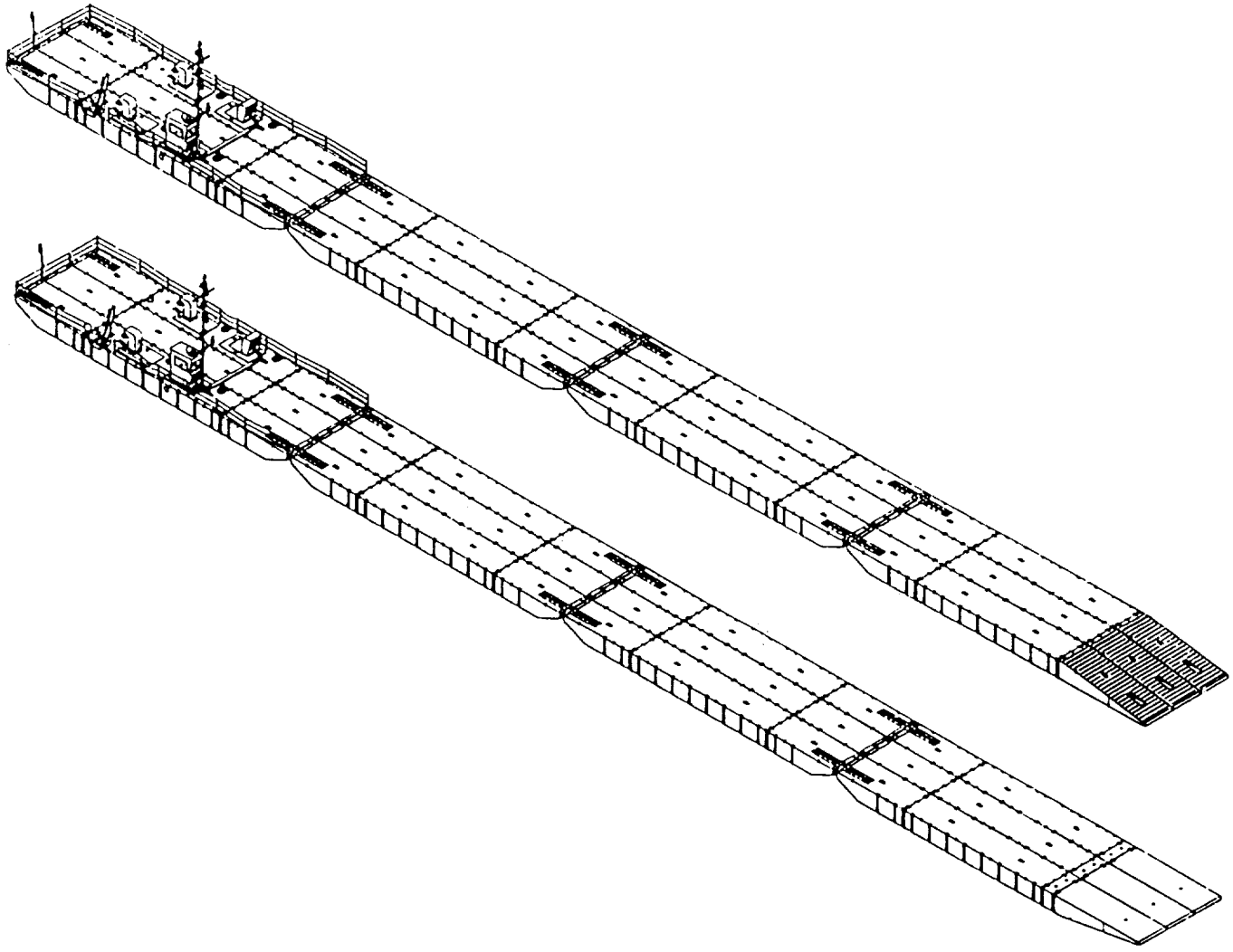
TECHNICAL MANUAL

OPERATOR'S MANUAL

MODULAR CAUSEWAY FERRY (MCF)
NSN 1945-01-398-3856



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TECHNICAL MANUAL

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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 29 August 1997

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MODULAR CAUSEWAY FERRY (MCF)
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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Tank-Automotive and Armaments Command, ATTN: AMSTA-AC-NML, Rock Island, IL 61299-7630. A reply will be furnished directly to you.

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Section I. General Information

1-1 SCOPE

a. Type of manual: Operator's Manual.

b. Purpose of Equipment: The purpose of the MCF is for Logistics-over-the-Shore (LOTS) for the deployment and handling of supplies between ship and beach. Modular causeway sections are connected together to form a floating, powered causeway.

c. This chapter provides the operator with information to complete forms and records as well as familiarization with the MCF and its equipment. Functional and physical descriptions of the major equipment, components, and applicable interface equipment are provided.

1-2 MAINTENANCE FORMS AND PROCEDURES. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750 as contained in the Maintenance Management Update.

1-3 CORROSION PREVENTION AND CONTROL (CPC).

a. The operator is to always look for recurring instances of corrosion. It is important that any corrosion problems with the MCF be noted on DA Form 2404 as a continual deficiency. It is important for the operator and crew to be diligent in CPC so that improvements can be made to prevent the problem in future in like pieces of equipment or components.

b. While the operator and crew understand that corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic hoses and fittings below deck, or controls and indicators in the operators cab. Unusual cracking, softening, swelling or breaking of these materials may be a corrosion problem.

c. If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report, in addition to the DA Form 2404. Use of keywords such as "corrosion." "rust" "deterioration" or "cracking" will ensure that the information is identified as a CPC problem.

d. The form should be submitted through the maintenance chain to the address specified in DA PAM 738-750.

1-4 DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE. Procedures for "destruction of Army material to prevent enemy use" are contained in TM 750-244-6.

1-5 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs). If your MCF system needs improvement, let us know. Send us an EIR. You the user, are the only one who can tell what you don't like about your equipment, design or performance. Put it on a SF 368 (Product Quality Deficiency Report) Mail it to us at: Commander, U.S. Army ATCOM, AMSAT-I-WTT, 4300 Goodfellow Blvd., St. Louis, MO, 63120-1798.

1-6 WARRANTY INFORMATION. The MCF is warranted to be free of material and workmanship defects within the scope of the purchase specifications for a period of eight months after government acceptance. Report all defects in material and workmanship to your supervisor, who will take appropriate action.

The manufacturer does not warrant conditions resulting from damage and/or neglect from use outside the scope of normal operating and maintenance procedures as set forth in the applicable manuals.

1-7 OFFICIAL NOMENCLATURE AND NAME(S)

a. Nomenclature Cross Reference List

COMMON NAME	OFFICIAL NOMENCLATURE
Pump-Jet	Water Jet Propulsion System
Intermediate Module	MCF P40, 40 Foot Non-Powered Pontoon Assembly
End Rake Module(s)	MCF P20RR, 20 Foot Right Raked Pontoon Assembly MCF P20CR, 20 Foot Center Raked Pontoon Assembly MCF P20LR, 20 Foot Left Raked Pontoon Assembly
Beach/Sea End Module	25 Foot Beach End Module Assembly
Powered Module	Propulsion Module Assembly
Adaptor Module	P3 Adaptor Assembly
Drive Train	Engine, Marine Gear, Drive Shaft and Transfer Case

b. Abbreviations.

Bll	Basic Issue Items
CAGE	Commercial and Government Entity
CFM	Cubic Feet per Minute
CN	Can
CPC	Corrosion Prevention Control
CTN	Carton
DA	Department of the Army
DSC	Digital Selective Calling
EA	Each
EIR	Equipment Improvement Recommendations
F	Fahrenheit
GAL	Gallon
GPH	gallons per hour
HP	Horse power
HPU	Hydraulic Power Unit
IAW	In Accordance With
ISO	International Standards Organization
LOTS	Logistics-over-the-Shore
MAC	Maintenance Allocation Chart
MCF	Modular Causeway Ferry
MCS	Module Causeway Sections
NSN	National Stock Number
PMCS	Preventive Maintenance Checks and Services
PSF	Pounds per square foot
PSI	Pounds per square inch
PT	Pint
QT	Quart
QTY	Quantity
RPSTL	Repair Parts and Special Tools List
RPM	revolutions per minute
RTCH	Rough Terrain Container Handler
SLWT	Side-Loadable Warping Tug
U/M	Unit of Measure

Section II. Equipment Description.

1-8 EQUIPMENT CHARACTERISTICS, CAPABILITIES AND FEATURES

a. The MCF system is a combination of modules assembled to form section assemblies. Individual modules connect together by means of the male/female vertical connectors located around the perimeter of each module. Section assemblies are then connected end-to-end to form the completed causeway ferry. The sections are secured to other sections by means of flexor connectors. The assembled MCF consists of four sections: one Powered Section, two (Non-Powered) Intermediate Sections, and one Combination Beach/Sea End Section. The Powered Section and the (Non-Powered) Intermediate Sections are 24 feet wide and 80 feet long, the (Non-Powered) Combination Beach/Sea End Section is 24 feet wide and 85 feet long. When all four sections are connected end-to-end, they form a single MCF which is 24 feet wide and 325 feet long. The powered section is assembled with two propulsion modules that facilitate self-powered movement and maneuvering. The powered section is fitted with an operators cab, intake and exhaust plenums, interconnection (cable) assembly, navigational lighting system, hand rails and emergency anchor with all above deck components located to allow drive through operation. The cab and navigational lighting can be installed on either the port or starboard side of the Powered Section.

b. The fully assembled MCF has a cargo capacity of 350 short tons; can maintain the speed of 6 knots at maximum load capacity in a sea state condition 2 and carries enough fuel to operate under those conditions for 10 hours. The fully loaded MCF will maintain a freeboard of approximately 12 inches, can execute a 180° turn within 2 minutes, a 360° turn in 4 minutes, and can be brought from full speed (6 knots) to a dead stop within 320 feet. The propulsion (diesel) engines are capable of being started in an ambient temperature of -25° F.

c. The MCF is used to transport containerized, rolling and breakbulk cargo from ocean going vessels in the stream to the beach. The unassembled components of the causeway ferry are transported in ISO pack configuration by sea T-ACS, Lighter Aboard Ship (LASH), Fast Sealift Ship (FSS) and/or commercial container ships to the operational area and assembled after arrival. (Components can also be transported by rail and motor vehicle over improved and unimproved roads.) Upon arrival in the operational area the MCF can be assembled on deck, on land, or in water of sea-state "0". The MCF is designed to augment the Modular Causeway System (MCS) in applications where powered assemblies are required. The system utilizes the Navy "flexor" and shear connector system for causeway end-to-end connection, and is interchangeable with existing Navy Lighter (NL) and Army MCS hardware at the sectional level. The MCF modules are interchangeable with existing Army MCS modules. The MCF modules are ISO container compatible and are also outfitted with ISO corner fittings.

d. The MCF, with maximum payload, is capable of beaching and retracting under its own power in those gradients commonly found in beach environments and operating in surf conditions up to 5 feet.

1-9 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS. The MCF system (Figure 1-1) consists of one Powered Section, two Intermediate Sections and one Combination Beach/Sea End Section. The Powered Section can be broken down to the Propulsion Modules, the Center Module (non-powered), End Rake Modules, Connectors, the Operator's Cab, the Intake Plenum, Exhaust Plenums, Navigation Masts, the Module Electrical Interconnect, the Anchor Board and Hand Rails. The Intermediate Sections can be broken down to Center Modules (non-powered), End Rake Modules and Connectors. The Combination Beach/Sea end Section can be broken down into Center Modules (non-powered), End Rake Modules, Connectors and Beach End Modules. When operating in the optional configuration, with the Beach End Modules in the inverted position, P3 Adaptor Modules are included in the breakdown increasing the length of the completely assembled MCF approximately 329 feet.

1-10 POWERED SECTION. The Powered Section (Figure 1-2) is made up of two Propulsion Modules, one Center Module (non-powered), two Center Rake Modules and four End Rake Modules connected together by Male/Female Locking assemblies. The Propulsion Modules and the non-powered module are each 8 feet wide and 40 feet long. The end rake modules are each 8 feet wide and 20 feet long and are configured as Right Rake Assemblies, Center Rake Assemblies, and Left Rake Assemblies. All Center Modules (non-powered) are 4 feet 6 inches deep. They are fully ISO-compatible and are completely interchangeable. The Powered Section is the prime mover for the MCF and is propelled by two 8 cylinder, 600 HP, diesel marine engines driving two 360^{o} steerable, 5,000 pound output, pump-jets. The cab with operator's controls is a self-contained unit designed to be removed for transport and can be mounted on either port or starboard propulsion module. Plug-in type electrical connectors are provided to tie electrical control into the cab location. A module electrical interconnect assembly is the electrical control link between the cab to the propulsion module opposite the cab. Navigation lighting is provided in the form of a 28-1/2 foot, main navigational mast mounted on the cab and a 8-1/2 foot stub mast that is installed at the extreme aft end of the powered section. Both masts are removable for shipment. Air intake and exhaust plenums are installed on the powered modules to provide air flow through the machinery spaces. One of the air intake plenums is integral to the cab. A hand held portable fire extinguisher mounts to either exhaust plenum. An anchorboard assembly with a 1500 pound anchor mounts to the starboard propulsion module, aft of the exhaust plenum. A removable personnel safety railing system is installed along both sides and across the aft end of the powered section. The powered section completely assembled weighs approximately 171,900 pounds.

1-10.1 Propulsion Module. The MCF Propulsion Module (Figure 1-3) has exactly the same external dimensions and ISO container corner fittings. The module is divided into three compartments separated by watertight bulkheads. The center (machinery)compartment is the largest and contains the drive train, engine cooling and exhaust components, hydraulic system and all electrical system components with the exception of one bilge pump, a single bilge pump control panel, and a pressure operated switch that are located in the lazaret. The drive train consists of an engine, Marine Gear, transfer case and pump-jet. Guarded drive shafts connect the Marine Gear to the transfer case and the transfer case to the pump-jet. The engine cooling and exhaust system consists of a sea chest (raw water inlet integral with the structure of the module), a butterfly valve, a duplex strainer, engine raw water pump, intercoolers, a fuel cooler, engine coolant heat exchanger, the Marine Gear oil cooler, the exhaust water shut-off valve, the transfer case oil cooler, the transfer case shut -off ball valve, the water cooled muffler and exhaust flappers. The hydraulic system ' consists of a hydraulic pump driven by the Marine Gear, a hydraulic motor drives the primary steering planetary gearbox mounted on the pump-jet, a hydraulic brake which is integral to the auxiliary steering planetary gearbox which is also mounted on the pump-jet, an electrically actuated way valve with auxiliary manual control, a manually operated 3/2 ball valve, a needle valve, a braking valve unit , a pressure filter and a hydraulic reservoir with return line filter. A manual hydraulic hand pump is also provided for manual release of the hydraulic brake in case of system malfunction. The powered module electrical system consists of an engine mounted alternator, 4 lead-acid storage batteries, the propulsion module circuit breaker panel "A6", a bilge pump control panel "A5", an engine junction box with Emergency Stop control "A4", an engine mounted Emergency Stop push button, a propulsion module junction box "A3", a Pump-Jet/Thruster junction box "A2JB2", a Pump-Jet/Thruster direction/aux battery junction box "A9", and a fire detection system consisting of two thermal detectors and a thermal switch electrically tied into the cab controls . If the temperature inside reaches 2250, fire alarm will sound in the cab. In the event of a fire, a manually activated fire suppression system will flood this compartment with CO_2. This compartment is also equipped with 5 electrically operated bilge pumps. The aft (fuel) compartment contains the fuel tank, fuel/water separator and fuel system shutoff valves. This compartment is also protected by the fire detection system. It is important to note that there are no electrical connections, controls or operating devices in this compartment. A bilge pump is not provided in this compartment. Fire detection is accomplished by means of a probe extending through the bulkhead that separates the fuel and machinery compartments with all electrical terminations made on the machinery compartment side. In the event of fire this compartment is flooded with CO_2 upon activation of the fire suppression system. The forward compartment (lazaret), contains the fire suppression system control and agent storage components and provides stowage for the emergency steering assembly when not in use. This compartment is equipped with a bilge pump and local bilge pump control, and is not protected by the fire detection or fire suppression system. Each propulsion module has six 3700 gph submersible bilge pumps; 5 in the machinery compartment and 1 in the lazaret. The pumps are locally controlled from control stations mounted in the machinery compartment and lazaret or remotely controlled from the operator's cab. The Pump-jet is driven by an 8 cylinder, diesel, marine engine delivering 600 hp at 2100 rpm on the output shaft. Weight of the propulsion module is approximately 41,100 pounds dry or 45,000 pounds fully fueled. Listed below are detail descriptions of the major components found inside each propulsion module.

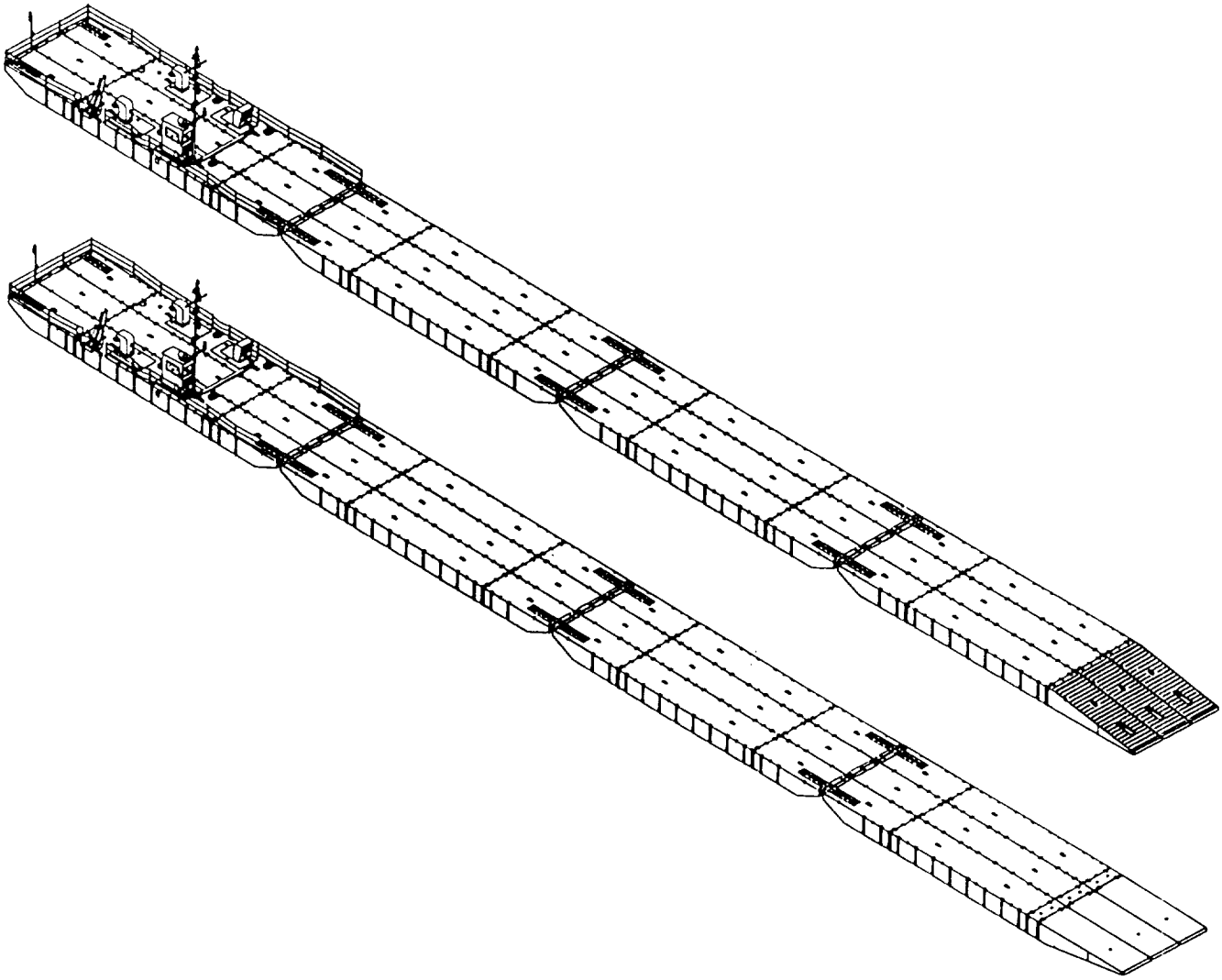

Figure 1-1. MCF (Full Arrangement).

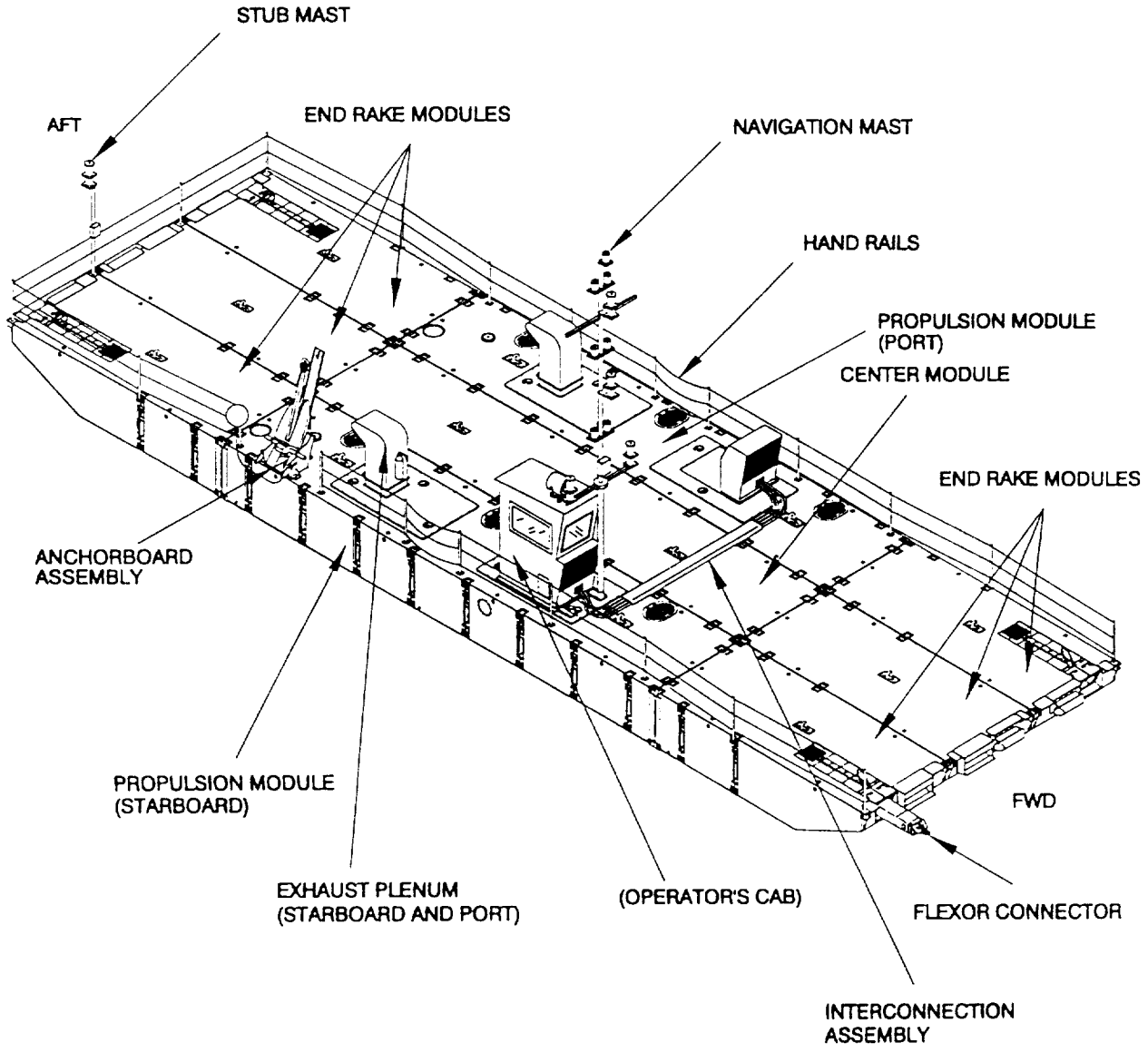

Figure 1-2. Powered Section.

a. Engine. 8 cylinder, water cooled, turbo charged, after cooled, two cycle, diesel marine engine, delivering 600 hp at 2100 rpm. With the exception of below deck Emergency Stop pushbuttons and automatic Emergency Stop actuation controlled by actuation of the fire suppression system, all operator control of the engine is accomplished from the operator's cab.

b. Exhaust System. The propulsion module exhaust system consists of a water cooled muffler assembly with inputs directly coupled from both engine turbocharger exhaust ports. The muffler is supplied with two exit ports, one is plugged and one is ported to the exhaust flapper, for configuration as either a port or starboard exhaust system. The piping between the turbocharger and muffler and between the muffler and exit exhaust flapper is a flexible silicon hose to accommodate for thermal expansion in the system.

c. Fuel System. Each propulsion module is equipped with a 400 gallon stainless steel fuel tank permanently welded inside the fuel compartment. Fuel suction and return lines are fitted with shut-off ball valves to isolate fuel to the tank when not in use or during repairs to the fuel system. A filler neck/strainer basket located on top of the fuel tank is accessible through a deck hatch from outside the fuel compartment. A dual purpose fuel-water separator and filter is located on the fuel tank in the fuel tank compartment at the rear of the module to remove water and contaminants from the diesel fuel.

d. Fuel-Water Separator/Filter. A dual purpose fuel-water separator and filter is located on the fuel tank in the fuel tank compartment at the rear of the module. Its main function is to remove water and contaminants from the diesel fuel.

e. Marine Gear. Mounted directly to the flywheel housing of the diesel engine, the Marine Gear provides the capability to reverse the directional rotation of the other drive train components making it possible to backflush the pump-jet. The transmission is equipped with an integral hydraulic system consisting of a pump, a shifting valve and internal hydraulic cylinders. The pump utilizes the transmission lubricating oil to operate hydraulic cylinders which shift the gearing the backflush, neutral or engaged configurations. The shifting valve is solenoid actuated from a toggle control switch in the operator's cab. In addition to powering the shifting cylinders, the pump also circulates case oil though an oil cooler that is plumbed into the engine raw water cooling system.

f. Transfer Case. The transfer case compensates for off set alignment between the output flange of the marine gear and the input flange of the pump-jet. It has a 1:1 gear ratio utilizing spur gears throughout and is equipped with an oil pump that circulates lubricating oil from its gear case though an oil cooler plumbed off of the engine raw water cooling system and back to the top of the transfer case to lubricate the upper gearing. The transfer case is connected to the marine gear and the pump-jet via drive shafts.

g. Machinery Guards. Removable metal machinery guards cover the drive shafts, engine flywheel, and alternator belt to protect personnel from contact with rotating parts.

h. Pump-Jet. Each propulsion module is equipped with a 360° steerable, pump-jet propulsion unit capable of delivering 5,000 lbs. of thrust. The pump-jet is works on the principle of a rotary pump and consists of a drive shaft driven upper gearbox assembly driving an impeller. Water is sucked into the pump-jet through a feeding funnel on the bottom of the module, is fed into the enclosing pressure casing, whose bottom plate is provided with three systematically arranged outlet nozzles from which water is ejected (angle 13^{o}). A hydraulic steering motor drives a spur gear through a planetary gearbox to rotate the pressure casing and bottom plate (steering nozzles) in both senses of rotation without limitation. A second planetary gearbox is provided to facilitate emergency steering. (An emergency steering control stand mounts above deck and interfaces with the through shaft of the planetary gearbox.) The emergency steering gearbox contains a spring set, hydraulically released disc brake. The brake maintains the position of the steering nozzle until rotation is called for by the operator. In the case of hydraulic system failure the brake can be released via the hydraulic hand pump, to facilitate emergency steering. An electromechanical feedback unit monitors relative steering position of the steering nozzle and transmits that position to a dial indicator in the operator's cab. An electric sensor monitors the oil level in the upper gearbox and sends a signal to an indicating light in the operator's cab when the oil level is below the required level.