastes on station, without discharging overboard. At no time should oily waste be placed into a sewage barge or vice-versa.

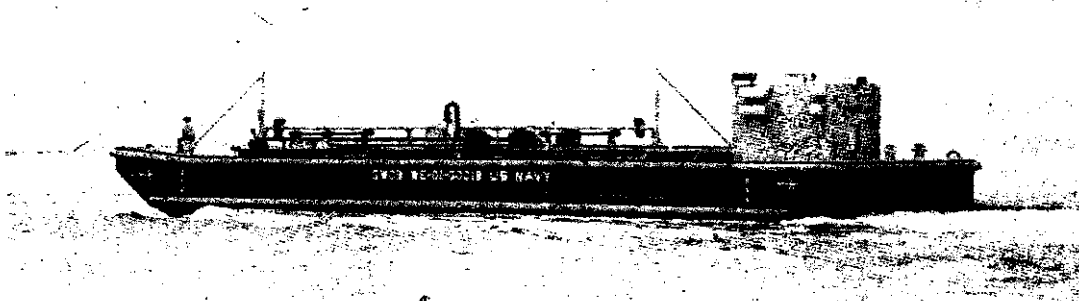


FIGURE 1-1

Ships Waste Offload Barge (SWOB) Under Tow

1.3 CARGO CARRYING LIMITATIONS. By design, the SWOB has an operating limitation of special importance which concerns the grade of cargo that can be carried. Based on tank vessel classifications by the United States Coast Guard (USCG) and the American Bureau of Shipping (ABS), the SWOB shall not carry oily waste which contains any amount of petroleum products with USCG Grade A, B, C or D. Operators are strongly cautioned against carrying any petroleum product other than USCG Grade E, see Table 3-1 on page 3-1. An OIL SWOB is not a suitable container for sewage; at no time should oily waste be placed in a sewage barge or vice-versa.

1.4 PURPOSE OF THE MANUAL. The purpose of the manual is to familiarize operators, mechanics and port managers with the characteristics of the OIL SWOB. While the major thrust of the manual concerns operating and maintenance procedures, general information is also included on overall design feature.

1.5 ADDENDUM TO MANUAL. The manual applies strictly to OIL SWOBs built by Marine Power and Equipment Company (numbers 1 through 42). The manual also applies to OIL SWOBs built by Tacoma Boatbuilding Company (numbers 56 through 60); however, these SWOBs have different components and arrangements that are described fully in the Addendum. Operation and maintenance procedures that are unique to SWOBs 56 through 60 are also found in the Addendum; one should refer to the manual proper for information that pertains to both series of oil barges. While SEWAGE SWOBs (numbers 43 through 55) are similar in many respects, the manual does not apply to these barges.

## CHAPTER 2. DESCRIPTION

2.1 GENERAL ARRANGEMENT. The SWOB is a nonself-propelled multipurpose tank barge designed to transfer ship-generated wastes from Naval ships to shore treatment facilities. Figure 2-1 shows an elevation and planview of the SWOB. There are some variations of arrangement; for instance, later designs are not outfitted with king posts and cargo booms. Major features of all designs include four cargo tanks with surrounding void space, a deckhouse for power and control equipment, a pump room located below the deckhouse, and a forward storage compartment.

2.1.1 Hull Characteristics. The SWOB hull characteristics are as follows:

Length, overall	107'9"
Length, between perpendiculars	106'0"
Breadth, overall	27'8"
Breadth, molded	26'0"
Draft, light, without margin	1'11"
Draft, full load, without margin	5'11"
Depth, to deck at side	8'3"
Displacement, full load, without margin	394.4 long tons
Displacement, light, without margin	105.3 long tons

2.1.2 Tank Configuration. The barge is divided into four independent cargo tanks by a centerline longitudinal bulkhead and a midships transverse bulkhead. Each tank is fitted with a swash bulkhead running transversely across the center of each tank. Also, tank sumps are located inboard next to each of the after tank bulkheads. Expansion trunks are located amidships. The general tank layout is indicated in Figure 2-2. The total capacity of the SWOB is about 77,000 gallons; however, the piping system allows cargoes to be segregated in each tank. The capacity for each tank is given below. Tank sounding (ullage) curves are given in Figure 2-3.

<u>Tank</u>	<u>100% Capacity</u> <u>(gallons)</u>
Starboard No. 1 (FWD)	18,885
Port No. 1 (FWD)	18,992
Starboard No. 2 (AFT)	19,016
Port No. 2 (AFT)	20,131

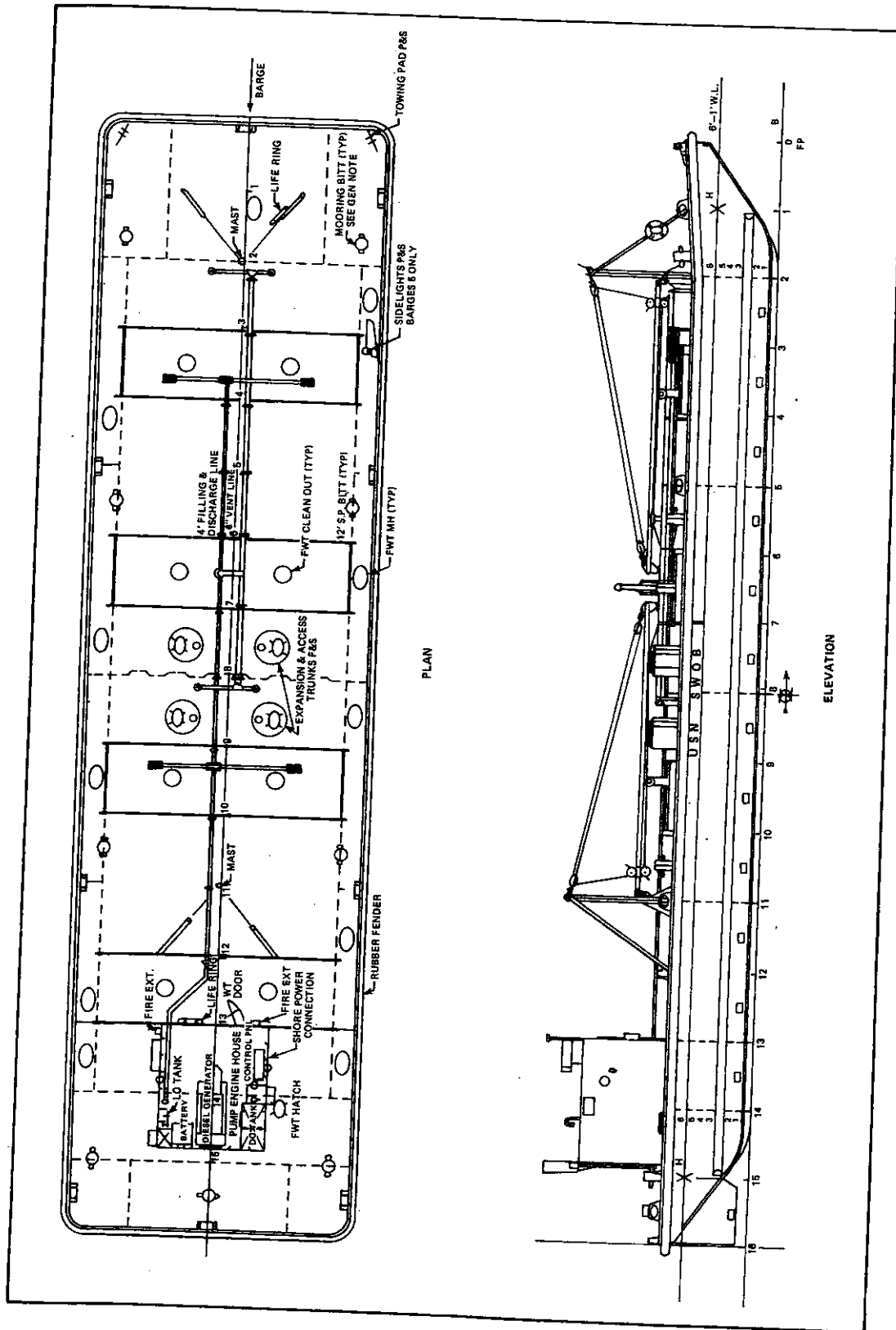


FIGURE 2-1  
 Layout of Ship Waste Offloading Barge (SWOB)

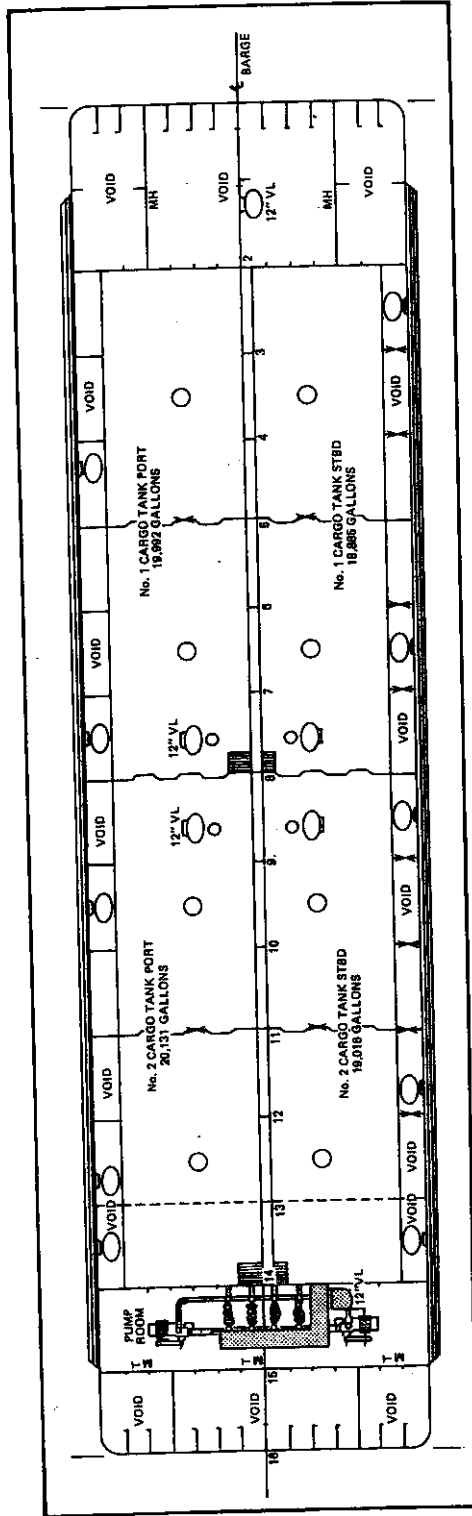
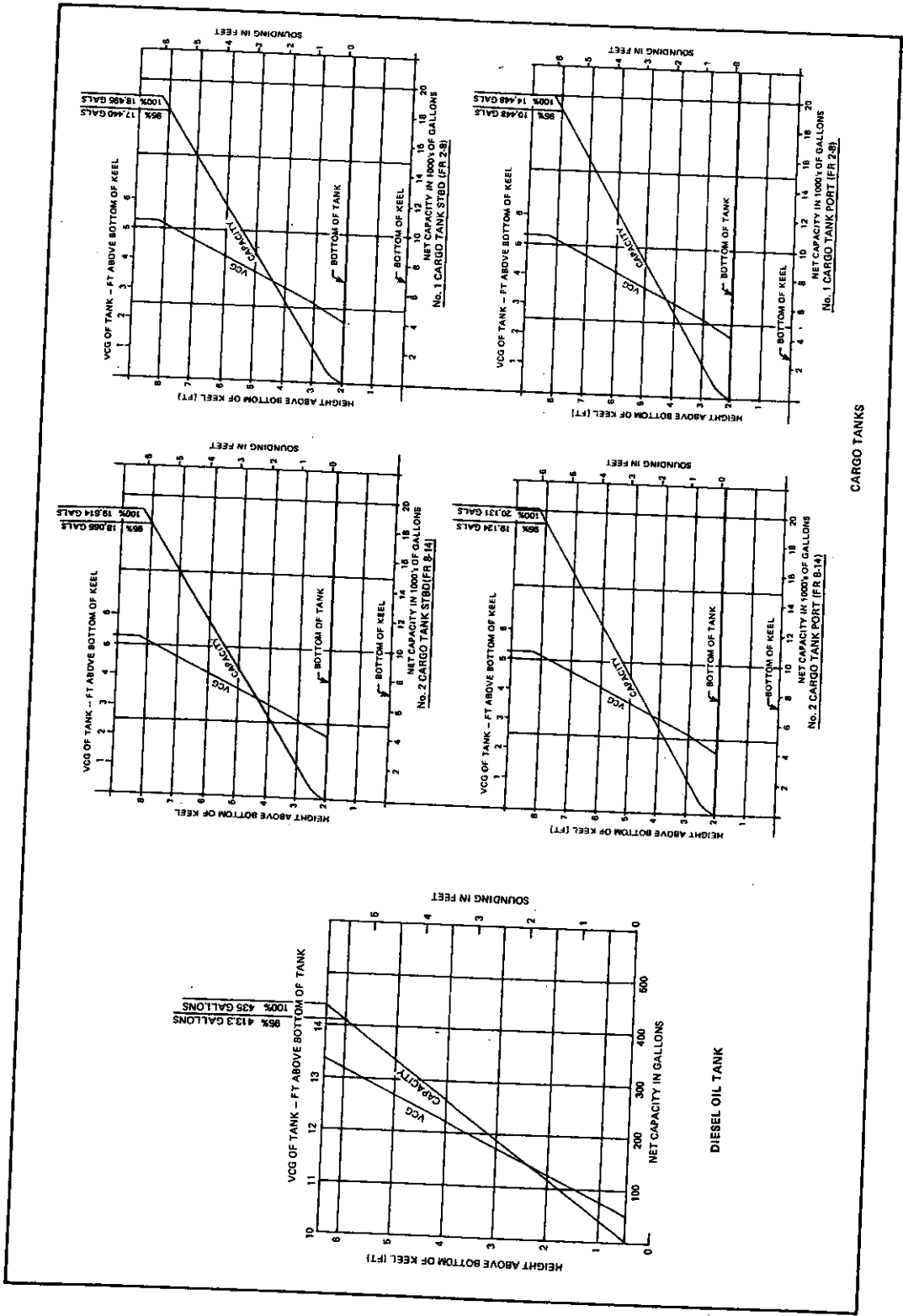


FIGURE 2-2  
Tank and Void Arrangement





CARGO TANKS

FIGURE 2-3  
Tank Capacity Curves

2.1.3 Void Space Configuration. Watertight void spaces (required for buoyancy) are arranged to reduce the possibility of oil leakage from the SWOB. The design affords a double hull construction whereby the tanks' walls do not form any portion of the hull bottom or sides. Therefore, if a tank should leak, it will fill a void space rather than spill overboard. The arrangement of void space is shown in Figure 2-2. Access to the voids is required for inspection. Entrance to the side and bottom voids is through manholes located outboard along the main or weather deck. The two forward voids are entered through the forward storage compartment and the three after voids are entered through the pump room.

2.1.4 Deckhouse. The deckhouse provides an enclosure for the control and power equipment. Included in the deckhouse are the 440v AC diesel generator, tank level indicators, tank level alarms, cargo valve controls, 24v DC battery supply, electrical panels, and diesel oil tank. Cowled air ducts provide natural ventilation through the deckhouse.

2.1.5 Pump Room. The pump room is located directly below the deckhouse. Access to the space is through a hatch adjacent to the starboard side of the deckhouse. In the pump room are two cargo pumps, two 440v AC motors and a cargo transfer manifold composed of four 3-way cargo valves. An electric blower provides forced ventilation in the space.

2.1.6 Forward Storage Compartment. The forward storage compartment is for the stowage of deck gear such as mooring lines and chafing gear. Cargo hoses are to be stored on deck in the racks provided. The compartment is entered through a hatch located on the foredeck. Except for the hatch, no ventilation is provided.

2.2 CARGO PIPING LAYOUT. The piping on the SWOB is arranged to achieve the following modes of flow:

- (a) Loading cargo from an external source (e.g., from a ship),
- (b) Offloading cargo to an external source (e.g., to a shore treatment facility), and
- (c) Transferring cargo between tanks on the SWOB.

The piping system for these modes is indicated in Figure 2-4. Cargo is loaded or offloaded through any one of the four filling/discharge stations on deck. These stations do not correspond to any particular tank. For example, the filling/discharge station located forward on the starboard side does not necessarily fill the starboard No. 1 tank. All filling/discharge stations join a single pipe which terminates at the pump room



cargo transfer manifold. Tank loading/offloading sequence is controlled with the manifold. Of course, an operational limitation of this system is that loading and offloading cannot occur simultaneously.

2.2.1 Description of Loading. Cargo must be pumped (or gravitated) into the SWOB. The cargo pumps on the SWOB are intended for offloading and transfer only. One or more tanks can be filled by positioning the appropriate 3-way valve(s) on the cargo transfer manifold. Each valve corresponds to a particular cargo tank. With the appropriate valve in the FILL position, the cargo flows into the selected tank via the pipe connected to the tank sump. Other valves should be in the CLOSED position. With more than one valve in the FILL position, selected tanks can be expected to equalize their levels. Components of the piping system will be described in Section 2.3 and the step-by-step procedures for loading will be described in Section 3.3.

NOTE

Do not fill the cargo tanks through the expansion trunk manhole; this procedure should be avoided because:

(a) Open manholes enable tank gas to escape freely. Depending on the gas properties (toxic, flammable, malodorous, etc.) hazards may exist.

(b) Hose handling and securing is difficult.

(c) Trash of various sorts (e.g., cigarettes, rags, soda cans) may be tossed into the open manhole which may, for example, block the tank sump or provide sources of ignition.

(d) The loading rate cannot be controlled or stopped on the SWOB, a feature which can be crucial in the event of overtopping.

(e) The distribution of cargo to other tanks may be more difficult or at least slower.

2.2.2. Description of Offloading. Cargo is offloaded via the pipe connecting the cargo transfer manifold and the selected cargo tank sump (see Figure 2-4). Any combination of tanks can be offloaded by positioning the appropriate 3-way valves in the cargo transfer manifold. Each valve corresponds to a particular cargo tank. With the appropriate valve in the DISCHARGE position, the cargo pump takes suction on the selected tank and discharges to the filling/discharge station(s) on deck. Other valves should be in the CLOSED position.

The step-by-step offloading procedures will be described in Section 3.4.

NOTE

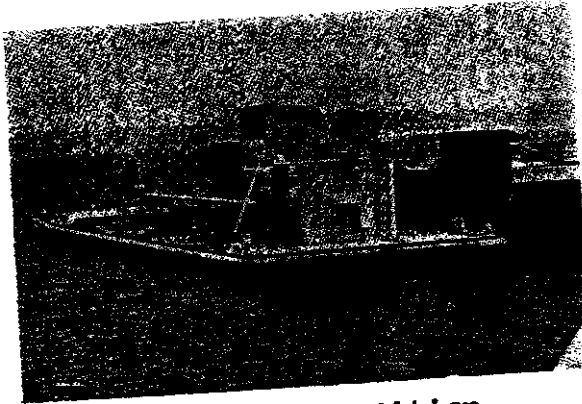
The SWOB's are not fitted with cargo pump check valves. As a result, both cargo pumps must be operated together or else a great portion of the flow will bypass through the secured pump. That pump, in most cases, will then reverse rotation (i.e., "backwheel"). If for some reason (e.g., motor failure) both pumps cannot be operated, the affected pump should be blocked (e.g., with a wood strong-back through the pump pulley) to prevent backwheeling. Warning tags should be placed on the motor circuit breakers to remind the operator against starting the pump.

2.2.3 Effects of Inclination During Offloading. The SWOB is shown in several ballasted conditions in Figure 2-5. Depending on the sequence of offloading, some cargo may be trapped in the after cargo tanks. The particular sequence to be avoided is: offloading after tanks before offloading the forward tanks. The reason for this is if one (or both) of the after tanks are unloaded, the stern rises and cargo runs to the forward end of the after tank. With this inclination the tank sump will lose suction with about 10% of capacity remaining in the forward end of the tank. This remaining cargo can only be pumped out if the forward tanks are emptied so the SWOB comes to even keel. This situation can be prevented by pumping the forward tanks first or by pumping off all tanks equally. Operationally, this can be inconvenient, particularly when various cargoes are being carried; for example, clean oil in the aft tanks and waste oil in the forward tanks. In this case, the best procedure is to offload the waste oil before the clean oil.

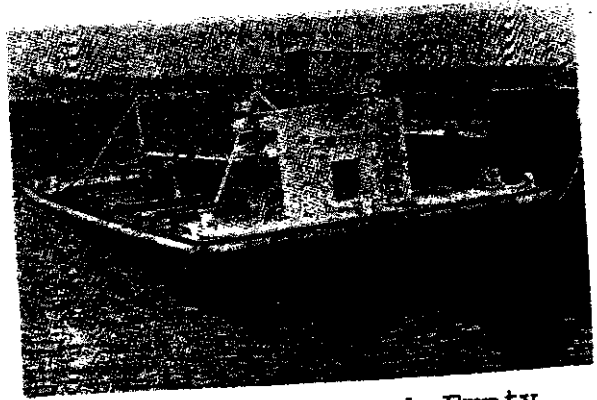
2.2.4 Description of Transfer Mode. In the operation of the SWOB it may become necessary to transfer cargo from one tank to another. This can be done by placing the appropriate valve on the cargo transfer manifold to the DISCHARGE position whereby suction is taken on a selected tank and by placing the cargo valve for the tank to be filled in the FILL position. All other valves, including the fill/discharge station valves, must be closed prior to pumping. The liquid level in two or more tanks will be equalized by gravity by placing the corresponding 3-way valves in the FILL position.

## 2.3 CARGO HANDLING COMPONENTS

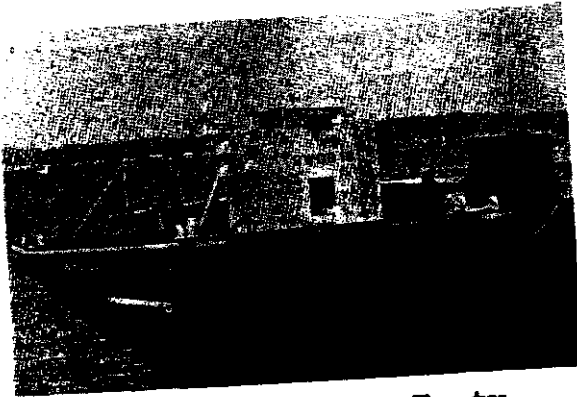
2.3.1 Cargo Pumps. Two cargo pumps are provided for the offloading and transfer of cargo between tanks (see Figure 2-6). Both pumps are Blackmer, Pump Division/Dover Corporation, Model



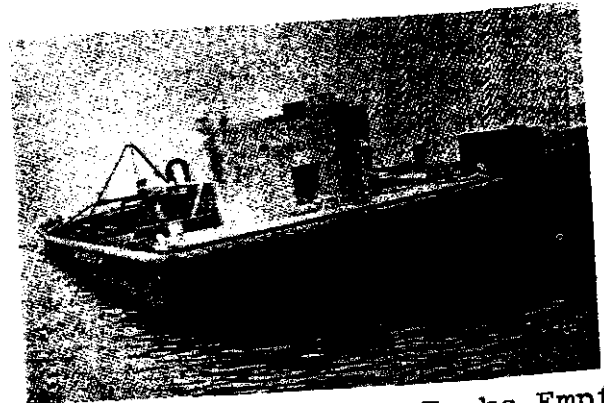
A) Loaded Condition



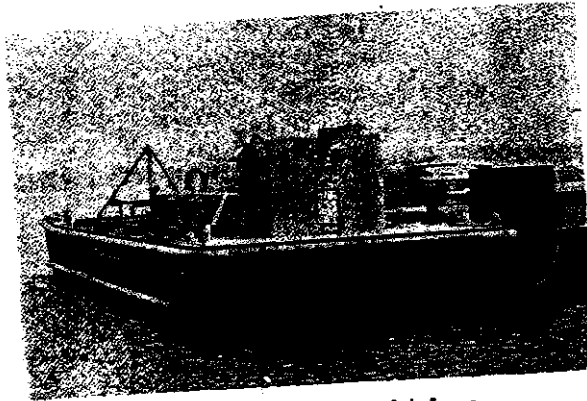
B) STBD After Tank Empty



C) Both After Tanks Empty



D) After and STBD FWD Tanks Empty



E) Light Condition

FIGURE 2-5  
SWOB Loading Inclinations

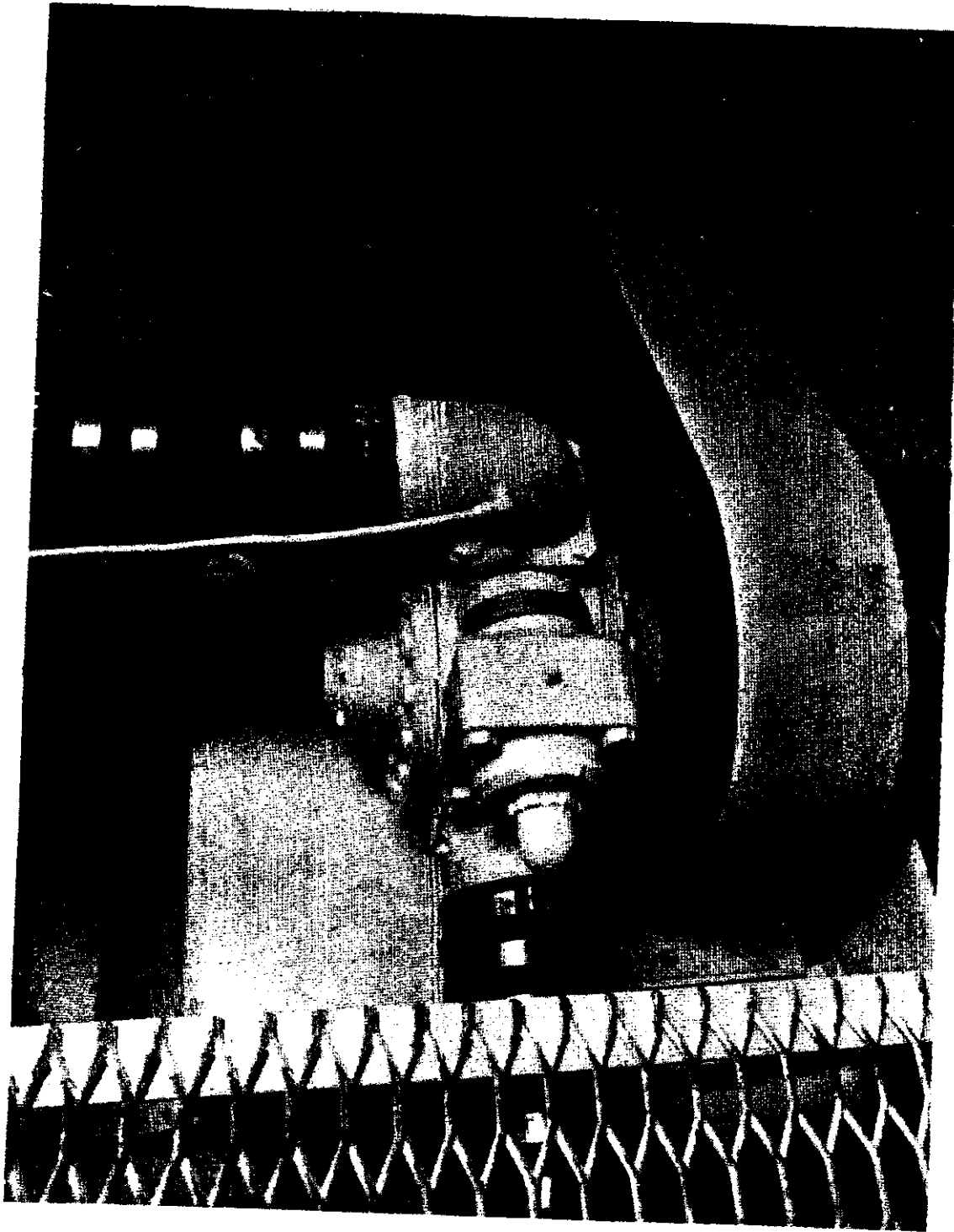


FIGURE 2-6  
Cargo Pump and Motor-Starboard Side

GPLG4C pumps. They are positive displacement and of the rotary vane type. Each pump will deliver approximately 200 gpm at a discharge head of 70 psig. The discharge curves are given in Figure 2-7. An internal relief valve, returning to the pump suction, is set for 80 psig. A (discharge) pressure gauge is provided in the deckhouse. Preventive and corrective maintenance procedures are described in Chapters 4 and 5, respectively<sup>1</sup>.

NOTE

These pumps are not intended for pumping abrasive cargoes or those containing abrasive particles such as sand or scale. Loading of such cargo must be avoided to limit vane wear. If such service is required, suitable suction strainers should be fitted.

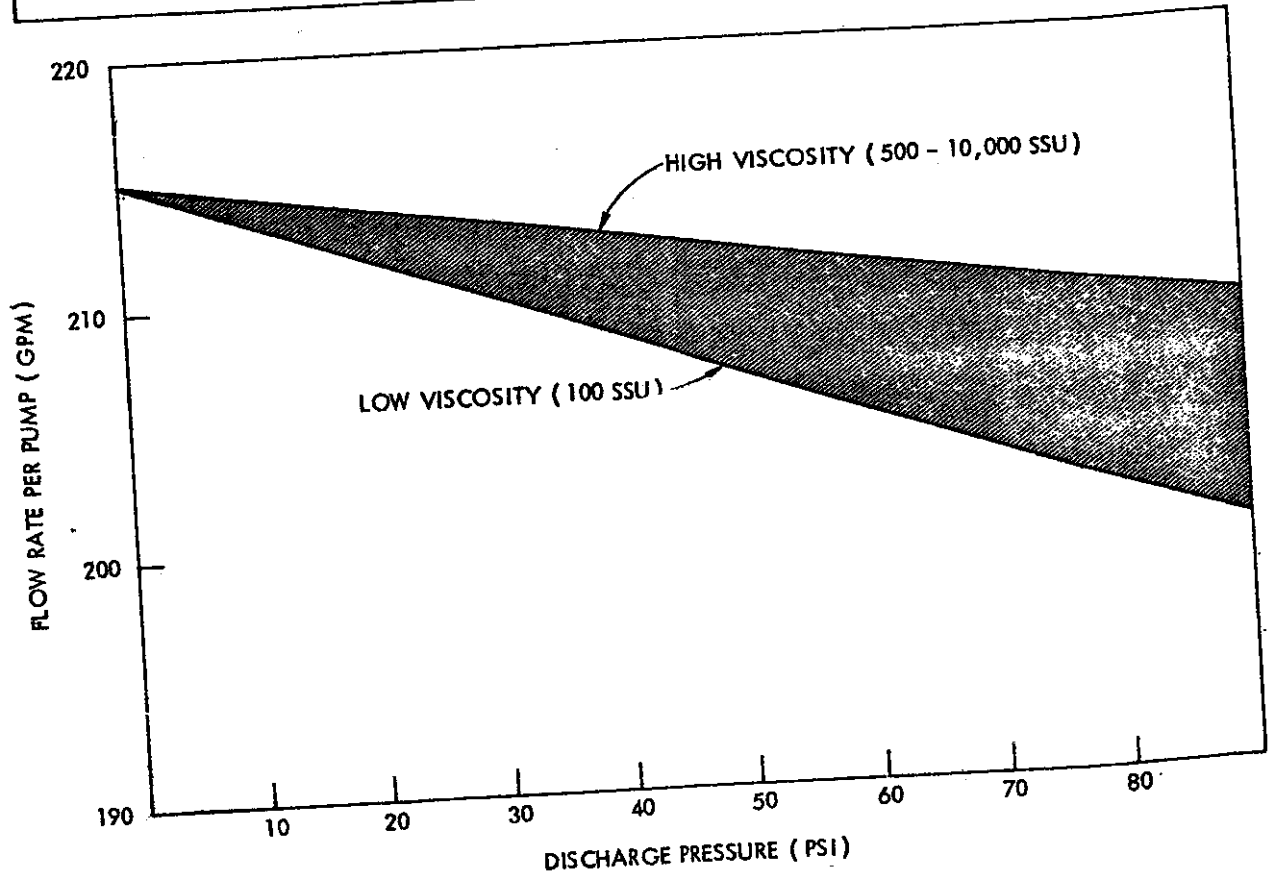


FIGURE 2-7  
Oil SWOB Pump Capacity Curves

<sup>1</sup> Further details and replacement part numbers are included in NAVSEA 0947-LP-228-6010 Technical Manual.



2.3.1.1 Pump Motor and Drive. Each cargo pump is belt-driven by an electric motor. The motor is a 15 hp Lincguard™, Frame 254T manufactured by the Lincoln Electric Company and is connected to 440v AC three phase power. The belt drive is an Eaton-type positive drive manufactured by Eaton Corporation, Industrial Drives Division. Belt guards are provided for safety<sup>1</sup>.

2.3.1.2 Power Sources. Each cargo pump requires 60 amps (per phase) at 440v AC. This can be supplied by either the diesel generator or the shore power connection. When using the shore connection care must be taken to verify proper phase rotation by observing the phase sequence indicator. Electrical switch-gear for motor control and starting is located in the deck-house. These controls operate on 120v AC single phase power.

2.3.2 Electrically Operated Cargo Valves. The cargo transfer manifold, located in the pump room, is composed of four (4) electrically operated cargo valves, each corresponding to a single tank (see Figure 2-4). The valves are 4", bottom-ported, 3-way ball valves, Model DP-20-F15-8 manufactured by the Pittsburgh Brass Manufacturing Company. As installed, the bottom-port is connected to the tank sump while the forward-facing port is connected to the FILL side of the manifold and the aft-facing port is connected to the DISCHARGE side. The electric operators atop the valve are manufactured by Raymond Control System, Incorporated. The operator, Model MAR-160, rotates the valve to any one of three positions: FILL, DISCHARGE or CLOSED. The selection switch for these commands is located in the deck-house. Preventive and corrective maintenance procedures are described in Chapters 4 and 5, respectively<sup>1</sup>.

2.3.2.1 Power Source. Power (120v AC) to the valve operators is supplied from either the diesel generator or shore power by way of a 440v AC to 120v AC step-down transformer. Each valve operator draws approximately 3 amps at 120v AC, single phase. With no power, the valves can be operated in the manual mode by depressing the handwheel (which clutches into the valve motor reduction gear) and rotating it to the proper position.

NOTE

When the handwheel is depressed to the manual mode an electrical lock-out switch prevents electrical operation. If the handwheel is not fully lifted to the automatic position (declutched), the valve cannot operate electrically. Care must be taken when changing from manual to automatic operation.

<sup>1</sup> Further details and replacement part numbers are included in NAVSEA 0948-LP-114-1010 Technical Manual.

2.3.2.2 Valve Position Indicator. Valve position is indicated in two ways, electrically and mechanically. The electrical indication way is provided by a system of lights (120v AC) located beside each tank level indicator (see Figure 2-8). In the FILL position an amber light shows and in the DISCHARGE position a green light shows. When the valve is rotating or when the valve is in the CLOSED position, lights do not show. In the absence of AC power, the valve position is indicated by means of a pointer on the valve stem (i.e., below the operator near the valve body). In the FILL position the pointer is forward and in the DISCHARGE position the pointer is aft. With the pointer to the port side, the valve is closed.

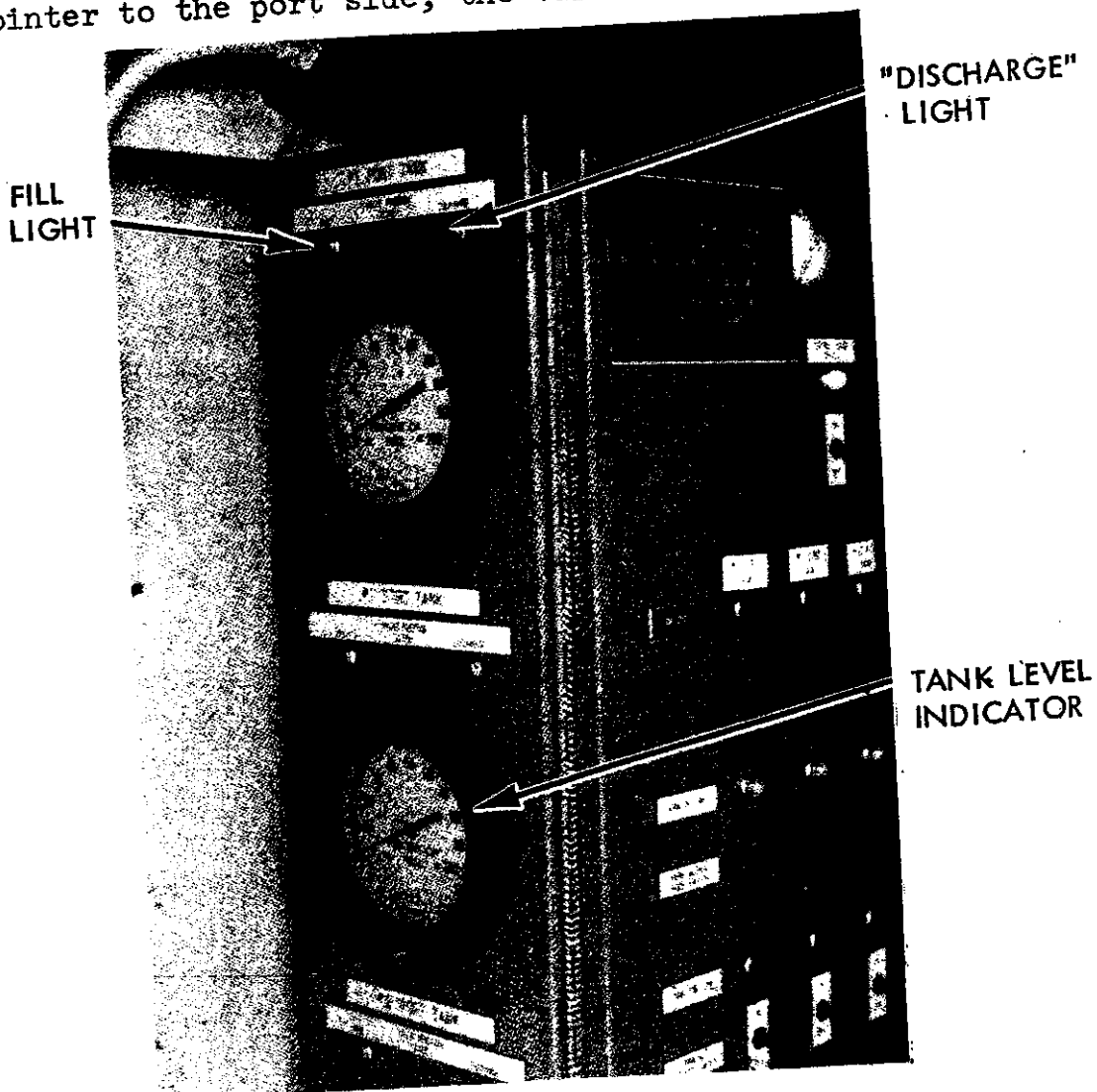


FIGURE 2-8  
Tank Level Indicator and Cargo Valve Position Lights

2.3.3 Filling/Discharge Station Valves. Each filling/discharge station is equipped with a hand operated shut-off valve and a camlock fitting for the hose connection. They are two-way, 4" ball valves, Model SP-20-F15, manufactured by The Pittsburgh Brass Manufacturing Company. The camlock fittings are 2-1/2" size and commercially available from any number of sources. Other cargo hoses may be mated by removing the camlock fitting and connecting directly to the 4" valve flange. On some SWOBs, diverter valves are placed between the port and starboard filling/discharge stations. These valves are 3-way, 4" bottom entry ball valves, Model DP-20-F15-B, manufactured by The Pittsburgh Brass and Manufacturing Company<sup>1</sup>.

NOTE

These valves can be difficult to open when pressure is acting on one side.

2.3.4 Cargo Hoses. Each SWOB is equipped with four fifty-foot sections of cargo hose with camlock end fittings. These hoses may be joined together or used separately. Four storage racks are provided on deck. The cargo hoses are also used in conjunction with the pump room bilge pump.

## 2.4 LEVEL INDICATOR, ALARM AND PUMP CUT-OFF SYSTEMS.

2.4.1 Principle of Operation. The operation of the OIL SWOB level indicator, alarm and pump cut-off systems is based on the principle that the pressure of air flowing slowly through a submerged indicating tube (as shown in Figure 2-9), is directly proportional to the level in the tank. That is, the higher the level in the tank, the higher the pressure in the indicating tube and vice versa. Therefore, measuring the air pressure in the tube is the same as measuring the tank level. To control these systems, three primary functions are required:

- (a) Supplying a nearly constant flow of air to the indicating tubes (one for each tank),
- (b) Measuring the pressure of the air flow to the indicating tubes, and
- (c) Triggering electrical contacts (to activate the alarm or cut-off) when specific air pressures are reached.

<sup>1</sup> Further details and replacement part numbers for all valves are included in NAVSEA 0948-LP-114-1010 Technical Manual.

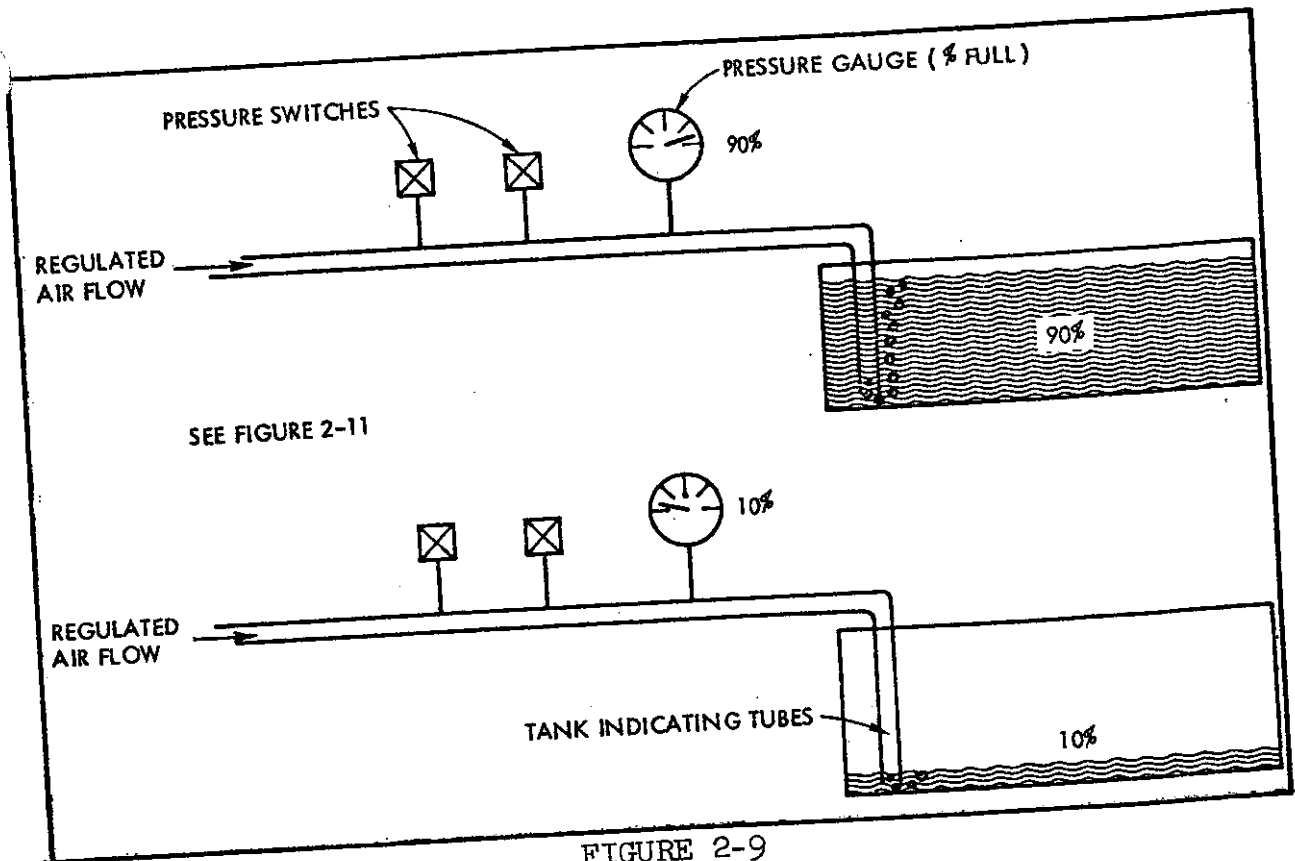


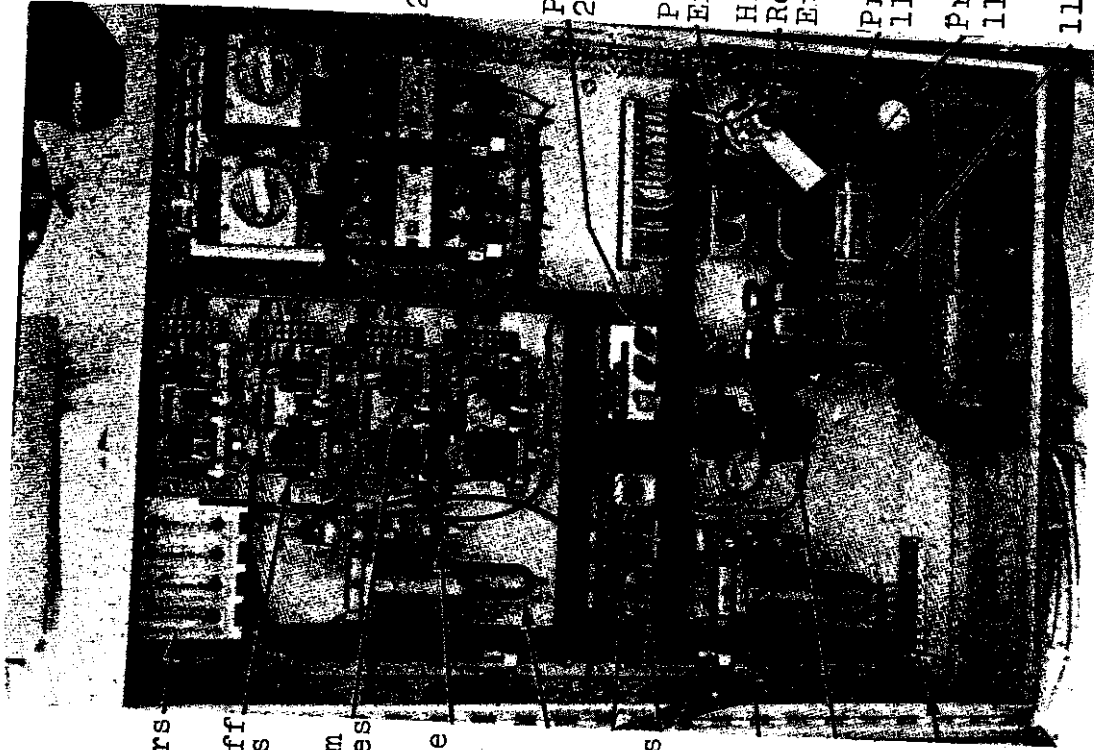
FIGURE 2-9  
Level Indicator Principle

The arrangement of pressure regulators, gauges and switches, etc. is shown in Figure 2-10. Functional relationships of these various components are given in block form in Figure 2-11. The three functions and their associated components are described below.

2.4.1.1 Regulated Air Supply. Accurate indication of tank level depends on the rate of air flow. For each indicator 1.0 ( $\pm 0.3$ ) SCFM of air is required. The air can be supplied from one of the two (30 air psig) supplies: a 120v AC compressor mounted inside the control panel (see Figure 2-10) or an externally mounted pressure bottle. By using the pressure bottle supply, the level indicating an alarm system can operate on battery power (24v DC) alone. This is useful, especially during loading operations or routine checks, since the diesel generator (440/120v AC) need not be used to operate the 120v AC air compressor.

a. The choice of either the air compressor or external bottle is controlled automatically by 24v DC and 120v AC electrical solenoid valves shown in Figures 2-10 and 2-11. With the shore power and generator secured and the 24v DC system

- 4 - Flow Meters
- 4 - Low Level Alarm/Pump Cut-Off Pressure Switches (24VDC)
- 4 - High Level Alarm Pressure Switches (24 VDC)
- 4 - Low Pressure Regulators
- 4 - Air Filters
- Time Delay Switch
- 4 - Control Relays
- Two Way Air Valve (24 VDC)
- Three Way Air Valve (110 VAC)
- 4 - Level Indicator Gauges (Located on Side Panel)



- 2 - Circuit Breakers
- 2 - Motor Starters
- Power Fuses - 6A  
24 VDC and 110 VAC
- Pressure Gauge for External Bottle
- High Pressure Regulator for External Bottle
- Pressure Switch for 110 VAC Compressor
- Pressure Gauge for 110 VAC Compressor
- 110 VAC Air Compressor

FIGURE 2-10

Internal Control Panel Layout

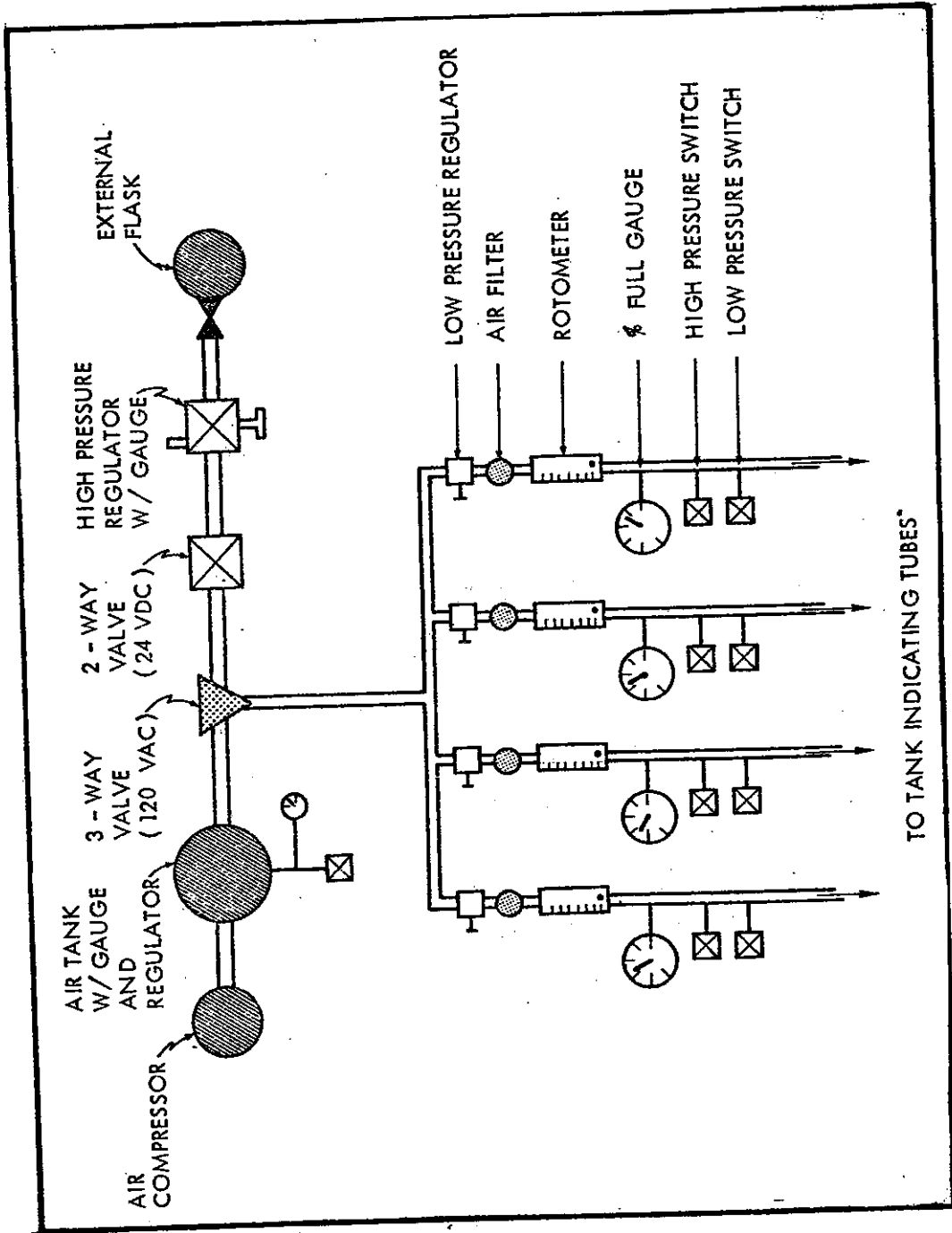


FIGURE 2-11  
 Block Diagram of Level Indicator,  
 Alarm and Pump Cut-Off System

activated, air<sup>1</sup> flows from the bottle through a high-pressure regulator (reducing down to 30 psig pressure) and through the 2-way (24v DC) valve and 3-way (120v AC) valve to the four low-pressure regulators (see Figure 2-11). The 3-way valve prevents flow into the secured air compressor. With both the 120v AC and 24v DC systems activated, the 3-way (120v AC) valve operates and changes position to block flow from the 2-way (24v DC) valve and allows flow from the air compressor to the four low-pressure regulators. Because it takes a while for the air compressor to build up pressure (30 psig), a time delay switch controlling the 3-way valve (see Figure 2-10) is provided to insure that air flow is not interrupted during power transfer.

b. Flow beyond the 3-way valve is divided into four identical branches, each corresponding to one tank as shown in Figure 2-11. In the branch lines the flow passes through the low-pressure regulator and the air filter; the flow rate is adjusted manually to the required 1.0 SCFM with the Dwyer rotometer (refer to Figure 4-3).

2.4.1.2 Pressure Measurement. Flow from the rotometer leads into the indicating tube which ends at the tank bottom. At the tube ending the flow vents to the free surface. The pressure at the roto-meter is nearly equal to the pressure at the end of the indicating tube and, as noted earlier, is directly proportional to the tank level (i.e., the height of fluid above the tube ending). Therefore, the pressure gauge (see Figures 2-8 and 2-10) attached to the indicating line provides a remote and visual indication of the tank level. However, rather than reading in units of pressure (e.g., inches of H<sub>2</sub>O) the gauge scale is calibrated to the more convenient PERCENT FULL scale.

2.4.1.3 Level Alarm and Pump Cut-Off Switches. To afford a high degree of safety, level alarms and cut-off switches are provided to prevent cargo tank overtopping or running the cargo pumps dry. Both features (i.e., alarms and cut-offs) would not be required if someone would maintain a constant watch on the tank level indicator. To ease this burden, high and low-level pressure activated electrical switches (see Figures 2-10 and 2-11) are installed for each of the four indicating tubes. The switches (eight of them) are of the diaphragm type which operate electrical microswitches. The high-pressure diaphragm actuates one 24v DC switch (for the high level alarm) while the low-pressure diaphragm actuates both a 120v AC switch (for the pump cut-off) and a 24v DC switch (for the low level alarm).

---

<sup>1</sup> To increase safety, nitrogen rather than air is used in the external pressure bottle; however, operationally there is no difference.

a. When the tank level drops the pressure in the indicating tube drops. At a threshold value of 10% FULL, the pressure becomes low enough to actuate the low-pressure diaphragm. Closure of the 24v DC switch causes the alarm to sound and the red warning light to flash (both the alarm and the warning light are located outside the deckhouse). Simultaneous closure of the 120v AC switch trips the motor controller causing the cargo pump to stop.

b. On the other hand, when the tank level rises, the pressure in the indicating tube rises. At a threshold value of 90% FULL, the pressure becomes high enough to actuate the high-pressure diaphragm. Closure of the 24v DC switch causes the alarm to sound and the red light to flash as it did for the low-level alarm.

c. Lights are provided on the front door of the control panel to indicate which tank has caused the alarm to sound and the type of alarm (e.g., high or low-level alarm). The layout of these lights is shown in Figure 2-12. The upper row of red lights indicate 90% FULL and the lower row of red lights indicate 10% FULL. The middle row of amber lights show which tank has triggered the alarm. Switches are provided to silence the horn and to override the pump cut-off circuit.

d. The MANUAL OVERRIDE SWITCH for the pump is provided so that remaining tanks can be pumped or tanks can be pumped to less than 10% capacity.

Step-by-step operational procedures for the level indicators, level alarms and pump cut-off will be described in Chapter 3. Preventive and corrective maintenance procedures are described in Chapters 4 and 5, respectively<sup>1</sup>.

2.4.2 Power Sources. Both 120v AC and 24v DC are used in the level controls for independent functions. Specifically, the level indicators and level alarms operate only on 24v DC. However, both require air supply (for diaphragm actuation), either from the external pressure bottle or the 120v AC air compressor. The pump cut-off mechanism also requires an air supply, but the circuitry is solely 120v AC in this case. The 24v DC power switch for the control system is located on the panel door. Both 24v DC and 120v AC fuses are located inside the panel as indicated in Figure 2-10.

2.4.3 Effects of Inclination and Waves. The level indicators, alarms and cut-off system respond to the liquid level above the indicating tube(s). As a result, erroneous readings can be

<sup>1</sup> Further details concerning specific components or replacement part numbers are included in NAVSEA 0986-LP-057-0010 Technical Manual.



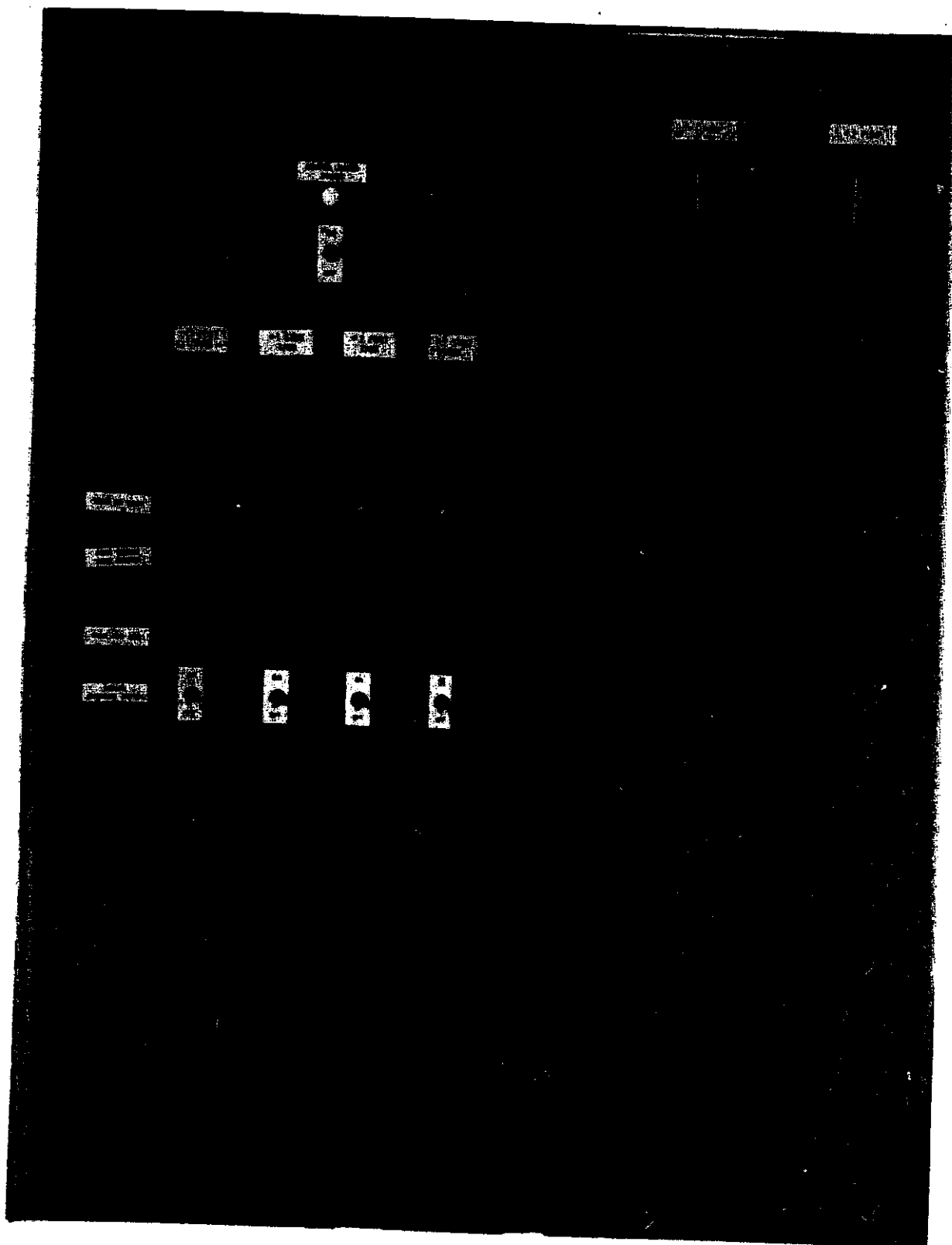


FIGURE 2-12  
Arrangement of Alarm Panel Lights

taken when the barge is inclined. The change in gauge reading is small for small angles of inclination. However, the effect may cause the level alarms to sound or pumps to cut-off seemingly without reason. The operator should check the situation and take appropriate action, for example, override the pump cut-off. Waves rocking the barge may cause similar problems.

NOTE

To avoid false alarms the tank level should not be left close to the 10% or 90% capacity level, particularly when the presence of internal tank waves are likely.

2.4.4 Other Means of Measurement. If the tank level indicating system fails, the operator can use any number of devices to measure the tank level. For example, an ullage tape or a wood pole. The conversion of tank level to capacity is given in Figure 2-3.

2.5 DESCRIPTION OF POWER SYSTEM. The SWOB is equipped with 440v AC/three phase, 120v AC/one phase and 24v DC electrical service. The 440v AC bus is supplied by either the onboard diesel generator or, when pier-side, by shore cable. 120v AC is supplied from the 440v AC bus by a bank of four lead acid storage batteries.

2.5.1 Power Distribution. 440v AC power feeders from the generator and the shore cable lead to the 440v AC power panel. From there, power is distributed to the two cargo pump motors and the 440/120v AC step-down transformer. Three overcurrent circuit breakers are provided on this panel; one for the generator, one for the shore power and one for the cargo pump motors. The 440/120v step-down transformer is protected by a 10A (440v AC) fuse which is located inside the transformer cabinet. An important protective device on the 440v AC system is a sliding bar interlock on the power panel which prevents simultaneous operation of shore and generator power.

WARNING

Since the interlock is fastened to the power panel cover, all power should be secured when removing the cover to prevent accidental parallel operation.

The shore power is connected through a Crouse-Hinds (No. RPE-641-014-Pl2AT) power receptacle located on the starboard side of the deckhouse and a Crouse-Hinds (RPE-541-390-S12AT) shore power plug. To assure that the phase rotation of the shore power is compatible with the SWOB circuitry, a Knopp, Model K-3 phase rotation indicator is provided.

NOTE

If phases are connected incorrectly, the cargo pumps will rotate in the reverse direction. All other AC equipment will operate normally.

2.5.2 120v AC System. Power to the 120v AC system is supplied through the 5KVA, 440/120 single phase step-down transformer and is distributed through the 120v AC panel. Circuit breakers are provided on the panel for all branch circuits which include the battery charger, the vent fan, the pump room lights, deck-house lights and the control panel. 120v AC service is required for the control panel to operate the cargo pump motor starters, the air compressor system and the transfer cargo valve system. These systems are protected with a 6A (120v AC) fuse located inside the control panel (see Figure 2-10).

2.5.3 24v DC System. 24v DC service is supplied by four 12v DC (205 A.H.) lead acid storage batteries. Pairs of the batteries are connected in series and each pair is an independent 24v DC supply. One pair provides power for starting the diesel generator while the other is used for the level alarm, level indicators and navigational lighting. A 24v DC power switch is provided for the level alarm and level indicator on the control panel; a 6A (24v DC) fuse is located inside (see Figure 2-10). Switches and fuses for the navigational lighting are located in the 24v DC panel. Batteries are recharged by a 120v AC, 40 amp automatic battery charger manufactured by Lewco Electronics.

2.5.4 Diesel Engine. The prime mover for the generator is a 4-71 Detroit Diesel manufactured by a division of The General Motors Corporation<sup>1</sup>. A starting system, including an ether canister for cold weather, and a throttle for speed control is mounted on the engine. Instrumentation includes a tachometer, oil, temperature, and pressure gauges. An emergency shut-down device is fitted which can be released from outside the forward bulkhead of the deckhouse. Fuel for the engine is stored on-board in a 435 gallon service tank. With a full tank, the engine can operate at full load for 72 hours. Air for combustion is drawn from inside the compartment and exhaust is discharged through the after bulkhead.

NOTE

The proper fuel, according to manufacturer recommendations, is ASTM D-975 (grades 1-D and 2-D). Residual fuels and furnace oils, generally, are not to be used.

<sup>1</sup> Details and replacement parts numbers for the engine are covered in NAVSEA 0961-LP-069-1010 Technical Manual.

2.5.5 Generator. The generator, manufactured by DELCO, a division of The General Motors Corporation, is a 440v AC, three phase, 60 cycle rotating field type with a maximum continuous power output of 75 kw. The power controller, Model E-600 is manufactured by Emerson Power and Control Incorporated, Seattle, Washington. The controller includes an adjustment to control the output voltage, a frequency meter (adjusted with engine speed), a voltmeter and ammeter with phase selector<sup>1</sup>.

## 2.6 DESCRIPTION OF SAFETY AND NAVIGATION EQUIPMENT.

2.6.1 Lighting System. 120v AC 100 watt incandescent lights are installed inside the deckhouse and pump room. A switch on the 120v AC distribution panel turns on the deckhouse lights; a second switch in the pump room must be switched on to light that compartment. Also, two emergency battery lanterns are provided for each compartment.

2.6.2 Navigation Lights. Navigation lights are operated off the 24v DC system and include port and starboard side lights, stern light, anchor light and red loading light. A photocell switch is installed atop the deckhouse which can turn on these lights automatically when darkness falls.

### NOTE

For this system to operate, the photocell switch and selected switches (e.g., anchor light) must be in the ON position. The photocell manual override switch must be in the OFF position.

2.6.3 Blower: The blower is operated off the 120v AC system. The blower draws air from the pump room and discharges to the atmosphere. Air enters the pump room through a cowl located on the port side of the deckhouse.

### IMPORTANT

The blower should be operated at least 5 minutes prior to entering or operating equipment in the pump room.

2.6.4 Sacrificial Anodes. The hull is afforded cathodic protection with sacrificial anodes bolted to the hull sides, just below the light draft water line. In all, forty-two anodes are uniformly distributed around the hull.

<sup>1</sup> Details and replacement part numbers for these units are covered in NAVSEA 0961-LP-069-1010 Technical Manual.

- 2.6.5 Fendering. The SWOB is protected by an upper and lower course of rubber "D" cross section fenders. The upper course is just above the deep draft water line and the lower course is just above the light draft water line.
- 2.6.6 Spill Coaming. Spill coaming design varies on many SWOBs, however, each serves to contain accidental deck spills. Care should be taken to plug all coaming drains during loading, offloading and transfer operations.
- 2.6.7 Fire Extinguishers. Two 18-pound, dry chemical, portable fire extinguishers are provided. They are located in red boxes on the port and starboard side of the deckhouse.
- 2.6.8 Life Rings. Life rings are located on the bow and stern of the SWOB. They are 25 inches in diameter and are made of plastic uni-cellular construction.
- 2.6.9 Bilge Pump. A hand operated bilge pump, stored in the pump room, is provided. The suction and discharge ports are fitted with camlock coupling so that the cargo hoses may be used to pump the bilges.
- 2.6.10 Warning Signals. A red flag and mast are provided to indicate that the SWOB is engaged in loading or offloading operations. At night, the red light should be displayed in lieu of the red flag. A sign is also provided warning that NO OPEN LIGHT, NO SMOKING and NO VISITORS are permitted during loading or offloading. In conjunction with the level alarms, a flashing red warning light and horn are mounted on the forward bulkhead of the deckhouse.

## CHAPTER 3. OPERATION

3.1 GENERAL OPERATING GUIDELINES. Several general operating practices for the SWOB are listed below<sup>1</sup>. Step-by-step procedures for loading and offloading cargo are given in Sections 3.3 and 3.4.

(1) The operator (i.e., person-in-charge) must be familiar with the characteristics and hazardous properties, if any, of cargo that the barge will be handling. Typical shipboard sources include bilges, dirty ballast, tank strippings and tank washing, which may contain high concentrations of Navy Special, Navy Distillate, JP-5 and lubricating oils. The SWOB may not, under any circumstances, handle cargoes which contain any amount of product with U. S. Coast Guard Grade A, B, C or D. The OIL SWOB is intended only for the carriage of Grade E cargoes. The U. S. Coast Guard grade for common petroleum products is given in Table 3-1.

TABLE 3-1

Classification of Common Petroleum Products

U. S. Coast Guard Grade	Product	Flashpoint, °F
A	Natural Gasoline	<80°
B	Motor Vehicle Gasoline	<80°
C	Most Petroleum Crudes	<80°
	Aviation Gasoline	<80°
	Liquid Paint	<80°
	Turpentine	95°
	Stoddard Solvent	100 - 110°
D	Most Kerosenes	115 - 150°
	Some Diesel Fuels	115 - 150°
	Most No 1 Fuel Oils	100 - 150°
	Most No 2 Fuel Oils	110 - 150°
	Some No 5 Fuel Oils	130 - 150°
	Kerosene Cleaning Solvents	100 - 165°
	Naphtha Cleaning Solvents	100 - 110°
E	Some Kerosenes	150 - 165°
	Most Diesel Fuels	150 - 190°
	Some No 1 Fuel Oils	150 - 165°
	Some No 2 Fuel Oils	150 - 165°
	Most No 5 Fuel Oils	>150°
	Lube Oils	>150°
	Navy Special	>150°
	Navy Distillate	>150°
	JP-5	>150°

<sup>1</sup> For more detailed information on cargo handling, operators are encouraged to refer to U. S. Coast Guard Publication CG 174, "A Manual for the Safe Handling of Flammable and Combustible Liquids and Other Hazardous Products."

(2) Carefully plan the tank loading sequence. Allow for change in barge draft and inclination by providing slack in mooring lines, cargo hoses, and the shore power cable. Figure 2-5 shows the SWOB in various loaded conditions. Problems caused by barge inclination are described in Sections 2.2.3 and 2.4.3.

(3) Find out the anticipated cargo loading rate. Calculate approximate time required to fill each cargo tank. In general, it is good practice to start loading at reduced rate and increase the rate to maximum after checking for proper pump operation, leaks, etc. Similarly, when topping off, reduce the loading rate.

(4) The operator must be certain all personnel involved in cargo operations understand and coordinate their duties before pumping starts. Communication (such as 2-way radio) with the person controlling the loading or unloading rate is essential since pumping may have to be stopped at a moment's notice.

(5) Pumping should be stopped if:

- (a) an oil spill occurs,
- (b) the cargo hose or piping is leaking,
- (c) the cargo hose is pinched between the barge and the dock (or vessel),
- (d) the barge is surging excessively,
- (e) another boat comes alongside,
- (f) a cargo valve gets jammed,
- (g) an open fire occurs in the vicinity, or
- (h) a severe electrical storm is in progress.

(6) Cargo tank openings such as hatches, manholes, tank cleaning plates and ullage ports should be secured during cargo operation. When ullage ports are open, flame screens should be in place.

(7) Oil spill coaming should be plugged and drip pans be provided for other areas which may be prone to leaking (e.g., cargo hose connections).

(8) Signals and signs shall be displayed to alert others to the cargo handling operations. Alongside the dock, a red flag is required by day and a red warning light at night. While at anchor, a red flag is flown by day, but at night a red light is not displayed. A sign shall be posted visible to persons approaching the barge stating "WARNING, NO OPEN LIGHTS, NO SMOKING, NO VISITORS."

(9) No repair work which involves welding, burning, grinding or similar sources of ignition is to be done during cargo operations.

(10) The blower should be operated at least five minutes prior to entering or operating any equipment in the pump room.

(11) Between sunset and sunrise it is required that lights be provided to illuminate the deck of the barge. These lights can be provided by the vessel or the pier terminal.

(12) While cargo operations are underway, the operator should periodically check:

(a) mooring lines, cargo hose, and shore cable for snagging, chafing, or in the case of the cargo hose, leakage,

(b) water surface around the barge for signs of oil,

(c) weather, tides, waves and surrounding harbor conditions,

(d) all equipment for proper operation; inspect for leakage, overheating, safety hazards, etc., and

(e) the cargo tank levels.

(13) If a spill should occur, take steps to halt the discharge, contain the slick if possible, and notify the local on-scene commander.

### 3.2 HANDLING PROCEDURES.

3.2.1 Towing. The SWOB does not require special towing or handling procedures other than those normally used for tank barges. The method of towing should, therefore, be left to the discretion of a qualified tug operator. The SWOB operator, however, should avoid unusual trim conditions which may hinder towing or reduce seakeeping qualities of the barge.

3.2.2 Waterbody Restrictions. BY DESIGN, THE SWOB IS INTENDED FOR USE ON RIVERS OF THE UNITED STATES AND ON CONNECTING INTRACOASTAL WATERWAYS ONLY. The barge must not be used on the Great Lakes of North America, coastwise operation, or on any ocean. Severe wave conditions should be avoided regardless of the waterbody.

3.3 LOADING PROCEDURE. The operator must be familiar with the cargo piping layout and the cargo handling components (see Chapter 2) before attempting to load the SWOB.



- (1) Review General Operating Guidelines in Section 3.1.
- (2) If repairs were made, check to see that they were completed properly.
- (3) Start level indicators and activate level alarm. Refer to Section 3.5.1 for this procedure.
- (4) Set cargo transfer valves in the pump room. Cargo transfer valves should be in either FILL or CLOSED positions. They are positioned by depressing the valve handwheel and rotating. When the pointer (located on the valve stem between the remote operator and valve body) is forward the tank can be filled and when to port the valve is closed. Generally, the valve should not be left in the DISCHARGE position (pointer aft) since cargo will leak past the cargo pump and fill another tank. If the shore power is connected, the valves can be operated remotely from the deckhouse control. In this case, the valve position is indicated by lights on the control panel beside the level indicators.

NOTE

It is generally not advisable to run the generator for short periods of time such as just to operate the cargo valves.

- (5) Check filling/discharge valve stations on deck. Valves not in use must be closed.
- (6) Check camlock hose couplings, clean or lubricate as necessary.
- (7) Connect hoses between barge and cargo loading manifold (i.e., shore or vessel).

NOTE

It is a good safety procedure to use an electrical bonding connector during loading and offloading. Electrical bonding between the barge and shore side facility is used to reduce the potential build-up of stray electric currents or static charges which could create a hazard should a spark occur from making or breaking cargo couplings. Most terminals have a bonding connector available which is a single wire with electrical clips on both ends and a switch in between. See Figure 3-1. With the switch open, one clip is attached to the shore piping (to ground) and the other clip to the barge (to the hull). When the switch is closed, the electrical potential is equalized. The cargo hose is then attached.

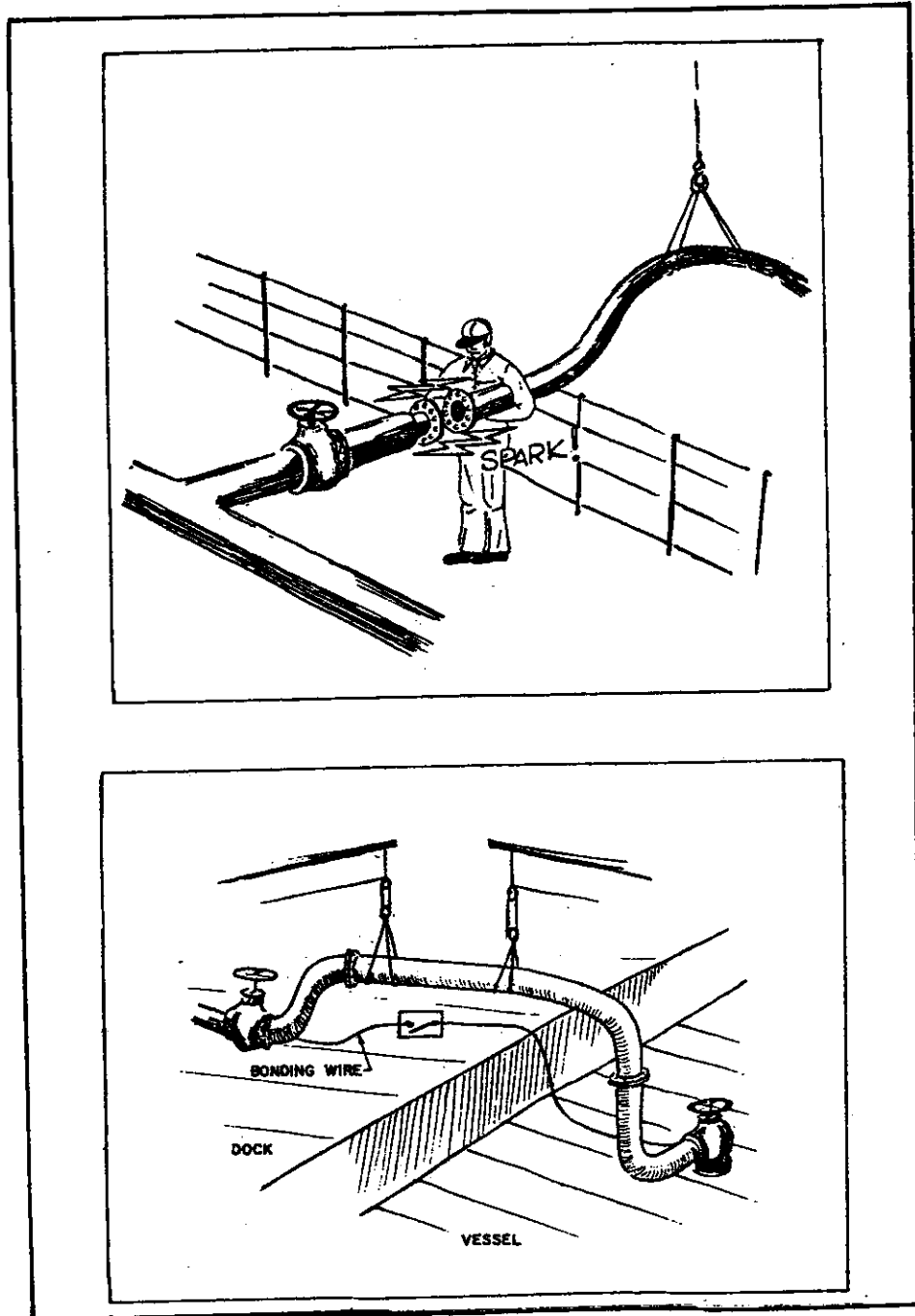


FIGURE 3-1

Electrical Bonding Connection  
Between Vessel and Dock

Taken from U. S. Coast Guard Publication CG-174, September 1, 1976

- (8) Be certain the hose will not snag or chafe.
- (9) Inspect the condition of the hose. Look for cuts, slashes or worn spots. Replace or repair if required.
- (10) Before pumping, check all cargo valves on the barge and shore for alignment.
- (11) Commence pumping at reduced rate. Check for leaks and filling of proper tanks.
- (12) Increase the pump pressure slowly. Repeat hose inspection (step 8). Check for leaks around barge.
- (13) Set the watch. Refer to item 12 in Section 3.1, above.
- (14) Reduce the loading rate when topping off the cargo tank and/or transferring to other tanks. The following items should be kept in mind:
  - (a) Closing off one tank increases the rate of flow to other tanks in the FILL position.
  - (b) The rate of flow into a tank which is nearly full can be quickly reduced by opening the valve to an empty tank.
  - (c) Care should be taken not to over-pressurize the cargo hose.
  - (d) After topping off a tank place the cargo valve in CLOSED position.
  - (e) The liquid level in topped off tanks should be checked frequently to make certain the level is not changing.
  - (f) The man in charge of topping off tanks must give the operation his undivided attention.
- (15) When loading is completed make certain hatches and ports are dogged tight.
- (16) Disconnect hoses (at ship's end first, allowing contents to drain into the SWOB's piping), cap, and store on rack provided. Break bonding connection.
- (17) Make note of the quantity and type of cargo in the tanks. It is preferable to keep an accurate log of this information.

### 3.4 OFFLOADING PROCEDURE<sup>1</sup>.

(1) Review the General Operating Guidelines in Section 3.1.

(2) If repairs were made, check to see that they were completed properly.

(3) Put the generator or shore power on the line. Refer to Sections 3.6.2 or 3.6.3 for this procedure.

(4) Turn on the pump room blower. Operate at least five minutes prior to entering or operating equipment in the pump room (even the lights!).

(5) Rotate pumps by hand one or two turns. Check for smooth operation, condition of belts and seal leakage.

(6) After the generator is warmed up, or the shore power is connected, place the cargo pump 440v AC circuit breaker to the ON position.

(7) Place cargo pump motor controls (on the control panel) to the ON position after checking that motor starting switches are in the OFF position.

(8) Start level indicators and activate the level alarm. Refer to Section 3.5.1 for this procedure.

(9) Activate the low level pump cutoff by setting MANUAL OVERRIDE SWITCH (on the control panel) to the OFF position.

#### NOTE

If any tank has less than 10% of capacity, place MANUAL OVERRIDE SWITCH for that tank to ON position.

(10) Set cargo transfer valves in the pump room. Cargo transfer valves should be only in either DISCHARGE or CLOSED positions. The valves are operated remotely from the deck-house. Valve position is indicated by lights on the control panel besides the level indicators. Valve position can also be found by a pointer located on the valve stem between the remote operator and the valve body. When the pointer is aft, the tank will be emptied and when to port, the valve is closed. The valves must not be left in the FILL position (pointer aft) since cargo will fill those tanks. One exception is if cargo is to be transferred between tanks.

<sup>1</sup> The operator must be familiar with the cargo piping layout and the cargo handling components (see Chapter 2) before attempting to offload the SWOB.

(11) Check filling/discharge valve stations on deck. Valves not in use must be closed.

(12) Check camlock hose couplings. Clean or lubricate as necessary.

(13) Connect hoses between barge and cargo loading manifold (i.e., shore or vessel).

NOTE

It is a good safety procedure to use an electrical bonding connector during loading and offloading. Refer back to Item 7 and Figure 3-1 in Section 3.3, Loading Procedure.

(14) Be certain the hose will not snag or chafe.

(15) Inspect the condition of the hose. Look for cuts, slashes or worn spots. Replace or repair as required.

(16) Before pumping, check all cargo valves on the barge and shore for alignment.

(17) Start pumping by placing motor starting switches to the AUTOMATIC position. Both pumps must be operated together, see Section 2.2.2 for the reason.

(18) Repeat hose inspection. Check for leaks around the barge.

(19) Set the watch. Refer to Item 12 in Section 3.1, above.

(20) The pumps will stop when any tank reaches 10% capacity. To pump remaining tanks, close the cargo valve of the 10% tank and place the MANUAL OVERRIDE SWITCH to the ON position. The pumps will restart. Continue pumping out all remaining tanks.

NOTE

If it is required to empty a tank below 10%, leave the cargo valve for that tank open and place the MANUAL OVERRIDE SWITCH to the ON position. Do not run the pump dry for extended periods of time.

(21) When offloading cargo and/or transferring to other tanks, the following items should be kept in mind:

(a) Closing off one tank increases the rate of flow out of the other tanks in the DISCHARGE position.

(b) To prevent cargo draining back into the cargo tank, close the cargo valve before stopping the pump.

(c) The level in an empty tank should be checked frequently to make certain that the level is not changing.

(22) When offloading is completed, make certain hatches and ports are dogged tight.

(23) Disconnect hoses, drain, cap, and store on racks provided. Break bonding connection.

(24) Make note of the quantity and type of cargo discharged. It is preferable to keep an accurate log of this information.

### 3.5 OPERATION OF LEVEL INDICATORS AND LEVEL ALARM

#### 3.5.1 Startup Procedure.

(1) Open valve on pressure flask and check pressure. (see Figure 4-4 for location of gauge).

#### NOTE

When shore power or the generator is on line, the 120v AC air compressor will automatically supply the required air to the system. Gas from the pressure flask will not be expended unless 120v AC service is off.

(2) Turn on 24v DC control power switch. The white light will come on; if not, see Section 5.18.1. When the control power switch is turned on, the level alarm will most probably sound. The flashing amber light on the control panel indicates which tank is triggering the alarm (e.g., a dry tank). Flip the HORN SILENCE MODE SWITCH to silence the alarm. The amber light will remain lighted but will stop flashing.

(3) Check air flow rotometers located inside the control panel (see Figure 4-3). If necessary, adjust knob on rotometer to obtain 1.0 SCFM. Do not readjust high or low pressure regulators. If no flow is indicated, see Section 5.18.3.

(4) Level indicators will now read properly. Also, the level alarms are activated and will sound if the level drops below 10% or rises above 90%.

#### NOTE

False alarms can occur; some causes are noted in Section 2.4.3.

(5) When the alarm sounds, the following sequence will occur:

(a) Horn and flashing red light located outside forward bulkhead of deckhouse will turn on,

(b) The 90% or 10% light will be on,

(c) The amber HORN ON light will flash for the affected tank.

(d) Discharge pumps will shut down (for 10% alarm).

The operator should then take corrective action. To silence the alarm, flip HORN SILENCE MODE SWITCH. The amber HORN ON light will remain on indicating which tank is affected. When the level reaches a "safe" condition the amber light will go out as will the 90% or 10% light.

### 3.5.2 Securing Procedure.

(1) Shut off 24v DC control power switch.

(2) Close valve on external pressure flask.

#### NOTE

The system should always be secured after completion of loading or unloading operations to conserve flask pressure.

## 3.6 POWER SYSTEM OPERATION.

### 3.6.1 Generator Operation.

#### 3.6.1.1 Startup Procedure.

(1) Clear the area of tools, rags or other items which may interfere with the generator operation. Check the overall condition of the engine (i.e., hoses, belts, etc.).

(2) If repairs were made, check to see that they were completed properly.

(3) Check engine oil for proper level (see Section 4.1.1).

(4) Check radiator coolant for proper level (see Section 4.1.3).

(5) Check fuel level (see Section 4.1.7) and open fuel supply valve to engine.

(6) Check radiator and oil drip pan for fouling (see Sections 4.1.5 and 4.1.6).

(7) Check if area around diesel exhaust pipe is clear. Consider the effects of engine smoke, noise and heat.

(8) Check emergency cutoff. Reset if necessary (see Figure 3-2).

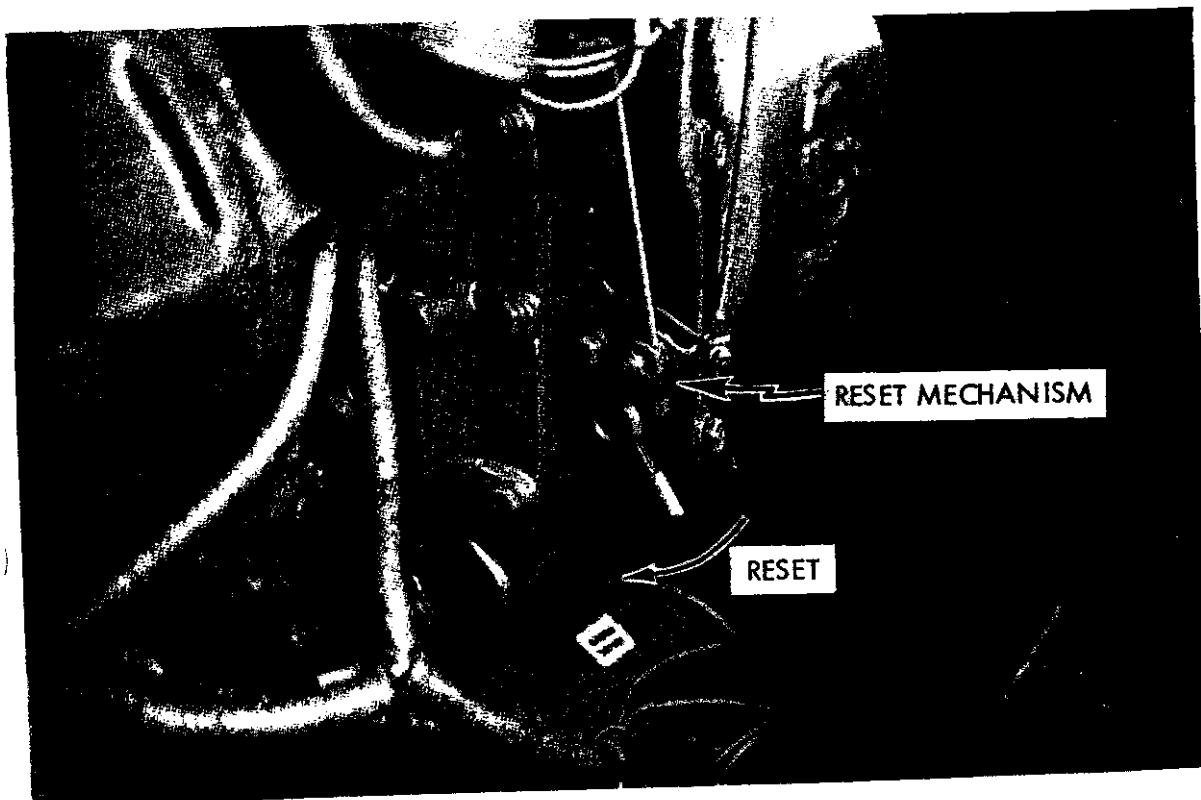


FIGURE 3-2  
Emergency Shutoff Reset Cam for Diesel

NOTE

The blower can be seriously damaged if the engine is rotated with emergency cutoff tripped.

(9) Check to see if the generator circuit breaker is in OFF position.

NOTE

Interlock must be across GENERATOR switch handle.



(10) Set the throttle in the part-open position. This is done by depressing the throttle button and rotating in clockwise direction (about 1/3 way between second and third detent).

(11) Depress starter switch and release when engine starts.

NOTE

Do not crank for more than 30 seconds. As engine accelerates to speed, retard throttle to idle position (second detent). If engine fails to start, skip to Step 14.

(12) Check oil pressure gauge, coolant temperature gauge and ammeter. Oil pressure should rise to at least 30 psi within 10 to 15 seconds after starting.

NOTE

If oil pressure does not develop, secure engine by retarding throttle to STOP position. Refer to Section 5.3.

(13) Allow engine to run at idle position for five minutes to warm up (avoid extended idling periods). Engine temperature should reach from 160° to 185°F and the ammeter should be at 0 amps. Look and listen for unusual noises, leaks, etc. and check engine exhaust occasionally.

NOTE

If an unusual condition should arise during warm up, secure engine and refer to Section 5.

(14) If the engine did not start, allow one minute for starter motor to cool and try three more times. If the engine still does not start, refer to Section 5.1.

(15) In cold weather, use "Quick Start" starting aid system as follows:

(a) Press engine starter button as before,

(b) While the engine is turning, raise valve lever located below starter fluid cannister for one or two seconds and release, and

(c) If the engine does not start, repeat procedure as in Step 14.

CAUTION

Starting fluid is highly flammable and toxic and possesses anesthetic properties.

(16) After warm up, slowly accelerate engine to RUN position (third detent).

(17) Adjust engine speed at RUN position to 1800 RPM. This is accomplished with the knurled vernier knob on throttle.

(18) On generator control panel check that frequency meter reads 60 Hz. To adjust frequency, raise or lower engine speed with vernier knob.

(19) Adjust voltage by turning the control on the automatic voltage regulator (labeled "Voltage Adjust") to 440v AC.

(20) Rotate Voltmeter and Ammeter Switch through all phases. Ammeter should remain at zero and Voltmeter at 440v AC. If phases are out of balance, see Section 5.7.

(21) Inspect the engine and check all gauges.

(22) The generator is now ready to place on the line.

3.6.1.2 Connecting the Generator to the Load.

(1) Check that the cargo pump selector switches are in the OFF position, cargo pump circuit breakers on the control panel are in the OFF position, and the main cargo pump breaker is in the OFF position.

NOTE

If the pumps are operating on shore power before power transfer, shut off switches in the order stated above.

(2) Place shore power breaker in OFF position.

(3) Slide the interlock to the left. Place generator main circuit breaker in the ON position. The generator is now on line.

NOTE

Each time the load on the generator is changed significantly (e.g., turning cargo pumps ON), check generator voltage and frequency; readjust as required.

### 3.6.1.3 Securing Procedure.

- (1) Remove the load from the line.
- (2) Place the generator main circuit breaker to the OFF position.
- (3) Slow the engine and place the throttle in the idle position. Allow the engine to run at idle for several minutes.
- (4) Place the throttle in the STOP position to stop the engine.

#### NOTE

Do not stop the engine using the emergency shut-down system, since it can cause oil to be sucked past the oil seals into the blower housing.

- (5) Close the fuel shut-off valve to the engine. Refill the fuel tank to prevent condensation.

### 3.6.2. Shore Power Operation.

#### 3.6.2.1 Connecting Procedure.

- (1) Check the shore receptacle for proper voltage and grounding.
- (2) Check that the shore power switch on the power panel is in the OFF position.

#### NOTE

Interlock should be across the shore power switch handle.

- (3) Install the cable on the SWOB.
- (4) Check phase rotation by pressing the push-button on the phase rotation indicator. The indicator (the black dot on the disc) must rotate in the direction of the arrows (clockwise).

#### NOTE

If the phase rotation is incorrect, the cable wiring must be changed. To do this, interchange any two phases. Do not check phase rotation after the shore power is placed on line.

- (5) Shore power cables should be carefully secured to prevent chafing, straining or pinching. Consider the effect of tides and waves. Check the cable periodically.

### 3.6.2.2 Connecting the Shore Power to the Load.

(1) Check that cargo pump selector switches are in the OFF position, cargo pump circuit breakers on the control panel are in the OFF position, and the main cargo breaker is in the OFF position.

#### NOTE

If the pumps are operating on generator power before power transfer, shut off switches in the order stated above.

(2) Place the generator circuit breaker in the OFF position.

(3) Slide the interlock to the right. Place the shore power main breaker in the ON position. Shore power is now on line.

### 3.6.2.3 Disconnecting Procedure.

(1) Remove the load from the line.

(2) Place the shore power main breaker to the OFF position.

(3) Disconnect the shore cable.

## CHAPTER 4. PREVENTIVE MAINTENANCE

4.1 DIESEL GENERATOR. Preventive maintenance covers those tasks that must be done on a routine basis to keep the equipment in proper operating condition. This usually requires four types of tasks: inspection, replacement, cleaning and lubrication. Each of these routine tasks is listed in Table 4.1. This maintenance schedule chart shows the preventive maintenance tasks and their recommended frequency. Furthermore, each task is keyed to the following sections that provide functional descriptions of the maintenance.

4.1.1 Engine Oil. Check the oil level daily before starting the engine. Add oil if necessary, to bring it to the proper level on the dip stick. Select the proper grade of oil in accordance with the instructions given in NAVSEA 0961-LP-069-1010. It is recommended that new engines be started with 100 hour<sup>1</sup> oil change periods. The drain interval may then be gradually increased or decreased following past experience or the recommendations of an independent oil analysis laboratory or the oil supplier (based on the oil sample analysis) until the most practical oil change period has been established.

4.1.2 Oil Filter. Change the engine oil filter elements and gaskets each time the engine oil is changed. Any deviation, (such as changing the filter every other oil change) should be based on laboratory analysis of the drained oil and used filter elements to determine if such practice is practical for proper protection of the engine.

4.1.3 Coolant. Check the coolant level daily and maintain it near the top of the radiator upper tank. Clean the cooling system every 1,000 hours or every 12 months using a good radiator cleaning compound in accordance with the instructions on the container. After the cleaning operation, rinse the cooling system thoroughly with fresh water. Then fill the system with soft water, adding a good grade of non-chromate rust inhibitor and ethylene glycol antifreeze (refer to Engine Coolant Section of NAVSEA 0961-LP-069-1010).

4.1.4 Hoses. Inspect all of the cooling system hoses at least every 500 hours or 6 months for signs of deterioration. Replace the hoses if necessary.

4.1.5 Radiator. Inspect radiator and louvers for dirt accumulation; if necessary, clean with grease solvent. Do not use

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<sup>1</sup> Note, time intervals given in hours are for elapsed operating time.



fuel oil, kerosene or gasoline. It may be necessary to lubricate louver linkages.

4.1.6 Oil Drip Pan. Clean engine and drip pan of oil and grease at least every 300 hours or 12 months. Inspect for excessive oil leakage; if necessary, follow up with repairs. Do not use fuel oil, kerosene or gasoline.

4.1.7 Fuel Tank. Keep the fuel tank filled to reduce condensation to a minimum. Select the proper grade of fuel in accordance with NAVSEA 0961-LP-069-1010. Diesel Fuel Oil Specifications. Open the drain at the bottom of the fuel tank every 200 hours or 2 months to remove any accumulated water or sediment.

4.1.8 Strainer and Filter. Clean strainers and replace fuel filters every 300 hours.

4.1.9 Air Cleaner.

(1) Remove dirty oil and sludge from the oil bath type air cleaner cups and center tubes every 10 hours. Wash the cups and the elements in clean fuel oil and refill the cups to the level mark with the same grade and viscosity heavy duty oil as used in the engine.

(2) It is recommended that the body and the fixed element in the heavy-duty oil bath type air cleaner be serviced every 500 hours or as conditions warrant. Clean or replace the element in the dry type Donaldson "Cyclopac" air cleaner when the restriction indicator instrument indicates high restriction or when a water manometer reading at the air inlet housing indicates the maximum allowable air inlet restriction (refer to NAVSEA 0961-LP-069-1010. Directions for cleaning are given in NAVSEA 0961-LP-069-1010).

4.1.10 Air Box. Drain air box drain tank every 300 hours. Disassemble tubing and tank and clean every 12 months. Clean with fuel oil.

4.1.11 Ventilation System. Remove the externally mounted crankcase breather assembly every 1,000 hours or 12 months and wash the steel mesh pad in clean fuel oil. Clean the breather cap mounted on the valve rocker cover in clean fuel oil every time the engine oil is changed. (Refer to NAVSEA 0961-LP-069-1010).

4.1.12 Blower Screen. Inspect the blower screen and gasket assembly every 1,000 hours and if necessary, clean the screen in fuel oil and dry with compressed air. Install the screen and gasket assembly with the screen side of the assembly toward the blower.

4.1.13 Starting Motor. The electrical motor is lubricated at the time of original assembly. Oil is added to the oil wicks, which project through each bushing and contact the armature shaft, by removing the pipe plugs on the outside of the motor. The wicks should be lubricated every 6 months or whenever the starting motor is taken off the engine or disassembled.

4.1.14 Batteries.

(1) Check the electrolyte level every ten hours. Specific gravity of the electrolyte should be checked every 100 hours.

(2) Clean the battery terminals every 1,000 hours. Remove the terminals and wire brush electrical contacts. Reassemble and coat terminals with grease.

4.1.15 Tachometer Drive. Lubricate the tachometer drive every 100 hours with an all-purpose grease at the grease fitting. At temperatures above 30°F use a No. 2 grade grease.

4.1.16 Linkages/Trip. Lubricate all external engine linkages every 200 hours using engine oil or grease where necessary.

4.1.17 Tune-Up. There is no schedule interval for performing on engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. However, adjustments to the valve and injector mechanisms, governor, etc. should be checked every 300 hours.

4.1.18 Drive Belts. Check belt tension and condition after 200 hours; if necessary, replace and retension. Check Detroit Diesel In-Line 71 Service Manual for tensioning and break-in procedure.

4.1.19 Overspeed Governor. Lubricate the overspeed governor with 5 or 6 drops of clean engine oil every 500 hours. Avoid excessive lubrication. Do not lubricate the governor while the engine is running.

4.1.20 Shut-Down System. Actuate and reset the shut-down system every 300 hours or each month to be sure it is functioning correctly.

4.1.21 Generator Bearing. Check oil level in the sight gage every 200 hours. Use the same grade and viscosity of oil specified for the engine. Do not overfill. Recheck the oil level after running the generator for several minutes. Change bearing oil every 6 months.

4.1.22 Insulation and Brushes.

(1) After 100 hours or new brushes, or brushes in



generators that have not been in use over a long period, remove the end frame covers and inspect the brushes, commutator and collector rings. If there is no appreciable wear on the brushes, the inspection interval may be extended to 6 months. To prevent damage to the commutator or the collector rings, replace the brushes before they become shorter than 3/4 inch.

(2) Keep the generator clean inside and out. Before removing the end frame covers, wipe off the loose dirt. Loose dirt and dust may be blown out with low pressure air (25 psi maximum). Remove all grease with a cloth only.

(3) Electrical insulation should be checked every 6 months according to the procedure in NAVSEA 0961-LP-069-1010.

4.1.23 Ether System. The ether starting system should be checked every 300 hours and, if necessary, replaced. Spare bottles should be kept on hand.

4.1.24 Lagging. Lagging on the exhaust system should be checked every 2 months for tightness and made secure to piping if found loose.

#### 4.2 CARGO PUMPS.

##### 4.2.1 Pump and Motor Bearings.

(1) Check motor and pump bearings for overheating during daily or routine operation. Bearings should be warm (but not hot) to touch. Check motor field windings for overheating in the same manner.

(2) The pump ball bearings should be lubricated at least every 50 hours or once a month with a light No. 2 lithium-base type of grease. Apply slowly with a hand gun to the grease fittings on each bearing cover until excess grease begins to ooze from the relief fittings. It is normal for some grease to escape from the tell-tale holes under the bearing covers for a short period after lubrication. If this condition persists, the head should be removed and the mechanical seal examined for wear or damage.

(3) Motor bearings should be lubricated at least every 50 hours or once a month with one ounce of light grease per bearing. Use a good quality rust inhibiting polyurea-based grease such as Chevron SRI.

4.2.2 Pump Seal. Check pump seals and pump casing for leakage daily. Leakage will appear at the tell-tale holes under the bearing housing on the pump head. If leakage becomes excessive, the entire mechanical seal assembly should be replaced. If

leakage appears from between the pump cylinder and the head, the head should be removed and its "O" rings inspected for cuts and nicks. If the "O" ring is damaged, it should be replaced.

4.2.3 Relief Valve. Check the cargo pump discharge pressure every 200 hours. This can be accomplished by operating both pumps with all deck discharge valves closed and the cargo transfer valves in the DISCHARGE position. Discharge pressure should not exceed 80 psig.

NOTE

Pumps should not be operated in this mode, except for this brief check of the internal relief valve. Low (shut-off) pressure indicates excessive vane wear requiring a pump overhaul (see Section 5.11.3).

4.2.4 Pump Foundation. Check pump and motor foundation bolts for tightness every 200 hours. Special attention should be given to new installations and should be checked after 10 hours of operation.

4.2.5 Pump, Motor, and Pipe Supports. Check pump, motor and cargo piping for excessive vibration every 50 hours. Check for broken supports and leakage. Repair as required.

4.2.6 Hose Couplings. Check hose couplings between the pumps and cargo piping every 100 hours. Inspect for swelling, cracking or fatigue. Replace as necessary; do not wait for failures to occur. When replacing coupling, be sure to place transfer valves to no-flow position and drain discharge piping.

4.2.7 Cargo Pump Drive Belt. Check belt condition every 100 hours. Inspect for inadequate tension, fraying along the edges and cracking. Replace or readjust as necessary. Adjust belt so that 30 pounds of force will deflect the midspan of the belt three-tenths of an inch. Check tightness of taper lock pulley bolts.

4.2.8 Electrical Insulation. Check electrical insulation of motor every 6 months.

4.2.9 Strainer. If suction strainer is fitted, clean basket every 50 hours of operation or as necessary.

### 4.3 CARGO VALVES.

4.3.1 Valve Glands. Check if cargo valves leak under discharge pressure every 200 hours or every 2 months; if necessary, tighten packing glands or replace packing or valve seats.

#### 4.3.2 Valve Operation, Manual/Auto.

(1) Operate all cargo valves in the manual mode of operation every 200 hours or once a month. Also, lubricate needle bearing on cargo valve stem every month with light oil. See Figure 4-1 and Figure 4-2 for lubrication point.

(2) Check that valve wheels on the automatic operators return freely from the manual to the automatic mode of operation; if necessary, lubricate the valve stem bearing on the casing with light oil.

(3) Operate valves in the automatic mode of operation to check that opening and closing times are uniform; the traversing time from FILL to DISCHARGE should be about 16 seconds.

4.3.3 Hose Connector Lubrication. Lubricate all levers on camlock cargo hose couplings every month with light oil. Check that camlock levers operate freely.

#### 4.4 CONTROL SYSTEMS.

4.4.1 Air Compressor and Filter Blowdown. Blowdown air receiver and air filter once every two months or every 200 hours. Check that all water and sediment is removed.

4.4.2 Air Compressor Suction Filter.

(1) Clean air compressor suction filter every 12 months. The filter can be cleaned by unscrewing from the cylinder head. Push out screens and felt pad. Thoroughly wash parts in thinner or solvent. Replace felt pad after several cleanings. Never operate the compressor without the filter.

(2) Clean high pressure air filters every 12 months. Remove four bowl screens and bottom filter element screw. Remove filter and clean in thinner or solvent.

4.4.3 Calibration Check.

(1) Check level indicator flow meters every 10 hours. With indicators operating, adjust flow meters to read 1.0 SCFH. (see Figure 4-3).

(2) Compare level indicator readings with dip stick or ullage readings every 6 months (with barge on even keel).

4.4.4 Alarm Operation and Light Check. Check for proper operation of alarm and warning lights every 100 hours.

4.4.5 Nitrogen Bottle Check. Check supply pressure of nitrogen bottle every 50 hours. Pressure gage is located on pressure

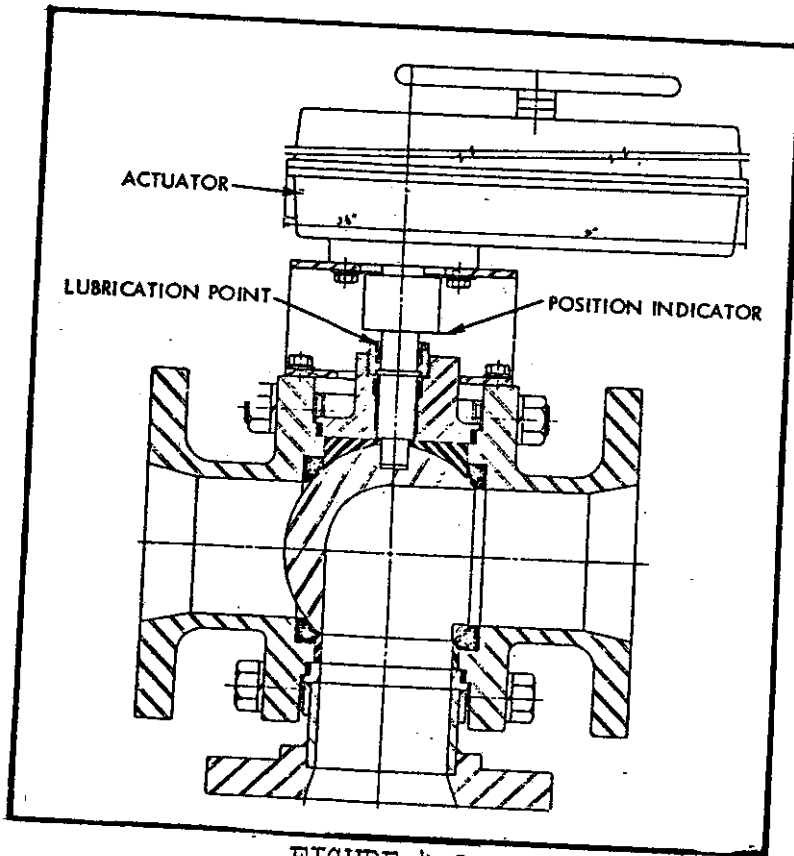


FIGURE 4-1  
Cross Section of 3-Way Cargo Valve

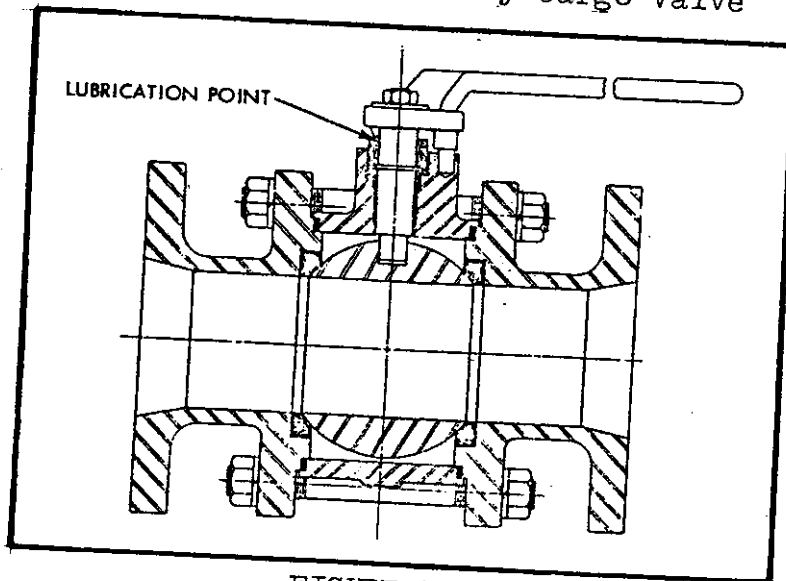


FIGURE 4-2  
Cross Section of 2-Way Cargo Valve

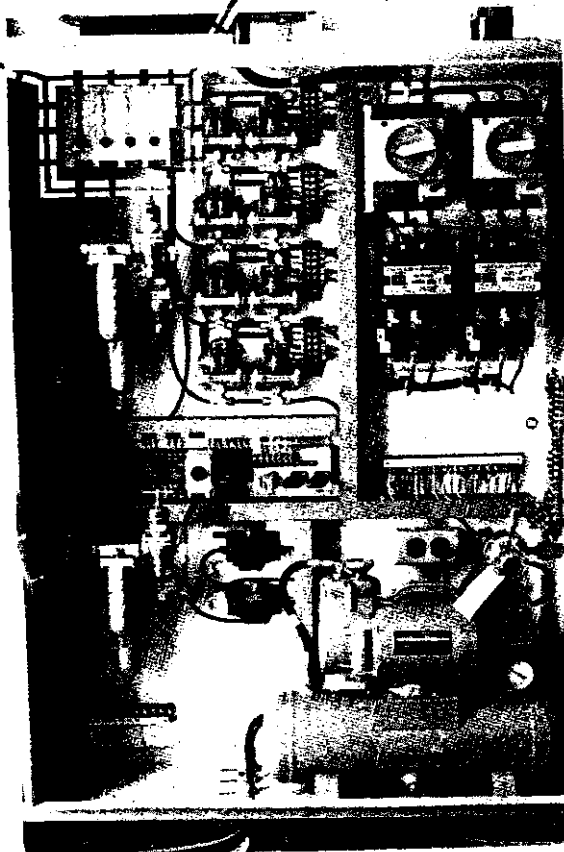
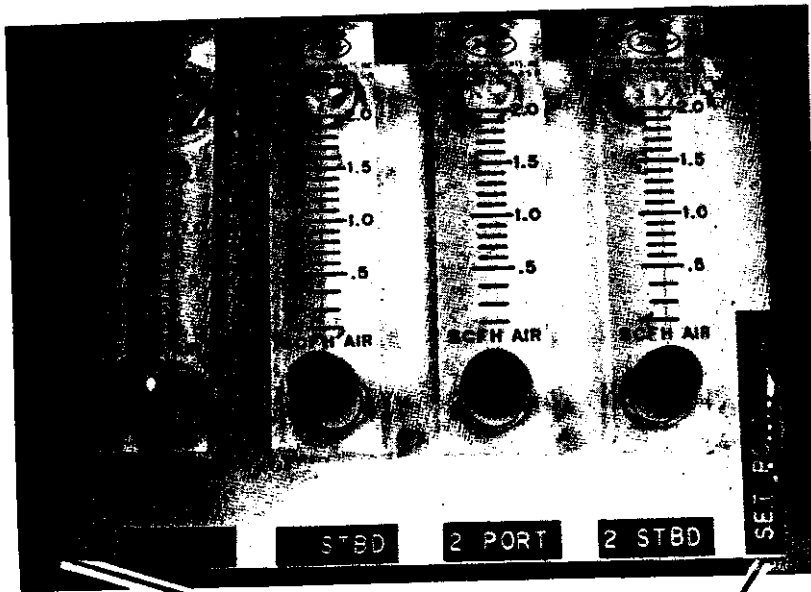


FIGURE 4-3  
Location of Rotometers

regulator inside the control panel (see Figure 4-4). Replace bottle when pressure falls below 200 psig.

4.4.6 Wiring. If connected, inspect the condition of the shore power cable every 200 hours. Check for chafing or straining. All wiring should be inspected every 6 months. Check for grounds to hull, broken harness, cracking or corrosion; replace or repair as required.

4.4.7 Power Panels and Interlock.

(1) Check electrical panels for corrosion or improper operation every 6 months; replace paint or repair as required.

(2) Interlock should be checked for proper operation. All power must be secured at that time. Check that shore and generator power cannot be operated together.

4.4.8 Emergency Lantern. Check emergency lanterns for proper operation every 6 months. Replace bulbs and batteries as required.

4.4.9 Battery Charge. Check battery charger every 2 months. Charging current should not exceed one-half ampere when batteries are near full charge. Inspect for corrosion on connectors.

4.5 MISCELLANEOUS.

4.5.1 Blower. Clean and lubricate blower every 6 months. Access to blower motor is through blower casing door.

4.5.2 Safety Equipment Check. Check all safety equipment daily for proper location and condition. Fire extinguishers should be checked every 6 months for proper charge.

4.5.3 Deck Gear Lubrication. Check all hinged or moveable joints for proper lubrication every 2 months. This is to include hatches, winches (if fitted) and dogs. Lubricate as necessary with oil or light grease.

4.5.4 Tanks, Voids and Vents.

(1) Inspect tank vent screen every 6 months. Check for corrosion and dirt. If necessary, remove screen and clean with solvent.

NOTE

Tanks should be certified gas-free prior to inspection. Proper procedures for entering fuel oil tanks must be followed.

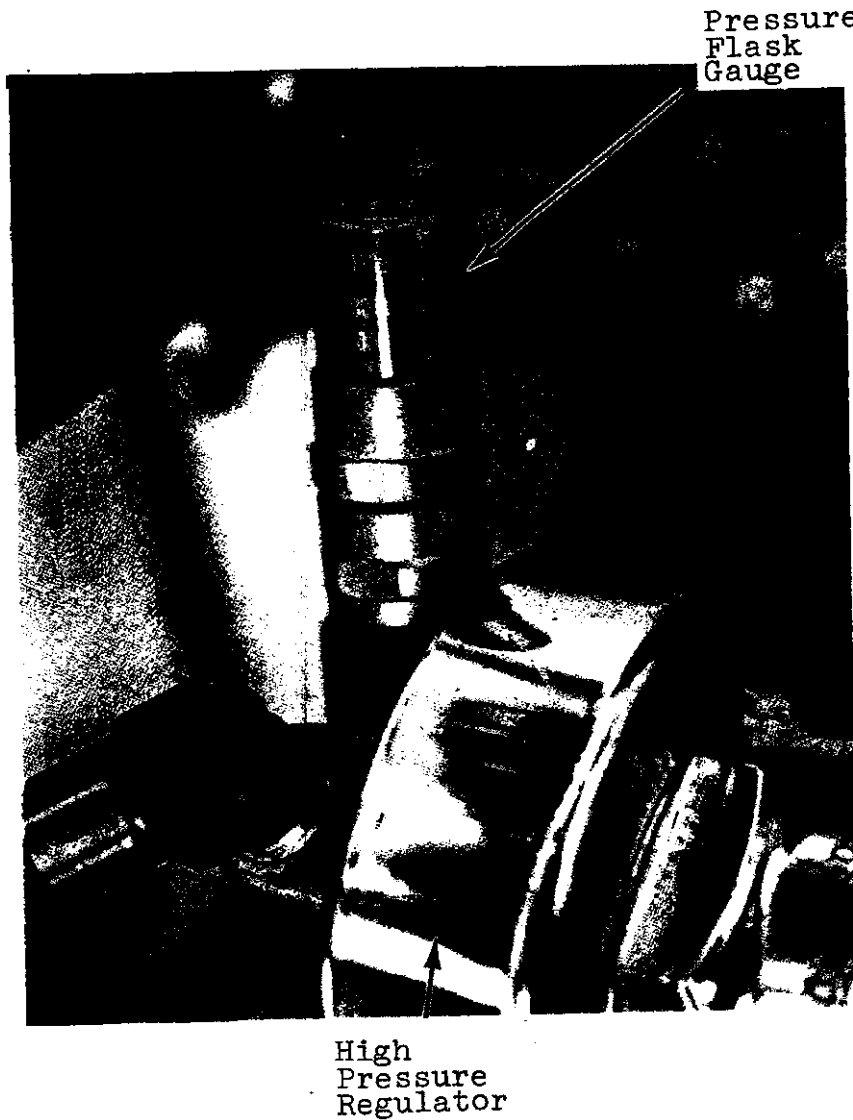


FIGURE 4-4

Location of Pressure Flask Gauge

NOTE: Cargo pump circuit breakers must be in off position to open the control panel.

(2) Inspect tank and void internals every 12 months. Check for corrosion, sump blockage and damage. Make repairs or clean as required. Clean tank level gauge internal components.

4.5.5 Anode Protection. Sacrificial anodes should be checked every 12 months. These anodes are located below the water line as indicated by small rectangles in Figure 2-1. However, they may be exposed by ballasting as shown in Figure 4-5. Therefore, they may be checked during cargo operations.



FIGURE 4-5  
Anode Position on Starboard Skeg - Exposed  
By Ballasting

4.5.6 Paint Inspection. Inspect hull and equipment every two months to determine need for painting and/or touching-up. Painting should be done as required. Painting instructions and a solvent chart are given in Tables 4.2 and 4.3, respectively.



TABLE 4-2  
Painting Instructions

	SURFACE PREPARATION	1st Coat	2nd Coat	3rd Coat	Additional	Remarks
Bottom and side to 1'-10" draft including exterior of skegs. (a)	Near white blast to SSPC 10-63T or Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Formula 150 Green 3 mils	Epoxy Formula 151 Haze Gray 3 mils	Epoxy Formula 154 Dark Gray 2 mils	Vinyl AF Formula 121/63 2 coats 4 mils total	Gen Notes 2A, 2B
Sides, bottom, logs and skegs from 1'-10" draft to deck. (b)	Near white blast to SSPC 10-63T Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Formula 150 Green 3 mils	Epoxy Formula 151 Haze Gray 3 mils	Epoxy Formula 153 Black 2 mils	---	Gen Notes 2A
Exterior flat deck: fwd, aft and outboard of exposed deck framing; exposed deck framing, including walkways and deck perimeter. (c)	Near white blast to SSPC 10-63T Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Devran 201 3 mils	Epoxy Nonakidd Devran 237M Gray 20 mils MIL-D-23003 Ty2	---	---	Gen Notes 2A
Exterior deck within area with exposed framing: exposed deck framing, and deck house deck (d)	Near white blast to SSPC 10-63T or Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Devran 201 3 mils	Epoxy Devran 209 Deck Gray 2 mils	Epoxy Devran 209 Deck Gray 2 mils	---	Gen Notes 2A
Deck house exterior including house top and ladder (e)	Near white blast to SSPC 10-63T or Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Devran 201 3 mils	Epoxy Formula 151 Haze Gray No. 27 3 mils	Epoxy Formula 151 Haze Gray No. 27 2 mils	---	Gen Notes 2A, 4, 6
Steel hull fittings in the weather cleats, king posts, cargo booms, stowage clips, etc. (f)	Near white blast to SSPC 10-63T or Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Devran 201 3 mils	Epoxy Formula 151 Haze Gray No. 27 3 mils	Epoxy Formula 151 Haze Gray No. 27 2 mils	---	Gen Notes 2A
Voids including double bottom voids, wing voids, voids in fwd and aft rake (g)	Wire brush or blast to remove all loose rust and mill scale	Red Lead 52-MA-201	Red Lead 52-MA-201	---	---	Gen Notes 2B(2), 3
General galvanized surfaces (h)	Wire brush or blast to remove all loose rust and mill scale	Devran 201 2½ mils	Formula 151 Haze Gray No. 27 2½ mils	---	---	Gen Notes 2A, 2B, 6

TABLE 4-2 (Continued)

	SURFACE PREPARATION	1st Coat	2nd Coat	3rd Coat	Additional	Remarks
Sewage tanks - interiors, ladders, etc. (1)	Near white blast to SSFC 10-63T or Wheelabrator to near white and apply preconstruction primer at wheelabrator (Devran 208)	Epoxy Devran 244HS 4 mills	Epoxy Devran 244HS 4 mills	---	---	Gen Notes 2A, 3
Pumproom, including bulkheads, overhead, bottom, shell and foundations and deck gear storeroom (j)	Wire brush or blast to remove all loose rust and mill scale	Devran 201 2½ mills	White Gloss 52-MA-106	White Gloss 52-MA-106	---	Gen Notes 2A, 3
Deckhouse, interior steel items, shelving (k)	Wire brush or blast to remove all loose rust and mill scale	Devran 201 2½ mills	White Gloss 52-MA-106	White Gloss 52-MA-106	---	Gen Notes 2A, 3, 4
Hull marking, Draft marks (l)	Wipe area with appropriate solvent	White Enamel	White Enamel	---	---	

Specifications listed below apply to the following types of coating:

COATING

- (a) Formula 150 Green . . . . .
- (b) Formula 151 Haze Gray . . . . .
- (c) Formula 154 Dark Gray . . . . .
- (d) Formula 121/63 . . . . .
- (e) Devran 237M Dark Gray . . . . .
- (f) Red Lead 52-MA-201 . . . . .
- (g) Enamel 52-MA-152 Gray No. 27 . . . . .
- (h) Enamel 52-MA-106 White Gloss . . . . .
- (i) Devran 244 MS Orange . . . . .
- (j) Devran 244 MS White . . . . .
- (k) Devran 201 . . . . .
- (l) Devran 208 . . . . .
- (m) Formula 153 Black . . . . .
- (n) Devran 209 Deck Gray . . . . .

SPECIFICATIONS

- MIL-P-24441/1 (3)
- MIL-P-24441/2 (3)
- MIL-P-24441/5 (3)
- MIL-P-15931C
- MIL-P-23236 (5)
- Available through U.S. Maritime Admin., Division of Naval Architect.
- Available through U.S. Maritime Admin., Division of Naval Architect.
- Available through U.S. Maritime Admin., Division of Naval Architect.
- MIL P 23236 (5)
- MIL P 23236 (5)
- MIL P 23236 (5)
- MIL P 23236 (5)
- MIL P 24441/4 (3)
- MIL P 23236 (5)

TABLE 4-2 (Concluded)

GENERAL NOTES

1. No coatings specified herein may be applied at an ambient or surface temperature of less than 35° F or over wet surfaces. Surfaces receiving an epoxy coat must be dry.
2. The following guide is given for determining intervals between successive coats:
  - A. Epoxy Coatings
    - (1) Minimum Interval: A following coat can be applied only after the solvents have dissipated from the preceding coat.
    - (2) Maximum Interval: Recoating should occur before the preceding coat is fully cured. In event the preceding coat has cured, apply a 0.5 mil tac coat of the next coating material. Wait approximately 5 - 10 minutes before applying the specified millage of the next coat. It is preferable to avoid this procedure whenever possible.
    - (3) After formula 150 has been applied, the order in which formulae 151-156 are applied is of no significance other than obtaining desired final color.
  - B. Other Coatings
    - (1) Anti-foul Formula 121/63 should be applied within approximately 12 hours of launching, the time varying with temperature and humidity.
    - (2) Red lead 52-MA-201 and enamel 52-MA-152, 52-MA-106 should be dry to touch.
3. Enclosed spaces should be effectively ventilated between coats.
4. Care shall be taken to effectively mask off airports, dead lights, shaft seals, stuffing boxes, lenses, valve stems, winch gear teeth, fiberglass, etc., prior to blasting in the area or application of paint.
5. All paint and coating compounds referred to herein are as supplied by Devoe & Raynolds.
6. Generally, galvanized surfaces are to be painted to match the surrounding area. Primer is to be Red Lead Devran 201 or 52-MA-201. Top coats to be same in number and type to match surrounding areas.
7. Where galvanize has been damaged by welding or other causes, the damaged area shall be touched up with Red Lead or Devran 201 prior to application of system given in General Note 6 above.
8. Where an epoxy or zinc coating has been damaged by welding or other causes the damaged area shall be sandblasted to near white or disc-sanded, washed down with a detergent, then wiped down with appropriate Devran thinners, then full coating system applied. Devran 3665 is to be used in areas of 244HS.
9. Where an enamel or red lead surface has been damaged, the affected area shall be wire brushed or disc-sanded.
10. Before application of any coating, all bare spots in the preceding coat shall be touched up.
11. All coating thicknesses referred to herein are DRY FILM thickness.
12. Any areas not specifically mentioned herein are to be painted to match the surrounding area.
13. Prior to application of any coating compound, surface shall be wiped free of any dirt, grease, or oil with appropriate solvent.
14. Thinners for the following products: See Solvent Sheet.

TABLE 4-3

Solvent Chart

	#1 <u>MD 1931</u>	#2 <u>MD 3630</u>	#4 <u>MD 3665</u>	#11 <u>MD 3767</u>	#14 <u>MD 3984</u>	#20 <u>MD 542</u>	#22 <u>MD 3985</u>
MARE ISLAND EPOXY Formula 150, 151, 153 Formula 154		CU X					
Devran 201	CU X			CU X			
Devran 237M	CU X			CU X			CU X
Devran 244FS	CU		X	CU			
Conventional Paint Alkyd, Enamel, Red Lead					CU X		CU X

CU = Clean Up

X = Use for Viscosity Reduction

## CHAPTER 5. CORRECTIVE MAINTENANCE

5.1 DIESEL ENGINE - WILL NOT START. Corrective maintenance procedures are followed when systems or components on the SWOB operate abnormally. Common malfunctions are indexed in Table 5.1. Numbers in this table are keyed to the appropriate paragraphs within the chapter. For those symptoms not included, refer to the manufacturer's technical manual. Table 5.2 lists NAVSEA technical manual numbers and manufacturer's name and address for several SWOB components.

### 5.1.1 Engine Will Not Rotate or Low Cranking Speed.

(1) Check the charge on the battery. Recharge the battery if a light load test indicates low or no voltage. Replace battery if it is damaged or will not hold a charge.

(2) If necessary, check starting motor, solenoid and switch for proper operation. Clean and/or replace electrical terminals that are corroded or damaged.

(3) For cold weather, check that proper grade of lubricating oil is used (see NAVSEA 0961-LP-069-1010). At low temperatures, the ether starting aid system will reduce the cranking time and battery drain.

(4) If the engine still does not rotate, internal damage may be indicated. Partial engine disassembly may be required to determine the extent of damage. In this case refer to NAVSEA 0961-LP-069-1010.

### 5.1.2 No Fuel.

(1) Check fuel storage tank level. Drain and clean strainer, check for flow obstruction, air leaks, and/or water in fuel lines.

(2) If clean fuel is in all lines, check the fuel pump. Conduct fuel flow test as outlined in Section 2.0 of NAVSEA 0961-LP-069-1010.

(3) Check for binding in the governor-to-injector linkage; readjust or free the linkage as required.

5.1.3 Emergency Trip. Engine will not start if the emergency shut-off linkage is tripped closed. Reset to position shown in Figure 3-2.

5.1.4 Low Compression. Low compression may be due to burned or sticking exhaust valves, worn or broken piston rings, leaking

TABLE 5-1  
Trouble Shooting Guide

System	Problem	Symptom	Corrective Maintenance Description
Diesel Engine	Will Not Start	Engine will not rotate or low cranking speed	5.1.1
		No fuel Emergency trip Low compression	5.1.2 5.1.3 5.1.4
	Abnormal Operation	Uneven running or frequent stalling	5.2.1
		Lack of power Detonation or preignition	5.2.2 5.2.3
	Low Oil Pressure	Lubricating oil	5.3.1
		Pressure gauge Poor circulation Oil pump	5.3.2 5.3.3 5.3.4
	High Coolant Temperature	Coolant	5.4.1
Insufficient heat transfer Poor circulation		5.4.2 5.4.3	
Low Coolant Temperature	Improper circulation Leaking thermostat seal	5.5.1 5.5.2	
Smokey Exhaust	Black or gray smoke	5.6.1	
	Blue smoke White smoke	5.6.2 5.6.3	
Generator	Improper Output Voltage	No voltage at no-load	5.7.1
		Low voltage or low frequency at no-load	5.7.2
		Dropping voltage with load	5.7.3
	Vibration	Vibration with no-load	5.8.1
Vibration with load		5.8.2	
Overheating	Bearing overheating	5.9.1	
	Stator overheating	5.9.2	
Cargo Pumps	Reduced Discharge	Loss of suction	5.10.1
		Improper operation	5.10.2
		Pump failure	5.10.3
		Relief valve	5.10.4
		Incorrect rotation or electrical output	5.10.5
Inclination		5.10.6	
Excessive Wear	Belt wear	5.11.1	
	Seal leakage	5.11.2	
	Vane wear	5.11.3	
Noise and Vibration	Noise and vibration	5.12	
Cargo Valve	Jammed	Jammed under pressure	5.13.1
		Valves inoperable	5.13.2
Leakage	Valve seat leakage	5.14.1	
	Valve gland leakage	5.14.2	
Valve Actuator	Inoperative	Handwheel position incorrect	5.15.1
		Improper electrical output	5.15.2
		Safety shut-off switch inoperable	5.15.3
		Improper limit switch settings	5.15.4
Hums or Stalls	Excessive torque	5.16.1	
	Improper electrical output	5.16.2	
Improper Position	Improper limit switch setting	5.17.1	
	Jamming	5.17.2	
Tank Level Indicator	Inoperative	Inoperative in battery mode (24VDC)	5.18.1
		Inoperative in generator/shore mode (110 VAC)	5.18.2
		One or all indicators inoperative - either mode	5.18.3
Inaccurate	Indicates higher than actual tank level	5.19.1	
	Indicates lower than actual tank level	5.19.2	
Level Alarm	Inoperative	Air and electric systems	5.20.1
		Pressure switches - high level alarm	5.20.2
		Pressure switches - low level alarm	5.20.3
		Electrical control circuit fault (24 VDC)	5.20.4
Erratic Operation	Intermittent circuit	5.21.1	
	Low or irregular air pressure	5.21.2	
	Waves or listing	5.21.3	
Low Level Pump Cutoff	Inoperative	Mode switch	5.22.1
		Air and electrical system	5.22.2
		Pressure switch low level cutoff	5.22.3
		Electrical control circuit fault	5.22.4
Pump Motor Controller	Inoperative	Electrical failure	5.23.1

TABLE 5-2  
Major Component Index

<u>Component</u>	<u>Manufacturer's Name and Address</u>	<u>NAVSEA Technical Manual Number</u>
Diesel Engine	Detroit Diesel Allison General Motors Corporation Detroit, Michigan 48228	NAVSEA 0961-LP-069-1010
Generator and Voltage Regulator	DELCO General Motors Corporation P. O. Box 1042 Dayton, Ohio 45401	NAVSEA 0961-LP-069-1010
Power Controller	Emerson Power and Control Inc. 2025 15th Avenue West Seattle, Washington 98119	NAVSEA 0961-LP-069-1010
Radiator Shutters	Evans Products Co. Automotive Division Coldwater, Michigan 49036	NAVSEA 0961-LP-069-1010
Cargo Pumps	Dover Corporation Blackmer Pump Division Grand Rapids, Michigan 49509	NAVSEA 0947-LP-228-6010
Pump Motor	The Lincoln Electric Company Cleveland, Ohio 44117	NAVSEA 0947-LP-228-6010
Pulleys and Belt	Eaton Corporation Kenosha, Wisconsin 53140	NAVSEA 0947-LP-114-1010
Cargo Valves	Pittsburgh Brass Manufacturing Company Valve Division R.D. 6 Box 387-A Sandy Hill Road Irwin, Pennsylvania 15642	NAVSEA 0948-LP-114-1010
Valve Actuator	Raymond Control Systems Inc. 13th and Indiana Avenue St. Charles, Illinois 60174	NAVSEA 0948-LP-114-1010
Control Panel	Superior Custom Controls 15616 34th Northeast Seattle, Washington 98155	NAVSEA 0986-LP-057-0010
Air Compressor	ITT-Pneumatic P. O. Box 4748 4601 Central Avenue Monroe, Louisiana	NAVSEA 0986-LP-057-0010
Motor Starter	Cutler-Hammer Milwaukee, Wisconsin	NAVSEA 0986-LP-057-0010

cylinder head gaskets, improper valve adjustment, improper blower operation or other factors. In the event of low compression, refer to NAVSEA 0961-LP-069-1010.

## 5.2 DIESEL ENGINE - ABNORMAL OPERATION.

### 5.2.1 Uneven Running or Frequent Stalling.

(1) Check the engine coolant temperature gauge and if the temperature does not reach 160° to 185°F, refer to the procedure outlined in paragraph 5.4. Check engine fuel spill-back line. The return fuel temperature must be less than 150°F or a loss in horsepower will occur. Check for water, air or other blockage in fuel lines.

(2) If rough running persists, check the injector timing and the position of the injector racks. If the engine was not tuned correctly, perform engine tune-up.

(3) Erratic engine operation may also be caused by leaking or faulty injectors, low compression or a bind in the governor or the governor-to-injector linkage. For tune-up and governor adjustments consult NAVSEA 0961-LP-069-1010.

### 5.2.2 Lack of Power.

(1) Check for damaged or dirty air cleaners. Clean, repair or replace as required. Check blower intake screen for obstructions.

(2) Check the ambient air temperature. A power decrease of up to 0.5 horsepower per cylinder will occur for each 10°F air temperature rise above 90°F.

(3) Conduct a fuel flow test and check spill-back line temperature (see NAVSEA 0961-LP-069-1010). Remove the air line covers and inspect cylinder liner ports. Clean the ports if they are over half plugged. If the problem persists, perform an engine tune-up as specified in NAVSEA 0961-LP-069-1010.

### 5.2.3 Detonation or Pre-ignition.

(1) Check coolant temperature; if it does not reach 160° to 185°F refer to the procedure outlined in Section 5.5.

(2) Check oil bath air filters for proper oil level. Clean the air box drains and drain tubes to prevent accumulations and oil carryover to engine cylinders. Inspect blower oil seals for leakage. This is accomplished by removing the



air inlet housing and watching through the blower inlet for oil radiating away from the blower shaft oil seals while the engine is running. If oil is passing through the seal, overhaul the blower (see NAVSEA 0961-LP-069-1010).

(3) Check injector timing and the position of each injector rack. Perform an engine tune-up, if necessary. If the engine is tuned correctly, the detonation may be caused by an injector check valve leak or injector tips enlarged or broken. Replace faulty injectors (see NAVSEA 0961-LP-069-1010).

### 5.3 DIESEL ENGINE - LOW OIL PRESSURE.

5.3.1 Lubricating Oil. Check oil level and bring it up to the proper level. Adjust reading when the SWOB is listing. Check that proper oil has been used. Recommended oil specifications are provided in Section 13.3 of The Detroit Diesel In-Line Service Manual. Low viscosity may be caused by dilution with fuel. In which case, check injector nut seal ring and fuel pipe connections for leaks. High engine oil temperature will also reduce oil viscosity. Check oil cooler for plugging or fouling.

5.3.2 Pressure Gauge. Check for faulty gauge; replace with a reliable gauge. Check electrical pressure sender. Clean gauge line and gauge orifice plate, if plugged.

5.3.3 Poor Circulation. Poor circulation may be caused by a plugged oil cooler, a malfunctioning oil cooler by-pass, pressure regulator failure, excessive bearing wear or missing gallery plugs. Refer to procedures outlined in NAVSEA 0961-LP-069-1010.

5.3.4 Oil Pump. Failure of the oil pump will cause a reduction or a loss of oil pressure. Check for clogged intake screen, air leaks in the pump suction, faulty relief valve, worn pump or flange leakage on the pressure side (see NAVSEA 0961-LP-069-1010).

### 5.4 DIESEL ENGINE - HIGH COOLANT TEMPERATURE.

5.4.1 Coolant. Check level of coolant in the cooling system. Refill as required.

5.4.2 Insufficient Heat Transfer. If necessary, clean the cooling system with a good cooling system cleaner. Clean the radiator exterior and louvers for plugging and restrictions to the free passage of air. Check for collapsed coolant hoses and proper tension of the fan belt (see NAVSEA 0961-LP-069-1010). Repair or replace the temperature-controlled shutters if inoperative (see Bulletin pertaining to Evans Vernatherm Radiator Shutters).

### 5.4.3 Poor Circulation.

(1) Thermostat may be inoperative. Remove, inspect and test the thermostat for proper opening temperature; replace if faulty. Check water pump for loose or damaged impeller. Check for air leaks on the suction side of the water pump. Replace defective parts.

(2) Remove the coolant filler cap and operate the engine. Check for combustion gases in the cooling system. The cylinder head must be removed and inspected for cracks if combustion gases are present (see NAVSEA 0961-LP-069-1010).

## 5.5 DIESEL ENGINE - LOW COOLANT TEMPERATURE.

5.5.1 Improper Circulation. The thermostat may not be closing. Remove, inspect and test the thermostat. Install a new thermostat, if necessary. Check operation of the radiator shutters in cold weather.

5.5.2 Leaking Thermostat Seal. Excessive leakage of coolant past the thermostat seal is a cause of continued low coolant operating temperature. When this occurs, replace the seal.

## 5.6 DIESEL ENGINE - SMOKEY EXHAUST.

### 5.6.1 Black or Gray Smoke.

(1) Black or gray smoke is a result of insufficient combustion which may be caused by high back pressure or insufficient air for combustion. Check exhaust piping for obstruction and air inlet for restrictions. Air restrictions to the cylinder may be caused by clogged cylinder liner ports, air cleaner or air blower screen. Clean these items. Check that emergency trip is fully open, readjust, if necessary.

(2) Check for improperly timed or faulty injectors and improperly positioned injector racks. Perform engine tune-up as required (see NAVSEA 0961-LP-069-1010).

(3) Check for the improper grade of fuel and refer to Section 13.3 of NAVSEA 0961-LP-069-1010.

5.6.2 Blue Smoke. Blue smoke is a result of lubricating oil burning in the exhaust system. Check for high level in engine oil sump or severe angles of SWOB inclination. Check that air boxes are drained. Other causes are leaking oil seals and worn piston rings. See NAVSEA 0961-LP-069-1010 for further details.

5.6.3 White Smoke. White smoke is caused by misfiring cylinders or low cetane fuel. Check for faulty injectors and replace as necessary.

## 5.7 GENERATOR - IMPROPER OUTPUT VOLTAGE.

5.7.1 No Voltage at No-Load. Secure diesel. Remove cover from generator control panel. Reset voltage regulator circuit breaker. This circuit breaker (red pushbutton) is located in the lower right-hand corner of the control on the voltage regulator. If condition persists, problem may be in the generator or control assembly (see NAVSEA 0961-LP-069-1010).

5.7.2 Low Voltage or Low Frequency at No-Load. Check that engine speed is at 1800 RPM. Engine speed may be adjusted by means of the vernier thumbscrew on the engine throttle control. Frequency should be 60 cycles per second at 1800 RPM. Voltage can be adjusted by means of the voltage control located on the generator control panel. The generator output is 440v AC.

5.7.3 Dropping Voltage with Load. Engine speed may be low. Readjust speed as indicated in paragraph 5.7.2. Abnormal engine operation may cause this problem (see paragraphs 5.2.1 and 5.2.3).

## 5.8 GENERATOR - VIBRATION.

5.8.1 Vibration with No Load. Check excessive bearing runout, loose brush rig, or loose armature attachments. If problem persists, check diesel (see NAVSEA 0961-LP-069-1010) for vibration.

5.8.2 Vibration with Load. Check for proper voltage in all three phases. Use voltmeter and selector switch on the generator control panel. If there is a major voltage imbalance in the phases, refer to NAVSEA 0961-LP-069-1010, Section V for resistance checks. Generator must not be operated in this condition.

## 5.9 GENERATOR - OVERHEATING.

5.9.1 Bearing Overheating. Check oil level and refill as required (see paragraph 4.1.21). If oil is required frequently, replace seal. If overheating persists, bearing may have to be replaced.

5.9.2 Stator Overheating. Check stator resistance as indicated in NAVSEA 0961-LP-069-1010.

## 5.10 CARGO PUMPS - REDUCED DISCHARGE.

5.10.1 Loss of Suction. Check that cargo valves are in proper position. Do not rely on the panel lights. Check pointer on

the cargo valve stem. Operate valve manually if necessary. (See Section 3.3 for cargo valve operation.) Obstructions or air leaks in the suction line will also prevent pump discharge. Clean suction strainers (if fitted). During periodic tank inspections (paragraph 4.5.4) check tank sumps for fouling or blockage.

5.10.2 Improper Operation. If check valves are not fitted in the pump discharge lines, both pumps must be operated at the same time. Operating one pump without the other will result in reduced flow and pressure. Incorrect valve position will also cause low discharge. Check that valves are positioned in the FILL, CLOSED, or DISCHARGE position as required.

5.10.3 Pump Failure. Excessively worn vanes, rotor, or casing will reduce flow rate and discharge pressure. Refer to paragraph 5.11.3 for vane replacement procedures. Pump failure may also be caused by belt failure or improper motor operation. Check generator for proper output (see paragraph 5.7).

5.10.4 Relief Valve. Improperly adjusted relief valves will cause by-passing of the flow and a reduction in pressure. Reset the relief valve to obtain 80 psi shut-off head.

5.10.5 Incorrect Rotation or Electrical Output. Check for proper pump rotation and electrical output. The pump rotation is indicated by an arrow on the pump head. Pump rotation will be reversed with incorrect phase rotation.

5.10.6 Inclination. Due to steep barge inclination, the pumps may lose suction at the tank sump, especially at the after tank sumps. Tank level indicators may read incorrectly and low level alarms may not sound. Care should be taken not to run pump dry for extended periods (see Chapter 3 for operational procedures).

## 5.11 CARGO PUMPS - EXCESSIVE WEAR.

5.11.1 Belt Wear. Improper belt tension or incorrect pulley alignment will result in excessive belt wear and premature failure. Readjust belts according to the procedure outlined in paragraph 4.2.7. Check pump and motor foundation bolts and taper lock pulley for tightness and alignment.

### 5.11.2 Seal Leakage.

(1) Excessive leakage from the tell-tale hole located below the pump bearing indicates seal leakage (see Figure 2-6). However, periodic dripping from the tell-tale hold is within normal operation of the pump. Failure of the seal is caused by pumping gritty fluids or improper pump rotor balance.

(2) If leakage appears from between the pump casing and the head, the head should be removed and its "O" ring inspected for cuts and nicks. Seal and "O" ring replacement procedures are indicated in paragraph 5.11.3.

5.11.3 Vane Wear. Vane wear may be caused by running the pump dry, pumping gritty fluids or by running the pump in a by-passing or recirculating condition (shut-off head) for extended periods. These situations should be avoided if possible. Vane replacement procedures are as follows:

- (1) Disconnect power to pump and tag "DO NOT CLOSE SWITCH."
- (2) Place all cargo valves in CLOSED position.
- (3) Relieve pressure on pump, and drain.
- (4) Unbolt and remove bearing cap (on bearing opposite pump pulley).
- (5) Bend locking tang on the lockwasher and remove the locknut and lockwasher by turning counterclockwise.
- (6) The pump shaft should then be checked for burrs or roughness which may cut the pump shaft seal.
- (7) Mark the position of the pump head on the casing.
- (8) Unbolt and remove the pump head. The pump head, seal and bearing come off together. Once bolts are removed, the head may have to be pried off with a screwdriver. The bearing and seal are slip-fit on the shaft.
- (9) If the seal or "O" rings have been leaking, replace these parts at this time. The mechanical seal is removed by unbolting the four capscrews in the pump head and lifting from its recess. Clean the recess and repack the bearing (see paragraph 4.2.2.1). Be certain the seal is properly in place and the two driving prongs on the seal are outward through the pump head. Care must be taken to engage these prongs in the shaft when reinstalling the head.
- (10) Rotate the pump shaft so that two vanes correspond to the 1 o'clock and 11 o'clock position. Slide out these two vanes and replace with new ones (see Figure 5-1). Be certain that the wearing or rounded edge of the vanes contact the cylinder and the relief grooves in the vane face toward the leading or pressure side. With new vanes installed, turn shaft and repeat operation for remaining four vanes.

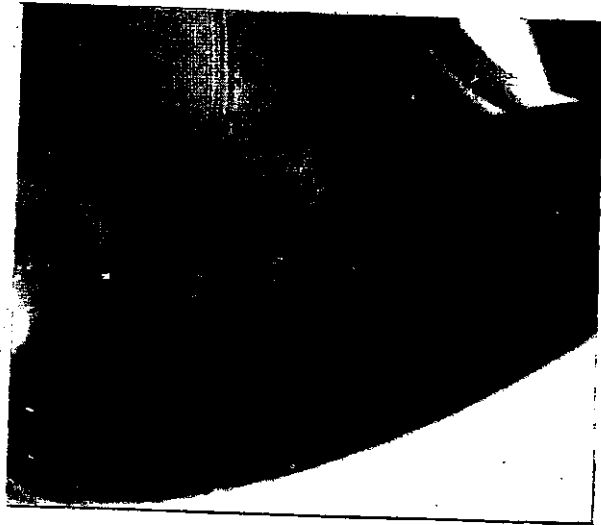


FIGURE 5-1  
Removing Pump Vane From The Cargo Pump

(11) Replace the pump head and be sure prongs of the pump seal are engaged into the shaft and head is in original location. (see Step 7).

(12) Replace and hand-tighten bolts. Rotate pump by hand to check for binding. Tighten down all bolts and check again for binding.

(13) Adjust locking collar. This adjustment is important. Improper adjustment may cause bearing failure. Replace lockwasher and locknut as it was removed. Tighten with a spanner or by tapping with a screwdriver. This insures the bearing is bottomed in the head recess. Do not over-tighten. Loosen locknut one complete turn.

(14) With the locknut loose, tighten the locknut until the rotor begins to drag when rotated. Back off the nut the width of one lockwasher tang. Secure the locknut by bending

down one tang into the locknut groove. The pump should turn freely.

(15) Check the adjustment by grasping the nut and washer. The nut should rotate back and forth slightly. If this cannot be accomplished, back off the nut (one tang stop at a time) until the washer can be moved back and forth.

(16) Replace the bearing cover. Turn pump over by hand.

(17) Place pump on line; check for noise, discharge pressure, and overheating.

5.12 CARGO PUMPS - NOISE AND VIBRATION. Noise and/or vibration is commonly caused by loose or worn vanes or other shaft imbalance. Noise may also be caused if the vanes are installed backwards, if the bearings are worn, or if there is recirculation through the pump relief valve. Severe vibration may be caused by loose pump and/or motor foundation bolts.

### 5.13 CARGO VALVE - JAMMED.

5.13.1 Jammed Under Pressure. When cargo valves are in the closed position and under pressure (about 80 psi), it has been found that they may be hard to turn. However, if the pressure is lower, they operate easily. If required, valves can be adjusted (see paragraph 5.14.1).

### 5.13.2 Valves Inoperable.

(1) If valves are completely inoperable, the valve must be disassembled and rebuilt. Replacement parts are listed in NAVSEA Technical Manual 0948-LP-114-1010 or are available from Pittsburgh Brass Manufacturing Co., Irwin, Pa.

(2) If the valves are difficult to operate, loosen all body bolts to ease operation. Retighten body bolts evenly so that the breakaway (or opening) torque at the stem is 50 foot-pounds.

### 5.14 CARGO VALVE - LEAKAGE.

5.14.1 Valve Seat Leakage. If the valve seat leaks when the valve is closed, tighten all body bolts evenly. Do not over-tighten or exceed 50 foot-pounds breakaway torque at the valve stem. If the problem persists, the valve seals or valve may have to be overhauled (see NAVSEA Technical Manual 0948-LP-114-1010 for proper part numbers).

5.14.2 Valve Gland Leakage. If the valve gland leaks, tighten valve stem gland. If problem persists, replace packing (see NAVSEA Technical Manual 0948-LP-114-1010 for proper part numbers).

## 5.15 VALVE ACTUATOR - INOPERATIVE.

5.15.1 Handwheel Position Incorrect. Check if actuator handwheel is in automatic position. This can be accomplished by lifting handwheel and disengaging from manual position. Lubricate handwheel shaft to ensure smooth spring return from manual to automatic position.

5.15.2 Improper Electrical Output. Check generator for proper output. Refer to Section 5.7.

5.15.3 Safety Shut-Off Switch Inoperable. If actuator does not operate, the safety shut-off switch on handwheel stem may be improperly adjusted (see Figure 5-2). Remove cover, readjust limit switch so that it is engaged (contact open) only when the handwheel is depressed for manual operation.

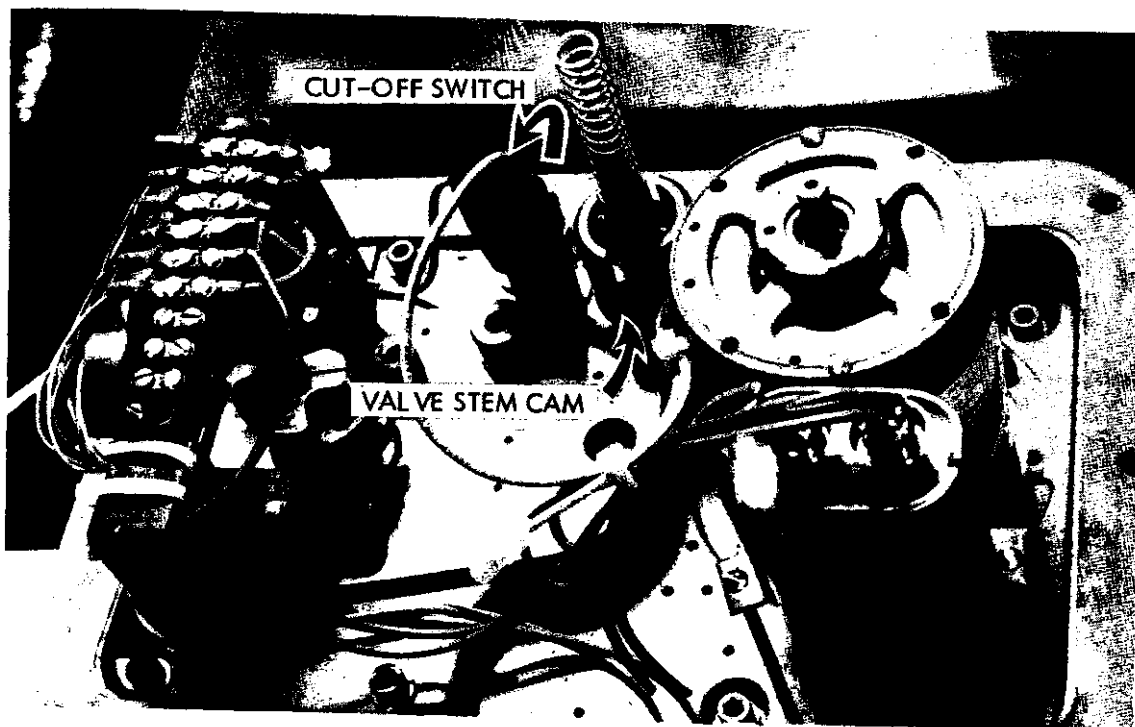


FIGURE 5-2

Valve Actuator Cut-Off Switch for Manual Operation

5.15.4 Improper Limit Switch Setting. Improper limit switch



settings will prevent activator operation. Refer to NAVSEA 0948-LP-114-1010 Technical Manual or Raymond Control Systems, Inc., St. Charles, Illinois for proper adjustment procedure.

## 5.16 VALVE ACTUATOR - HUMS OR STALLS.

### 5.16.1 Excessive Torque.

(1) Remove valve actuator to check torque of cargo valve. The breakaway torque at the valve stem should be about 50 foot-pounds. If necessary, readjust as indicated in paragraph 5.13.2.

(2) Check the actuator gear train by engaging handwheel in manual position and turning. If binding or rough operation is apparent, gear train must be repaired.

5.16.2 Improper Electrical Output. Check generator for proper electrical output. Refer to Section 5.7.

## 5.17 VALVE ACTUATOR - IMPROPER POSITION.

5.17.1 Improper Limit Switch Setting. Improper limit switch setting will cause improper valve positioning. Refer to NAVSEA 0948-LP-114-1010 Technical Manual for proper adjustment procedure.

5.17.2 Jamming. Jamming of the gear train or valve will prevent proper valve position. Refer to paragraph 5.16.1.

## 5.18 LEVEL INDICATOR - INOPERATIVE.

### 5.18.1 All Indicators Inoperative - Battery Mode (24v DC).

(1) Check that power 24v DC is being supplied to the panel; check power fuse inside control panel (6 amp). See Figure 2-10 for location of fuse.

(2) Check external bottle pressure (see Figure 4-4). Bottle pressure should be at least 200 psi. Replace, if necessary. If problem persists check pressure downstream of the high pressure regulator (see Figure 2-11). Pressure should be 30 psig (max). Readjust as required. Next, check two-way electric (24v DC) solenoid valve for proper opening and closing (see Figure 2-10).

(3) If problem still persists see paragraph 5.18.3.

### 5.18.2 All Indicators Inoperative - Generator/Shore Power Mode (120v AC).

(1) Check that power (120v AC) is being supplied to the

panel, check power fuse inside control panel (6 amp). See Figure 2-10 for location of fuse.

(2) Check that compressor (120v AC) is operating properly and pressure is at 30 psig (max). If pressure is not achieved check compressor pressure switch setting. For further details see NAVSEA 0986-LP-057-1010.

(3) If problem persists, check three-way electric (110v AC) solenoid valve (see Figure 2-10) for proper opening and closing. Note, the three-way valve is controlled by an adjustable time delay (see Figure 2-10) which allows the compressor to build up pressure before operating the indicators. Check electrical circuit and contacts. Refer to wiring diagram in NAVSEA 0986-LP-057-0010.

(4) If problem persists see paragraph 5.18.3.

#### 5.18.3 One or All Indicators Inoperative - Either Mode.

(1) The operating pressure past the solenoid valve (or at the inlet to each of the four low pressure regulators) must be 30 psig (max). If the pressure is not adequate, refer to paragraph 5.18.1 or paragraph 5.18.2.

(2) Check that flow meters (see Figure 4-3) are set at 1.0 SCFH. If meters cannot be adjusted several items should be checked: low pressure regulator should be set at 3 psig, air filters should be clean and free of moisture, and the flow meter should operate freely.

#### NOTE

Oil and water may foul the meter and jam the ball. To clean the meter remove air connections and flush with alcohol. Do not use high pressure to clean air lines or meters since tank indicators may be damaged. If problem persists check if tank indicator gauge is broken. This may be accomplished by temporarily interchanging tank indicator air line connections. Replace tank indicator gauge if required. In freezing weather, air lines, regulators, valves, filters or indicators may become frozen. To prevent freezing follow instructions in paragraph 4.4.1.

#### 5.19 LEVEL INDICATOR - INACCURATE.

5.19.1 Indicates Higher Than Actual Tank Level.

(1) Inclinations of the SWOB may cause discrepancy between indicator readings and the actual tank level. See paragraph 2.4.3 for details. High density fluids also "read high."

(2) Check that flow meters are set at 1.0 SCFH (see Figure 4-3). If air lines (outside the control panel) become clogged or pinched closed, the indicator will read higher than the actual tank level. Check for air line blockage in the tank, at deck and bulkhead penetrations and in straight air line runs. Open or replace air lines as required. If level still reads high, check if tank indicator gauge is broken. This may be accomplished by temporarily interchanging tank indicator line connections. Replace indicator as required.

#### 5.19.2 Indicates Lower Than Actual Tank Level.

(1) Inclinations of the SWOB may cause discrepancy between indicator readings and the actual tank level. See paragraph 2.4.3 for details. Low density fluids tend to "read low."

(2) Check that flow meters are set at 1.0 SCFH (see Figure 4-3). If meters cannot be adjusted see paragraph 5.18.3. A major reason for low readings is leakage of the air lines anywhere between the indicator and the air line termination at the tank bottom.

(3) Check all fittings for air tightness using soap bubbles or a similar technique. Repair or replace air line as necessary. If level still reads low, check if tank indicator is broken. This may be accomplished by temporarily interchanging tank indicator air line connections. Replace indicator as required.

#### 5.20 LEVEL ALARM - INOPERATIVE.

5.20.1 Air and Electrical System. Air supply and electrical systems (battery mode) must work properly if alarms are to be functional. If the air or electrical systems do not operate see paragraphs 5.18.1, 5.18.3, 5.19.1 and 5.19.2.

#### 5.20.2 Pressure Switches - High Level Alarm.

(1) The high level alarm for each tank is triggered by an independent 24v DC pressure switch. These four switches are oriented vertically as shown in Figure 2-10. The uppermost switch is for the number one port tank. The second switch down is for the number one starboard tank, the third switch down is for the number two port tank and the lowest switch is for the number two starboard tank. Each switch has two sets of contacts, normally open and normally closed. When the tank level is above 90% the high level alarm switch is actuated.

(2) If pressure switch does not operate, refer to NAVSEA 0986-LP-057-0010 for replacement part number. If the pressure switch operates properly see paragraph 5.20.4.

5.20.3 Pressure Switch - Low-Level Alarm. The low-level alarm for each tank is triggered by a separate 24v DC pressure switch. These four switches are oriented vertically as shown in Figure 2-10. The uppermost switch is for the number one port tank. The second switch down is for the number two port tank, the third switch down is for the number one starboard tank and the lowest switch is for the number two starboard tank.

NOTE

A 110v AC switch for the pump cutoff is also mounted on each of the four pressure switches. These switches are not part of the alarm circuitry (see paragraph 5.22.2). The low-level alarm switches (24v DC) have normally closed contacts. When the tank level is above 10% , the switch is open.

If the pressure switch does not operate refer to NAVSEA 0986-LP-075-0010 for replacement part number. If the switch operates properly see paragraph 5.20.4.

5.20.4 Electrical Control Circuit Fault (24v DC). If the pressure switch operates properly check control relays. These relays are oriented horizontally as shown in Figure 2-10. The left-most relay is for the number one port tank, the second relay is for the number one starboard tank. The third relay is for the number two port tank and the right-most relay is for the number two starboard tank. Also check the toggle switch (Horn Silence Mode Switch), the diode module and the horn located outside the generator house. For wiring details and replacement part numbers, refer to NAVSEA 0986-LP-057-0010.

## 5.21 LEVEL ALARM - ERRATIC OPERATION.

5.21.1 Intermittent Circuit. Poor electrical contacts in the pressure switch, control relay, toggle switch (Horn Silence Mode Switch) or the diode module will result in erratic operation (see Figure 2-10). For wiring details and replacement part numbers refer to NAVSEA 0986-LP-057-0010.

5.21.2 Low or Irregular Air Pressure. Low or irregular air pressure will cause alarms to sound. Throw HORN SILENCE MODE SWITCH and check for cause of air pressure failure, see paragraphs 5.19.1, 5.19.2, 5.18.1 and 5.18.3.

5.21.3 Waves or Listing. Internal tank sloshing or listing of the barge due to improper loading sequence may cause alarms to sound. Throw HORN SILENCE MODE SWITCH and check the tank for proper level by sight or ullage measurement.

#### 5.22 LOW-LEVEL PUMP CUTOFF - INOPERATIVE.

5.22.1 Mode Switch. Check that the Motor Control Switch (on separate panel) is in the AUTO mode. Pump low-level cutoff will not function in START mode.

5.22.2 Air and Electrical System. Level indicators, air and electrical systems (Generator/Shore Power Mode) must work properly if pump cutoff is to be functional. If the air or electrical systems do not operate see paragraphs 5.18.2, 5.18.3 and 5.19.1.

5.22.3 Pressure Switch - Low-Level Pump Cutoff. The low-level pump cutoff for each tank is triggered by a separate 120v AC pressure switch. These four switches are oriented vertically as shown in Figure 2-10. The upper-most switch is for the number one port tank, the second switch down is for the number two port tank, the third switch down is for the number one starboard tank and the lowest switch is for the number two starboard tank.

#### NOTE

A 24v DC switch for the low-level alarm is also mounted on each of the four pressure switches. These switches are not part of the cutoff circuitry (see paragraph 5.20.3). The low-level cutoff switches are normally open. When the tank level is greater than 10%, the switch is closed.

If the switch does not operate, refer to NAVSEA 0986-LP-057-0010 for replacement part number. If switch operates properly see paragraph 5.22.4.

5.22.4 Electrical Control Circuit Fault (120v AC). If the pressure switch operates properly check MANUAL OVERRIDE SWITCH. If pump does not start with switch closed (ON) or with Pump Selector switch on START position, check motor starter for proper operation. See NAVSEA Technical Manual 0986-LP-057-0010 for wiring diagram and motor starter details.

5.23 PUMP MOTOR - INOPERATIVE. Check that Generator or Shore Power is putting out 440v AC (see paragraph 5.7) and "Cargo

Pump" circuit breaker is in ON position. Check that 120v AC panel has power. If there is no 120v AC, check fuse located in 440/120v AC transformer box. Replace fuse (10A) if necessary. Check that cargo pump circuit breakers are in ON position. Depress circuit breaker reset. Check motor for electrical short or open circuit. For wiring details, see NAVSEA Drawing Number 301-44-70036.

5.24 SWOB BARGE DOCKING PLAN. A docking plan is presented in Figure 5-3. Note that the block spacing shown for the port side or the starboard side may be used.

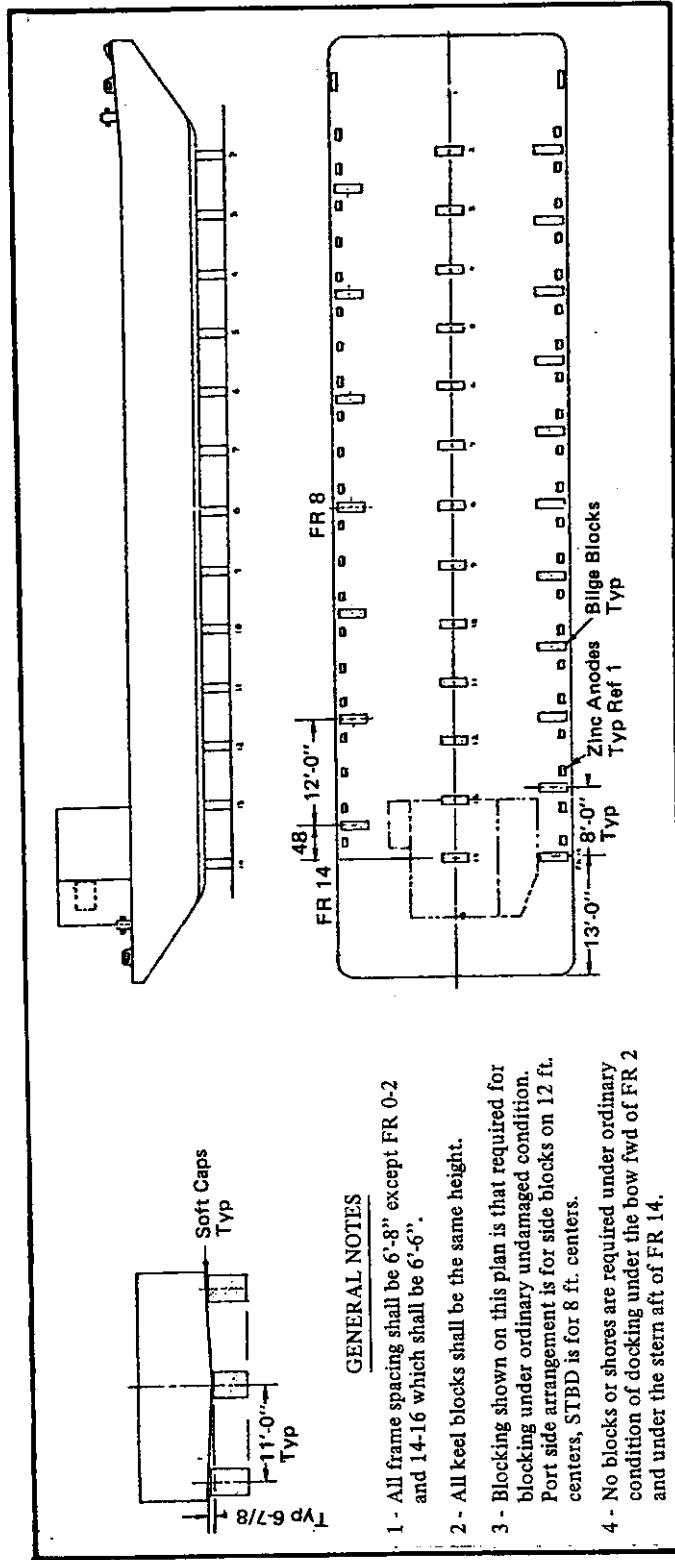


FIGURE 5-3  
SWOB I Class (43 Series) Docking Plan

ADDENDUM

OIL SWOB NUMBERS 56 THROUGH 60



## ADDENDUM

### OIL SWOB NUMBERS 56 THROUGH 60

A.1 INTRODUCTION. This Addendum has been included in the manual to extend its application to OIL SWOBs numbered 56 through 60. These SWOBs, constructed by Tacoma Boatbuilding Company, are basically similar to OIL SWOBs numbered 1-42 that were built earlier by Marine Power and Equipment Company. This Addendum discloses various differences between the two series of SWOBs and points out changes to the operation and maintenance that are a consequence of these differences.

A.1.1 PRINCIPAL DIFFERENCES. The most important changes are:

- a. Direct drive centrifugal oil pumps in place of belt driven, rotary vane, positive displacement cargo pumps.
- b. Multi-level float switches in place of a continuous reading, air-bubbler type, level sensing system.
- c. Four manually operated, remote deck stands in place of electrically actuated controllers for the 3-way ball valves on the cargo transfer manifold.

A.1.2 MINOR DIFFERENCES. There are numerous less important changes, many a direct result of the ones listed above; these include, but are not limited to:

- a. Electrical Panels - all changed.
- b. Check valves, pump isolation valves, suction strainers, and suction and discharge pressure gauges have all been added to the piping system.
- c. Sacrificial anodes are placed on the bottom of the hull rather than on the sides.
- d. The fuel tank and batteries are external rather than located in the deckhouse.
- e. The pump room bilge pump is connected directly to the cargo manifold piping.
- f. A generator heater has been added.
- g. A single coaming encompasses all cargo hatches and fill/discharge stations. Four valved deck drains, each discharging to one of the cargo tanks, have been provided to drain spilled oil from the enclosure.
- h. Piping for priming the pumps has been added.

A.1.3 ORGANIZATION. All sections and subsections are numbered

with regard to corresponding sections in the manual proper, starting with Chapter 2. For example, A.3.2.4.3 corresponds to Chapter 3, Section 2.4.3 in the main text. The heading is usually the same as in the corresponding section, but in some instances the heading has been reworded to suit the actual characteristics of the newer SWOBs. Where a corresponding section or subsection strictly applies to both series of OIL SWOBs, or where differences are considered of no great consequence, the title is simply followed with the notation: "NO CHANGE". Where a corresponding section's subject matter is not relevant to the newer SWOB, the title or head is either reworded, as noted above, or followed with the notation: "VOID". Note, subsections that follow a section, but have the same classification (i.e., no change, or void) as the section, have not been relisted.

A.2 DESCRIPTION.

A.2.1 GENERAL ARRANGEMENT. NO CHANGE.

A.2.2 CARGO PIPING LAYOUT. Figure 2-4 is replaced by Figure A-1. Three filling/discharge stations are provided (labeled SHORE DISCH CONN) in Figure A-1.

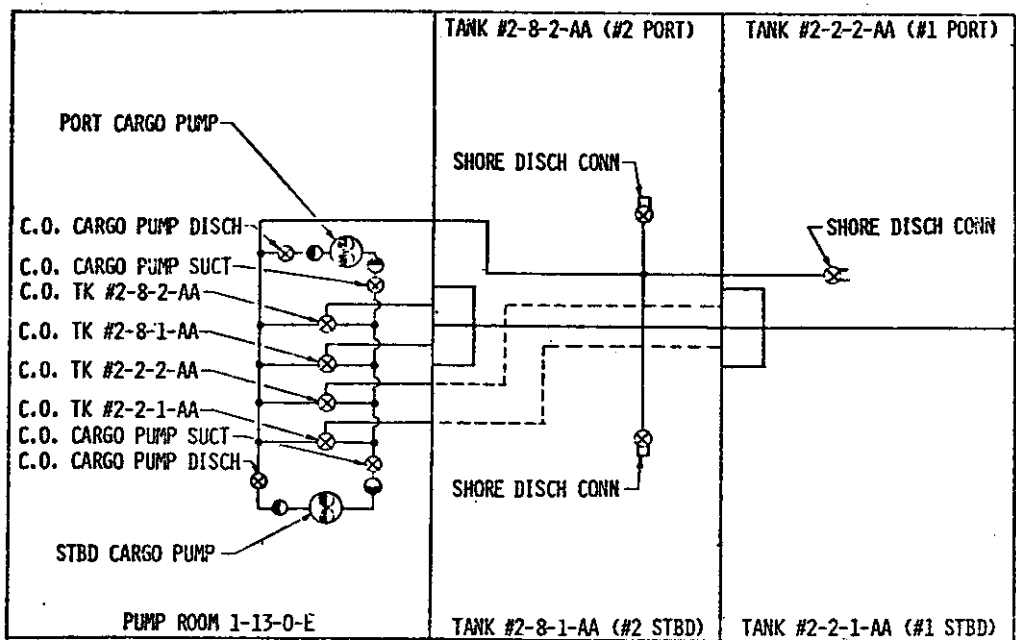


FIGURE A-1

Schematic Piping Arrangement

A.2.2.1 Description of Loading. NO CHANGE.

A.2.2.2 Description of Offloading. Check valves are provided, so pumps may be operated singly or together, as desired.

A.2.2.3 Effects of Inclination During Offloading. Instructions for the discharge of oily waste, one tank at a time, are printed incorrectly on label plates inside and outside of the deckhouse:

<u>AS PRINTED</u>	<u>CORRECT</u>
(1) TANK #2 PORT	(1) TANK #1 STBD
(2) TANK #1 STBD	(2) TANK #2 PORT
(3) TANK #2 STBD	(3) TANK #1 PORT
(4) TANK #1 PORT	(4) TANK #2 STBD

A.2.2.4 Description of Transfer Mode. NO CHANGE.

A.2.3 CARGO HANDLING COMPONENTS.

A.2.3.1 Cargo Pumps. Two Aurora Pump Company, Model 382A, centrifugal, oily waste pumps are provided. Figure A-2 shows a

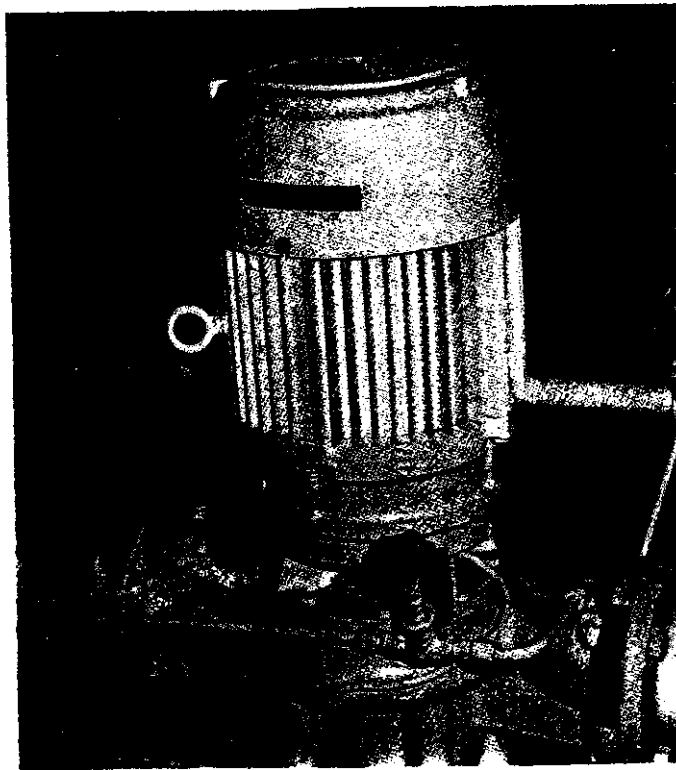


FIGURE A-2  
Oily Waste Pump (STBD)

typical installation (replaces Figure 2-6). Each pump is rated for 160 gpm at 65-foot total head at 3500 rpm (Figure 2-7 is void). A suction pressure gauge is furnished for each pump and is located in the pump room. Three discharge pressure gauges are mounted above the tank level sensor panel in the deckhouse; one is connected to the riser pipe leading to the discharge/fill pipe on deck, and the other two are connected to the port and starboard pumps. Simplex suction strainers (Mueller Steam Specialty Co.) are provided and moderate quantities of abrasive sand and scale in the cargo can be tolerated<sup>1</sup>.

A.2.3.1.1 Pump Motor. Each pump is directly coupled to a vertical shaft, type JV, totally enclosed, fan cooled motor manufactured by U.S. Motors, a Division of Emerson Electric Co. The 7½ hp motor draws about 10.2 amps (3-phase, 450v AC) at full load<sup>1</sup>.

A.2.3.1.2 Power Source. A 450v, 3-phase, electrical control box for each pump is mounted on the forward bulkhead of the deckhouse. A step-down transformer in each box supplies single phase 120v AC power for the switchgear. A schematic wiring diagram is shown in Figure A-3. Start, stop and manual override switches are provided on the box covers and on remote switch boxes mounted near the cargo valve deck stands, beside the deckhouse on the starboard side.

A.2.3.2 Manually Operated Cargo Valves. The cargo transfer manifold located in the pump room is connected to each cargo tank through a 3-way, 4-inch, 100 psi Morland ball valve. Mechanical stops allow the valve handle to rotate only 180°. The valve is CLOSED fully counterclockwise. In the FILL position (90°) the fill/discharge side of the manifold is connected to the cargo tank. When rotated fully clockwise (180°) to the DRAIN position, the pump suction side of the manifold is connected to the cargo tank. See Figure A-4.

A.2.3.2.1 Remote Control. Each cargo valve may be actuated from a deck stand beside the starboard deckhouse bulkhead. The handles are connected to the valves by reach rods through two right angle gears. Spring-loaded detents lock the handles in position: CLOSED, FILL or DRAIN.

A.3.2.2 Valve Position Indicator. VOID.

A.2.3.3 Filling/Discharge Station Valves. The three filling/discharge stations are each fitted with a 2-way, 4-inch Morland

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<sup>1</sup> Further details and replacement part numbers are included in NAVSEA 9503-AT-MMD-010/MOD. 382A Technical Service Manual.

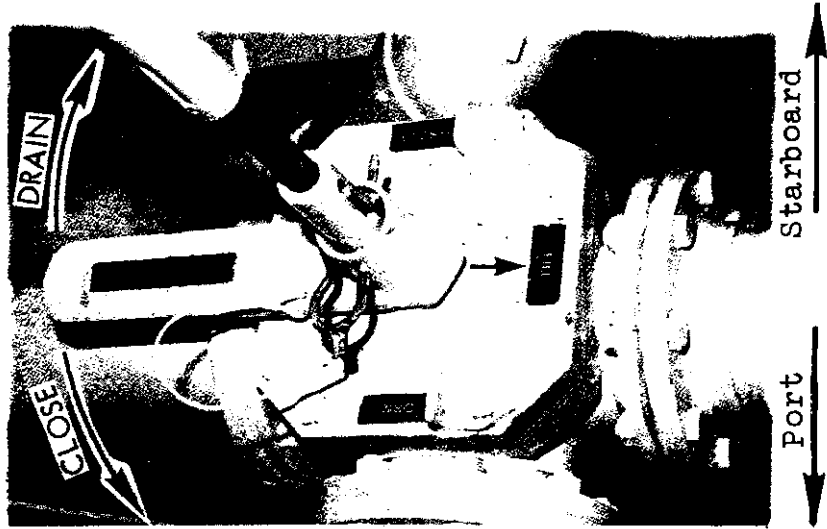


FIGURE A-4

View of Cargo Manifold Valve in Pump Room

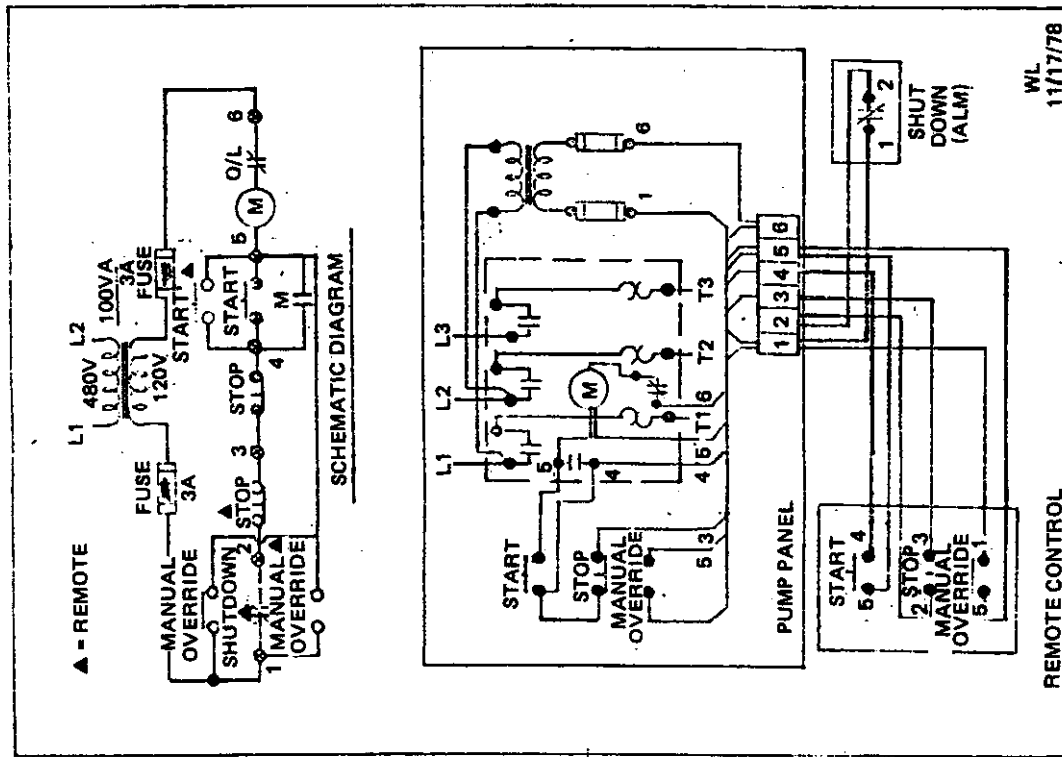


FIGURE A-3

Oil Waste Pump Wiring Diagram

ball valve. Note, the same model valves are fitted in the suction and discharge pipes to each cargo pump.

A.2.3.4 Cargo Hoses. NO CHANGE.

A.2.4 LEVEL INDICATOR, ALARM AND PUMP CUT-OFF SYSTEMS.

A.2.4.1 Principle of Operation. Each cargo tank is fitted with a stainless steel gauge tube housing magnetically actuated switches that are controlled by five 2-inch diameter, stainless steel floats. A typical installation is shown in Figure A-5 (replaces Figures 2-9, 2-10 and 2-11). Each float can slide easily up and down the tube, but collars fitted on the tube limit the travel to about  $\frac{1}{2}$ -inch. As the liquid level rises in a tank, each float rises, in turn, to activate its corresponding switch. The switches cause gauge panel lights to turn on, in sequence, as the level rises past 10, 25, 50, 75 and 90 percent of tank capacity, Figure A-6 (replaces Figure 2-3).



FIGURE A-5

Two Views of the Float Gauge System

A.2.4.1.1 Regulated Air Supply. VOID.

A.2.4.1.2 Pressure Measurement. VOID.

A.2.4.1.3 Level Alarm and Pump Cut-Off Switches. An alarm bell is mounted on the side of the gauge light panel shown in Figure A-7 (replaces Figure 2-12). Relay switches inside this panel sound the alarm when:

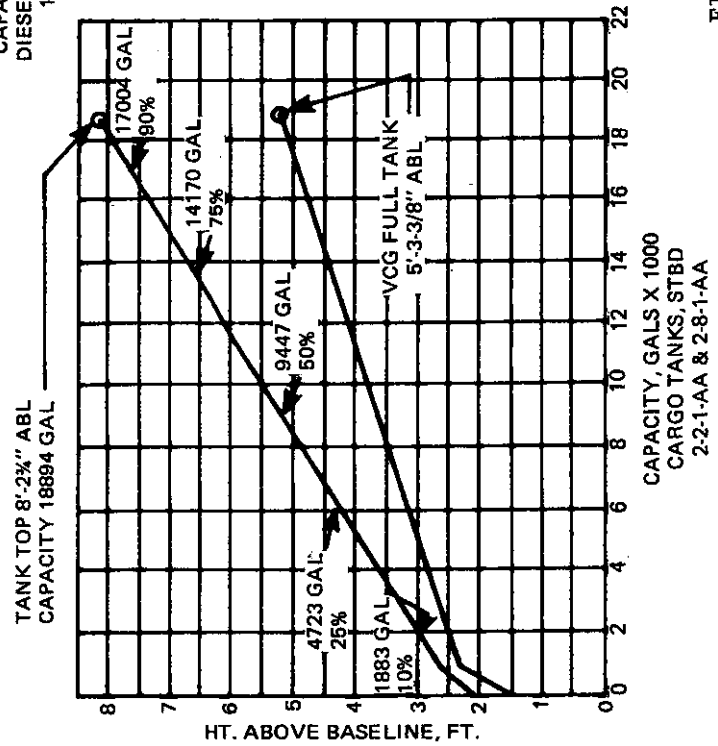
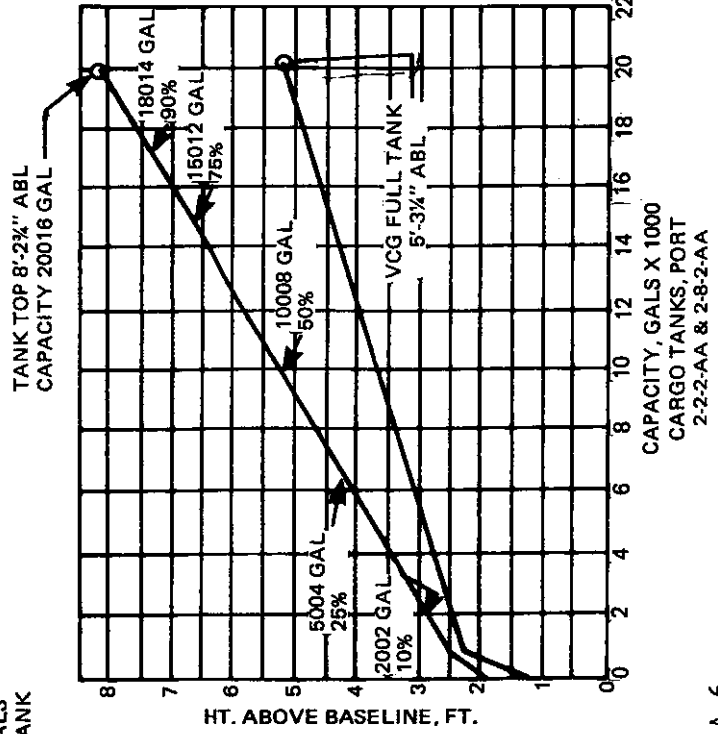
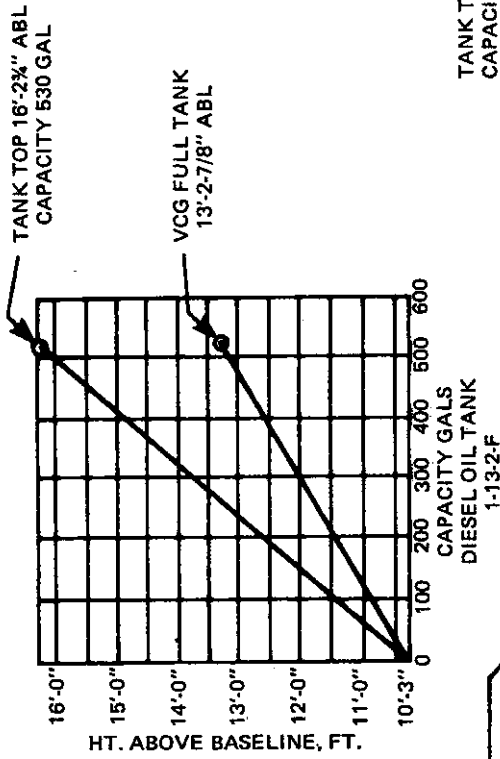
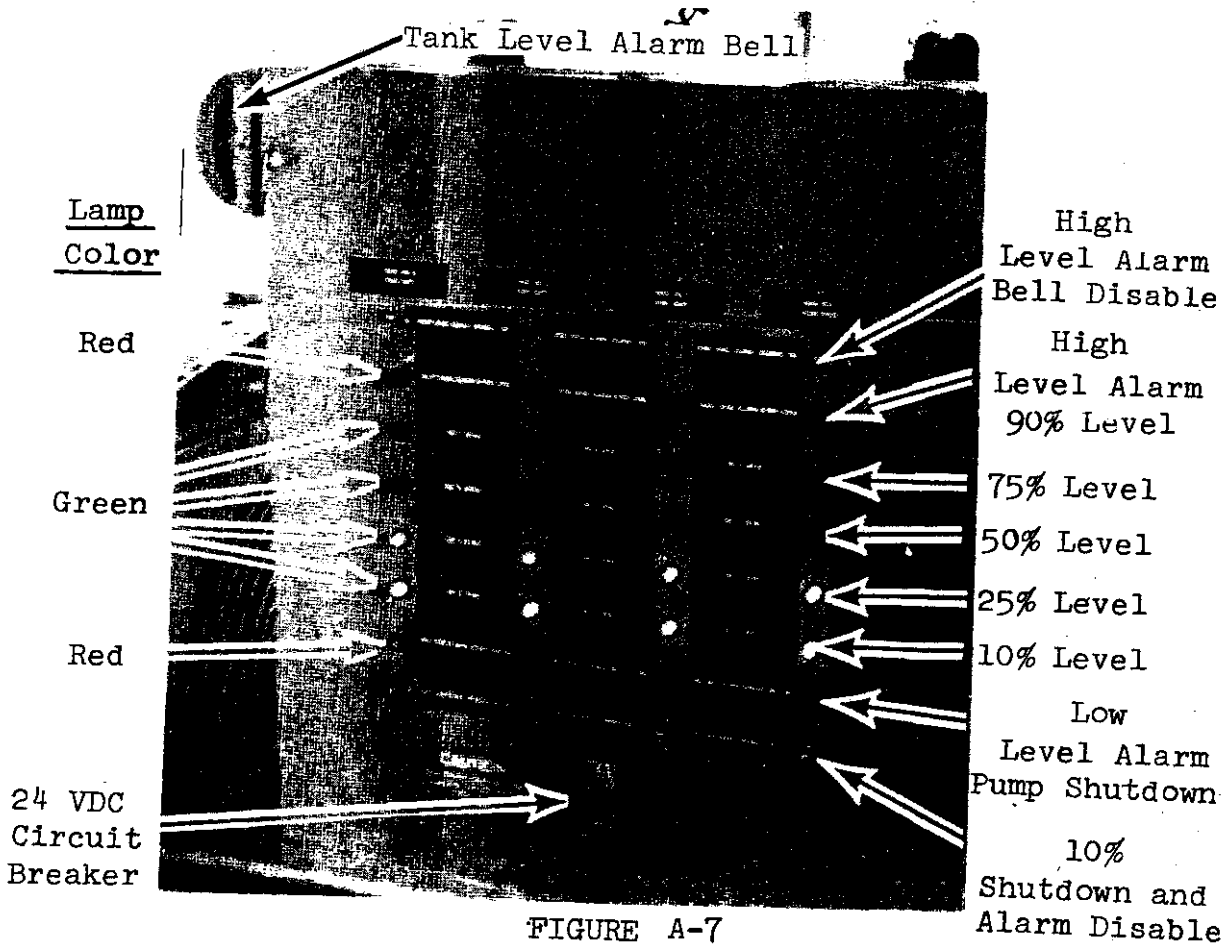


FIGURE A-6  
Tank Capacity Curves

- a. Any 90 percent level indicator is lighted.
- b. Any "low-level alarm pump shutdown" indicator is lighted.

The alarm can be turned off with the corresponding "disable" switch located next to each of these red indicator lights (the 10, 25, 50 and 75 percent level lights are green). The "low level" relays also automatically stop the cargo pumps when these indicators light, unless the disable switch is off (down).



View of Level Gauge Panel (From Outside the Deckhouse)

A.2.4.2 Power Sources. The level alarm and gauge light system run entirely on 24v DC. However, the pump cutoff relay acts to open a 120v AC switch that is mounted in the panel (see Figure A-3). A circuit breaker on the panel front also serves as an on/off switch for the system.

A.2.4.3 Effect of Inclination and Waves. NO CHANGE.



A.2.4.4 Other Means of Measurement. Tank sounding tubes are located on deck near each of the gauge tubes, and metal sounding rods are stored beneath the starboard hose storage rack at the aft end of the spill coaming. The conversion of tank level to capacity is given in Figure A-6. The levels for switch activation are:

<u>Tank Capacity</u>	<u>Height Above Floor</u>
10%	11 inches
25%	22 "
50%	39 "
75%	57 "
90%	68 "

#### A.2.5 DESCRIPTION OF POWER SYSTEM.

A.2.5.1 Power Distribution. The 450v, 3-phase distribution panel receives power from either the diesel generator or shore connection. A mechanical interlock on the two breakers prevents paralleling shore power with the generator. Four breakers feed power to: the two cargo pump control boxes, the pump room exhaust fan control box and the 450/120v transformer. The panel also features a phase rotation indicator, three fused, ground fault, indicator lights and a "shore power available" indicator light.

A.2.5.2 120v AC System. The 120v distribution panel receives single phase power from the step-down transformer. Breakers feed power to three branch circuits: lighting (deckhouse and pump room), generator heating, and the 120v AC/24v DC rectifier. Two ground fault indicator lights are on this panel.

A.2.5.3 24v DC System. Batteries are automatically charged by the rectifier from the 120v distribution panel. One battery bank supplies power to the navigation light panel and the other one is connected to both the tank level indication system and the diesel engine starter.

A.2.5.4 Diesel Engine. NO CHANGE. (See A.3.6)

A.2.5.5 Generator. NO CHANGE. (A generator heater is furnished.)

#### A.2.6 DESCRIPTION OF SAFETY AND NAVIGATION EQUIPMENT.

A.2.6.1 Lighting System. NO CHANGE.

A.2.6.2 Navigation Lights. NO CHANGE.

A.2.6.3 Blower. The pump room blower operates on 440v AC power.

Air enters the pump room from a supply duct located in the aft starboard corner of the deckhouse. The blower exhausts through a duct in the aft port corner of the deckhouse.

IMPORTANT

The blower should be operated at least 5 minutes prior to entering or operating equipment in the pump room.

A.2.6.4 Sacrificial Anodes. The Anodes are located on the hull bottom. (See Figure 5-3).

A.2.6.5 Fendering. NO CHANGE.

A.2.6.6 Spill Coaming. See Section A.1.2.

A.2.6.7 Fire Extinguishers. NO CHANGE.

A.2.6.8 Life Rings. NO CHANGE.

A.2.6.9 Bilge Pump. The bilge pump is permanently installed in the pump room. It discharges into the cargo manifold through a stop and a stop/check valve. The stop valve should normally be kept closed as a safety measure to prevent wastes from backing through the bilge pump into the pump room. To pump the bilge, the cargo valve for an empty cargo tank should be opened to the FILL position and all the other cargo valves should be CLOSED (pumping into a partially full cargo tank requires excessive man-power). If necessary, disconnect the union on the discharge piping in order to prime the pump. The bilge cannot be emptied completely because the suction strainer for the bilge pump lies a few inches above the bottom.

A.2.6.10 Warning Signals. NO CHANGE.

A.3 OPERATION.

A.3.1 GENERAL OPERATING GUIDELINES. NO CHANGE.

A.3.2 HANDLING PROCEDURES. NO CHANGE.

A.3.3 LOADING PROCEDURE. Cargo manifold valves are set, by hand, to the FILL position. The spring loaded detent is raised with one hand while swinging the deckstand handle with the other. Generally, the remote handle must be rotated about 30° past the desired position to allow for twisting in the reach rod. When the valve is correctly aligned, the remote handle will "center" on the detent, i.e., there will be no torque on the rod with the detent engaged. If there is any doubt about the alignment, a check can be made in the pump room.

NOTE

To maintain even trim, it is preferable to fill all four tanks together or in opposing pairs: #1 port and #2 starboard, or #1 starboard and #2 port.

A.3.4 OFFLOADING PROCEDURE. Note the following changes.

(1) Prime the pumps by opening the priming vent valves located near the deck stands beside the starboard deckhouse bulkhead (after placing one or more cargo manifold valves in DRAIN position). Wait 30 seconds, then start pump(s). The priming vent valve(s) should be closed as the discharge pressure rises in order to prevent transferring cargo into the #2 starboard tank.

(2) One pump can be used to offload or transfer cargo; a check valve prevents backflow through the idle pump. Discharge rate can be increased by:

(a) Using both pumps.

(b) Draining more tanks simultaneously.

(c) Discharging through more than one cargo hose and reducing the length of hose. Under typical conditions, the barge can be offloaded (from 90% to 10% capacity) using both pumps in five to six hours (200 gpm) or using one pump in seven to eight hours (140 gpm). Normal pump discharge pressure will range from 15 to 30 psig.

(3) Transfer cargo from one tank (DRAIN) to another (FILL) with one pump at up to 300 gpm and with two pumps at over 400 gpm. Discharge pressure will only be a few psig.

(4) Trim barge by gravity in a few hours by placing all cargo manifold valves in DRAIN position.

(5) Pumps will stop automatically when the tank level falls to 10% capacity, if the corresponding "10% Shutdown Alarm Disable" switch is armed, i.e., on or up.

(6) A tank may be stripped by flipping its "10% Shutdown Alarm Disable" switch down to the off position. Note the Warning in Figure A-8. Pump seals may be damaged if the pump runs dry for an extended period. The pump may require priming after stripping a tank (Item 1, above).

### A.3.5 OPERATION OF LEVEL INDICATORS AND LEVEL ALARM.

(1) The system is activated with the 24v DC power (breaker) switch on the panel. When turned on, the bell may ring once because of transient surges. If it rings continuously, one or more tanks are either at the 10% or 90% level. Silence the bell by flipping the corresponding alarm disable switches down to off. The remaining switches should be flipped up so that the alarm system is armed to give warning to changing status in the tanks. Typical conditions for the panel are illustrated in Figure A-8.

(2) The bank of red and green lights on the panel indicates the status of the fluid level in each tank. Each light is lit when the tank level is greater than its switch activation point (see Figure A-6). The exception to this rule is the "Low Level Alarm" light (red) that is turned on whenever the level is below 10%. When the level is at or very near the GEMs float activation point, the corresponding light will blink on or off.

(3) As filling or draining operations proceed, it is a good practice to flip on (up) a corresponding alarm bell disable switch as soon as an alarm condition (red light) is relieved, that is, changed to all green.

(4) Cargo pumps will shut off automatically when the level drops to 10% capacity if the alarm bell switch is on. While the alarm bell is ringing, a pump can be operated by holding in the manual override button on the pump control panel or remote pump control box. Restart the pump normally by silencing the low level alarm first.

#### NOTE

Flipping a 10% Shutdown and Alarm Disable Switch up or down will sometimes create electrical transients that "kick-out" the pumps even though the level is above 10% capacity. Simply restart the pumps normally.

(5) Check accuracy of level indicators with the sounding tubes, see Section A.2.4.4.

(6) When operations are complete, the level indicating system may be turned off to conserve battery charge. Cargo pumps can only be operated by holding in the manual override button when this system is off.

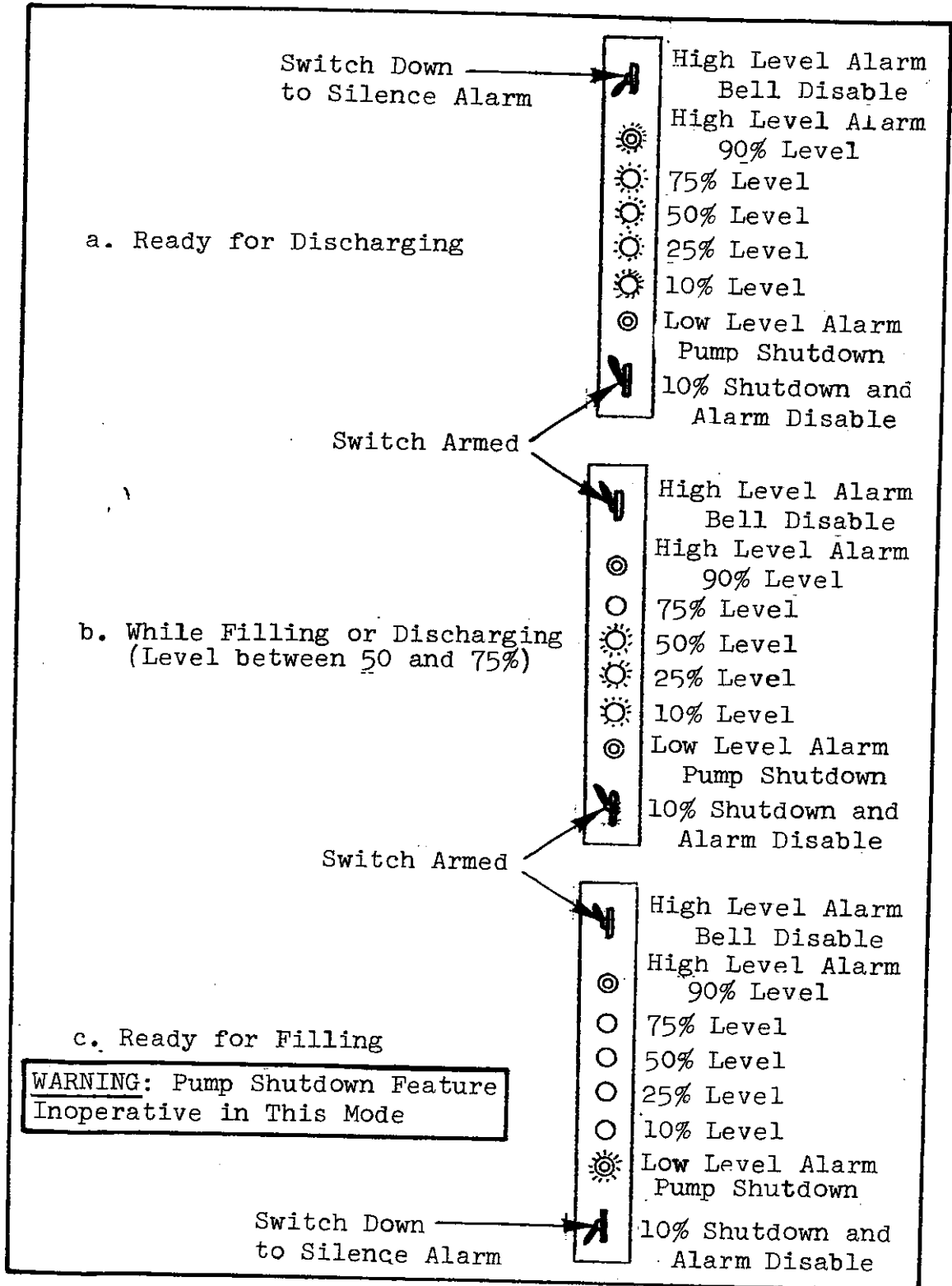


FIGURE A-8  
Typical Gauge Light Panel Conditions

A.3.6 POWER SYSTEM OPERATION. Generally NO CHANGE. However, note that the interlock for shore power and generator power breakers is internal rather than on the panel cover. Also, the "Quick Start" starting aid is activated with a knob on the engine next to the start button.

CAUTION

Ether is hazardous. Do not confuse the Quick Start knob with the start button. Inject ether only while cranking the engine, but never use ether when the engine is running.

The ground fault indicating lamps are connected to ground through a normally closed spring-return push button. A ground on any line will cause the respective lamp to dim or go out while the other lamp(s) burn brightly. If the lamps are not equally lit, the push button provides a means of checking the "normal" (ungrounded) condition of the lamps. The change in intensity with the button pushed in indicates a ground fault and the degree of the fault.

IMPORTANT

A fault indicator should be cleared immediately even though a single ground fault on an ungrounded system does not interrupt service.

A.4 PREVENTIVE MAINTENANCE.

A.4.1 DIESEL GENERATOR. NO CHANGE. The generator heater is provided to prevent injury to the electrical insulation from moisture condensation during periods of idleness. The heater should be turned on when shore power is available and the generator will not be used for 24 hours or more.

A.4.2 CARGO PUMPS.

A.4.2.1 Pump and Motor Bearings. The Aurora pump is lubricated by the liquid being pumped and therefore does not require periodic lubrication. The motor has sealed bearings that are lubricated for life.

A.4.2.2 Pump Seal. NO CHANGE.

A.4.2.3 Relief Valve. VOID.

A.4.2.4 Pump Foundation. NO CHANGE.

A.4.2.5 Pump, Motor and Pipe Supports. NO CHANGE.

A.4.2.6 Hose Couplings. VOID.

A.4.2.7 Cargo Pump Drive Belt. VOID.

A.4.2.8 Electrical Insulation. NO CHANGE.

A.4.2.9 Strainer. Suction strainers are fitted and should be cleaned every 50 hours of pumping or if the suction pressure gauge indicates an excessive head loss in the flow to the pump (except for cargo transfer operations or pumping off viscous cargo, the suction head will normally read from 2 to 6 inches of mercury).

A.4.3 CARGO VALVES.

A.4.3.1 Valve Glands. NO CHANGE.

A.4.3.2 Valve Operation, Manual. Lubricate remote control deck stands, reach rod deck penetrations, universal joints and angle joints once a month. Check alignment as per Section A.3.3.

A.4.3.3 Hose Connector Lubrication. NO CHANGE.

A.4.4 CONTROL SYSTEMS.

A.4.4.1 Air Compressor and Filter Blowdown. VOID.

A.4.4.2 Air Compressor Suction Filter. VOID.

A.4.4.3 Calibration Check. The accuracy of the level gauge system is practically assured as long as the panel lights and level switches are all operational. No periodic maintenance is required.

A.4.4.4 Alarm Operation and Light Check. Operation of the alarm bell should be checked daily when any of the red panel lights are lit. A suspect bulb can be interchanged with any other bulb on the gauge panel to check its operation.

A.4.4.5 Nitrogen Bottle Check. VOID

A.4.4.6 Wiring. NO CHANGE.

A.4.4.7 Power Panels and Interlock. NO CHANGE.

A.4.4.8 Emergency Lantern. NO CHANGE.

A.4.4.9 Battery Charge. NO CHANGE.

A.4.5 MISCELLANEOUS. NO CHANGE. (See A.2.6.4, however.)

A.5 CORRECTIVE MAINTENANCE.

A.5.1 DIESEL ENGINE - WILL NOT START. NO CHANGE.

A.5.2 DIESEL ENGINE - ABNORMAL OPERATION. NO CHANGE.

A.5.3 DIESEL ENGINE - LOW OIL PRESSURE. NO CHANGE.

A.5.4 DIESEL ENGINE - HIGH COOLANT TEMPERATURE. NO CHANGE.

A.5.5 DIESEL ENGINE - LOW COOLANT TEMPERATURE. NO CHANGE.

A.5.6 DIESEL ENGINE - SMOKEY EXHAUST. NO CHANGE.

A.5.7 GENERATOR - IMPROPER OUTPUT VOLTAGE. NO CHANGE.

A.5.8 GENERATOR - VIBRATION. NO CHANGE.

A.5.9 GENERATOR - OVERHEATING. NO CHANGE.

A.5.10 CARGO PUMPS - REDUCED DISCHARGE.

A.5.10.1 Loss of Suction.

(1) Check that cargo valves are in proper alignment by observing the valve stem handles in the pump room.

(2) Check suction pressure gauges in pump room (with pump running). A high vacuum with low flow indicates an obstruction in the suction line. Clean out simplex suction strainer. Check tank sump for fouling or blockage. A low vacuum indicates air leakage or loss of prime; refer to Section A.3.4 for priming procedure.

A.5.10.2 High Discharge Pressure. Check discharge hoses for kinks: Minimize the length of discharge hose. Run two parallel hoses to point of discharge.

A.5.10.3 Pump Failure. Cavitation damage or erosion of pump rotor will reduce flow rate. Pump failure may also be caused by improper motor operation. Check generator output (frequency and voltage). Check for binding due to damaged pump or motor bearings. Refer to Technical Service Manual, NAVSEA 9503-AT-MMD-010/MOD. 382A, for repairs.

A.5.10.4 Relief Valve. VOID.

A.5.10.5 Incorrect Rotation. NO CHANGE.

A.5.10.6 Inclination. NO CHANGE.

A.5.11 CARGO PUMPS - EXCESSIVE WEAR.



- A.5.11.1 Belt Wear. VOID.
- A.5.11.2 Seal Leakage. Damage to the pump seal will be indicated by leakage from the rotor shaft below the motor. When repairing seal, check wear rings for excessive wear.
- A.5.11.3 Vane Wear. VOID.
- A.5.12 CARGO PUMPS - NOISE AND VIBRATION. Noise and vibration may be caused by defective motor bearings, a damaged impeller and insecure mounting. However, incomplete purging of air from the piping can cause loud "howling" sounds; these may be silenced by cycling the pumps to dislodge trapped air pockets and by priming, Section A.3.4.
- A.5.13 CARGO VALVE - JAMMED. NO CHANGE.
- A.5.14 CARGO VALVE - LEAKAGE. NO CHANGE.
- A.5.15 VALVE ACTUATOR - INOPERATIVE. VOID.
- A.5.16 VALVE ACTUATOR - HUMS OR STALLS. VOID.
- A.5.17 VALVE ACTUATOR - IMPROPER POSITION. There is normally some binding and backlash in the manual, remote control, reach rod design. The handle on the deck stand must usually be moved 10° to 30° past the detent position to align the valve. If binding becomes excessive, remove the large cotter-key that joins the reach rod to the valve shaft to determine whether the binding is in the valve or in the reach rod assembly.
- A.5.18 LEVEL INDICATOR - INOPERATIVE.
- A.5.18.1 All Indicators Inoperative. Check the 24v DC power supply, the panel's breaker switch, and/or the external gauge wiring for open circuits.
- A.5.18.2 Light Remains On. Check for the following:
- (1) Float stuck in incorrect position, see Section A.5.18.4.
  - (2) Switch overloaded, contacts fused. A spare stem is provided in the forward storage locker.
  - (3) Short in external or internal indicating circuits.
- A.5.18.3 Light Remains Off. Check for the following:
- (1) Faulty bulb; replace.
  - (2) Float in incorrect position, see Sections A.5.18.4 and A.5.18.5.

(3) Open circuit in external or internal wiring.

A.5.18.4 Float and Stem Cleaning. Generally, the stems and floats may be cleaned, in place, by brushing and wiping with a hydrocarbon solvent. If removal is necessary, mark locations of all collars on stem and mark floats as to their proper level station and as to their upper ends. DO NOT DIP COMPLETE UNIT IN SOLVENT.

A.5.18.5 Collar Adjustment. The location of the switch center position can be determined by slowly moving the switch float up and down the stem. A man stationed at the panel should call out when the switch is activated. Then adjust the two stop collars to permit the float to over-travel the center position by 1/4- to 1/2-inch in either direction.

A.5.19 LEVEL INDICATOR - INACCURATE. VOID.

A.5.20 LEVEL ALARM - INOPERATIVE. Check for faulty bell, open circuits in the internal wiring, and faulty relay switches — nine relays activate the low-level and high-level alarms, and low-level pump cutoff.

A.5.21 LEVEL ALARM- ERRATIC OPERATION.

A.5.21.1 Intermittent Circuit. NO CHANGE.

A.5.21.2 Switching Transients. Flipping any of the alarm disable switches can cause a momentary ring.

A.5.21.3 Waves or Listing. NO CHANGE.

A.5.22 LOW-LEVEL PUMP CUTOFF - INOPERATIVE. Check the (normally closed) relay switch operation and check wiring for short circuits.

A.5.23 PUMP MOTOR - INOPERATIVE. The 24v DC level indicator panel must be switched on to close the pump cutoff relay switch (except that the pumps can be run by holding in the manual override button). Check that Generator or Shore Power is putting out 440v AC and that "Cargo Pump" circuit breaker is on. Check two 3-Amp fuses in the pump control panel. Check pump for free rotation and motor for electrical faults.