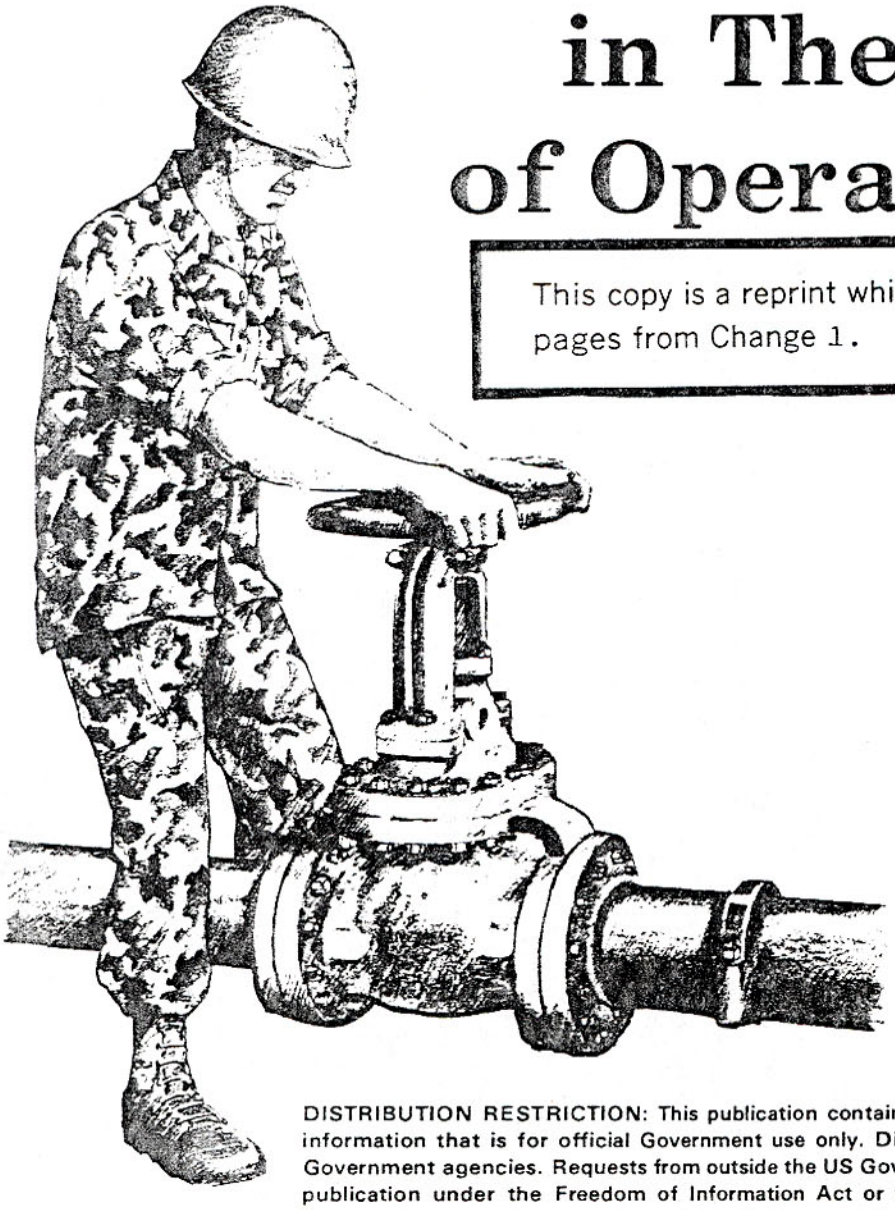
FM 10-67

DEPARTMENT OF THE ARMY FIELD MANUAL

Petroleum Supply in Theaters of Operations

This copy is a reprint which includes current pages from Change 1.



Change
No 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 10 October 1985

PETROLEUM SUPPLY IN THEATERS OF OPERATIONS

This change updates information on several petroleum product report forms (DA Forms 5463-R and 5464-R). The newly added Appendix G provides blank, reproducible copies of these forms.

FM 10-67, 18 February 1983, is changed as follows:

1. New or changed material is indicated by a star (★).
2. Remove old pages and insert new pages as indicated below:

Remove pages	Insert pages
i and ii	i and ii
6-1 through 6-4	6-1, 6-2, 6-3, and 6-4
A-5	A-5
	Appendix G

3. File this transmittal sheet in the front of the publication.

FIELD MANUAL
NO 10-67

C1, FM 10-67
*FM 10-67
HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 18 February 1983

Petroleum Supply in Theaters of Operations

*This manual supersedes FM 10-67, 1 October 1968.

The provisions of this publication are the subject of international agreement 2115, Fuel Consumption Unit.

Figures

Tables

CHAPTER 1

INTRODUCTION

Purpose

This manual is a guide for commanders, staff officers, and other persons concerned with planning, organizing, and operating an Army petroleum distribution supply system in a theater of operations. Concepts and doctrine are presented to enable the planner to design a responsive petroleum supply system that will insure that units are organized and equipped to provide necessary petroleum support to US forces.

Scope

Doctrine for the development and operation of a theater petroleum supply system is discussed separately for a developed and an undeveloped theater of operations. Responsibilities for the command, control, and operational missions of petroleum units operating in the theater are discussed in detail. Quality surveillance of petroleum products and petroleum safety measures, critical to petroleum supply operations, are treated in separate chapters. Packaged petroleum products (for example, lubricants, greases, and specialty items in containers of 55 gallons or less) are not discussed in detail. The doctrine included in this manual is oriented toward operations in a tactical theater and may not relate directly to normal peacetime garrison operations. Responsibilities of both management and operators are discussed, and the systems described are applicable to both conventional and chemical or nuclear warfare. This manual may not be cited as authority for requesting personnel or equipment.

Recommended Changes

To recommend changes and suggest improvements, send comments to--

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Comments, preferably submitted on a DA Form 2028 (Recommended Changes to Blank Forms and Publications) should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Provide reasons for each comment so that it can be understood and evaluated.

When used in this publication, "he," "him," "his," and "men" represent both the masculine and feminine genders unless otherwise stated.

CHAPTER 2

PETROLEUM SUPPLY SYSTEM IN THE DEVELOPED THEATER

Section I
PLANNING THE SYSTEM

Description of System

Packaged products shipped by ocean freight are received at dry-cargo port or beach facilities and those shipped by airfreight are received at air terminals. Packaged products are stored at general support supply bases and distributed through direct support supply organizations to consumers throughout the theater. Bulk fuels not locally procured are received from ocean tankers at marine petroleum terminals. Bulk fuels are transferred by pipeline to tank farms. Figure 2-1 shows the bulk petroleum distribution system in a developed theater. The system includes discharge facilities, which include tanker moorings, piers, docks, and piping manifolds at ports, sea terminals, or at other points of entry; inland tank farms; storage terminals; and other petroleum storage facilities. It also includes pump stations and pipelines.

l Large-scale combat operations may justify construction of welded or coupled pipelines to move bulk fuels from communications zone (COMMZ) storage locations to the combat zone. Airbases and tactical airfields are serviced by the pipeline system when feasible. Hosehnes are used to service smaller or temporary large-volume requirements. The pipeline system extends as far forward as possible, usually into the corps rear area, with hoseline extensions into corps storage sites. Since bulk petroleum makes up over 50 percent of the tonnage moved in the theater of operations, pipelines significantly reduce other transportation requirements (rail and highway) and congestion. The system is supplemented by other means of bulk delivery, such as barges, rail tank cars, tank vehicles, and aircraft. Branch lines are used where practical to supply major users from the main pipeline. Hoselines are used as temporary means of supply to general support suppliers. Tank vehicles, rail tank cars, and hoselines are used to move bulk petroleum products from general to direct support echelons. Bulk transporters usually move bulk fuel from the direct support echelon to using units. Using units are authorized organic equipment to receive the bulk products and to refuel their vehicles and aircraft without resorting to cans and drums. The following are basic principles of petroleum distribution:

•Continuity of pipeline operations is maintained by multiple modes of communication (teletype, radio, and telephone) along the pipeline.

• The basic petroleum operating concept is to keep storage tankage full at all times. The schedule for movement of fuel through the system is based on available ullage and product demand.

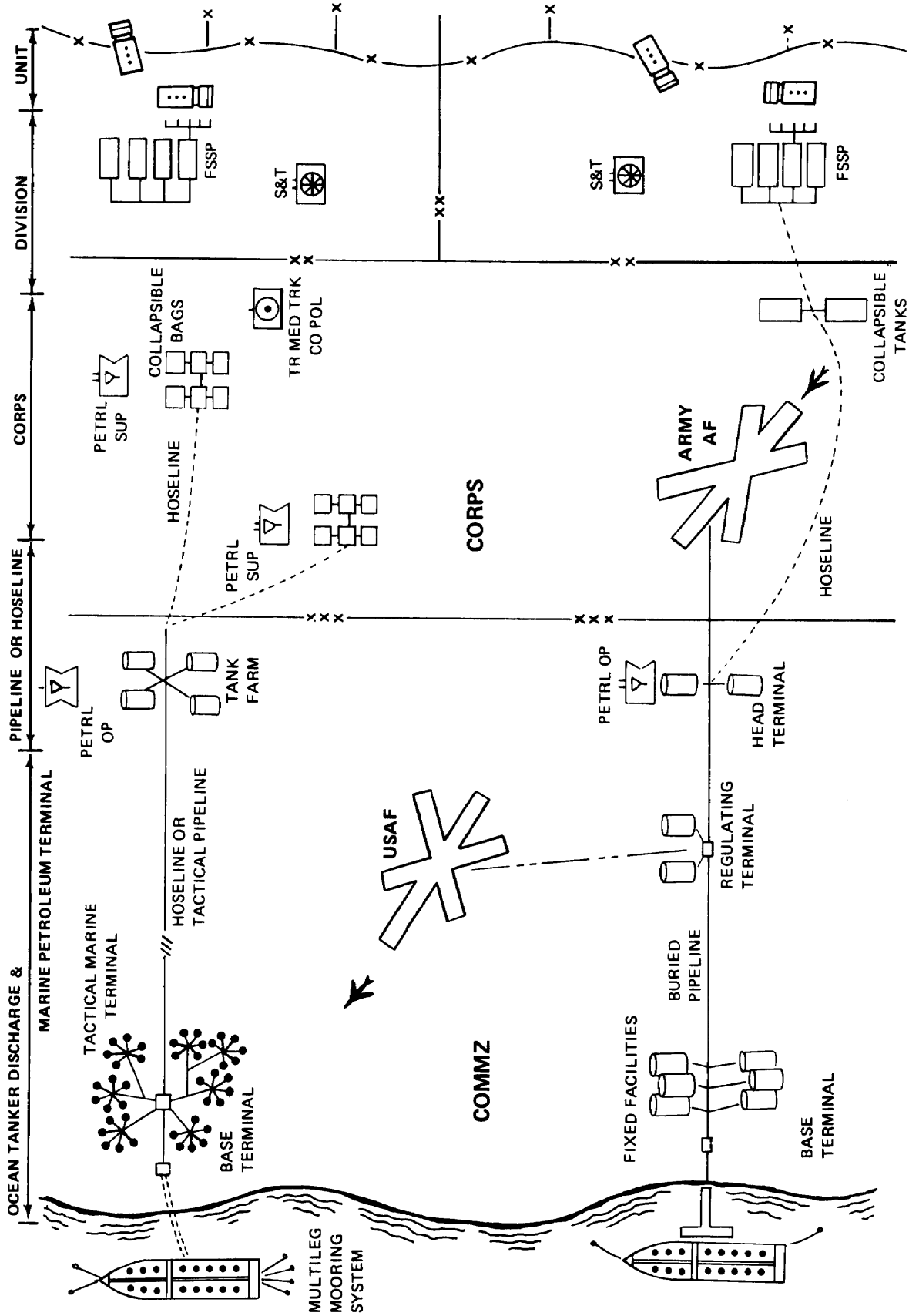


Figure 2-1. Bulk petroleum distribution system in a developed theater.

- Pipeline surveillance is essential to detect leaks, sabotage, toxic chemical agent contamination, damage, and pilferage. A combination of walking, motorized, and observation aircraft patrols and air mobile security teams is necessary for patrolling the system.
- The use of packaged fuel is limited to the minimum amount needed for continuous support. Bulk reduction is performed as near to the intended consumer as practicable to reduce transportation requirements,
- Distribution is made from bulk terminals and storage areas to the consumer by pipeline, hoseline, rail tank car, barge, tank vehicle, and aircraft. Some local distribution is made by tank vehicles that are organic to the petroleum pipeline and terminal operating companies. Line-haul operations are usually carried out by transportation medium truck companies (petroleum) assigned to the petroleum group, petroleum battalions, or corps support command.
- Packaged products are distributed by ground, air, and water transport.
- Rail tank cars and tank vehicles are used to deliver bulk products to using units whenever the lines of communication are secure. When lines of communication are not secure, aircraft carrying collapsible tanks, 500-gallon collapsible drums, and 55-gallon drums are used. Helicopters are used to move 500-gallon drums internally or by sling load. Cargo aircraft may also be used to transport containers and dispensing equipment to forward areas. Air Force capabilities for delivering petroleum products are discussed in section IV of chapter 3.

- In a theater of operations, a bulk distribution system using pipelines and hoselines reduces the need to haul fuel by road or rail. Also, fewer combat service support personnel are needed to operate a pipeline system as compared to using other modes of transportation or operating a packaged petroleum supply distribution system.

Planning for Bulk Petroleum Supply

Planning for petroleum supply support parallels, in general, the pattern of planning outlined in FM 101-5. Time, space, distances, terrain, existing resources, scope of requirements, and the operating environment are all planning factors. One of the most important planning elements for petroleum support is requirements computation. Supply publications (especially SB 710-2), FM 101-10-1, and STANAG 2115 (appendix D) contain planning data for Class III supplies that are particularly helpful, and they should be used by the petroleum planner in coordination with engineer theater development planning.

- Planning *Elements.* Petroleum supply planning involves five major elements--
- Amount and type of product to be distributed (requirements).
- Receipt and distribution points (storage locations).
- Distribution system or method (transportation mode).
- Equipment to be used (pump/pipeline equipment/rail/truck/ boat).
- Organizations and personnel required to operate the system and its equipment (units).

Planning Considerations. The petroleum supply system must be designed for the operations and climate of the specific theater. Plans must take into account--

- The mission and force (size and composition) to be supported.
- The requirements of that force.
- Seasonal requirements.
- The capability of installations and/or units (to include the host nation) to provide required support.
- The speed with which pipelines and hoselines can be constructed and extended.
- Requirements for terminals, offshore unloading facilities, and distribution points.
- Requirements for both bulk and packaged products.
- The availability of petroleum operating units and other units needed to construct, install, and maintain petroleum distribution and storage facilities and communications equipment.
- Terrain, since this impacts both on the

ability to install petroleum, oils, and lubricants (POL) facilities and POL usage factors.

• *Planning Categories.* Petroleum supply planning falls into two basic categories--logistical and operational.

• Logistical planning requires the translation of such factors as troop strengths, numbers and types of fuel-consuming equipment and vehicles, and tactical objectives into specific fuel requirements and distribution plans. Planning of this nature is started well in advance of actual operations at theater and theater-army level. The purpose of the planning is to insure that products, distribution facilities, and operating units and personnel will be available when needed.

• Operational planning includes planning both for reaching the rated capacity of the distribution system and for maintaining that capacity to meet requirements placed upon it. This planning is carried on along with operations. Revisions may be necessary because of tactical developments, losses in handling capacity due to enemy action, and other factors that keep the system from operating as planned,

Supply Levels

The Department of the Army prescribes supply levels for the theater army in terms of days of supply. The theater army commander prescribes levels for the combat zone and the COMMZ.

• For planning purposes only, a minimum of a 30-day theater supply level should be established for bulk fuel in the developed theater. In actual practice, this level may be greater than 30 days depending upon available tankage and other factors. The major portion of the theater level is maintained in the COMMZ. See figure 2-2.

• Supply levels must take into account the needs of all users, including Air Force, Navy, and allies (when so designated).

Host Nation Support

In wartime, when logistical support from their own system may not be readily available, US combat forces maybe supplied through agreements with a host nation. In this case, the host nation supplies US forces with common items and services. The type and amount of support provided should, if possible, be specified in signed agreements and included in wartime logistical plans of all nations concerned. The amount of support--civil or military--that a host nation can provide depends on its national laws, its industrial capability, its economy, and its willingness to give such support. Regardless of the difficulty in obtaining host nation support agreements, they should be aggressively pursued.

• Host nation resources will most likely support the COMMZ, the corps, and the divisional areas, as appropriate. Host nation support, if available, can significantly reduce support requirements.

• Procedures for mutual support among NATO nations are contained in directives agreed upon for civil military cooperation (CIMIC). A host nation can be requested to provide civil resources, including facilities, food, services, or labor. National or allied commanders submit requests for CIMIC support to the territorial command of the host nation. Where possible, and preferable, national/allied CIMIC agreements are made with the host nation in peacetime.

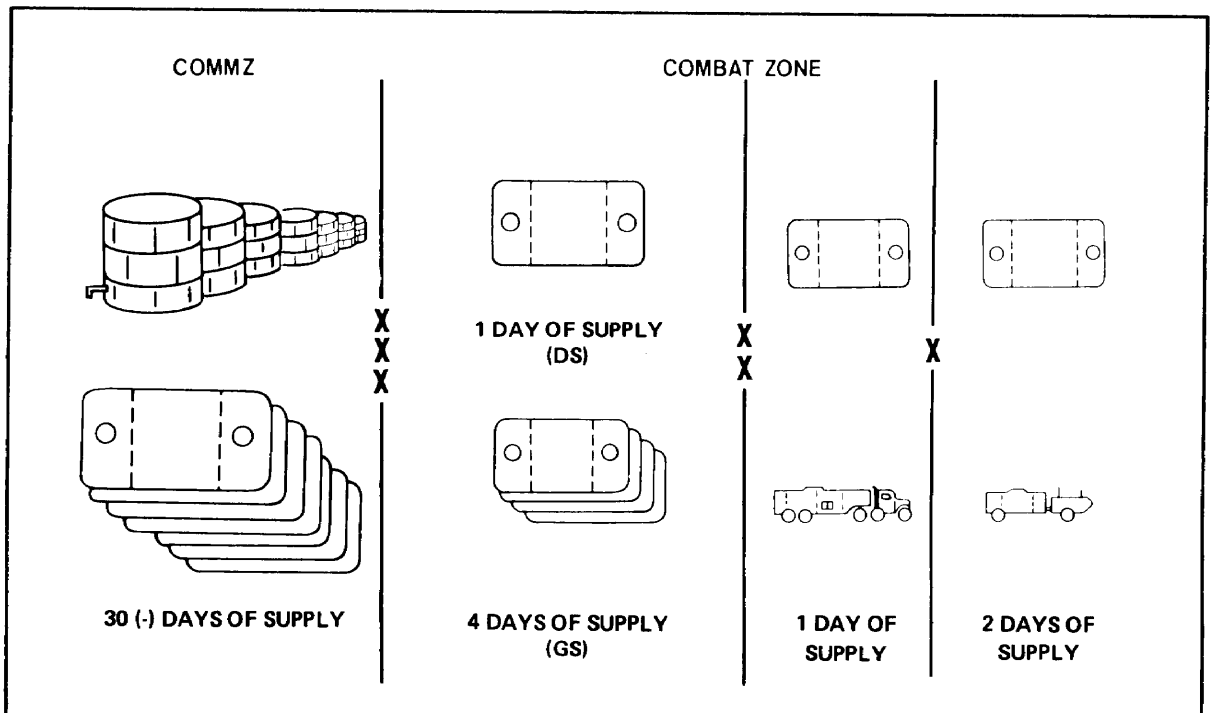


Figure 2-2. *Minimum days of supply for bulk Class III to be held in organic storage (large theater of operations).*

Section II

DEVELOPING THE SYSTEM

Introduction

In the developed theater, an existing petroleum distribution system is normally operating in support of the peacetime civilian economy and military forces. However, to support the tactical situation it may be necessary to modify the present system, renovate old facilities, or build new ones. Whenever possible, active duty US Army personnel should be trained to operate existing distribution systems.

Tanker Loading and Unloading Facilities

Existing tanker loading and unloading facilities in a developed theater may require supplemental facilities. These facilities may include tanker moorings, wharfs, docks, mooring buoys, shore booster and transfer pump stations, and storage tanks. Additional information on such facilities is contained in TMs 5-301-1 (Army Facilities Components System - Planning (Temperate)), 5-301-2 (Army Facilities Components System - Planning (Tropical)), 5-301-3 (Army Facilities Components System - Planning (Frigid)), 5-301-4 (Army Facilities Components System - Planning (Desert)), 5-302-1 (Army Facilities Components System - Designs; Vol I), 5-302-2 (Army Facilities Components System - Designs; Vol II), 5-303 (Army Facilities Components System - Planning Logistic Data and Bills of Materials), 5-343 (Military Petroleum Pipeline

Systems), and in FMs 10-18 (Petroleum Terminal and Pipeline Operations) and 10-69 (Petroleum Supply Point Equipment and Operations). Because of the hazards involved in handling petroleum products, installations near tanker loading and unloading facilities must be protected against fire. When new facilities are built, fire protection, dispersion, security, collective protection, and safety matters must be considered. Tanker facilities should be able to load or unload the largest scheduled tanker in 24 hours or less. Table 2-1 gives statistics on tankers. The T-5 and the Handy-Size tanker are used as the standard for military planners. Docks and piers are preferred to offshore moorings for loading and unloading.

Terminals

A petroleum terminal can be a single tank farm or a complex of dispersed tank farms with varying capacities. The number of tank farms in the terminal depends on the storage capacity required; however, standard installations usually have capacities of 50,000 to 250,000 barrels in increments of 50,000 barrels. Tank farms are connected by pipelines and manifolded so that more than one petroleum product can be moved into, out of, and between storage tanks and tank farms as required for storage and distribution.

- *Capacity Required.* The total amount of tankage required depends on the fuel requirements to support the theater supply level. Factors to be considered in determining storage requirements are phased requirements for product, rate of fuel consumption, frequency of deliveries, tanker capacities, port capabilities, and tanker turnaround time between the theater source of supply and the pipeline base terminal. Probable losses and delays due to enemy action and weather and the operating capacity of the pipeline and other means of transportation must also be considered.

- *Types of Tanks.* Two basic types of storage tanks are used in petroleum supply systems in a developed theater: permanent welded steel tanks and semipermanent bolted steel tanks. Although permanent welded steel tanks are preferred, semipermanent bolted steel tanks are used if additional tankage is required and construction time is limited. If available, collapsible fabric tanks may be substituted. Specifications and other information about such tanks are contained in TM 5-343 and FM 10-69.

  - The floating-roof, welded steel storage tank (American Petroleum Institute (API) standard 650) is best for storing volatile products (AVGAS, MOGAS, and JP-4), When this tank is not available in the military supply system, other tanks conforming to API standard 650 may be used. Military and commercial welded steel tanks of all types may be found in a developed theater.
  - Semipermanent bolted steel tanks are type-classified in sizes of 100-, 250-, 500-, 1,000-, 3,000-, and 10,000-barrel capacities.

- *Location and Layout.* To meet the tactical situation, existing petroleum terminals in the developed theater may require modification or additional terminals may have to be constructed. The general locations of required terminals will be given in the theater petroleum distribution plan. The location, as well as the size and number of terminals, depends on tactical, logistical, and other military considerations. The primary planning consideration is flexibility to insure continuity of distribution if one or more terminals are destroyed by enemy action. Distribution systems designed for peacetime may have to be altered to compensate for the enemy's capability to destroy them in time of war. Other factors in determining location and layout are the requirements for efficient operation, control, and dispersion. The petroleum distribution system is a compromise between military necessity on the one hand and technical efficiency on the other. A discussion of the engineering considerations and factors that influence the selection of specific sites and the design, construction, and layout of terminals appear in TM 5-302-1, TM 5-302-2, TM 5-343, and FM 10-18. An example of a petroleum distribution system is shown in figure 2-3.

- *Base Terminals.* The base terminal is the

Table 2-1. Tanker statistics

Class (US Maritime Commission designation)	DWT (1,000 tons)	Length	Draft[1] (fully loaded)	Cargo Capacity[2] (bbls)	Cargo tanks	Cargo pumps			Size of hose connections (in)	Discharge pressure[3] (psi)
						Number	Hourly capacity per pump (bbls)	Hourly capacity all pumps (bbls)		
AO-22[4]	16.5	517	32 ft-0 in	138,000	9	4	2,000	8,000	8	125
AO-143[4]	22.2		35 ft-0 in	187,100	9	4	4,285	17,000	8	125
T-1	4				7				8	
M-A1			12 ft-11 in	11,840		2	857	1,700		100
M-A2		311	13 ft-0 in	12,460		2	857	1,700		100
M-BT-1			19 ft-4 in	30,800		3	1,043	3,100		80
M-BT-2		325	19 ft-3 in	31,300		3	1,043	3,100		80
T-2	16.5				9				8 to 10	
SE-A1		529	30 ft-2 in	138,335		3	2,857	8,500		125
SE-A2			30 ft-2 in	138,335		3	2,857	8,500		125
SE-A3			30 ft-2 in	138,335		3	2,857	8.500		125
T-3	18.5		30 ft-0 in	131,000	10	2	4,000	8,000	8 to 10	125
T-5	16.5 to 20.0	620	36 ft-0 in	170,000 to 190,000	9	3 or 4		10,000	8 to 10	125
HANDY-SIZE[4] (HST)	25.3	587	32 ft-6 in	222,006	7	4	6,000	24,000		125
SUPER	25 to 37.5	627-676	32 ft-0 in to 35 ft-9 in	200,000 to 300,000	10	3 or 4		20,000 to 28,000	10 to 12	125
GIANT[5]	37.5 to 65	676-860	35 ft-9 in to 42 ft-3 in	300,000 to 520,000	10	4		20,000 to 30,000	10 to 12	125
MAMMOTH[5]	65 to 106	940	42 ft-3 in to 49 ft-0 in	520,000 to 864,000	10	4		25,000 to 50,000	10 to 12	125

[1] There are minor variations in each class of vessels from the data shown above. The values indicated for "Draft" in the tabulations are maximums for each class.
[2] The US Navy tankers 95 percent loaded to provide for expansion. All others 98 percent loaded.
[3] Use 100 psi for planning purposes.
[4] US Navy designation.
[5] Giant and mammoth tankers are used primarily for movement of crude oil.

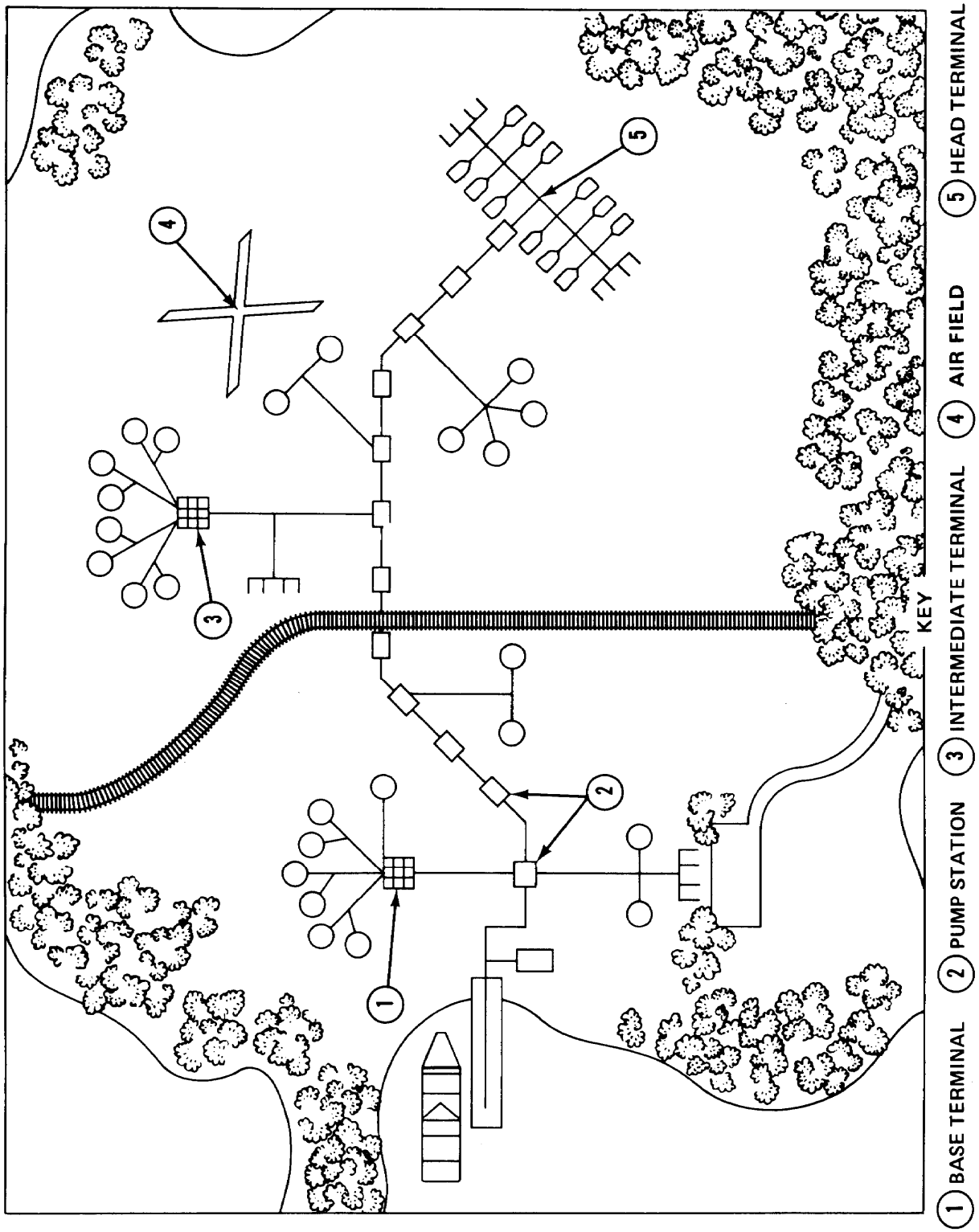


Figure 2-3. Example of a petroleum distribution system.

initial bulk petroleum storage facility in a developed theater. It is located at a port or wherever fuel is introduced into the theater. A theater may have more than one base terminal. Because it is a prime military target, the use of alternate facilities should be considered. These should be widely dispersed so that they cannot be destroyed or critically damaged by a single attack. The base terminal is usually the largest single bulk fuel installation of a pipeline system; therefore, in order to receive tanker deliveries, the area selected for its location must provide room for future expansion.

• *Intermediate Terminals.* Usually, the pipeline system in a developed theater extends many miles and will have one or more intermediate terminals. These are located where branch pipelines leave the main line and serve as reserve storage and dispensing facilities and as regulating tankage. The tactical situation will determine the size of an intermediate terminal and the amount of product that must be distributed in that area.

• *Head Terminals.* A head terminal, also called a "pipehead terminal," is located at the end of a pipeline system farthest inland. Usually, welded and/or bolted steel tanks are used at a head terminal in a developed theater. However, when engineer support is limited, collapsible tanks may be used. The head terminal is placed as close to the corps support area as feasible.

• *Regulating Tank Installations.* A pipeline system may include regulating tankage installations in addition to normal pipeline terminals. The primary function of regulating tankage is to maintain a source of supply of products for forward movement through the pipeline or to store products at an intermediate location when there is an interruption in flow to the head terminal. Their use reduces delay in delivering products forward. They may be placed at pump stations between base and head terminals. Their number and location depend on the quantity of products handled and the capability of the pipelines system. These installations are also used as reserve storage sites.

Pipelines

Petroleum pipelines can move large volumes of fuels rapidly without burdening other modes of transport. In developed theaters, welded, buried, high-pressure cathodically protected pipelines are widely used in commercial and military systems. The total pipeline system may include or may be expanded using coupled pipeline and flexible hoseline. Pipe and tubing are discussed below. Hoseline is discussed in chapter 3. For a more detailed coverage, refer to TM 5-343, FM 10-18, and FM 10-20.

• *Standard-weight Pipe.* Standard-weight pipe is manufactured to the specifications of the American Petroleum Institute (API) and is referred to as API STD5L pipe. It is made in diameters of 4, 6, 8, 12, 14, 16, 18, 20, and 22 inches, but the Army seldom stocks pipe over 12 inches in diameter. It comes in 20-foot lengths grooved for coupling (victaulic) and in random lengths beveled for welding. This is the pipe used in submarine and river-crossing lines and in lines operated at high pressures.

• *Lightweight tubing.* Lightweight tubing is made of light gage steel with API STD5L nipples welded to each end, It comes in 4-, 6-, 8-, and 12-inch diameters and 20-foot lengths. Because of its thin walls, lightweight tubing is not used for buried or submerged lines or in populated areas.

Pump Stations

Pump stations are necessary to push products through the pipeline, feed the pipeline, and transfer fuel between tanks and dispensing outlets. Additional information on pump stations is included in FM 10-18 and in chapter 3 of this manual.

Dispensing Facilities

Dispensing facilities are located at points where bulk fuel is transferred from one means of transportation to another or where fuel is packaged or delivered to using vehicles. Dispensing facilities are installations such as tank vehicle and rail tank car loading facilities, retail vehicle filling stations, can-

and drum-filling points, airfields, and fuel supply installations.

Rail Tank Car Facilities

Standard American tank cars usually have one compartment and range in capacity from 6,000 to 13,000 gallons. Jumbo cars have a 20,000-gallon capacity, In oversea theaters, personnel should routinely expect to use rail tank cars manufactured in the country of operation. Because there are differences in the design and capacity of tank cars, particularly between standard American and foreign cars, the design of loading facilities at tank farms where cars are filled and at the delivery points where they are unloaded varies. Loading and unloading facilities may be designed to serve from one car up to a full train at the same time depending on the demand. Information on constructing loading facilities is in TM 5-302. Information on cleaning tank cars is in FM 10-20.

Tank Vehicle Facilities

Facilities for loading and unloading tank vehicles must be provided in any distribution system. The type of facility used depends upon its location in the theater, the size of the military operation, resources available, etc. Provisions must be made for both top and bottom loading tank vehicles, In some situations, a fuel system supply point maybe used; in others, a permanent structure with greater capacity may be required. TM 5-302-1 shows a standard two-station loading facility (drawing 12-43).

Barge Facilities

In some instances, barges may be the most economical means of moving bulk fuel inland. When such is the case, existing loading facilities may be expanded or new facilities constructed. Drawing 12-04 in TM 5-302-1 shows a facility for barges and small vessels.

CHAPTER 3

PETROLEUM SUPPLY SYSTEM IN THE UNDEVELOPED THEATER

Section I

PLANNING THE SYSTEM

Description of System

Packaged products are received from shipping at dry-cargo beach facilities or from aircraft at air terminals. Packaged products are shipped to general support supply bases for distribution through direct support supply units to consumers throughout the theater. In the undeveloped theater, road nets, rail lines, and easily traversed lines of communication normally will not be available. Bulk fuels are received in the undeveloped theater in over-the-beach operations using tactical marine terminals. Hoselines initially carry the products inland and, where possible, fuels are airlifted by Air Force transport to link up with ground forces. Coastal tankers may be used to move products from deep-draft tankers to moorings in water too shallow for the larger ships. Bulk fuel is transferred by flexible hoselines to tank farms, made up of collapsible storage tanks. The petroleum supply system in an undeveloped theater includes tanker mooring facilities; floating hoselines; submarine pipelines; and inland tank farms and terminals using hoselines, collapsible tanks, and bolted steel tanks. It also includes pump stations, flexible hoselines, coupled pipelines, and tank vehicles. Bulk fuel is moved from base terminals and rear storage locations to the combat zone by flexible hoselines. Coupled pipelines are used when the beachhead is expanded. Tactical air bases are connected to the main hoseline or pipeline and to the appropriate tank farm initially by hoselines. The pipeline and hoseline system extends as far forward as possible, usually into the corps rear area. The system must be established. Hoselines offer the most rapidly and easily deployed system. When the hoseline system exceeds 10 to 15 miles, a more permanent system is required. The initial system will probably consist of the tactical marine terminal, portable 350- and 600-gpm pumps, hoselines, and collapsible storage tanks. As the beachhead is expanded and the theater expands, rigid tactical pipelines, bolted storage tanks, and fixed pumping assemblies will be required. Other means of delivery such as tank vehicle, barge, and aircraft will be incorporated into the system as required. The undeveloped theater will be structured as the developed theater is structured. As soon as practical, the COMMZ, corps support, and division support areas will be formed. In the early stages, the theater may only consist of a division support area, which later expands to add the corps support area. The COMMZ may never be formed depending upon the duration and geographic expansion of the operation. As in the developed theater, general support petroleum units will normally also provide direct support on an area basis.

Planning for Bulk Petroleum Supply

Planning for bulk petroleum supply is the same in the undeveloped theater as it is in the developed theater. See page 2-3 for a detailed discussion.

Unified Command Plan

The unified command plan is the basis for all subordinate tactical and logistical support plans for the theater. This plan sets forth broad concepts, establishes objectives, assigns missions, and allocates available resources. The joint petroleum officer is the unified commander's key staff member on petroleum matters. He furnishes supply and distribution data for inclusion in the command plan.

Theater Army Plans

The theater army commander and staff use the unified command plan as them guide in preparing the theater army tactical plan and the theater army logistics support plan. The theater army G4 (assistant chief of staff, logistics) first develops logistics support concept based on the tactical plan. He then prepares the implementing theater army logistics support plan. This type of planning provides the guidance and broad policies upon which operational planning is based. Theater army planning is started before the theater is established. During operations, the job of theater army planners is to revise basic plans for the conduct of the campaign and for developments in the tactical situation.

Theater Army Petroleum Distribution Plan

As a rule, the petroleum group is responsible for theater petroleum planning and the theater army petroleum distribution plan. In peacetime when no petroleum group is available, planning is done by the designated senior theater petroleum staff officer. In the undeveloped theater where personnel assets are limited, the senior petroleum officer is responsible for continued planning. General principles and procedures for development, improvement, and expansion of resources of an area to support operations are discussed in FM 100-10. The theater army petroleum distribution plan is prepared and published as an annex to the theater army logistic support plan. A suggested format for a distribution plan is provided in appendix B.

- *Facilities.* The petroleum distribution plan specifies the facilities to be used. Shore storage facilities should be large enough to allow tankers to unload in minimum time. However, in an undeveloped theater, facilities initially available are usually limited, and delays in unloading tankers are expected. The plan should give the size of terminals, tank farms, laboratories, and other facilities and where they should be placed on a time-phased basis to support the tactical plan.

- *Troop Lists.* The distribution plan must specify troop units needed on a time-phased basis to support the tactical plan. Timely arrival of engineer units to construct petroleum facilities and quartermaster and transportation units to distribute petroleum supplies is critical. Time-phased development of a petroleum distribution system is an important part of the overall logistics plan.

- *Theater Operational Project.* To make sure that petroleum handling and distribution facilities will be available when needed, the theater army petroleum officer prepares a project requirement. All long-range materiel requirements, including facilities, materials, and equipment needed to install and operate the petroleum distribution system, are submitted as a theater operational project requirement. Procedures are prescribed by AR 710-1 and AR 710-3.

- *Coordination.* The theater army petroleum officer coordinates with other key staff members to insure that the distribution plan is adequate and can be supported. He coordinates with the theater army transportation officer on plans for movement of fuel by means other than pipeline, with the theater army engineer on construction and major repair of the petroleum distribution system, with the G3 (assistant chief of staff, operations) on troop units and security measures, and with the G5 (assistant chief of staff, civil military operations) on matters

involving host nation support or coordination. He also coordinates with Air Force representatives to insure that the planned system will support requirements and to program construction of distribution facilities at airbases. In addition, he coordinates with other services, allies, or other agencies affected by the plan.

Supply Levels

The Department of the Army prescribes supply levels for the theater army in terms of days of supply. The theater army commander prescribes levels for the combat zone and the COMMZ.

- For planning purposes only, a minimum of a 15-day theater supply level should be established for bulk fuel in the undeveloped theater. In actual practice, this level may vary. The major portion of the theater level is maintained in the COMMZ. See figure 3-1.

- Supply levels must take into account the needs of all users, including Air Force, Navy, and allies (when so designated).

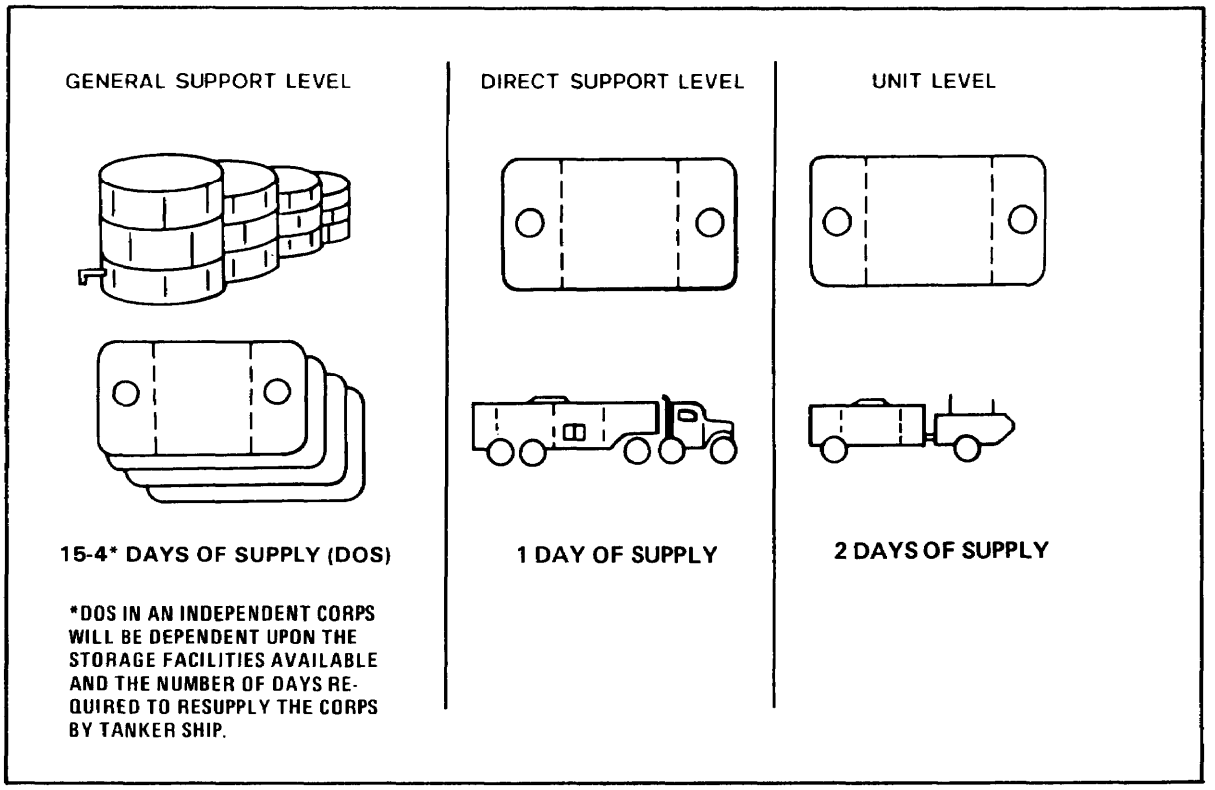


Figure 3-1. Minimum stockage policy for the independent corps.

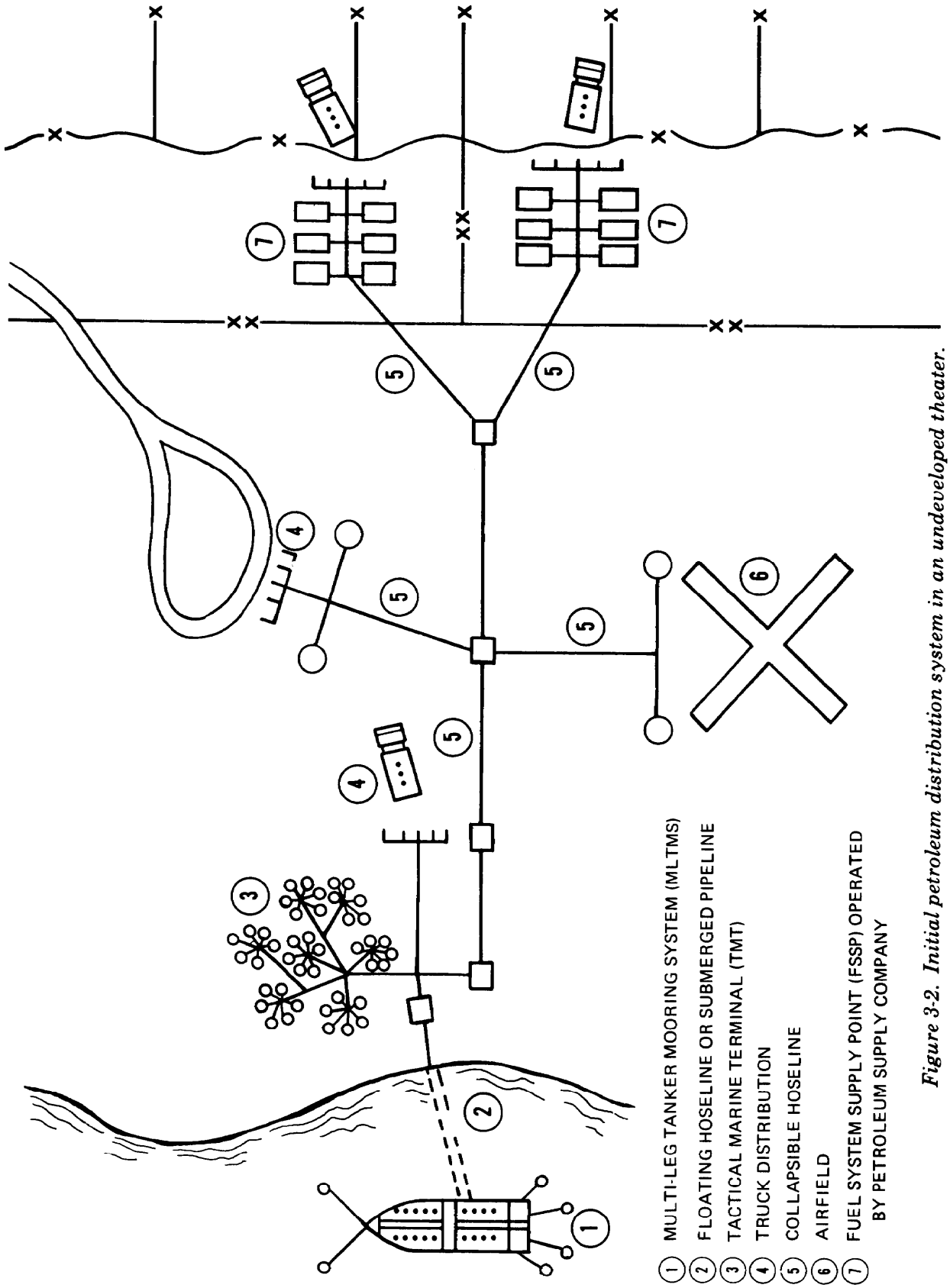


Figure 3-2. Initial petroleum distribution system in an undeveloped theater.

Section II

DEVELOPING THE SYSTEM

Introduction

Providing a fuel distribution system to support operations in an undeveloped theater presents many problems not faced in a developed area. In the undeveloped theater, the entire system has to be brought in and installed. Mooring facilities must be built, storage tanks constructed, and pipelines or hoselines laid to move fuel inland to consuming units. In the early stages of an assault, the assaulting force relies on its own equipment and personnel, backed up by combat service support units. As the operation progresses, additional units are brought in, and the system is expanded.

Shore Assault

When US forces deploy into an undeveloped theater, a petroleum distribution system is developed in the objective area as soon as practical. Tactical marine terminals and related equipment are set up and operated by supporting petroleum units. Initial fuel storage facilities are expanded as soon as possible so that vulnerable floating storage--tankers, barges, or other craft holding reserve fuel for shore tanks--may be released. As previously stated, the minimum bulk fuel requirement for the undeveloped theater is 15 days of supply. Fuel from beach storage is distributed by hoseline, tank vehicles, helicopters, and whatever other means are needed and available. Figure 3-2 shows an initial petroleum distribution system in an undeveloped theater.

Maturing System

When troop strengths increase and the tactical situation permits, construction of a more permanent distribution system begins. As the system expands to meet increased needs, facilities and equipment are added. These usually include terminals, tactical pipelines (bolted or hasty coupled), pump stations, and tank vehicle loading facilities. Tanker and barge unloading facilities may also be included. This system may or may not begin where a tactical marine terminal is installed, but it follows lines of communication. The exact location depends upon the logistical support plan. Figure 3-3 illustrates a distribution system in an undeveloped theater after D+90.

- In addition to planning for expanding the primary system, consideration is given to constructing more permanent alternate and secondary systems to insure uninterrupted supply to using units. These logistical plans are developed and acted on as the tactical operation progresses.

- The distribution system extends as far forward as practicable. It usually bypasses intermediate supply installations. By reducing multiple handling of product, the system can provide supplies in amounts needed in the shortest time possible.

- The senior petroleum staff officer (normally the COSCOM POL staff officer in an undeveloped theater), in coordination with the petroleum group commander, prepares or revises the petroleum supply system development plan. When doing so, he takes into account the types and amounts of product required by all users as well as when and where it is needed. In addition, he gets necessary priorities for constructing and expanding the system. By being on the commander's staff, he is in a position to monitor construction of the system throughout the theater and take what measures are required to insure that manpower and materials are available to expedite construction.

Tanker Loading and Unloading Facilities

In the undeveloped theater, as in the

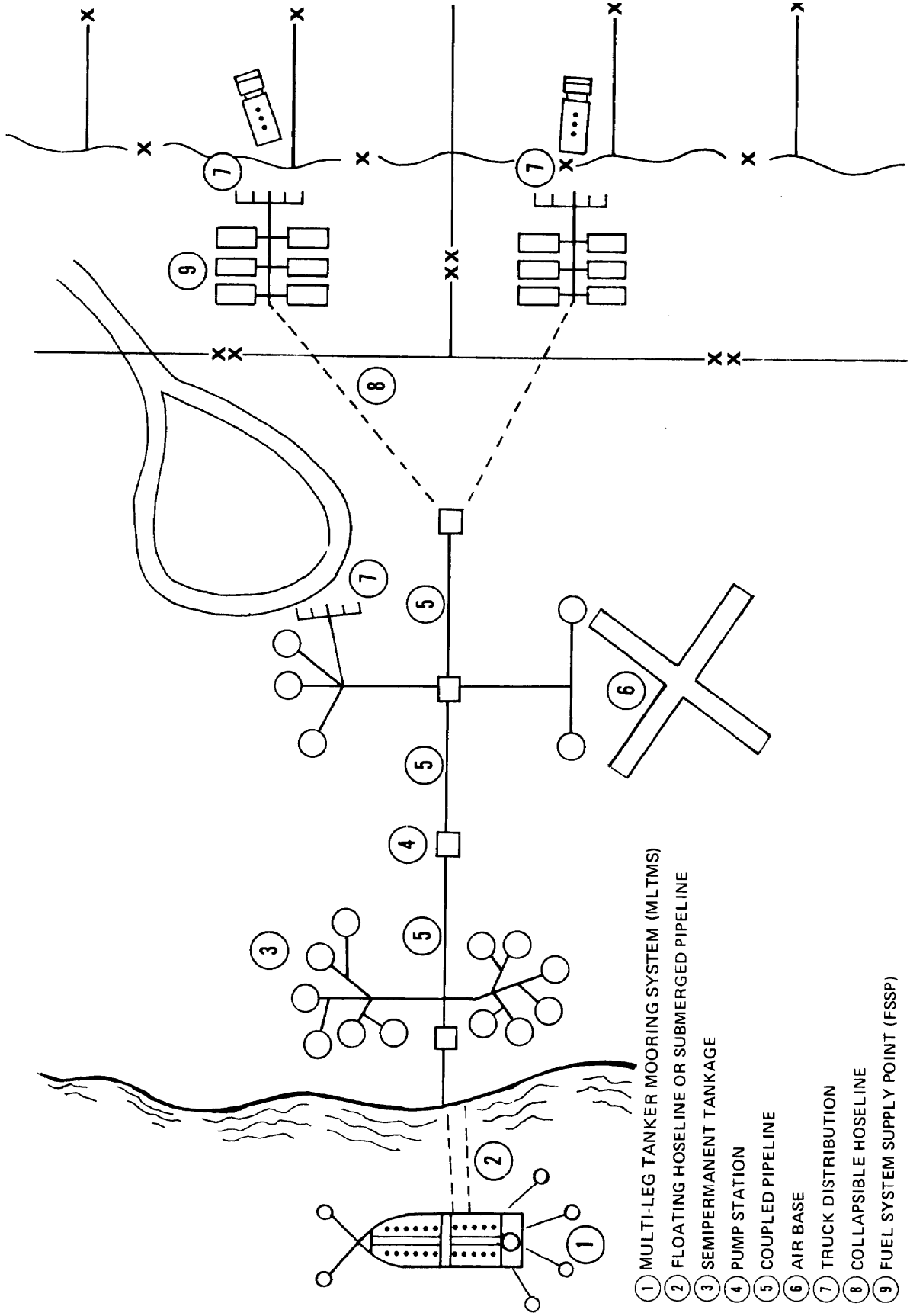


Figure 3-3. Petroleum distribution system in an undeveloped theater after D+90.

developed theater, the petroleum distribution system begins at the tanker loading and unloading facilities. As the assault operations begin, offshore facilities must be constructed. These include offshore tanker moorings, jetties, floating lines, and submarine pipelines. As operations progress and time permits, larger and more permanent facilities are constructed. Information on tanker loading and unloading facilities is contained in TMs 5-301-1/2/3 and 4, 5-302-1/2 and 3, and 5-343, and in FMs 10-18, 10-69, and 101-10-1.

• *Tanker Mooring Facilities.* There are many factors involved in establishing tanker mooring facilities.

• Onshore storage should be located in an area where there is enough space on shore (180 feet wide and 1,500 feet in from the shoreline) for construction operations. This area should ideally not have a slope greater than 5 degrees. In addition, there should be enough space for a booster pump station and storage tanks.

• Offshore moorings should be located in an area suitable for using submarine pipelines. Bottom topography should not have a change in slope greater than 5 degrees in order to prevent pipeline damage. Anchorages should be naturally protected from wind and tides as much as possible.

• Tanker moorings must be safe for the largest tanker that will use the facility. Table 2-1 in chapter 2 gives data on tankers. There must be at least 10 feet of water under the ship's keel for a radius of one-half mile at low tide to allow maneuvering. At the site, the sea bottom must provide satisfactory holding power for anchors. A sandy or other firm, but not rocky bottom is desirable. The effects of tide and currents should be considered.

• When moorings must be located in unprotected waters, the three-, four-, and seven-leg Army Facilities Components System (AFCS) ship mooring system may be used for water depths up to 120 feet. These Navy and Army moorings use standard anchors and heavy riser chain. Also available is a Multi-Leg Tanker Mooring System with four mooring legs that is capable of mooring 25,000 deadweight ton (DWT) tankers in 25- to 150-foot water depths when used with the ships' anchors. This tactical system uses explosive embedment anchors and wire rope risers. Single point moorings consisting of a single mooring buoy and capable of mooring up to 150,000-DWT tankers in adverse sea conditions are commercially available.

• When dock facilities are not available, jetties may be used in unloading tankers. Jetties need only be wide enough to carry the pipeline and provide a walkway from shore to the tanker. They are made mainly horn pilings and lumber. The jetty may extend as far as 1,000 feet from shore and have a 40- by 40-foot working platform at the tanker end. A self-elevating, barge-type pier (De Long Pier) can also be used as a jetty facility. FM 55-50 and TM 55-500 describe the self-elevating pier.

• Consideration must also be given to tankers on site, but not actually engaged in discharge of POL cargo. Sufficient port capacity should be available to allow these vessels to moor in the stream without interference with other ships and to lie in a protected anchorage.

• *Submarine Pipelines.* A submarine pipeline may be assembled in accordance with the designs provided in any of nine available AFCS facilities (TM 5-301-1). The depth of the water and rate of tanker discharge determine which facility is used. Submarine pipelines may be used to cross rivers, lakes, estuaries, and bays in addition to unloading tankers offshore. The proposed underwater route for the pipeline should be inspected by divers for obstructions, the nature of the sea bottom, and other pertinent information. The pipeline should enter the water from the beach at a gradual slope and rest on a firm foundation not subject to washouts. More specific information on the setting up of the submarine pipeline is included in TM 5-343.

• *Floating Hoselines.* There is currently only one type of floating hoseline available for use by US Army forces. This hoseline is

included in the tactical marine terminal. Small boats operating close to and along the shore should be particularly careful around a floating system so as not to damage the hose or foul the tensioning cable or telephone lines.

Terminals.

In the undeveloped theater, permanent terminals will probably not exist. Equipment used may differ from that in the developed theater.

• *Capacity Required.* The storage capacity of the bulk fuel distribution system depends on theater needs. As in the developed theater, determining storage requirements involves such factors as phased requirements for fuel, rate of fuel consumption, tanker size, planning for pipeline tanks and terminals, and frequency of delivery.

• *Types of Tanks.* The basic type of storage tank used in the undeveloped theater is the collapsible tank. When time and the tactical situation allow, semipermanent rigid bolted steel tanks are constructed. Specifications and other information about such tanks are contained in TM 5-343 and FM 10-69.

• *Collapsible Tanks.* The Army standard 10,000-gallon collapsible tank is the most commonly used collapsible tank in the petroleum distribution system. This tank measures 22 by 22 feet when empty and 20 1/2 by 20 1/2 by 4 feet when filled to capacity. Hose and fitting kits are used to connect any combination of collapsible tanks. Other collapsible tanks are available in capacities of 3,000, 10,000, and 50,000 gallons. A 500-gallon collapsible drum is also available.

• *Rigid Tanks.* Rigid bolted steel tanks may be used in the petroleum distribution system; however, they require more time to set up and put into operation than collapsible tanks. Bolted steel tanks are available in capacities of 100, 250, 500, 1,000, 3,000, and 10,000 barrels and are usually constructed by the engineer pipeline construction support company (TOE 5-177). Welded tanks of any size can be constructed when it appears that US forces will remain in the theater for a long period of time. Refer to TM 5-343 for details.

• *Location and Layout.* The general locations for petroleum terminals are given in the petroleum plan. In an undeveloped theater, the location, size, and number of terminals depend on the force to be supported and the availability of time and equipment. Since the petroleum distribution system in an undeveloped theater is composed of hoselines and collapsible tanks and not pipelines and steel tanks, there are limitations on the location and layout of terminals. More information can be found in FM 10-18, FM 10-69, TM 5-302, and TM 5-343.

• *Base Terminals.* Since the base terminal is the initial fuel storage facility in a theater of operations, it is the first terminal to be constructed. Due to the limited storage capability of collapsible tanks and the time involved to unload a tanker by hoseline, more than one base terminal may be needed. Base terminals are prime military targets, and if more than one is required, they should be dispersed to minimize damage from attack. Base terminals are usually the largest bulk fuel installations of the distribution system. Their locations must provide room for expansion, whether it is with collapsible tanks or with more permanent facilities. Base terminals in an undeveloped theater should provide, if possible--

- Enough storage capacity to unload, within 24 hours, the full cargo of the largest tanker that might be scheduled.
- Reserve storage for each type fuel to be carried by the system.
- Enough reserve operating capacity to receive and dispatch fuels at the same time.
- Enough storage capacity to allow fuel received to settle at least 24 hours before it is pumped through the system.
- Laboratory facilities for quality surveillance operations.

• *Intermediate Terminals.* Intermediate terminals are used when the distribution system extends over a considerable distance. As the system expands and hoselines are replaced by pipelines, intermediate terminals are needed. These may serve both as reserve

storage facilities and as dispensing installations. The size of intermediate terminals depends on the capacity of the distribution system and the nature of pumping operations. Usually, two tanks are used for each product.

• *Head Terminals.* A head terminal is at the end of the pipeline and the farthest inland of the terminals. It is usually located near the corps rear boundary. Bolted steel or collapsible tanks maybe used at these terminals. The types used depend on the tactical situation.

• *Regulating Tank Installations.* If regulating tanks are required, their main function is to store products when there is an interruption in the flow. They may be placed at pump stations or anywhere along the line where needed. The number and location of these installations depend on the quantity of product handled and the capability of the distribution system.

Hoselines and Pipelines

In the undeveloped theater, hoselines are an easy and quick way of moving large volumes of fuel from tankers to base terminals and inland storage facilities. An installed hoseline system must have proper surveillance because it is more easily damaged or sabotaged than pipeline. To set up hoselines, engineer support is not needed. When the tactical situation permits, the hoselines should be replaced with rapidly deployable pipeline, which allows a greater volume of product to flow through the system. This pipeline must be constructed by the engineer pipeline construction support company. Information on pipeline design is contained on page 2-9 of this manual and in TM 5-343.

• ***Hoseline Outfit.*** The initial petroleum distribution system in an undeveloped theater relies primarily on the 4-inch collapsible assault hoseline outfit to move bulk fuel. This outfit consists of 13,000 feet (about 2.5 miles) of 4-inch collapsible hose packed in flaking boxes, a 350-gpm pumping assembly, a flow-control kit, a regulator assembly kit, a roadway crossing guard, a hoseline suspension kit, a hoseline displacement and evacuation kit, a sling assembly, a hoseline packing kit, and a repair kit. Information on using and retrieving the hose is in TM 5-343, TM 5-3835-217-14, and FM 10-69.

• *Packaging,* The hose is packed in 13 flaking boxes, 1,000 feet to a box. Each 1,000-foot section consists of two 500-foot lengths joined together with an aluminum grooved coupling. A swivel joint with grooved ends is attached to one end of the assembly. This lets the hose assembly rotate continuously at the swivel connection. Three to five full flaking boxes are usually carrried on a truck, but this depends on the type truck and the terrain the truck must cross to lay the hoseline. The special sling assembly is used for lifting as many as three flaking boxes at a time onto the transporting vehicle.

• *Route selection.* A direct route free of obstacles should be chosen for the hoseline. The route should be parallel to an existing or planned road to aid in construction, patrol, operations, and security of the line. A route next to a secondary all-weather road is better than one next to a main supply route. All natural cover such as hedgerows, fence lines, and woods should be used. Difficult terrain, such as populated areas, marshes, swamps, and land subject to flooding, should be avoided.

• *Pipeline.* As the tactical situation permits and as engineer support becomes available, the hoseline system should be replaced with steel pipe. Because of limited time and construction support, a single pipeline may be used to move more than one type of product. Types of pipe used in the undeveloped theater are discussed below. Further information is in TM 5-343 and FM 10-18.

• *Standard lightweight steel tubing.* This type of tubing makes up most of the low-pressure pipeline system. (Maximum safe working pressure is 600 psi.) It can be assembled quickly and easily because the joints are coupled and not welded. This type of construction also allows damaged pieces of pipe to be replaced easily. Lightweight tubing comes in 20-foot sections in 4-, 6-, 8-, and 12-inch sizes. Because of its thin wall, the tubing

is not buried or used for submerged stream crossings.

• *API standard pipe.* When lightweight steel tubing is not suitable, commercial pipe made to the specifications of the American Petroleum Institute is used. API standard pipe comes in various lengths and is usually welded; however, it is also available in 20-foot sections grooved for coupling. The pipe comes in diameters of 4, 6, 8, and 12 inches. In a submarine pipeline, heavier weight 6-,8-, and 12-inch pipe is used. Weight-coated 16- and 20-inch pipe, sometimes used in submarine pipelines, is also available.

Pipeline Routes

The selection of the route for the main pipeline from the port of entry to the supported forces is primarily governed by the direction of the main military effort. In choosing the pipeline route, planners should avoid the main supply route and primary roads, important crossroads, swamps and low areas subject to flooding, populated areas, and installations that could be prime targets in an enemy attack. They try to select a route that is relatively level, parallels secondary roads, and passes near class III supply installations and supported airbases. TM 5-343 gives more data.

Pump Stations

The location and spacing of pump stations depend on the hydraulic design of the pipeline, the topographic features of the pipeline route, the type and properties of the design fuel, the operating characteristics of the pumping units selected, and the friction head losses for the selected size of pipe. Maintenance must also be considered when selecting the location and spacing of the stations and type of equipment to be used. Pump station operations are discussed in detail in FM 10-18 and TM 5-343.

• *Location.* The location of pump stations depends mainly on pipeline design. A pump station in the wrong location cannot pump at the required flow rate or will pump the required rate but at a reduced pressure. Because of rough terrain, a pump station may have to be located either downstream or upstream from the best design location to a better operating site along the pipeline. Detailed information on spacing and location is contained in TM 5-343.

• *Layout.* Layout plans for each pump station are prepared by the Corps of Engineers and are based on requirements submitted by the petroleum group (or the senior petroleum staff officer if no group is present). These plans give the location of tanks, pumps, and manifolds. Copies are given to the engineer units that construct the pump stations and to the quartermaster units that operate them. The information contained in the plans is essential to the dispatchers, scheduler, and the pump station operators.

• Station fuel storage tanks should be located to provide gravity flow of fuel to the pumps while not allowing heavy vapors to accumulate in operating areas. Pumps and other installation equipment must be readily accessible to maintenance and operating personnel.

• Underground shelter and collective protection should be provided, when possible, to protect the station crew from conventional and nuclear or chemical attack.

• Provision must be made for administrative, feeding, and other housekeeping facilities. A pump station building is not usually required while the pipeline is being constructed. However, the pump stations should be sheltered from the weather when time and materials are available.

• Because its location and mission are critical, the initial pump station needs special attention. This station should be located as close as possible to the base terminal from which it receives fuel. The initial station and the line connecting it to the base terminal must have enough pressure to maintain the required design flow rate under all conditions.

• *Pump Units.* Pump units are classified as booster, flood (feeder), transfer, mainline, and loading. Pump units used are determined from flow requirements, pipeline characteristics, and pump unit performance curves.

Pump units must be compatible with the size of the pipeline. Design information is contained in TM 5-343, and construction information is contained in AFCS manuals (TMs 5-301-1, 5-301-2, 5-301-3, 5-301-4, 5-302-1, 5-302-2, and 5-303).

• Generally, booster pumps are used to pump fuel from tankers to the base terminal storage tanks. Booster station manifold facilities are used to assemble these installations. These pumps are used when there is a long ship-to-shore pipeline, a long line from a dock to storage facilities, or where a terminal storage area is considerably above sea level.

• Flood (or feeder) pumps are installed to supply the required suction pressure between tank farm installations and mainline pump stations. They are also used to feed fuel through short branch lines to dispensing tank installations.

• Transfer pumps are connected with the switching manifold of tank farm installations to move large volumes of petroleum products into, out of, and within the tank farm. Transfer pumps may be used to transfer fuel from damaged or leaking tanks to serviceable ones or to consolidate fuel from partially empty tanks. The pumps may also be used to empty tanks to provide space for new fuel shipments that should not be mixed with existing supplies until they have been tested, to blend different batches of fuel according to uniform specifications, or to transfer fuel to loading racks.

• Mainline pipeline pumps are installed along the pipeline at the pump stations to maintain the pressure and flow of products within the line.

• Loading pumps may be required to move fuel from the storage tanks to dispensing areas when the required rate of flow is not supplied by a gravity system. Loading pumps are used for tank car and tank vehicle filling installations.

Dispensing Facilities

Dispensing facilities (bulk distribution installations) are located at points where bulk fuel is transferred from one means of transportation to another or where it is packaged or delivered to using vehicles. Dispensing facilities include tank truck loading facilities, vehicle filling stations, can- and drum-filling points, airfield and fuel supply installations, and tanks and pumping units needed to supply fuel for bulk reduction operations.

• Dispensing tanks and pumping units are set apart from mainline tank farms so they will not interfere with operation of the pipeline. However, it maybe necessary to use mainline tanks as dispensing tanks with truck-filling facilities located next to or in the tank farm. Dispensing tanks and pumping units normally have smaller capacities than those of the main pipeline to carry out the dispensing operations. Filling stations for individual vehicles may be set up near terminals, supply points, bivouac areas, and similar installations. Can- and drum-filling points may be located at terminals or at branch pipeline installations.

• Dispensing facilities maybe either fixed or portable; i.e., they may be disconnected from the feeder line for movement to another location. Although fuel requirements and supply procedures will vary from theater to theater and between various areas within a theater, standard designs are provided for tank truck and can- and drum-filling facilities.

• Bolted steel tanks, collapsible tanks, or tank vehicles may all be used as sources of fuel for dispensing facilities. The base terminal may include can- and drum-filling, tank vehicle loading, barge loading, and vehicle fueling facilities. Similar facilities may exist at intermediate and head terminals. An airfield dispensing installation may be located near a terminal and may be fed from a branch pipeline.

Tank Vehicle Loading and Unloading Facilities

As in the developed theater, facilities for loading and unloading tank vehicles are needed. The number and design of such facilities depend on the size of the military operation and the transport equipment in the theater. If permanent or semipermanent

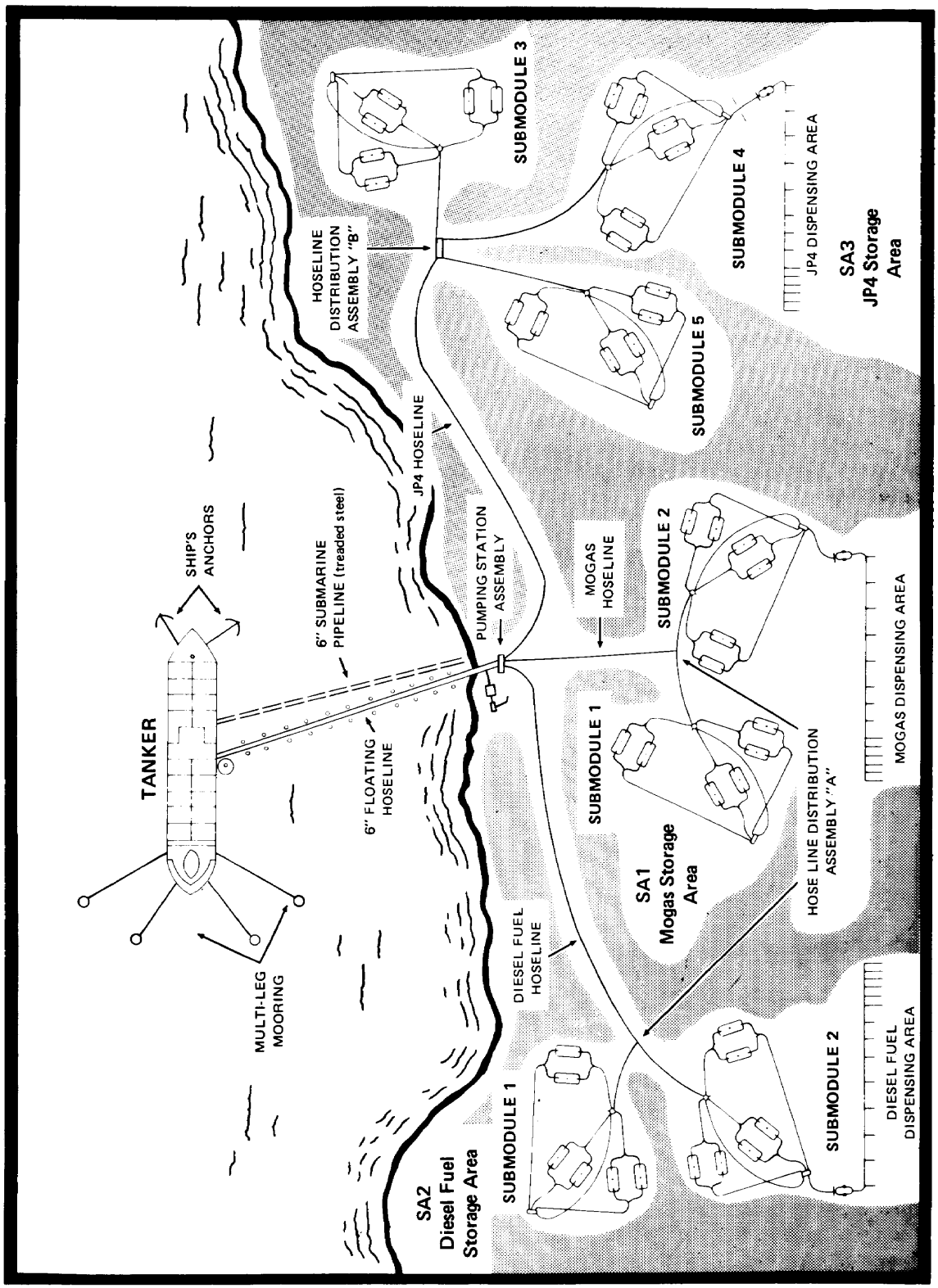


Figure 3-4. A recommended TMT layout.

facilities are needed, construction is the responsubility of the engineers.

Barge Facilities

If plans call for using barges in the theater, engineers are responsible for the construction of unloading facilities. An example of a standard barge and small vessel unloading facility design is drawing 12-04 in TM 5-302-1. Examples of the types of barges that may be used to support operations are in TM 55-500. Coastal tankers and barges, if not available from military sources, can be leased by the Military Sealift Command (MSC).

Section III

TACTICAL MARINE TERMINAL

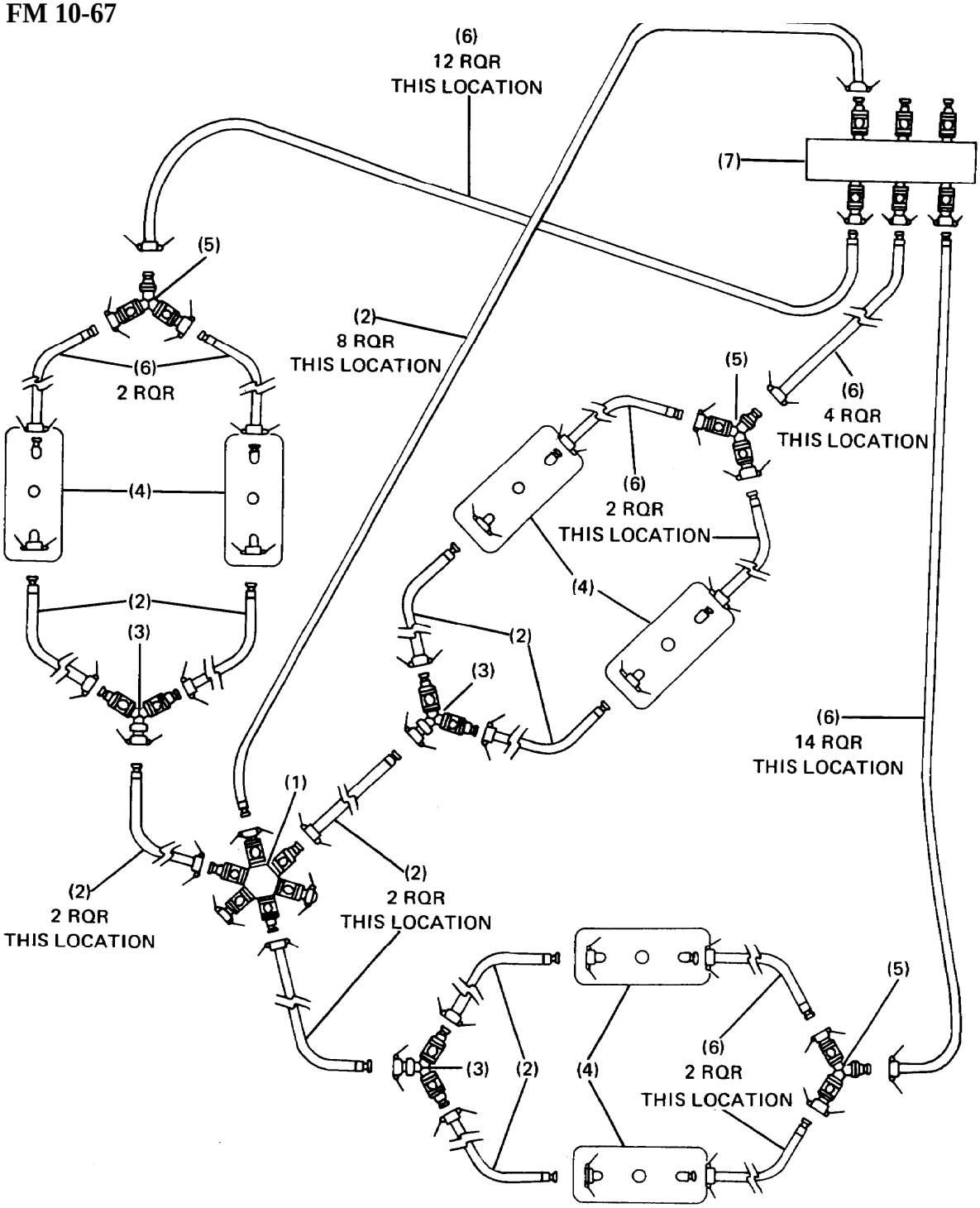
General

The tactical marine terminal (TMT) is a temporary fuel-handling system designed for the receipt, storage, and issue of bulk petroleum products to support forces deployed to an undeveloped theater. The system may also be employed in other areas where permanent petroleum port facilities are inadequate or have been damaged or destroyed. The TMT has a storage capacity of 2,100,000 gallons (50,000 barrels) and may be arranged for support as required or necessary to fit the terrain, mission, or operational needs. A typical layout is shown in figure 3-4. One of the seven TMT modules is shown in figure 3-5, The TMT consists of--

- Offshore multileg mooring system (for ships up to 25,000 deadweight tons).
- 5,000 feet of 6-inch hoseline with flotation collars.
- 5,000 feet of 6-inch steel threaded pipeline with anchors and markers.
- Forty-two 50,000-gallon collapsible storage tanks.
- Eight 600-gpm pumps.
- Six 600-gpm filter/separators.
- Fire suppression system.
- Hoses, fittings, and dispensing equipment.

Organization

The TMT is the initial facility of the petroleum distribution system that will eventually expand as the theater matures. In the early stages, the petroleum pipeline and terminal operating company may be responsible for command, control, and operation of the system. Normally, command and control of units operating the TMT will be the responsibility of a quartermaster pipeline and terminal operating battalion. As soon as the situation permits, elements of the petroleum group under the COSCOM assume the role of the senior petroleum logistics operator and planner in the theater, In any case, forces will be tailored to meet the needs of specific missions as determined by the senior operational commander. Other military services may be required to provide additional support and equipment as forces are added to the theater and petroleum consumption increases. Engineer support may be required for site preparation on shore. Installation of the offshore portion is accomplished by the engineer port construction company. (Note: Navy construction battalions (SEABEES) also have the capability to install the offshore portion and are assigned such a mission in support of marine amphibious operations.) In some instances, support from Army transportation units may be required for installation and operation of the TMT. For example, support vessels such as floating cranes, barges, line boats, and patrol boats in excess of those which are assigned to quartermaster and engineer units may be required, Forces will be delegated specific missions by the senior operational commander on site.



1. Manifold assembly
2. Discharge hose assembly, 6 inch by 50 foot (20 rqr)
3. Flanged wye assembly, Inlet (3 rqr) (FMC81718-666F-6)
4. Collapsible 50,000-gallon fuel tank (6 rqr)
5. Flanged wye assembly, Outlet (3 rqr) (FMC81718-667F-6)
6. Suction hose assembly, 6 inch by 25 foot (36 rqr)
7. Unit 604A Diesel engine driven 600-gpm pump assembly

Figure 3-5. Fuel tank module assembly.

Installation and Operation

• *Offshore.* An engineer port construction company (TOE 5-129) is required to install the offshore portion of the TMT. In most cases, additional support and equipment is required over and above that organic to the port construction company. Higher level engineer support is provided by the engineer group. Additional floating craft, such as tugs and cranes, may also be required. These are requested through channels from appropriate supporting units. A logical source of such support would be transportation units involved in nearby logistics over the shore (LOTS) or port operations.

• *Onshore.* The onshore portion of the TMT resembles a large fuel system supply point and functions as the base petroleum terminal in the undeveloped theater. A petroleum pipeline and terminal operating company (TOE 10-207) is responsible for installing the onshore portion of the system and is responsible for operating the entire TMT once it is installed. A petroleum wharf platoon (TOE 10-206) is augmented to provide the capability for transporting personnel between ship and shore and to assist in tanker moorings, handling and discharging of hoselines, quality surveillance tasks, and limited operational maintenance. Engineer support is required for other than operational maintenance.

Section IV

AIR FORCE CAPABILITIES

General

There is a requirement to support large numbers of personnel and equipment during intense short duration conflicts in Air Lines of Communications (Air LOC) environments with a limited number of aircraft.

Organization

The Air Force Military Airlift Command (MAC) provides the needed support with C-130, C-141, and C5A aircraft. Requirements are coordinated through channels in agreement with policies established in the theater.

Types of Support

• *Packaged Cargo.* Five hundred-gallon collapsible drums and 55-gallon drums may be internally loaded in cargo aircraft for delivery to airfields in the vicinity of the units being supported.

• *Airdrop.* When suitable aircraft loading and unloading areas are not available, fuel may be airdropped or delivered by low altitude parachute extraction systems (LAPES).

• *Aerial Bulk Fuel Delivery System (ABFDS).* The Air Force has aircraft specially equipped with a collapsible tank and a pump for deliveries of bulk fuels into areas where suitable landing sites are available.

• *Wet Wing.* The C-130 C-141, and C5A aircraft have internal pumps for defueling. Using Army ground equipment (hoses and nozzles), these aircraft can deliver JP-4 into Army storage containers located at or near suitable landing areas.

CHAPTER 4

ORGANIZATION FOR PETROLEUM SUPPLY

Section I

DEVELOPED THEATER

General

Today's modern military forces consume large amounts of petroleum products in support of combat operations. Special channels of responsibility for the supply of bulk petroleum products, both in the continental United States (CONUS) and in overseas theaters have been established to insure uninterrupted supply of this critical commodity. Integrated management of bulk petroleum is the responsibility of the Defense Logistics Agency (DLA), which works through the Defense Fuel Supply Center (DFSC). DFSC procures and, in coordination with the military services and the Military Sealift Command (MSC), arranges for delivery of products to the military services. DFSC coordinates tanker movements of bulk petroleum with the MSC. DFSC contracts with the commercial supplier either in CONUS or overseas and assures that required fuel is shipped to the theater. Responsibilities such as cataloging, standardization, and management of bulk petroleum inventories in other defense fuel support points remain with the military services. Each of the military services has service control points that coordinate on petroleum logistics matters with DFSC and provide technical support to their service. The services play a significant role in requirements computation, submission and delivery plans, and maintenance of contracts and budget programs for oversea areas. The US Army General Materiel and Petroleum Activity (USAGMPA) performs this function for the Army worldwide. The theater army organization for petroleum supply is shown in figure 4-1.

Joint Petroleum Office

The Joint Petroleum Office (JPO), established by the joint chief of staff, provides staff management of petroleum at the theater level on the staff of the unified commander. Subarea Petroleum Offices (SAPOs) may be established at the subunified command level to provide in-country staff responsibilities for all services. Specific responsibilities of the JPO are shown in Section I, Chapter 2, DOD 4140.25-M.

• Personnel assigned to JPOs and SAPOs are qualified in petroleum logistics and subject to assignment approval by the commander concerned. The offices are jointly staffed by personnel from each service (Army, Navy, Air Force) having a mission in the theater. Petroleum requirements for the US Marine Corps are normally included in the Navy's estimates.

•The JPO advises the theater commander and staff on petroleum logistics planning and policy matters. Under emergency conditions, the JPO advises on the allocation of

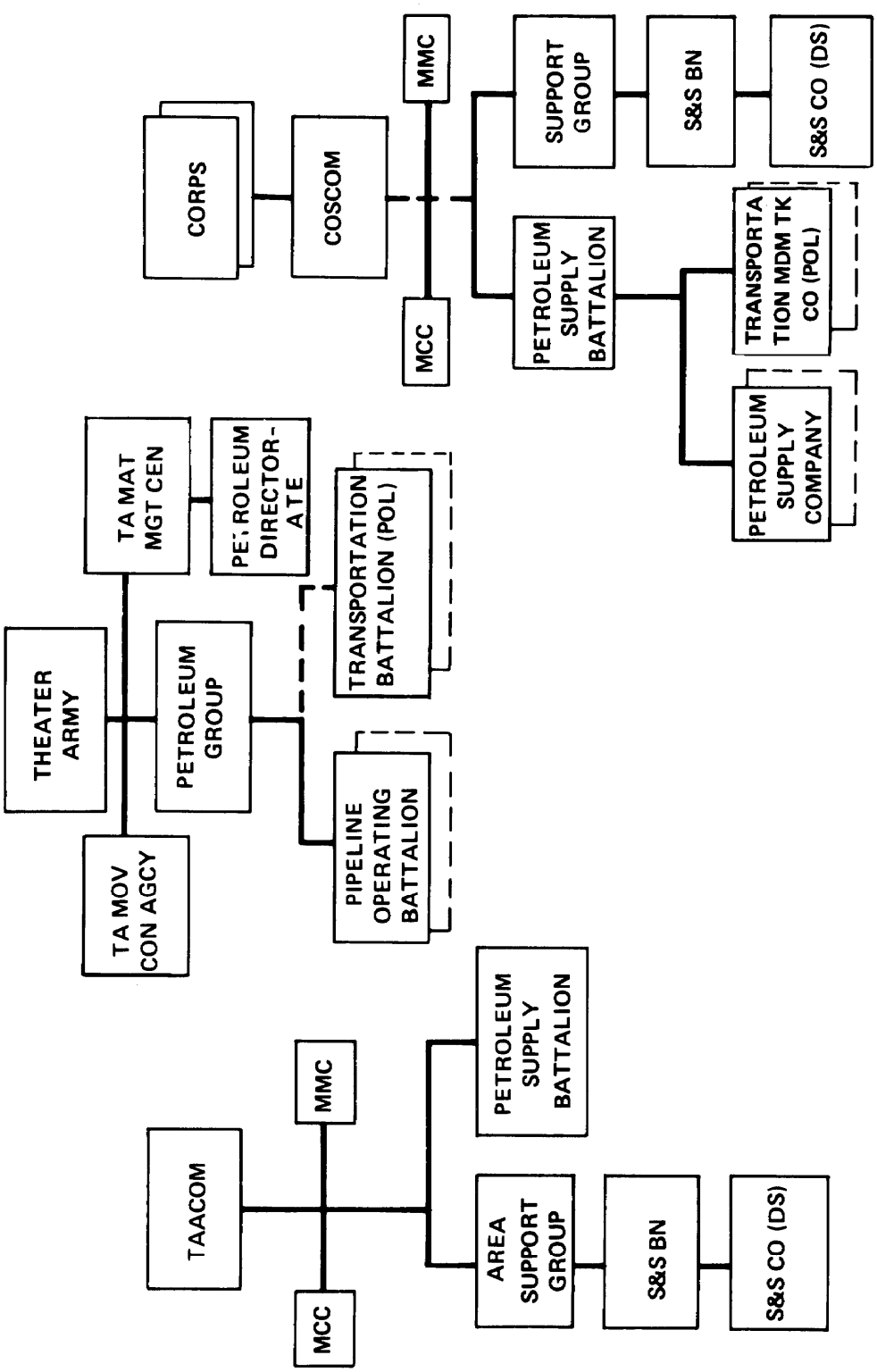


Figure 4-1. Petroleum organization in a theater of operations.

petroleum products and facilities and coordinates with the various military service control points of the services represented in the theater. It coordinates the quality surveillance program within the theater and assists DFSC in fulfilling its responsibilities.

• The JPO is responsible for submitting to DFSC the monthly petroleum slate which includes requirements of all the military services within the theater. Petroleum management for the entire theater is the ultimate responsibility of the JPO. Daily management of theater bulk petroleum is accomplished by the TAMMC in coordination with the other military services, DFSC and their Defense Fuel Region Office, and host nation activities.

Theater Army

Theater army headquarters provides broad planning guidance for Army petroleum support. It supervises current operations and conducts long-range planning. The petroleum group, assigned to the theater army, is the major Army petroleum operator for the theater (fig 4-2). When demand exceeds availability, the theater commander will establish an allocation system, based on priority, to support the theater plan of operations.

Theater Army Materiel Management Center

The theater army materiel management center (TAMMC) is the theater petroleum item manager for both bulk and packaged petroleum products and also collects long-range (annual) petroleum requirements for the theater. The TAMMC is responsible for recording consumption data (issues) and forwarding it to the theater army petroleum staff officer and the petroleum group. Petroleum requirements (long-range) and issue data are provided to the TAMMC by the division MMCS and corps MMCS on a cyclic basis as established by regulations or operational procedures, As a minimum, requirements are submitted annually and issue data is reported monthly. The TAMMC is responsible for providing petroleum management data for the theater. After coordination with the theater army petroleum staff officer and the commander of the petroleum group, the TAMMC submits the annual requirements for the theater to the JPO.

Engineer Command

The engineer command (ENCOM) provides construction support for petroleum facilities required to accomplish the theater support mission, The ENCOM plans and supervises construction or renovation of ports, roads, railroads, inland waterways, and bulk petroleum distribution and storage facilities.

Transportation Command

The primary mission of the transportation command (TRANSCOM) is to command and control transportation units providing transportation services for the theater. Some major functions are to —

• Supervise transportation interzonal services.

• Advise on transportation services in the theater.

• Recommend transportation policies.

• Recommend the allocation of transportation resources.

• Maintains liaison on transportation operations with other services and allied and host nation staffs.

Petroleum Group

The principal organization carrying out the bulk fuels distribution mission in the COMMZ is the petroleum group assigned directly to theater army. The petroleum group is responsible for the detailed petroleum distribution planning that is the basis for design, construction, and operation of the distribution system for the theater. The group is responsible for liaison with host nation staffs to include coordination of allied pipeline and distribution systems. The petroleum group and its subordinate units operate the bulk fuel distribution system extending from ports of entry through the COMMZ and as far into the combat zone as practicable.

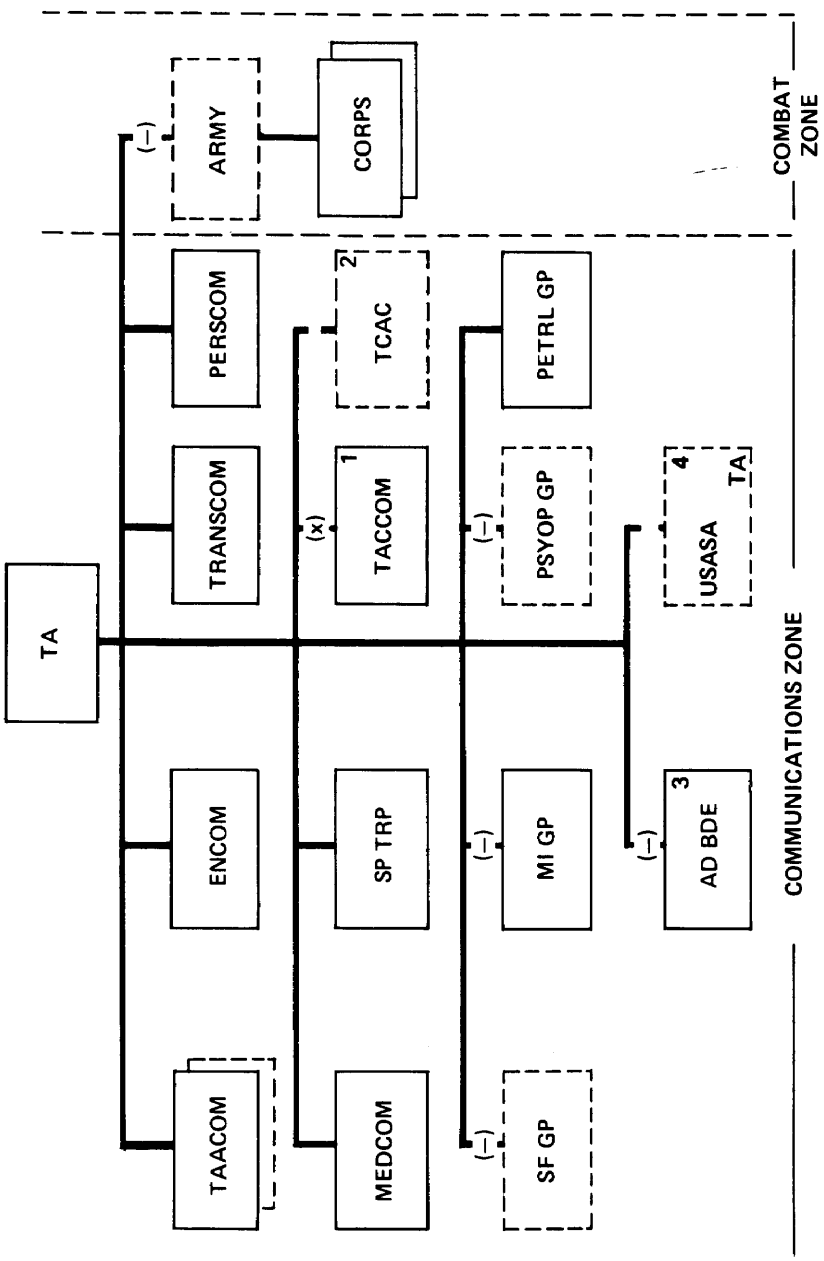


Figure 4-2. Theater army organization.

The theater army MMC provides allocation instructions and long term requirements data to the petroleum group and its subordinate units. The petroleum group and its subordinate units perform organizational and limited direct support (DS) maintenance on pipeline systems, while the ENCOM does renovation and new construction. The petroleum group headquarters is responsible for the day-to-day detailed supply operations of the petroleum pipeline distribution system. The headquarters keeps the theater army commander and his staff, to include the TAMMC, informed on all aspects of petroleum handling equipment, distribution, planning, and operations. Figure 4-3 shows the organization of the headquarters and headquarters company, petroleum group.

Petroleum Group Headquarters

The group headquarters plans, controls, and supervises the operation of the fuel distribution system. It also coordinates the efforts of the units employed to operate and maintain the theater petroleum distribution system, primarily interzonal pipelines. This headquarters develops requirements for petroleum handling equipment, facilities, construction, and petroleum units needed to develop, operate, and maintain the system. As operations expand, the group headquarters provides the planning needed to extend the existing distributing system. The group headquarters supervises two or more petroleum pipeline and terminal operating battalions, transportation motor transport battalions (POL), and other assigned or attached units when they are required. The headquarters can operate on a 24-hour basis.

Theater Army Area Command

The theater army area command (TAACOM) is a major subordinate element of the theater army given the mission of providing general support (GS) and direct support to all US Army forces passing through or located in its area of the communications zone. It may also be assigned to support allied forces in the theater. Some theaters of operations may have more than one TAACOM. In performing its combat service support mission, the TAACOM staff develops overall plans, policies, priorities, and allocations for subordinate operating commands and coordinates the commands' activities. It reviews the supply portion of theater army support plans. The TAACOM develops broad policies for and issues mission-type orders to subordinate commands. The TAACOM staff uses summary management reports and other data to perform its primary missions of planning and coordinating mid- and long-range combat service support operations. TAACOM headquarters follows established procedures and guidance in communicating with CON US, corps support command (COSCOM), other services, and allied forces and governments as authorized by the theater army. It prepares detailed combat service support plans, directives, and guidance affecting the theater army as a whole. Regardless of the command structure within the theater army, the TAACOM assists COSCOM in developing and supporting its requirements. Although COSCOM and TAACOM are on the same command level under theater army, COSCOM and TAACOM subordinate commands maintain continuous working relationships through liaison and direct computer-to-computer links.

Theater Army Area Command Materiel Management Center

The TAACOM materiel management center (MMC) is organized with a materiel management center office, unit headquarters section, service support division, and seven materiel management divisions. These seven divisions include aviation, electronics, armament and combat vehicles, missile and munitions, automotive, troop support materiel, and petroleum. The chief of each division is responsible for materiel management of items assigned to his division. Assignment of items depends on CONUS sources of support. Each division is broken down into branches that manage end item supply, maintenance, and repair parts supply. The petroleum division of the TAACOM MMC is responsible for

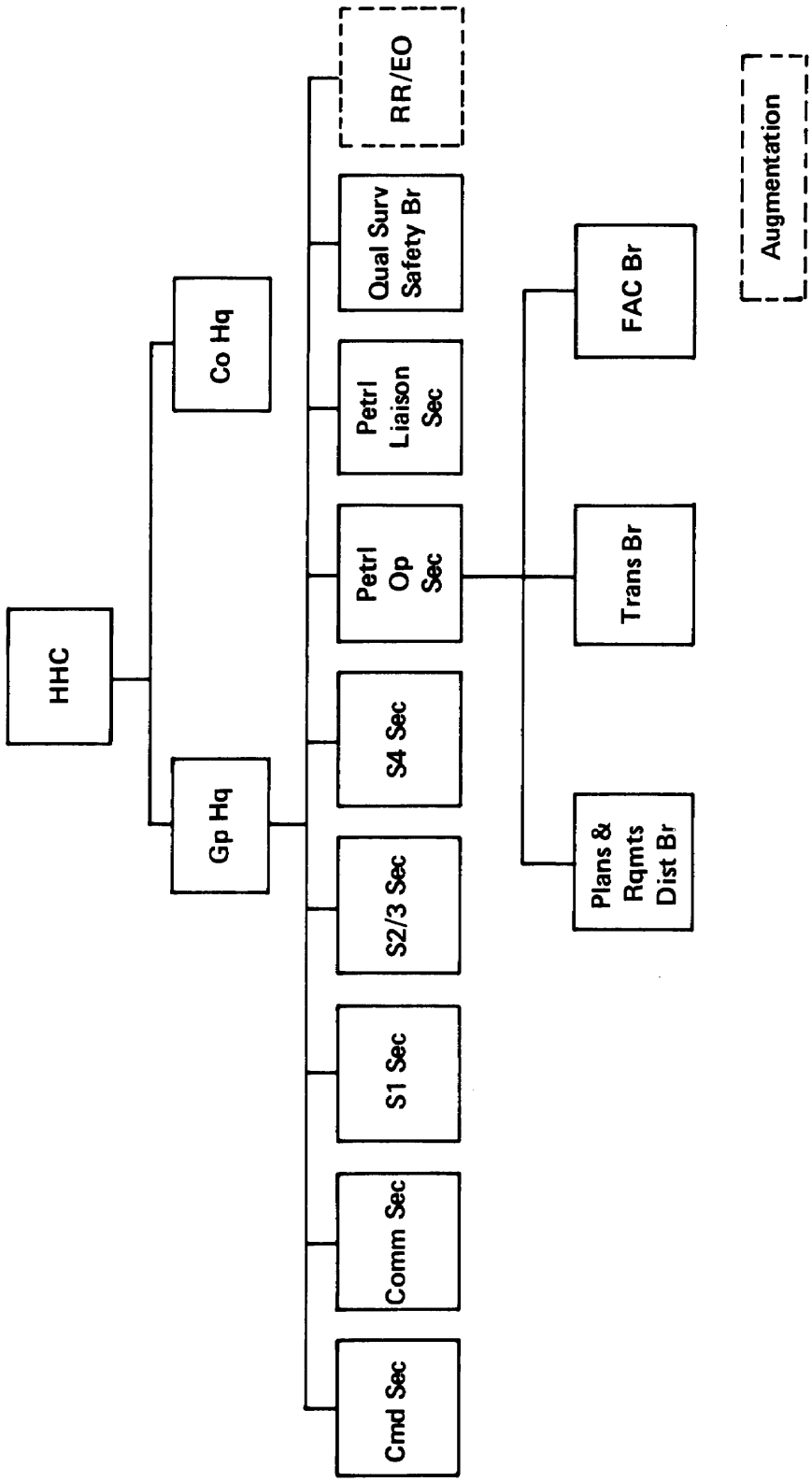


Figure 4-3. HHC, petroleum group.

receiving requirements for POL supplies from the supply and service company (DS) in its area. The petroleum supply battalion will provide wholesale petroleum supply to the supply and service company (DS). A relationship exists between the TAACOM MMC and the petroleum supply battalion similar to that between the theater army MMC and the petroleum group. Materiel release orders (MRO) will generally not be cut for petroleum issues and issues will normally be recorded by post-posting. Responsive support to the customer dictates that the day-to-day operational procedures employed provide him the most efficient system possible. Unless the MMC and petroleum issue facility are collocated, requests will be submitted by the customer and the fuel issued to him at the terminal or supply point (that is, at the same location). The petroleum division of the TAACOM MMC also coordinates with the theater army MMC for POL resupply to the petroleum supply battalion in its area.

Petroleum Pipeline and Terminal Operating Battalion

The petroleum pipeline and terminal operating battalion operates and maintains petroleum distribution facilities required to support a portion of the theater petroleum support mission. Operating battalions are assigned to the petroleum group as required. Pipeline battalions are responsible for operating ports of entry, pipelines, the tactical marine terminal, and other related facilities/ systems.

- *Responsibilities.* Each petroleum pipeline and terminal operating battalion supervises the operation and maintenance of a military petroleum distribution system or part of a system as determined by geographic needs. It operates facilities capable of storing 500,000 to 2,500,000 barrels of bulk petroleum products, depending on the size and location of terminal facilities available. A petroleum operating battalion operates a central dispatching and scheduling agency to schedule and direct the flow of bulk petroleum products through the multiproduct military pipeline. It also coordinates the movement of bulk products by means other than pipeline, such as barge, rail, and truck. An operating battalion maintains a prescribed reserve of petroleum products, supervises a program for quality surveillance, and may operate a base petroleum products laboratory. It also provides command and control for up to five petroleum pipeline and terminal operating companies, medium truck (POL) companies, and other units as required.

- *Supporting Organizations.* One or more of the following organizations may be assigned, attached, or placed in support of an operating battalion.
  - TOE 5-129, Engineer Port Construction Company.
  - TOE 5-177, Engineer Pipeline Construction Support Company. (This unit normally remains assigned to and under the control of the engineer group or combat heavy engineer battalion.)
  - TOE 1O-207, Petroleum Pipeline and Terminal Operating Company.
  - TOE 19-97, Military Police Security Company.
  - TOE 29-449, Labor Service Company.
  - TOE 55-18, Transportation Medium Truck Company (Petroleum).
  - Appropriate detachments, as required, organized under the provisions of the 500-series TOES to provide firefighting, utility, and maintenance teams; administrative, general duty, materials handling, and petroleum teams; signal operations, maintenance, and service teams; security guard and dog teams; feeding and automotive teams; and interpreter and translator teams.

Headquarters and Headquarters Company, Petroleum Pipeline and Terminal Operating Battalion

The headquarters and headquarters company is organized as shown in figure 4-4. Battalion headquarters is composed of the battalion commander, executive officer, chaplain, communications officer, and sergeant major. The headquarters company consists of a company headquarters and a communications section. The company headquarters performs the normal functions of

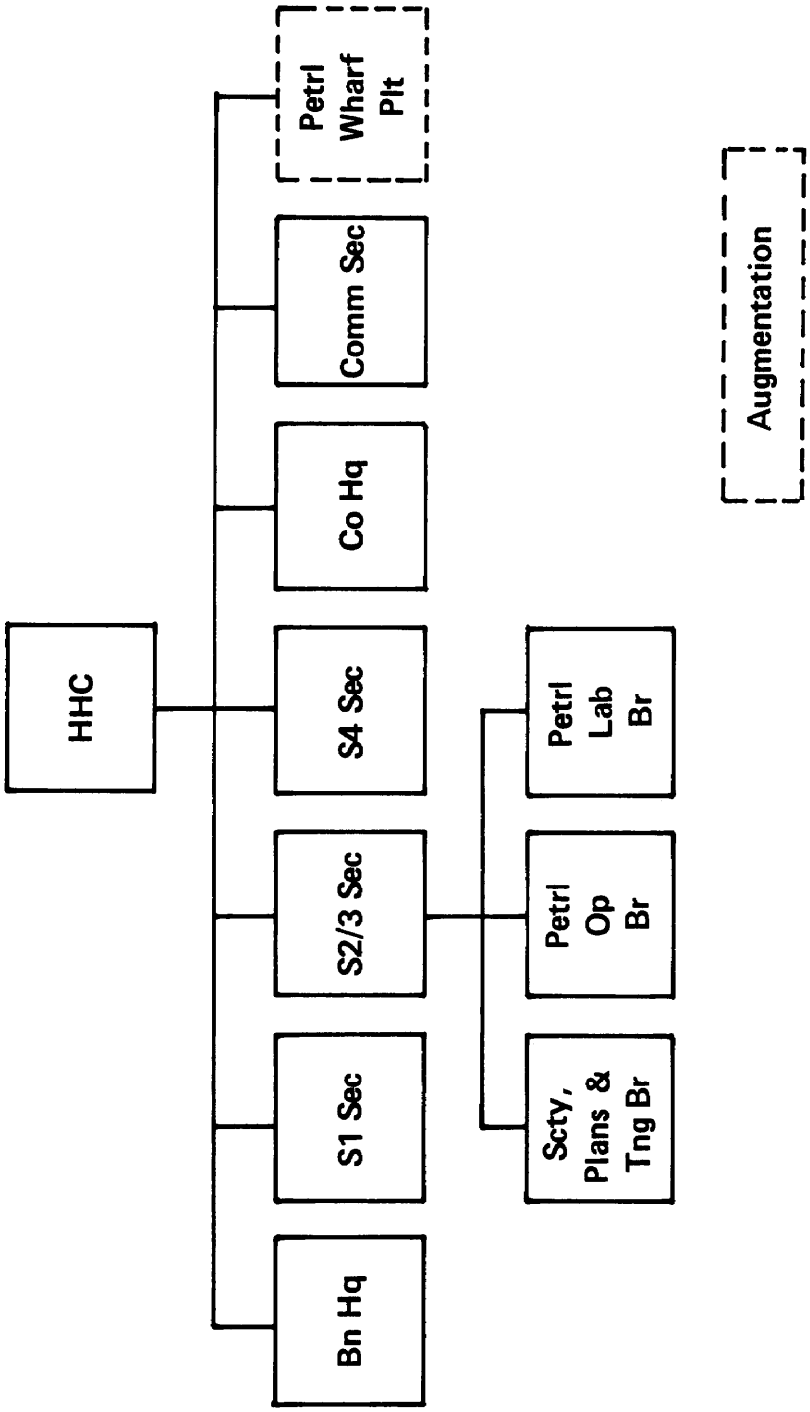


Figure 4-4. HHC, petroleum pipeline and terminal operating battalion.

unit command. The communications section provides signal communications for the headquarters and coordinates with signal units on installation and maintenance of the communications system.

• *S1 Section.* This section provides the necessary administrative and personnel management support required throughout the battalion.

• *S2/S3 Section.* This section contains a security, plans, and training branch; a petroleum operations branch; and a petroleum laboratory branch.

• *Security, plans, and training branch.* The security, plans, and training branch develops, plans, and supervises training of assigned or attached units. It develops and implements training programs for the headquarters and subordinate units and general educational development programs. It plans and supervises intelligence, counterintelligence, and civil affairs programs for the command. The branch develops and coordinates plans for the security and defense of the headquarters and subordinate units. The branch also collects and disseminates intelligence information.

• *Petroleum operations branch.* This branch directs the dispatching of bulk petroleum through a pipeline system and the movement of bulk products by means other than pipeline. Personnel in this branch provide instructions on the time, quantity, and type of fuel to be received at storage locations under battalion control. The branch also gives instructions on the time, quantity, and type of fuel to be shipped from these storage locations and the mode of transportation to be used.

• *Petroleum laboratory branch.* The petroleum laboratory branch does routine tests of petroleum products received and stored for use by military units in the theater of operations. It performs investigations and tests and makes recommendations on petroleum products reported to be contaminated or that affect the operation of military equipment. It analyzes, tests, identifies, and recommends what to do with captured petroleum stocks, stocks that have been marked incorrectly, and products whose markings have been destroyed. When organized under TOE 1O-2O6H41O, the unit can operate a base petroleum laboratory. When organized under TOE 1O-2O6H42O, it can operate a mobile petroleum laboratory.

• *S4 Section.* The supply and maintenance section is responsible for normal battalion internal supply functions. It consists of the battalion property book officer and other personnel who coordinate and supervise battalion supply matters. The section personnel also advise and assist subordinate units on unit supply matters. The maintenance portion of the section provides staff advice to the commander on maintenance of battalion equipment. It does necessary inspections and gives technical assistance to subordinate units on maintenance of operating equipment. The section may establish and operate a battalion organizational maintenance shop, or the battalion equipment may be supported by a subordinate company, assisted by battalion maintenance personnel.

• *Petroleum Wharf Platoon.* The petroleum wharf platoon, when authorized, is assigned to petroleum ports of entry to operate petroleum wharf and offshore facilities on a 24-hour basis. The platoon normally works with the company that is assigned to operate the base petroleum terminal or the tactical marine terminal (TMT).

Petroleum Pipeline and Terminal Operating Company

On a 24-hour basis, the petroleum pipeline and terminal operating company operates about 100 km (60 miles) of military multiproduct pipeline and terminal facilities for the storage and distribution of bulk fuels. The terminal facilities normally consist of two tank farms, each having a capacity ranging from 50,000 to 250,000 barrels. When the situation permits, personnel of the company may assist the engineers in the construction of the portion of the system that they are to operate and maintain. If it is required, the

company can install and operate an organic collapsible hoseline system. The company operates a tactical marine terminal when permanent or semipermanent facilities are not available. The company also operates loading facilities for shipment of products by coastal tankers, barge, rail tank cars, and tank vehicles. The petroleum pipeline and terminal operating company is normally assigned by the petroleum group to a petroleum pipeline and terminal operating battalion. It maybe attached to the TAACOM or an independent corps since it is responsible for receipt, storage, and distribution of all bulk fuels shipped to the theater. It may also function as a separate company under specified conditions. The company is normally employed in the COMMZ area of the theater of operations. It may begin its operations at beach heads of base terminals located near theater ports of entry or along any 60 mile section of the pipeline and extend as far forward in the theater as possible. When two or more of these companies are employed on a pipeline, they normally function under the command, control, and operating supervision of a petroleum pipeline and terminal operating battalion. Figure 4-5 shows the company organization.

• *Company Headquarters.* The company headquarters performs the normal functions of troop and unit command. It commands the petroleum pipeline and terminal operating company, performs unit administration and supply and food service functions, and operates dining facilities on a 24-hour basis. The company headquarters supervises tactical and technical training and internal security activities of the company petroleum terminal, pipeline, hoseline, and distribution operating activities.

• *Petroleum Products Control Section.* This section receives operating instructions from the system's dispatcher/scheduler or higher headquarters on the time of receipt, type, and quantity of bulk petroleum product received in the tank farms under company control. The section is also advised on the time, type, and quantity of fuel to be shipped by barge, tank car, tank vehicle, and pipeline and the operating pressures to be maintained in the pipeline. Upon receipt of operating instructions, the petroleum products control section prepares detailed schedules and instructions for issue to the terminal and pipeline operating platoons and pipeline sections. These include flow schedules; programs and instructions to pump station operators and tank farms for input and withdrawal of products in the company; and instructions on receipt, storage, and issue of petroleum products, and their delivery by rail, highway, air, and water transportation, The petroleum products control section performs supply control and accounting functions for petroleum products received, stored, and issued by the company and monitors bulk petroleum requests from the petroleum systems dispatcher. The section also receives activity reports from the operating platoons and consolidates and forwards appropriate reports to the battalion headquarters.

• *Maintenance Section.* The maintenance section provides organizational maintenance on the unit's wheeled vehicles, materials handling equipment, compressors, power generating equipment, radios and teletype equipment, and TOE items of equipment assigned to the company. The section provides an organic direct support maintenance capability only for organizational and direct support maintenance on equipment peculiar to petroleum pipeline distribution systems. The section maintains, in addition to the unit prescribed load list, expanded repair parts in support of direct support maintenance responsibility.

• *Terminal Operating Platoon.* The terminal operating platoon has a platoon headquarters, two tank farm sections, a storage and issue section, and a distribution section.

• *Platoon headquarters.* The platoon headquarters directs and supervises platoon operations and personnel. The platoon leader plans, organizes, coordinates, and directs terminal operations.

• *Tank farm section.* This section operates a tank farm complex consisting of

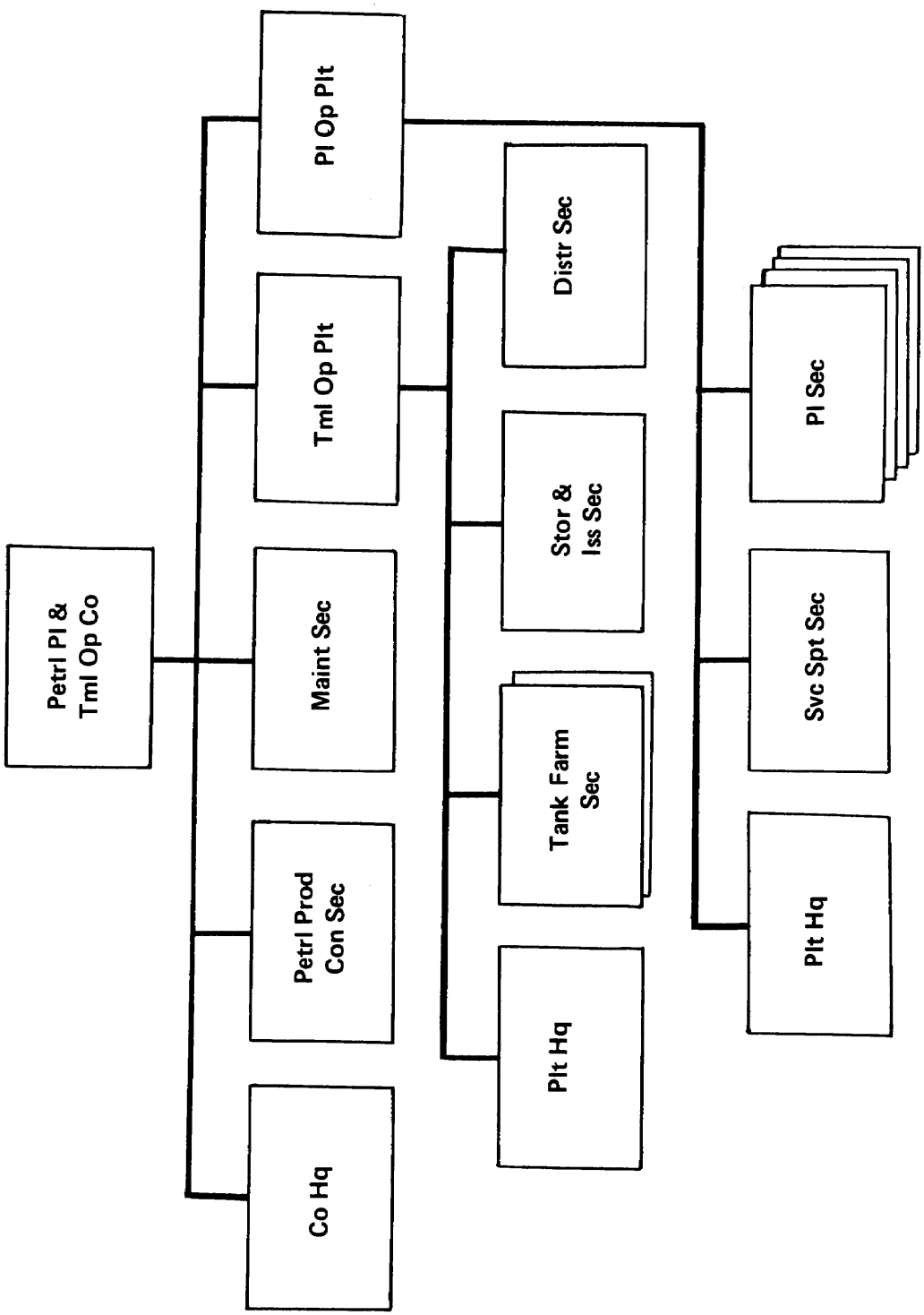


Figure 4-5. Petroleum pipeline and terminal operating company.

two tank farms with permanent and/or semi-permanent bulk storage facilities. The tank farm section has a maximum bulk petroleum storage capacity of 500,000 barrels. It is capable of transferring from 700 to 1,300 barrels per hour to the main pipeline system and of shipping approximately 250,000 gallons by other means. It also has the capability to operate a tactical marine terminal. The assigned personnel operate terminal booster and transfer pumps and manifold systems to receive bulk petroleum products from the main pipeline for storage in the tank farms and for return to main or branch pipelines for shipment forward. The personnel also help perform organizational maintenance on these facilities and operate one or more fixed loading racks for shipment of bulk petroleum by barge, tank car, and tank vehicle. At least four men are required to operate a tank farm per shift. In addition, a supervisor is required on each shift to be responsible for the security, operations, and maintenance. When required, the platoon may be augmented by an additional tank farm section to operate the constructed tank farm complexes consisting of four tank farms. Each tank farm ranges in size from 50,000 to 250,000 barrel capacity for a total of 200,000 to 1,000,000 barrels per complex.

• *Storage and issue section.* This section operates the fuel system supply point. This is a six-man operation per shift. The section also provides intra-unit movement of petroleum products. This is a one-man operation, but may be assisted by fuel system supply point personnel as required. When required, the section performs limited bulk reduction which requires two to four men.

• *Distribution section.* Personnel in this section provide local delivery of petroleum products to area direct support units using organic vehicles. This section also operates the collapsible hoseline outfit. This outfit can be used in over-the-beach operations to transfer product from barge or ship to on-shore storage facilities or as a temporary system to transport fuel across rolling country.

• *Pipeline Operating Platoon.* This platoon operates approximately 60 miles of multi-product pipeline 24 hours a day. The pipeline moves large amounts of petroleum product to support the theater distribution system. Four pump stations are located along the pipeline operated by this platoon. The pump stations move the product through the line to storage, to branch lines, to tank farms, or to dispensing facilities. The pipeline operating platoon is made up of the platoon headquarters, a service support section, and four pipeline sections.

• *Platoon headquarters.* The platoon headquarters supervises and directs the operation of the pipeline and pump stations. It prepares SOPs, directives, and other operating instructions.

• *Service support section.* This section does organizational and direct support maintenance on the pipeline, pump stations, and all related equipment assigned to the platoon. In normal operations, personnel of the section may work a maximum of 60 miles from the base of operations. Backup support and technical help is given by the company maintenance section. Maintenance functions include repairing and replacing valves, blinds, pressure gages, meters, line strainers, pump units, welded pipelines, coupled lines, hoselines, and related pipeline equipment.

• *Pipeline section.* Each of four identical pipeline sections operates a pump station and a portion of the pipeline, which it patrols to detect leaks, fires, sabotage, and pilferage.

Petroleum Supply Battalion

The petroleum supply battalion provides GS and DS petroleum support in the corps and TAACOM. Bulk petroleum is normally delivered to petroleum supply battalions by pipeline, rail, or tank vehicle from terminals operated by the petroleum pipeline and terminal operating company.

• *Responsibilities.* The petroleum supply battalion supports the divisional supply and transport battalion, nondivisional direct support units, and other customers as directed. It may also maintain a prescribed portion of reserve petroleum stocks through its attached units. The battalion provides both general

support and direct support for petroleum products.

• *Tailoring.* The battalion can be tailored rapidly to meet petroleum supply situations that arise. Any petroleum supply battalion can be tailored to meet a storage mission, an issue mission, or a combination of both through the attachment and detachment of units. Such attachment and detachment of units is coordinated with the battalion's higher headquarters. See figure 4-6.

• *Headquarters and Headquarters Detachment.* The headquarters and headquarters detachment is organized as shown in figure 4-7. It provides command and control and technical and operational supervision over assigned or attached petroleum supply companies and transportation medium truck companies (petroleum). The detachment is usually assigned to the COSCOM or TAACOM, or to the petroleum group for independent corps operations.

• *Battalion headquarters.* The battalion headquarters provides the necessary command and supervision for the technical operation of the battalion and its assigned and attached units. It is concerned mainly with mission accomplishment, employment and deployment plans, administration, training, and security of the battalion.

• *S1 section.* This section provides the necessary administrative and personnel management support required throughout the battalion.

• *S2/S3 section.* This section supervises the security and operation of the battalion's military petroleum supply and distribution system. It plans and supervises a program for quality surveillance of petroleum products within the battalion and its area of operation,

• *Security and plans branch.* This branch is primarily concerned with the deployment of the battalion, with tactical plans, and with the training of battalion personnel. It is also concerned with planning, coordinating, and supervising security of the petroleum distribution system and with unit perimeter security. The branch also coordinates decontamination operations, if necessary.

• *Petroleum operations branch.* This branch provides the technical and operational supervision for the storage and distribution of petroleum products within the battalion's supply and distribution system. The petroleum operations branch coordinates with the petroleum supply companies on site location, bulk receipts, and tankage allocation. The branch determines transportation requirements for quantities of bulk petroleum products to be distributed by tank vehicle and by air, rail, or water transportation, if required. The branch also schedules and dispatches transportation medium truck companies (petroleum) that distribute bulk petroleum.

• *S4 section.* The S4 section provides technical assistance on supply and maintenance to the units in the battalion. It requests, receives, and processes the necessary supplies and equipment for the subordinate units.

• *Detachment headquarters.* The detachment headquarters provides the necessary command and supervision for the unit. This includes administration, organizational supply, security, and training activities.

• *Communications section.* The communications section provides teletype and telephone communication support for the battalion and detachment headquarters. It also operates the battalion communications center.

Petroleum Supply Company

The petroleum supply company is assigned to the COSCOM or TAACOM and is normally attached to the headquarters and headquarters company of the petroleum supply battalion. The organization of the petroleum supply company (TOE 10-227) is shown in figure 4-8. The mission of the company is to receive, store, and transfer bulk petroleum to divisional and nondivisional direct support supply and service companies on a 24-hour basis. It also lays, operates, and retrieves petroleum hoseline. This unit can receive and issue a total of 685,000 gallons of bulk petroleum per day and can store as much as 1,480,000 gallons of petroleum in collapsible tanks. This storage capacity also includes a

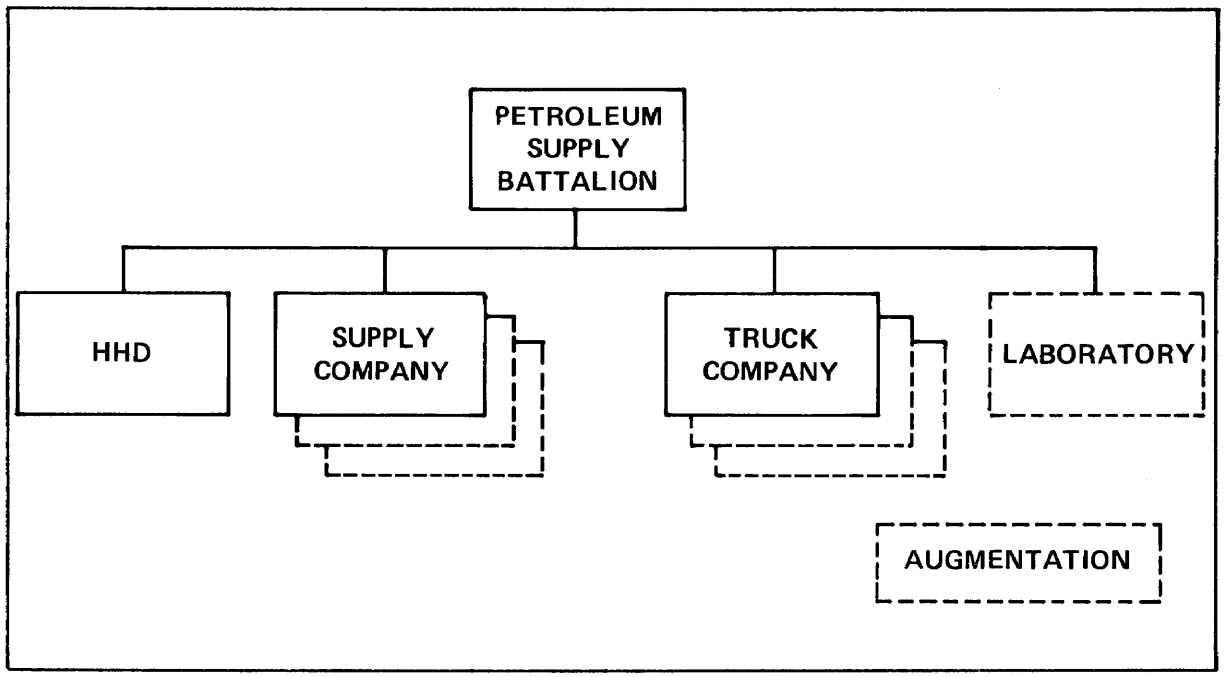


Figure 4-6. Petroleum supply battalion.

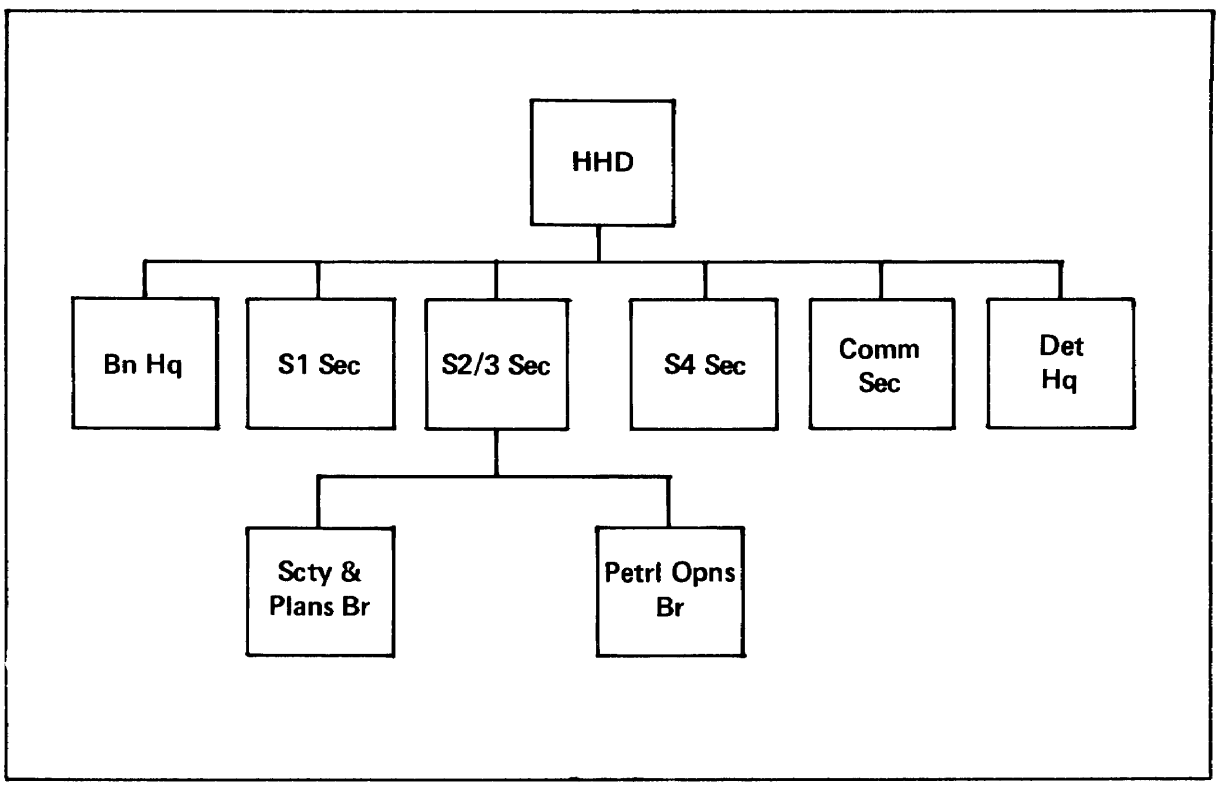


Figure 4-7. HHD, petroleum supply battalion.

prescribed portion of the command petroleum reserve stock.

• *Company Headquarters.* The company headquarters provides personnel for command and control of company operations. The headquarters staff establishes company policy and plans and coordinates unit security. It provides internal supply, food service, administration, communications, security, civil affairs, quality control, and organizational maintenance on unit arms.

• *Supply Platoons.* The petroleum supply company normally has two supply platoons. Each of these is composed of a headquarters and two supply sections.

• *Supply platoon headquarters.* The platoon headquarters is responsible for control and operation of subordinate supply sections and selection and preparation of operating sites. It also supervises the receipt, storage, issue, and distribution of bulk petroleum products.

• *Supply sections.* The supply sections provide and operate wholesale bulk petroleum storage facilities in collapsible tanks for transfer operations to direct support division support commands and supply and service companies, These sections can, on a 24-hour basis, install, operate, and retrieve approximately 10 miles of collapsible hoseline; provide limited mobile filling station service; and operate supply points at two locations.

• *Supply Control Section.* This section coordinates the receipt, storage, and issue of bulk petroleum. Control section personnel establish and maintain unit wire net communications.

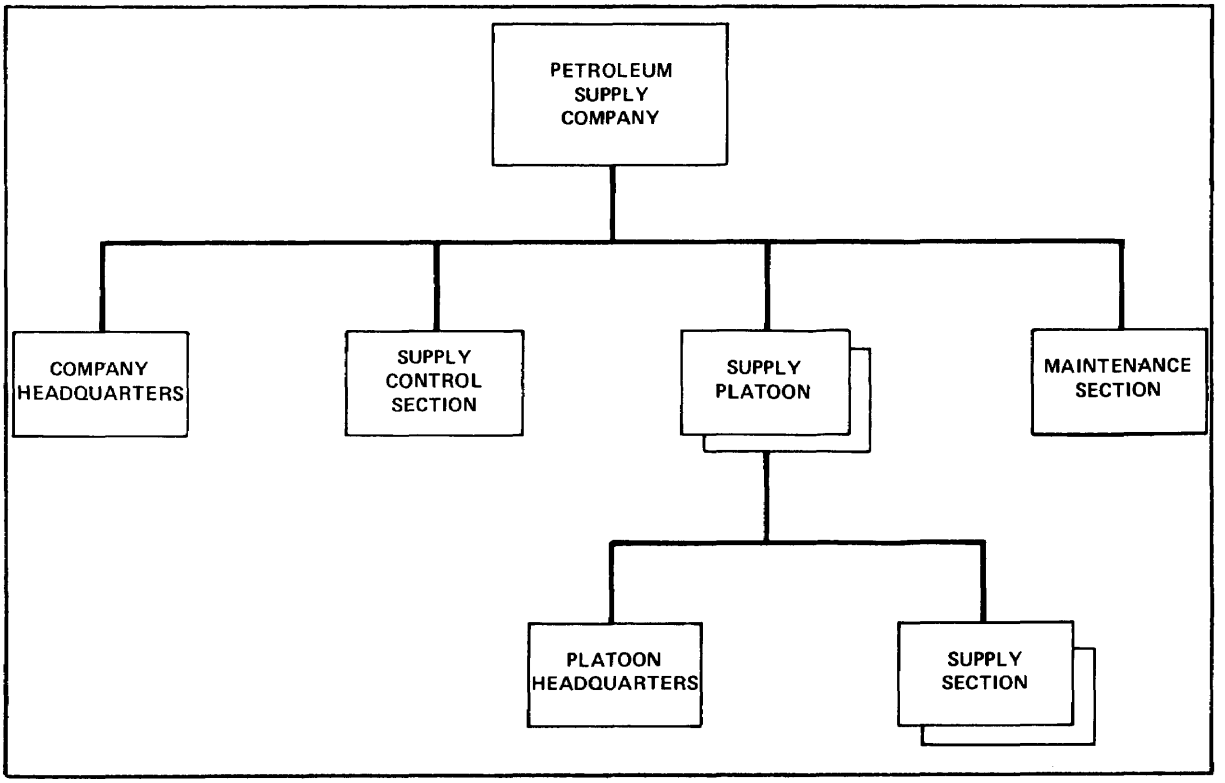


Figure 4-8. Petroleum supply company.

• *Maintenance Section.* The maintenance section provides personnel to supervise and perform organizational maintenance on generators, tracked and wheeled vehicles, construction and engineer equipment, and quartermaster special-purpose equipment. Section personnel may also be tasked with vehicle recovery.

Transportation Medium Truck Company (Petroleum)

The transportation medium truck company (petroleum) (TOE 55-18) can provide transportation for bulk fuel over an average highway system. The company organization is shown in figure 4-9. Operating platoons are manned around the clock. Each company can move 900,000 gallons per day in local hauls or 450,000 gallons per day in line-haul operations. This capacity is based on seventy-five percent availability of vehicles on the average; four round trips daily for local hauls or two round trips daily (one per 10-hour shift) for line hauls; and 5,000 gallons hauled by each fuel transporter on each trip.

• *Company Headquarters.* The company headquarters provides personnel for command and control of company operation. The headquarters staff plans and coordinates unit security and establishes company policy. It provides internal supply, food service, administration, communications, security, civil affairs, and organizational maintenance on unit arms.

• *Truck Platoons.* There are three truck platoons in the company. Each platoon has twenty trucks (ten per squad). Each squad has a squad leader and twenty drivers (two per vehicle).

• *Maintenance Section.* The maintenance section provides personnel to supervise and perform organizational maintenance on organic equipment except communications equipment.

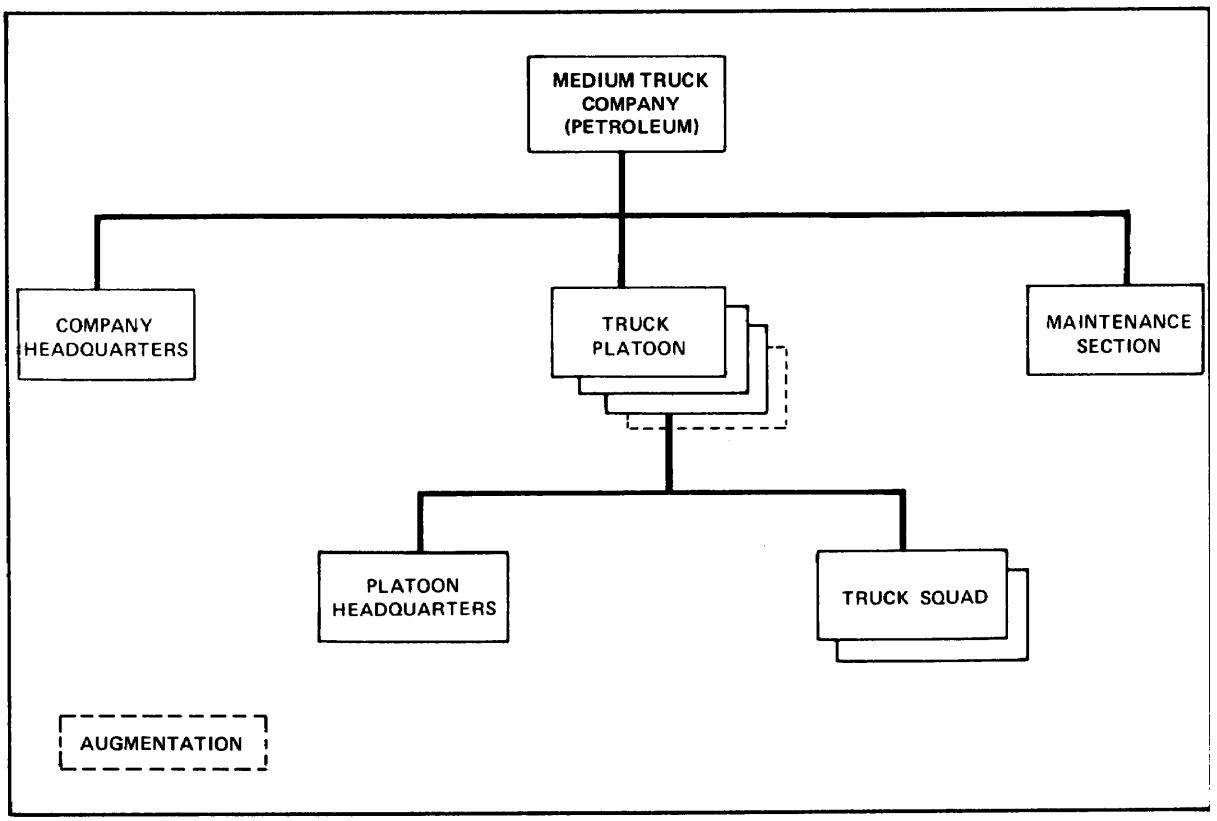


Figure 4-9. Transportation medium truck company (petroleum).

Section II

UNDEVELOPED THEATER

General

The independent corps normally does not have a communications zone (COMMZ). The corps is force structured (tailored) to be initially self-sufficient. The tailored slice of Echelons above Corps (EAC) support units required to make the corps self-sufficient is attached to and deployed with the corps COSCOM. As the theater matures and additional forces arrive in the theater, a COMMZ may be established.

Corps Organization

The petroleum group in the undeveloped theater is at the corps level, but it has the same functions as it has in the developed theater. Figure 4-10 shows the corps organization. This figure does not imply that the petroleum distribution organization is a fixed one not subject to change. The organizations under the petroleum group are tailored to the mission of the corps and the resources required. For example, either the petroleum

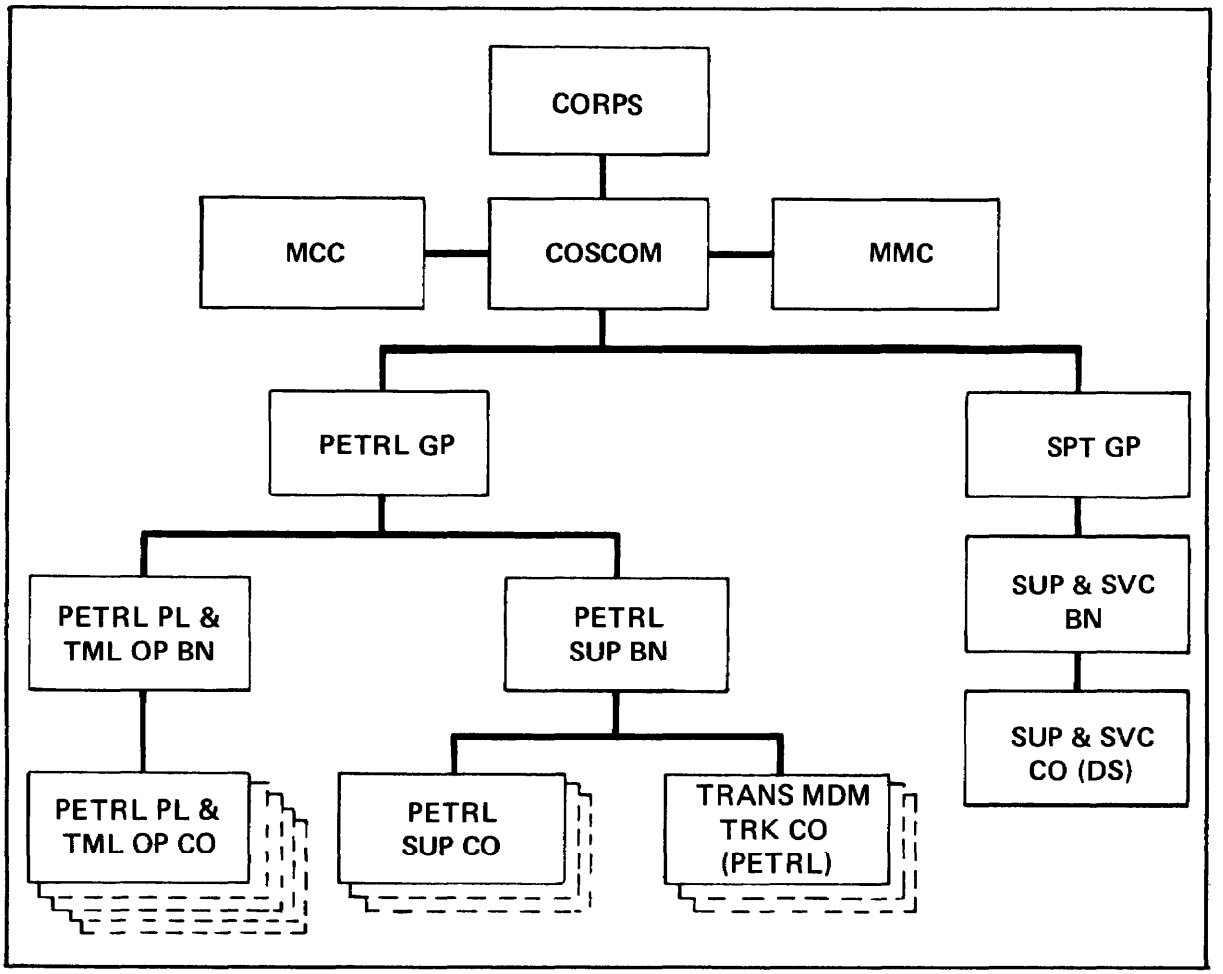


Figure 4-10. Type corps organization for petroleum operations in an undeveloped theater.

supply battalion or the petroleum pipeline and terminal operating battalion may consist of a mix of petroleum supply companies, transportation medium truck companies, and pipeline and terminal operating companies. Functions of the units in the COSCOM are covered in section I of this chapter.

Division Organization

The division organization in the undeveloped theater or independent corps is identical to the organization in the developed theater. Figure 4-11 shows this organization.

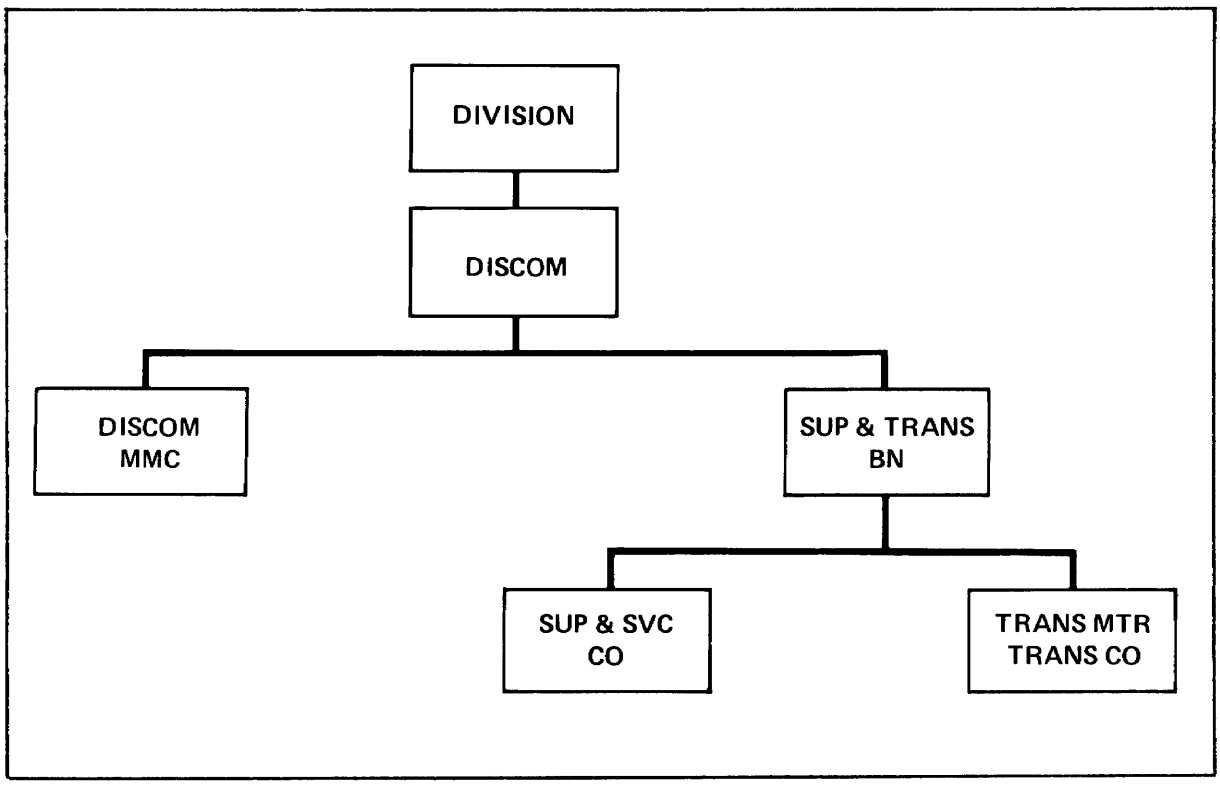


Figure 4-11. Division organization in an undeveloped theater.

CHAPTER 5

PETROLEUM SUPPLY OPERATIONS

Section I
SUPPLY OF PETROLEUM PRODUCTS

Petroleum Supply in the Communications Zone

In the developed theater, fuel is delivered to tank farms in the COMMZ by pipelines or hoselines operated by a pipeline and terminal operating company under the pipeline and terminal operating battalion. The COMMZ may have more than one TAACOM. Each TAACOM has an MMC and may have a petroleum supply battalion. Requests for petroleum products from the supply and service company (DS) go to the TAACOM MMC. The TAACOM MMC coordinates with the petroleum supply battalion (GS) which, in turn, delivers the fuel. The petroleum supply battalion requests its fuel through the TAACOM MMC. The TAACOM MMC provides its requirements to the TAMMC which, in turn, provides allocation instructions to the petroleum group. The TAMMC provides total Army projected theater requirements to the joint petroleum office and the group. Figure 5-1 shows the flow of status reports and requirements in a developed theater.

Petroleum Supply in the Corps

Bulk fuel supply in the corps differs between the developed and undeveloped theaters. Basic concepts are the same; however, the organizational structure varies.

• *Developed Theater.* Petroleum requirements are received in the COSCOM MMC from the division MMCS, armored cavalry regiments (ACR) and separate brigades, petroleum supply battalions, other nondivisional units, and nondivisional supply and service companies. The petroleum supply battalion provides general support and the supply and service company provides direct support. See figure 5-1. In some cases, the general support unit will also provide direct support.

• *Undeveloped Theater.* The undeveloped theater is organized as an independent corps. The petroleum group is part of the COSCOM and commands the operational units that provide petroleum general support. There may be any mix of petroleum-type units required to support the mission. The COSCOM MMC prepares a forecast of army requirements and combines it with other service's and allies' requirements and forwards the total requirement to the JPO. The JPO prepares a petroleum slate. The slate is then transmitted to DFSC. Figure 5-2 shows the petroleum requirement flow in the corps of the undeveloped theater.

Petroleum Supply in Divisions

In both the developed and undeveloped theater, the DISCOM MMC provides requirements to the COSCOM MMC. Fuel is received in armored-infantry-mechanized (AIM) divisions by the supply and service company of the supply and transport battalion. Fuel is furnished to air assault and airborne divisions by the main supply company of the

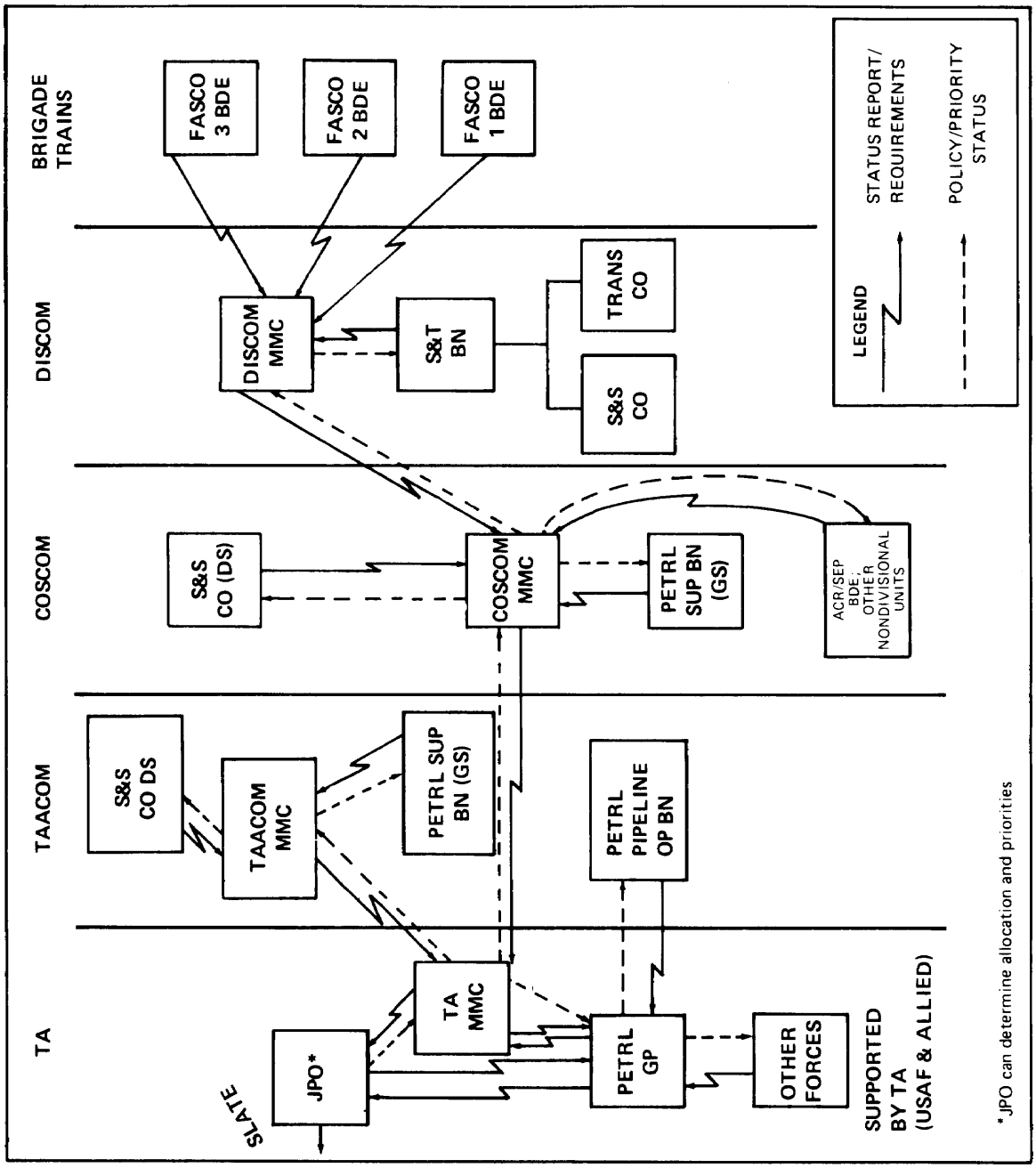


Figure 5-1. Flow of bulk petroleum requirements in a large theater.

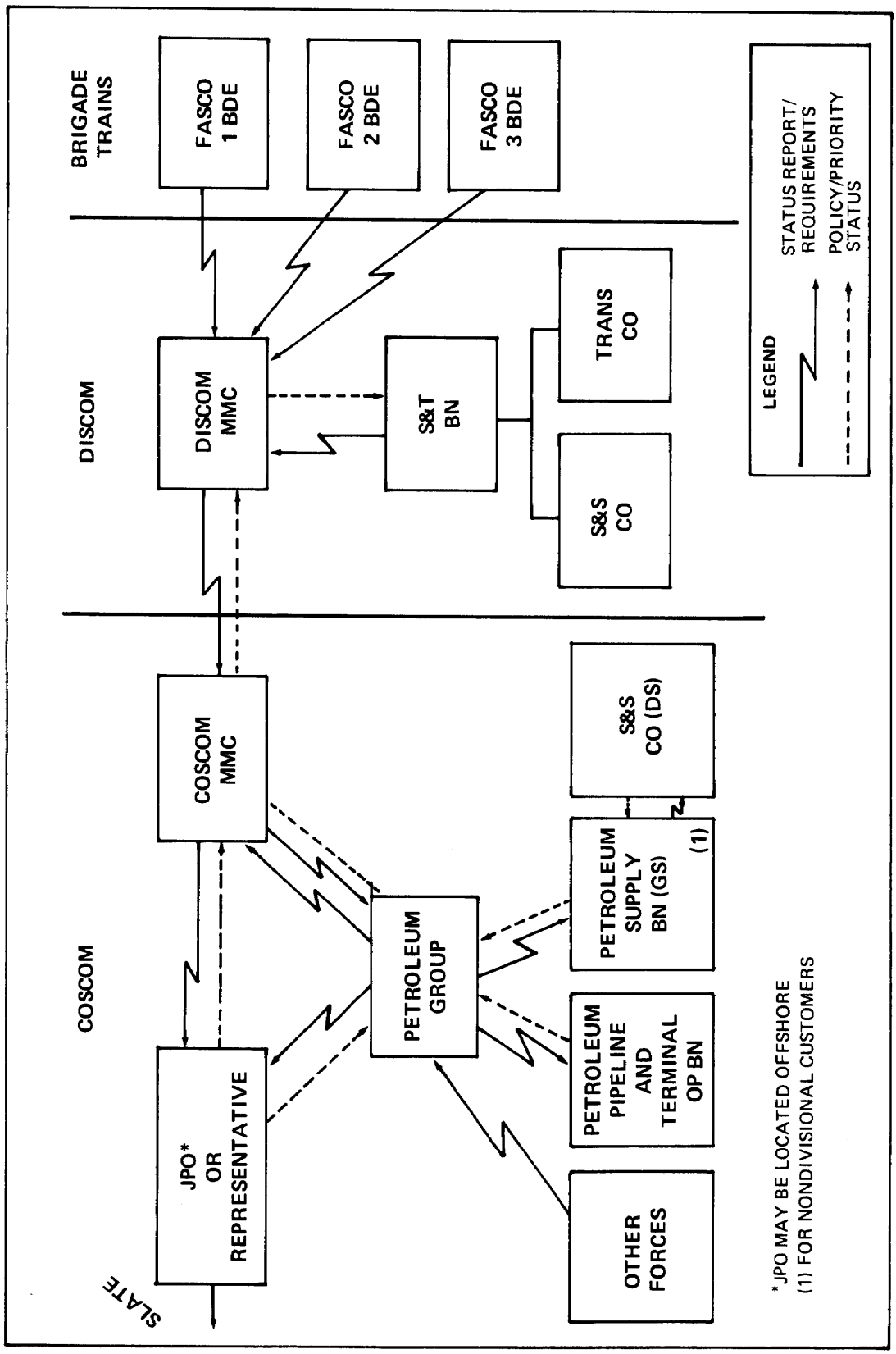


Figure 5-2. Flow of bulk petroleum requirements in an undeveloped theater.

organic supply and service battalion. In the developed theater the general support petroleum supply battalion provides the fuel Normally, supply point distribution is used in the division area with units picking up their fuel in the division support area. Operational necessity may require establishment of class III supply points in brigade support **areas operated by the supply and transport** battalion. In AIM divisions, both unit and supply point distribution are used to provide fuel to users in divisions and brigade support areas. Packaged class III products are requested through class II and class IV channels, but generally issued at class III supply points. Fuel can be delivered by 5,000-gallon tankers from the division distribution points to the brigade trains area or to designated rendezvous points where product can be transferred to 1,200-gallon tank trucks, trucks equipped with tank and pump units, or to GOER vehicles. The 5,000-gallon tankers may also be required to pick up product at the COSCOM petroleum GS supply point and deliver product to the division distribution point or to forward distribution points. Further discussion of petroleum product supply in divisions is in FM 29-50. See figure 5-3 for petroleum supply in the divisions.

Nondivisional Direct Support Petroleum Supply Organization

The supply and service company, direct support, TOE 29-147, provides fuel support to nondivisional units in the theater. In the corps area, one or more supply and service companies, direct support, may be assigned to the corps support group and further assigned to the headquarters and headquarters company of the supply and service battalion. In the COMMZ, the company and the nondivisional supply and service battalion are usually assigned or attached to the TAACOM area support group. The company establishes operating areas for receipt, storage, and issue of supplies and for service activities for which it is responsible. It receives requests for supplies from supported units, processes them, and issues necessary instructions to the appropriate operating element of the company. The bulk class III supply point is both a storage facility and a distribution point. Organic vehicles may deliver bulk petroleum to using units or they may be used as mobile filling stations, if necessary. Fuel system supply points are used to store fuel for units serviced by the company.

• *Supply and Service Operations Office.* The supply and service operations office is the mission control element of the company. It receives requests for supplies from supported units, processes them, and issues necessary instructions to the appropriate supply element of the company. This office also maintains stock locator records of supplies.

• *Petroleum Platoon.* The petroleum platoon is responsible for the receipt, storage, and quality surveillance of bulk and packaged petroleum products and for their distribution to supported units. It also provides local delivery of these products and performs container cleaning and bulk reduction operations as required.

• *Platoon headquarters.* The platoon headquarters supervises and controls platoon operations. It also reconnoiters and selects operating sites and performs quality surveillance functions.

• *Petroleum storage and issue section.* This section receives, stores, and issues packaged petroleum products and operates the bulk petroleum transfer and storage facilities. Based on 83 percent availability of storage tanks authorized, this section can provide storage for as much as 100,000 gallons of bulk petroleum. This section also operates the container cleaning machine used in limited decanting operations.

• *Distribution section.* The distribution section distributes bulk petroleum locally to supported units. Based on 75 percent availability of fuel-servicing vehicles and two trips per vehicle, the section can deliver as much as 81,900 gallons of fuel per day. This section may also establish mobile filling stations when they are justified by the volume of traffic.

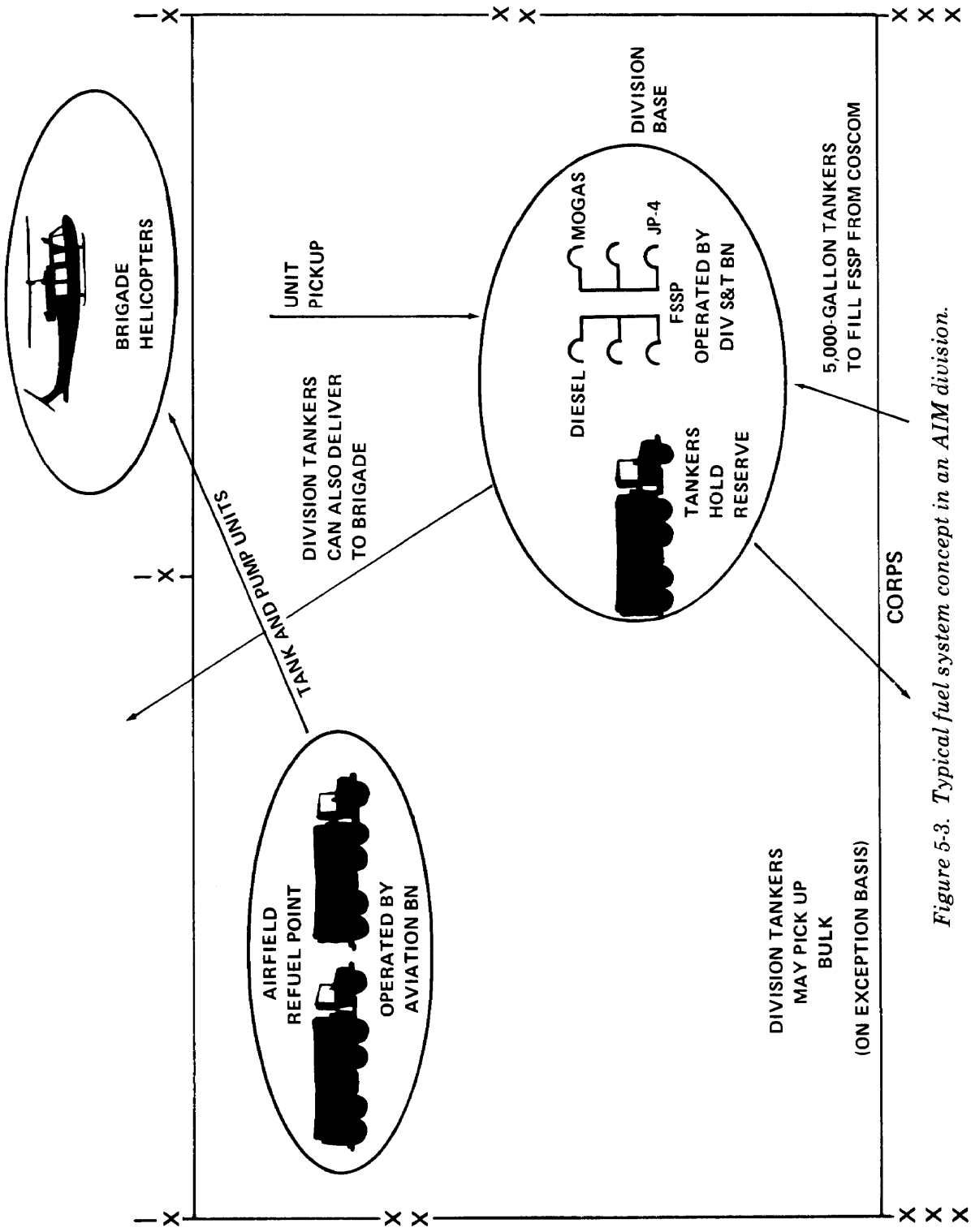


Figure 5-3. Typical fuel system concept in an AIM division.

Section II

FUEL CONSUMPTION ESTIMATES

General

Fuel consumption estimates or requirements are the key to designing an effective petroleum distribution system to support the theater. At theater level, fuel consumption estimates are the basis for acquiring theater petroleum tankage and for allocating supply levels throughout the theater. At theater army level, fuel consumption estimates are used to establish priorities for distribution and construction. At lower echelons, fuel consumption estimates are the basis for resupply. Theater fuel consumption estimates must be accurately determined to develop realistic plans in support of operational forces. Requirements are needed for operating divisions, Air Force, allies, and other large-volume consumers by location and time period. Determining the requirements allows the planner to determine such specifics as the number and types of tanker unloading facilities and the number of tank cars, tank vehicles, tanker aircraft, barges, and other bulk petroleum distribution equipment needed. Fuel consumption must be estimated as soon as possible so that it can be balanced against known capabilities and coordinated with other supply and transportation support requirements. Troop strengths to be supported and the number of major items of fuel consuming equipment in each phase of the operation are essential in the initial determination of petroleum requirements. The best available fuel consumption estimates should be obtained. These should be based on consumption factors contained in SB 710-2.

Computing Fuel Consumption (STANAG 2115 Method).

The STANAG 2115 method for computing fuel consumption uses the fuel consumption unit (FCU). One FCU is the basic unit for fuel calculations. It represents the quantity of fuel required for the operation of a given fuel consumer under assumed average operating conditions for a given standard performance. The calculation is made separately for each type of fuel. All fuel consuming equipment of the unit should be listed. The quantity of fuel required for each piece of equipment to do a standard performance should be calculated. Fuel consumption data is obtained from SB 710-2. The total of the individual consumption figures for all the equipment of the unit represents the FCU of the unit. An example of a FCU calculation is shown in figure 5-4. For units involved in combat operations or for special terrain or weather conditions other than normal, a series of operational factors are included in the STANAG for use in modifying the standard day to fit the combat day. These operational factors are shown in appendix D.

Experience Data

Actual experience data may be substituted for calculated estimates. Historical data and experienced actual consumption should be used when conditions are similar and data is reliable and has been verified. Requirements of consumer units can be compared with the capabilities of available distribution systems to determine the adequacy of the system. Requirements can also be computed on a scheduled basis, usually weekly or monthly.

Responsibilities

All consumers are responsible for estimating their own fuel requirements and submitting them in a timely manner. The theater army petroleum officer and the petroleum group staff review requirements submissions for accuracy.

(Unit Designation) Engineer Co.							
Type of equipment	Quantity	Individual consumptions (100 km or 12 hr)				Total (Gallons/Liters)	
		MOGAS Gallons (Liters)		Diesel Fuel Gallons (Liters)		MOGAS Gallons (Liters)	Diesel Fuel Gallons (Liters)
Crane	1	-		22	(83)	-	22 (83)
Compressor	1	-		30	(114)	-	30 (114)
Tank, dozer	2	-		54	(205)	-	108 (409)
Armored pers carrier	17	-		97	(368)	-	1,649 (6,246)
Motorcycle	1	1.5	(6)	-		1.5 (6)	-
Truck, 1/4 T radio	7	5	(19)	-		35 (133)	-
Truck 1, 5 T	4	-		6	(22)	-	24 (91)
Truck, 4 T cargo	9	-		10	(38)	-	90 (341)
Truck, 4 T dump	10	-		10	(38)	-	100 (379)
Truck, ambulance	1	-		6	(22)	6 (22)	-
Tank, bridge	2	-		238	(902)	-	476 (1,803)
Tool kit set No 1	1	5	(19)	-		5 (19)	-
Generator	1	8	(30)	-		8 (30)	-
Motor, outboard 9.5 hp	4	12	(45)	-		48 (182)	-
Saw, chain	16	1.5	(6)	-		24 (91)	-
Hand drill	16	1.5	(6)	-		24 (91)	-
Power unit	1	4	(15)	-		4 (15)	-
Cooking equipment	1	35	(133)	-		35 (133)	-
Heating equipment	1	-		3	(11)	-	3 (11)
Set seal drum	1	-		4	(15)	-	4 (15)
FCU OF THE UNIT						190.5 Gallons (722 Liters) of Mogas	2,506 Gallons (9,492 Liters) of Diesel Fuel

Figure 5-4. Calculation of a unit's FCU in gallons/liters.

• *Consumers'Responsibilities.* Consumers determine their initial requirements and report changes in consumption that warrant an adjustment in the supply distribution pattern. The processing of consumption data is made easier where and when electronic data processing and transmitting equipment is available.

• *Theater Army Petroleum Officer's Responsibilities.* The petroleum distribution system must provide the capacity to receive, store, maintain, and issue the types and quantities of fuels required. The theater army petroleum officer should, therefore, constantly evaluate and update the long-range petroleum distribution plan as refined requirements data becomes available. The petroleum group is charged with continual review of the total system's capabilities and makes appropriate recommendations to the theater army commander and staff.

CHAPTER 6

DISTRIBUTION OPERATIONS

Section I

PRODUCT MOVEMENT AND CONTROL

Fundamentals

Product movement and product control are so closely related that they must be discussed together. Product control, which includes centralized accountability, is a management function. Product movement by whatever means (pipeline, tank car, tank truck, barge, or air) is a supervisory and an operating function. Scheduling and related functions pertaining to pipeline operations are the responsibility of the petroleum group. Establishing the pipeline is the responsibility of the petroleum pipeline and terminal operating battalion. The actual operation of the pipeline and associated facilities is the responsibility of the petroleum pipeline and terminal operating companies.

Scheduling

Scheduling is the programed movement of products through the pipeline. It is a function of the petroleum operations section at the petroleum group headquarters. Scheduling is based upon estimated requirements, availability of products, transportation, and consumer needs for various types and grades of products. These factors are translated into movement schedules to get the requested product to the consumer. Schedules are prepared on a regularly established basis (monthly and/or weekly). The schedules are transmitted to all dispatchers so that they can plan their operations well in advance. The schedules serve as a basis for the daily dispatching directives (or pumping instructions) by which products are actually moved through the system. More information on monthly pipeline and daily pumping schedules is found in FM 10-18. When products are to be moved by means other than pipeline, the petroleum requirements distribution officer at petroleum group headquarters coordinates with the transportation movements officer and movements specialists organic to the group headquarters. Similar coordination is done by the petroleum distribution officer and movements control personnel at subordinate operating battalion headquarters.

Dispatching (Pipelines)

Dispatching is the process for controlling the movement of products through the pipeline by regulating pump stations and line pressures. Such control may be exercised, in the initial stage of operation (immature theater), by the dispatcher of the petroleum pipeline and terminal operating company operating the receiving or base terminal. As the system expands and requires a pipeline and terminal operating battalion headquarters, pipeline control is then assigned to the petroleum operations officer in the battalion headquarters. The petroleum operations officer of

that battalion becomes scheduler and chief dispatcher for the system. Personnel from petroleum pipeline and terminal operating battalion headquarters are normally pooled at a convenient location to provide centralized dispatching control. Effective dispatching is a matter of precision and timing. It involves the use of certain common control aids, such as a dispatching board, a streamer tape, or a graphic progress chart. Detailed technical instructions on the use of these aids are contained in FM 10-18.

Fuel Accounting in Pipeline Operations

It is the responsibility of the chief dispatcher to keep records of fuel received by the system, fuel delivered to installations along the line, fuel remaining in the system, and fuel lost, Such reporting is required since accurate scheduling is impossible unless the actual daily consumption rate of petroleum is known. Base terminals make hourly reports of fuel pumped into the line; other terminals make hourly reports of fuel received from or pumped into the line. Differences between fuel pumped and fuel received constitute gains or losses. Losses are of major concern to the dispatcher because they may represent breaks in the line, poor maintenance, or inefficient operation. These loss factors are of equal concern to stock controllers. Certain data are required to record the flow of petroleum through a pump station on a 24-hour basis: suction and discharge pressures; revolutions per minute of pumps; operating temperature for each pump at the station; leakage reports; and reports of flow of petroleum from the dock area to the storage tank area. This information is recorded on forms or in reports such as those listed below.

• *DA Form 4193.* DA Form 4193 (Petroleum Products—Pump Station Hourly Operations Record) is used for tabulating the flow of petroleum products that pass through a pump station on a 24-hour basis.

• *DA Form 4818.* DA Form 4818 (Petroleum Products—Pump Station Operations Log) is used by each shift in recording suction and discharge pressures, pump revolutions per minute, and water temperatures for each pump at a pump station.

★● *DA Form 5464-R.* DA Form 5464-R (Petroleum Products–Pipeline Leakage Report) is used to report a leak discovered in a line or at a terminal. A blank, reproducible copy of this form appears in appendix G.

•*DA Form 5038.* DA Form 5038 (Petroleum Products—Package Area Inventory) is used at supply points when packaged products are handled.

★● *DA Form 4786.* DA Form 4786 (Petroleum Products—Tank Farm Intake Record) is used to record the flow of products from the dock area to the sotrage tank area. Along with this form, a petroleum pipeline and terminal operating company will also be required to prepare DA Form 5463-R (Petroleum Products—Tank Farm Outturn Record); DA Form 3644 (Monthly Abstract of Issues of Petroleum Products and Operating Supplies); and an informal storage tank gage record as described in FM 10-18. A blank reproducible copy of DA Form 5463-R appears in appendix G .

•*Status Report.* Figure 6-1 shows a suggested format for a status report that may be used for stock control purposes. Such a format can be reproduced. Columns may be deleted or added, as required, for the specific information desired. These reports are readily convertible for machine processing.

• *Petroleum Accounting Procedures.* Detailed procedures for accounting for petroleum products are discussed in AR 703-1.

Transportation Control

In addition to controlling the flow of product through the pipeline, the petroleum distribution officers at petroleum group and at petroleum pipeline and terminal operating battalion headquarters decide which products are to be transported by rail, highway, air, and water. Movement by means other than pipeline must be closely coordinated with movement programs, directives, and policies of higher commands. TAACOM may

SUP PT No. 2 DATE 06APR

REPORT PERIOD 051800APR TO 061800 APR

UNIT

ITEM	RECEIPTS (GALLONS)	ISSUES (GALLONS)	ON HAND (GALLONS)
MOGAS	210,000	235,000	200,000
AVGAS	8,000	7,000	5,000
DIESEL	125,000	105,000	75,000
JP-4	6,000	5,000	4,500

Figure 6-1. Suggested format for status report.

assign or attach to the petroleum group transport units which are regularly engaged in the line haul movement of petroleum products. When this is done, rigid adherence to the following Department of the Army policies must be insured.

• Any highway transport units assigned or attached to the petroleum group will primarily be used for wholesale movement of products. So double handling will not occur, moving supplies from the source directly to the consumer is standing operating procedure (SOP).

• The assigned or attached highway transport units are not divided up by assigning them different functions; they are kept

together. When the total capability is not needed for petroleum transportation, transport elements are used for other transportation tasks. Detailed information on the operation of highway units is contained in FM 55-30 and FM 55-60. Various records and reports that may be prepared by the transportation movements officer and his assistants are discussed in FM 55-10.

• Rail tank cars, as required, are placed in petroleum terminal distribution areas to resupply established consumers. Rail transportation units are discussed in FM 55-20.

Section II

PIPELINE SYSTEM MAINTENANCE

Unit Responsibilities

Operating units do organizational and limited higher-echelon maintenance on pipelines, bulk storage equipment, off-vessel discharging hoses, and fixed and field dispensing equipment. Detailed instructions for pipeline maintenance are contained in FM 10-20. Unit pipeline maintenance consists mainly of:

• Minor repair work, cleaning, preservation, lubrication, scheduled preventive maintenance, and minor adjustments; external and internal cleaning, caulking, and peening of bolted tanks; and maintenance of camouflage.

• Replacement of exposed sections of grooved-type pipeline and couplings; replacement of valves and flanges; repair of small leaks with bolted clamps; and other repair not involving renovation or special equipment.

• Repairs or replacements that do not require movement of basic equipment and that can be done with handtools or small power tools.

Command Responsibilities

The petroleum group determines and places requirements on the engineer command for maintenance of pipeline systems and storage facilities. The engineer command provides engineer pipeline construction support companies to assist in making specialized repairs to pipeline systems and storage facilities.

• Detailed information for maintenance, repair, and renovation of pipeline and related facilities is contained in TM 5-343. The services performed include--

• Repair or maintenance that requires moving the equipment from the site.

• Repair or maintenance that requires special tools or welding equipment.

• Overhaul of the pump unit that requires removal of the pump cover or removal of the engine.

• Renovation, reconstruction, and repair that requires the use of special construction equipment and techniques such as laying looped lines to bypass major breaks in the line.

• Maintenance support companies (situated in the COMMZ) attached to the area support group provide direct support maintenance for other items of equipment used by pipeline operating units. These items include automotive items, generators, electronic equipment, instruments, and materials-handling equipment.

Section III

PIPELINE COMMUNICATIONS

General

When possible, the pipeline communications requirements are supported by the area communications system. When this is not possible, the United States Army Communications Command (USACC), in coordination with the petroleum group signal officer, gives required communications support as outlined in TB SIG 322-43. The equipment needed for such a system is provided on a project basis and is not authorized by TOE. This section discusses the pipeline communications system that is normally used.

Signal Officer

The signal officer at each area petroleum headquarters coordinates system requirements with signal agencies to insure maximum use of available facilities and services. The signal officer assigned to the petroleum group headquarters aids in the planning for support of the petroleum distribution system. This may involve preparing signal plans and policies for the headquarters and its subordinate operating units; designating circuits and frequencies to be used; and preparing plans for emergency communications. The signal officer may also be involved in designating other means of communications to be used when existing systems may be damaged or destroyed. He supervises internal communications support activities for the headquarters and inspects subordinate units to insure that the equipment is properly maintained and operated. The signal officer may aid the group commander in getting communications support from USACC that is not supplied by organic units.

Equipment

The pipeline communications system normally uses teletypewriters and telephones as the chief means of communication. Radios are used to link the chief dispatcher with district dispatchers and to link district dispatchers with pump stations, maintenance camps, and mobile air and land patrols. In undeveloped theaters, radios are used for communications until telephone lines can be established. Since continuous communication is vital, backup communications systems are necessary.

• The communications system begins at the petroleum pipeline and terminal operating company level. Each of these companies uses teletypewriters, radios, and telephones to control operating elements. Company elements and battalion and group headquarters use telephones for adminstration purposes.

• The petroleum distribution officer uses the communications system to control the flow of product through the pipeline.

Chief Dispatcher

The chief dispatcher is normally at a separate location from the first district dispatcher. However, the chief dispatcher control station may be combined with that of the first district dispatcher. The first district dispatcher is located at the base terminal end of the pipeline system. The chief dispatcher has a tape printing and transmitting teletypewriter, a telephone, and radio equipment. The teletypewriter is normally used as the primary method of communication, and the telephone system as the secondary.

• The chief dispatcher has a direct teletypewriter channel to the district dispatcher at each subcontrol station. This channel is provided on a party line basis as long as there are no more than nine subcontrol stations in the pipeline system. The chief dispatcher has a teletypewriter switchboard that is connected to the district dispatchers. The switchboard enables the chief dispatcher to contact any or all district dispatchers separately or in anycombination. It also allows the district dispatchers to contact adjacent district dispatchers.

• The chief dispatcher can communicate with subcontrol stations 1 and 2 by telephone.

• Mobile, high-frequency radio equipment is used for communications backup. These facilities are available to the chief dispatcher and to each subcontrol station. The backup system may be used with the regular system at the chief dispatcher or subcontrol station. The backup radio provides a radio-teletypewriter and voice capability. This allows the chief dispatcher an alternate means of contacting district dispatchers on a net operation basis. This system can be operated by remote control from the office of the chief dispatcher and each district dispatcher.

• If the chief dispatcher wants to notify all pump stations of a shipment, he has the message punched on a teletypewriter tape and transmitted to all the district dispatchers at the same time. Upon receipt of the message, the district dispatchers acknowledge receipt of the message and notify, through their communication circuits, the pump stations involved.

District Dispatcher (Subcontrol Station)

All district dispatcher subcontrol stations have teletypewriters and telephone capabilities. The teletypewriter is normally used as the primary system of communication and the telephone as the secondary.

• Each subcontrol station has a direct teletypewriter channel to the chief dispatcher. This channel is a private line unless otherwise directed by the chief dispatcher.

• Subcontrol stations 1 and 2 have direct contact with the chief dispatcher by telephone.

• Each subcontrol station has teletypewriter and telephone communications with adjacent subcontrol stations in either direction on a private-line basis. Each district station has a small telegraph and telephone switchboard that connects circuits coming into and within the district. This arrangement allows each district dispatcher to function as the chief dispatcher in an emergency.

• All pump stations and tank farms located in a single district communicate through a party line telephone channel with manual code-signaling and a party line teletypewriter channel. These circuits stop in the subcontrol stations at either end of the pump stations and tank farms. The teletypewriter circuit at each district station connects to a teletypewriter that can receive and transmit both tape and page copy.

• Permanent and temporary relay services are provided by the subcontrol station. Permanent services are mostly the relay of the chief dispatcher channels to more distant subcontrol stations. Temporary services are furnished other stations on the pipeline system on a request-as-needed basis.

• Each subcontrol station uses mobile radio communications equipment for backup communications. The equipment also allows the subcontrol station to contact the chief dispatcher and any other subcontrol station, if necessary.

• Each subcontrol station has the necessary communications equipment to function as the chief dispatcher control station if needed.

Pump Station and Tank Farm

Normally, all pump stations and tank farms have identical teletypewriter and telephone communications capabilities. Standby radio communications are also provided between adjacent pump stations.

• Teletypewriter service is furnished on a party line basis to all pump stations and tank farms in each district. This party line includes the subcontrol stations at both ends of the district. The circuit at each pump station is connected to a page-printing teletypewriter.

• Party-line telephone communication is provided to all pump stations and tank farms in the district and to the subcontrol station at each end of the district. Manual code signaling is used whereby each station on the party line is assigned an identifying code ring.

CHAPTER 7

QUALITY SURVEILLANCE

Section I
GENERAL

Quality Surveillance Organization

The organization for quality surveillance of petroleum products is under the control of the theater army commander. Base laboratories assigned or attached to the petroleum group, base laboratory sections organic to petroleum pipeline and terminal operating battalions, and mobile laboratories attached to petroleum supply battalions are the operating elements of the quality surveillance structure in the theater army.

Quality Surveillance Mission

The quality surveillance mission is to maintain the quality of petroleum products from point of origin to point of use. The quality surveillance program encompasses, but is not limited to, bulk fuel in waterborne carriers, tank cars, tank vehicles, pipeline systems, bulk storage, and packaged products. This includes inspecting, sampling, testing, handling, and performing preventive maintenance. The mission is also to recommend and assist in recovering, upgrading, downgrading, or disposing of products. To accomplish this mission, the appropriate petroleum organization--

• Operates and maintains laboratories to test all petroleum products in the command in a reasonable time. Data on testing procedures are contained in the appropriate ASTM or FTMS standard. Military Handbook 200, FM 10-71, and FM 10-72 provide guidance and requirements for a quality surveillance system.

• Provides advisory technical assistance to military activities in the theater, particularly in recovering and downgrading products. Laboratory personnel must spend a substantial part of their time in the field on inspections and in connection with quality surveillance problems that arise. When products tested do not meet deterioration limits, laboratory personnel recommend, through channels, alternate use, reclamation, or disposal.

• As required, inspects petroleum products procured in the theater.

• As required, gives technical assistance and performs laboratory analysis for Air Force, Navy, and other commands and agencies.

Responsibilities for Quality Surveillance

In order to meet specifications set at DOD level, products undergo quality surveillance from the time they are procured until they are used. Therefore, there must be a quality surveillance program throughout the theater of operations.

• The joint petroleum officer, responsible to the theater commander, insures there is a quality surveillance program within the command and monitors and assists in this program. He may be assisted by joint area petroleum offices (JAPOs) or subarea petroleum offices (SAPOs).

• The theater army command is responsible for setting up and maintaining a quality surveillance program for fuels and lubricants furnished to users by the theater army. The program for bulk and packaged products is carried out by the petroleum group through its petroleum pipeline and terminal operating battalions. A petroleum quality surveillance program is required at all levels of command and will be accomplished by the appropriate petroleum personnel assigned.

Personnel Competence

An effective quality surveillance program requires properly trained personnel. Everyone concerned with handling fuels and lubricants should be suitably trained and able to perform his or her duties. Although the handling of fuels and lubricants presents many hazards, products can be handled safely if product characteristics are understood and precautions are taken. Good housekeeping practices will insure order and cleanliness and will promote safety.

Product Contamination

Basic sources of product contamination are water, dirt, rust, and scale, and intermixing of products. Products may also be contaminated with chemical or biological materials that may not be readily visible. Contaminants change the quality of a product by adding undesirable characteristics that make the product unsuitable for its intended use.

Product Deterioration

Certain changes occur in stored products and become more marked as the product ages. These changes, which are forms of product deterioration, are mostly the result of natural causes. Although deterioration may be initiated or hastened by storage conditions, it is not usually observable to fuel-handling personnel. The most common forms of product deterioration are weathering, which is the loss of the more volatile components; gum formation; and the loss of oxidation inhibitors, tetraethyllead, and anti-icing agents. The degree of deterioration can be determined only by periodic laboratory testing.

Captured Petroleum Products

Sampling, testing, and other forms of quality surveillance are also done to captured products. The purpose of such tests or analyses is to identify the products and to make recommendations as to their use, reclamation, or disposal.

Section II

PROCEDURES FOR QUALITY SURVEILLANCE

General

Deterioration limits are tolerances established to permit use, under certain conditions, of products that do not fully meet specifications. When petroleum products do not meet the deterioration limits, quality surveillance personnel report the facts and circumstances and recommend alternate use or disposition to the petroleum group or COSCOM materiel management center (MMC) and advise the JPO. Proposed recovery measures are also reported, if appropriate. On packaged products, the petroleum group reports this information to the CONUS national inventory control point (NICP). On bulk product and packaged fuel, the petroleum group notifies the JPO of the facts, circumstances, reclamation measures taken or recommended, and the need for replacement supply. In turn, the JPO informs the Defense Fuel Supply Center (DFSC). The petroleum group performs such recovery measures as are approved. The minimum frequencies for testing products are listed in Military Handbook 200.

Types of Tests

Type A is a procurement inspection test. Types B-1, B-2, B-3, and C are performed in quality surveillance testing (see Military Handbook 200). In addition, visual checks for appearance, water, and sediment are made on samples at filling points for rail tank cars, tank vehicles, and containers before filling and when changing to fresh fuel tanks and containers. Such checks are also made on delivery-line samples or all-levels samples from tank cars and tank vehicles after loading and before discharge. The types of tests and minimum test requirements are given in Military Handbook 200.

• Suspected contamination of products should be confirmed by laboratory tests.

• All laboratory tests are performed in accordance with the method prescribed in the appropriate specification. Specifications and deterioration limits are absolute and are not subject to correction for tolerance of test methods. Whether or not a test and its results can be reproduced may determine if the results are acceptable. When the same test is conducted more than once on a given sample, the results are considered suspect if they differ by more than the amount specified in the test method. Minimum test requirements are given in Military Handbook 200.

• Each petroleum products laboratory maintains, through publications channels, an up-to-date file of Government fuel and lubricant specifications.

Significance of Tests

Each test of fuels and lubricants contained in the product specification has a certain significance in relation to the product tested. Some tests can give a quick, easy, and positive identification of the product in question and at the same time help to detect contaminants. A description of test equipment and test methods is in FM 10-70. Appendix E of this manual gives the significance and purpose of certain tests and may help personnel to appreciate and understand the scope and importance of the quality surveillance program.

Sampling

All samples are taken in accordance with standard procedures based on ASTM Standards on Petroleum Products and Lubricants (part 18, sampling method D270). Many precautions must be taken to insure that samples are representative. The types of precautions depend on the type of products being sampled; the tank, carrier, or container; and the sampling procedure used. Each sampling procedure is suitable for a specific product under definite storage, transportation, and container conditions. Since a sample is used for determining physical and chemical characteristics of a product, the basic principle of each procedure is to take a sample in such a manner and from such a location in the tank or container that the sample will be truly representative of the product. A description of sampling procedures and equipment is included in chapter 11 of FM 10-69.

Quality Surveillance Requirements

Quality surveillance of fuel products must begin upon receipt by the holding activity and continue until those products are delivered to the user. Detailed information regarding specific procedures used in each storage and/or transportation mode is contained in references as listed below.

• *Bulk Storage.* AR 703-1, DOD 4140.25M, Federal Test Method Standard 791, Military Handbook 200, Military Handbook 201, Military Standard 140, Military Standard 161, and Military Standard 457.

• *Bulk Transportation.*

• *Marine.* Commander of Military Sealift Command Instructions 3121.3, DOD 4140.25M, Military Handbook 200 and Military Handbook 201.

• *Tank Cars and Tank Vehicles.* AR 703-1, DOD 4140.25M, FM 10-69, FM 10-71, Military Handbook 200, and Military Handbook 201.

• *Pipeline.* AR 703-1, AR 715-27, DOD 4140.25M, FM 10-18, FM 10-20, FM 10-70, FM 10-207, Military Handbook 200, Military Handbook 201, and Military Standard 161.

• *Packaged Products.* AR 703-1, DOD 4140.25M, Military Handbook 200, Military Handbook 201, Military Standard 105, and Military Standard 290.

Reclamation

Reclamation is restoring or changing the quality of a product unsuitable for use in its present state to meet desired quality specifications. Petroleum products that do not meet specifications are reclaimed for use by downgrading, blending, purifying, or removal of water. Products that cannot be used for their original intended purpose may be furnished for use as a lower grade of the same or similar product or for another use. If this cannot be done, they are reported not suitable for use and are disposed of in accordance with instructions issued by the appropriate inventory or stock control center.

CHAPTER 8

SAFETY, SECURITY, AND REAR AREA PROTECTION

Section I

SAFETY

General

All personnel who receive, store, issue, and use petroleum products must take safety into consideration. Operators and supervisors at all echelons must be constantly alert, avoid violations of established safety practices, and become familiar with prescribed safety precautions and practices. FM 10-69 discusses safety principles and practices.

Toxic Chemical Agents

• Personnel working in petroleum operations in the theater of operations may be forced to function for extended periods of time in a toxic environment. This will force the unit commander to adopt an appropriate mission-oriented protective posture (MOPP) for the unit based on the nature of the threat and mission requirements. The commander must consider a number of points:

• The mission responsibilities in relation to operations in an NBC environment.

• The handling/operations of bulk POL in storage, transfer, and transport at various MOPP levels, including requirements for collective protection.

• The degradation of units and individuals while performing service and maintenance at various MOPP levels.

• The NBC training status of the units and assigned individuals.

• The availability of NBC school-trained personnel.

• The requirement for large scale decontamination and the responsibility therein.

• The degradation effect of various MOPP levels on the individual soldier in relation to morale, discipline, fatigue, etc.

• The effect of various toxic chemical agents on exposed bulk POL products is not known. POL product contamination will be a direct result of:

• The degree of exposure of the POL product. (This will generally be limited considering the closed systems involved in handling, transfer, and storage.)

• The type of POL product concerned and the "volubility product" of the various toxic agents in specific POL product.

• The extent to which air-breathing pumps would contaminate the product in a toxic chemical environment.

• The ambient concentration of the toxic agent and the duration of that concentration.

• The extent to which air-breathing pumps or engines would intake chemical agents designed to disrupt pump mechanical operations, e.g., clog air filters, congeal pump fuel, thus requiring replacement.

• The commander must, in the face of the

possibility of contaminated POL, consider:

• The mechanism for identifying the contamination and the degree of hazard involved.

• Safe handling, transfer, and storage (if necessary) of such contaminated POL.

• The decontamination of equipment used for the handling, transfer, and storage of contaminated POL.

• The safe and rapid disposition of contaminated POL by either disposal or recovery procedures.

• The commander must further consider the possibility of the effects of toxic chemical agents on the handling, transfer, and storage equipment. There are no test results that would indicate the effects of toxic agents on collapsible bulk bladders, airdrop bladders, or collapsible pipe; however, the data on toxic agent effects on rubber are available and would tend to indicate the likelihood of adverse effects on such fuel systems as a function of degree of contamination. Detailed information concerning toxic effects of chemical agents on petroleum products and equipment will be included in all operational manuals when data become available. Current doctrine dictates for as rapid as possible decontamination of these systems to preclude excessive absorption and degeneration of the material. These fuel systems, when operational, are under a significant amount of pressure, and ruptures caused by degenerated material may lead to excessive losses of bulk POL products. Further, the pressures combined with an increase in the temperature gradient may release toxic agents, contingent on the amount of prior absorption.

• The commander must always consider his need for rapid and complete decontamination of all fuel handling transfer and storage equipment. He will consider:

• Quantities of decontaminant available as opposed to possible needs.

• Training level of unit personnel to perform NBC decontamination operations.

• Decontamination expertise available to the unit (trained personnel).

• Supplemental decontamination support available to the unit.

• Mission requirements and operations during the decontamination process.

• Troop safety during decontamination and appropriate MOPP levels.

• Need for replacement of subassemblies that cannot be decontaminated.

Nuclear Weapons

The blast, heat, and nuclear radiation effects of nuclear weapons are all hazards to the petroleum supply system and petroleum products stocks.

• The chief hazard of nuclear weapons to petroleum supplies and facilities is the blast effect. Blast is most destructive to those supplies and facilities that are direct targets. Facilities such as underground pipelines and storage tanks are relatively safe from nuclear airbursts but are vulnerable to surface or subsurface bursts. Facilities above ground are vulnerable to air, surface, and subsurface bursts. Blast damage depends on such factors as dynamic pressure, terrain conditions, atmospheric conditions, nuclear burst yield, and height of burst. The greatest blast damage is delivered by a high-yield nuclear weapon detonated as an airburst.

• Thermal effects of nuclear explosions extend over a wide area. Heat from a nuclear explosion may cause flammable surfaces to ignite on contact.

• Neutron induced gamma activity (NIGA) may be detected in some equipment but the greater hazard is from NIGA in the surrounding terrain. Being hydrocarbons, POL products themselves remain unaffected by NIGA.

• Details pertaining to defense against nuclear attack are included in FM 21-40.

Fire Hazards

All petroleum products are fire hazards. There is relatively little hazard in a closed filled container except when the container is exposed to heat. However, there is a great hazard in a closed empty container containing vapors. Vapors expelled from a tank

prior to cleaning can be ignited easily, even at a considerable distance. When such vapors are ignited, flames can spread back to the point of origin and cause an explosion. Hazards exist in the possibility that vapors produced in making transfers, during use, or from spills or leaks maybe ignited. The best preventive measures are to control vapor formation and sources of ignition. A detailed discussion of these controls appears in FM 10-69.

Toxic Hazards

Toxic hazards are inherent in petroleum products. Because these hazards cannot be eliminated, personnel must be constantly aware of them and must use approved safeguards and prescribed procedures as a matter of habit. These hazards are discussed in detail in FM 10-69.

Section II

SECURITY, REAR AREA PROTECTION, AND DEMOLITION

Security

Security denotes all measures taken to protect supplies and equipment in transit and in storage against loss, damage, destruction, and compromise. Security means used include mechanical devices, active and passive defense measures, and preventive and corrective actions.

• Security is a command responsibility. The commander may give administrative and operational authority to a subordinate, usually referred to as the security officer. Provision has been made for such delegation within the petroleum group and petroleum pipeline and terminal operating battalions. Each of these activities contains a security officer as a part of its operations section.

• Security of supplies in transit, including railway security operations, ship and wharf security, truck and convoy security, and pipeline security are discussed in FMs 19-4 and 19-30. These publications also cover security of supplies in storage, including prevention of pilferage, personnel identification and control, and use of mechanical devices.

• Information about physical security of installations is contained in FM 19-30.

Rear Area Protection

The rear area battlefield is essentially void of combat forces but cluttered with support units which are vulnerable targets for enemy forces operating in rear areas, particularly if they perform communications or nuclear related functions or operate radar and electronic warfare equipment. The more dispersion required for protection against nuclear attack, the more rear area units are subject to airborne, airmobile or ground attack. Consequently, to insure continuous support of the main battle effort, it is essential that combat and combat service support units be able to defend themselves against attempts to disrupt their operations until reinforcements arrive. Thus, rear area protection (RAP) operations must be an integral part of combat support and service support functions.

• Rear area protection operations may be defined as all actions taken to prevent or neutralize localized enemy threats to units, activities, and installations in the rear area. It includes area damage control (ADC) prevention and control measures which are taken before, during, and after an attack or natural disaster to minimize its effects. Together, these actions represent an added dimension to the responsibilities of theater army area command (TAACOM), corps support command (COSCOM), and division support command (DISCOM) commanders. Thus, combat service support units may have to be diverted temporarily from their primary

missions to rear area protection tasks such as local security, base defense, firefighting, decontamination, emergency medical treatment, and traffic control. The commander responsible for rear area protection operations determines the manner and extent to which these units will be diverted.

• The theater army commander has overall responsibility for RAP operations within the COMMZ. In the corps, the deputy corps commander is the RAP officer who directs the rear area battle. To assist these individuals in defining and assigning RAP responsibilities, a rear area operations center (RAOC) is assigned to each TAACOM, area support group, and corps. The RAOC's mission is to plan, coordinate, advise, monitor, and assist in directing the execution of the rear area battle. Petroleum units interface with the rear area operations center (RAOC).

• Rear area protection maybe divided into two phases--the preparation phase and the operational phase.

• The preparation phase includes preventive and readiness measures taken before an enemy attack. These operations range from the initial planning to the actual reconnaissance, surveillance, and counterintelligence operations. Measures taken during this phase include establishing local security elements; organizing, equipping, and training units specifically designed for these missions; assigning area responsibilities; and establishing communications and warning systems. SOPs are written and rehearsed, and route patrolling and convoy escorting are carried out.

• The operational phase includes measures taken during or after an attack or a natural disaster. These actions begin when an incident occurs and include units sending reports to the commander concerned on the nature and extent of damage. These reports allow for necessary estimates and orders for establishing route clearances and redirecting supply flow. Thus, interruption of support to combat forces is reduced. Combat forces receive data in time to change priorities and tactical plans if needed. Fire prevention and firefighting actions are conducted. Salvage and search and recovery operations begin on order. Traffic and personnel movement controls are established. If necessary, nuclear, biological, chemical (NBC) decontamination is begun. Emergency supplies are distributed, and communications are reestablished.

• The extent to which the petroleum group becomes involved in rear area protection is prescribed by higher authority. The group and its units stand ready to participate in these operations as directed. Consequently, the group security officer stays in close contact with the RAOC. The group security officer also supervises development of petroleum group rear area protection plans and procedures. He directs implementation of plans and procedures by subordinate elements. A detailed discussion of rear area protection is contained in FM 90-14.

Protection of Petroleum Supplies

Protective measures for petroleum supplies include special packaging, proper storage, dispersion of supplies and installations, protection against chemical contamination and nuclear fallout, and maximum use of natural and artificial protective shelters or other shielding devices. Every advantage is taken of natural cover and camouflage for pipelines located above ground. Underground pipelines are used whenever possible. Embankments and underground storage facilities can be effectively used to reduce blast damage. Dispersion of packaged supplies limits and keeps under control fires that start as a result of nuclear explosions. Care is taken to keep combustible materials to a minimum in and around petroleum supply installations.

Demolition

Demolition is a command responsibility. It is performed only as a last resort and only to prevent supplies and equipment from falling into enemy hands. Except in emergencies, demolition is performed only on orders from higher headquarters. General instructions on demolitions are contained in TM 5-343. Unless otherwise specified, petroleum stocks are destroyed by burning.

APPENDIX A

R E F E R E N C E S

The following references should be checked frequently for the latest changes or revisions relating to material covered in this manual.

Army Regulations (ARs)

1-35	Basic Policies and Principles for Interservice, Interdepartmental, and Interagency Support
11-27	Army Energy Program
190-51	Security of Army Property at Unit and Installation Level
310-25	Dictionary of United States Army Terms
310-50	Catalog of Abbreviations and Brevity Codes
415-22	Protection of Petroleum Installations and Related Facilities
420-49	Heating, Energy Selection and Fuel Storage, Distribution, and Dispensing Systems
700-36	Oversea Laboratories for Support of Quality Surveillance on Petroleum Products
703-1	Coal and Petroleum Products Supply and Management Activities
710-1	Centralized Inventory Management of the Army Supply System
710-3	Asset and Transaction Reporting System
715-27	Petroleum Procurement Quality Assurance Manual

Department of the Army Pamphlets (DA Pams)

310-1	Consolidated Index of Army Publications and Blank Forms (Fiche)

Field Manuals (FMs)

3-87(HTF)	Nuclear, Biological and Chemical (NBC) Reconnaissance and Decontamination Operations
5-162	Engineer Construction and Construction Support Units
10-18	Petroleum Terminal and Pipeline Operations
10-20	Organizational Maintenance: Military Petroleum Pipelines, Tanks, and Related Equipment
10-68	Aircraft Refueling
10-69	Petroleum Supply Point Equipment and Operations

10-70	Inspecting and Testing Petroleum Products
10-71	Petroleum Tank Vehicle Operations
10-72	Petroleum Testing Facilities: Laboratories and Kits
10-207	Pipeline and Terminal Operating Company
10-227	Petroleum Supply Company
19-4	Military Police Combat Support, Theater of Operations
19-30	Physical Security
20-33	Combat Flame Operations
21-40	NBC (Nuclear, Biological and Chemical) Defense
29-10	Supply Management in the Field Army
29-45	General Support Supply and Service in the Field Army
29-50	Direct Support Supply and Field Services
31-85	Rear Area Protection (RAP) Operations
41-10	Civil Affairs Operation
54-2	The Division Support Command and Separate Brigade Support Battalion
54-7	Theater Army Logistics
54-9	Corps Support Command
54-10	Logistics: An Overview of the Total System
55-1	Army Transportation Services in a Theater of Operations
55-10	Army Movement Management Units and Procedures
55-20	Army Rail Transport Operations and Units
55-30	Army Motor Transport Units and Operations
55-50	Army Water Transport Operations
55-60	Army Terminal Operations
100-10	Combat Service Support
101-5	Staff Officers' Field Manual: Staff Organization and Procedure
101-10-1	Staff Officers' Field Manual: Organizational, Technical, and Logistical Data (Unclassified Data)

Technical Manuals (TMs)

3-220	Chemical, Biological, and Radiological (CBR) Decontamination
5-301-1	Army Facilities Components System--Planning (Temperate)
5-301-2	Army Facilities Components System--Planning (Tropical)

5-301-3	Army Facilities Components System--Planning (Frigid)
5-301-4	Army Facilities Components System--Planning (Desert)
5-302-1	Army Facilities Components System: Designs; Vo1 I
5-302-2	Army Facilities Components System: Designs; Vol II
5-303	Army Facilities Components System--Planning Logistic Data and Bills of Materials
5-343	Military Petroleum Pipeline Systems
10-1163	ASTM Manual for Rating Motor, Diesel, and Aviation Fuels
10-1165	Significance of ASTM Tests for Petroleum Products
55-500	Marine Equipment Characteristics and Data

Technical Bulletin (TB)

SIG 322-43	Fixed Signal Communication Facility Program: Coded Facility 43; Military POL Pipeline Communications System, 1 Section, 45 to 120 Miles

Joint Chiefs of Staff Publications (JCS Pubs)

2	(o) Unified Action Armed Forces (UNAAF)
3, Vol 1	(c) Joint Logistics and Personnel Policy and Guidance (U)

Military Handbooks

Military Handbooks are available from
Naval Publications and Forms Center,
5801 Tabor Ave., Philadelphia, Pa. 19120

MIL-HDBK-200	Quality Surveillance Handbook for Fuels, Lubricants, and Related Products
MIL-HDBK-201	Petroleum Operations

Tables of Organization and Equipment (TOEs)

5-129	Engineer Port Construction Company
5-177	Engineer Pipeline Construction Support Company
10-202	Headquarters and Headquarters Detachment, Petroleum Group
10-206	Headquarters and Headquarters Company, Petroleum Pipeline and Terminal Operating Battalion
10-207	Petroleum Pipeline and Terminal Operating Company
10-226	Headquarters and Headquarters Detachment, Petroleum Supply Battalion
10-227	Petroleum Supply Company
10-560	Petroleum Supply and Operations Teams
19-97	Military Police Security Company

29-146	Headquarters and Headquarters Compan, Supply and Service Battalion
29-147	Supply and Service Company, Direct Support
29-449	Labor Service Company
55-18	Transportation Medium Truck Company
55-84	Transportation Motor Transport Company, Supply and Transport Battalion, Infantry Division (Mechanized)
55-87	Transportation Motor Transport Company, Supply and Transport Battalion, Armored Division
55-88	Transportation Motor Transport Company, Supply and Transport Battalion, Infantry Division

Miscellaneous

Supply Bulletins are available from
US Army AG Publications Center
2800 Eastern Blvd.
Baltimore, Md. 21220

SB 710-2	Supply Control: Combat Consumption Rates for Ground and Aviation Type Petroleum Products

DOD Manuals and Military Standards are available from
Naval Publications and Forms Center,
5801 Tabor Ave., Philadelphia, Pa. 19120

DOD Manual 4140.25-M Procedures for Management of Petroleum Products

MIL-STD-105*	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-140*	Procedures for Determining Normal Loss Expectancies for Petroleum Liquids
MIL-STD-161*	Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels
MIL-STD-290*	Packaging of Petroleum and Related Products
MIL-STD-457*	Frequency for Inspection and Cleaning of Petroleum Fuel Operating and Storage Tanks

COMSC Instructions are available from
Commander, Military Sealift Command,
Washington, D.C. 20390

COMSC Instructions

3121.3*	Tanker Operating Instructions

Federal Test Method Standards are available from
US Government Printing Office
Washington, D.C. 20402

Federal Test Method Standard 791 *	Lubricants, Liquid Fuels, and Related Products; Methods of Testing
Forms	
★ **DA Form 5463-R**	Petroleum Products—Tank Farm Outturn Record
★ **DA Form 5464-R**	Petroleum Products—Pipeline Leakage Report
DA Form 3643	Daily Issues of Petroleum Products
DA Form 3644	Monthly Abstract of Issues of Petroleum Products and Operating Supplies
DA Form 4193	Petroleum Products Pump Station Hourly Operations Record
DA Form 4702-R	Monthly Bulk Petroleum Accounting Summary
DA Form 4786	Petroleum Products—Tank Farm Intake Record
DA Form 4818	Petroleum Products—Pump Station Operation Log
DA Form 5038	Petroleum Products—Package Area Inventory
DD Form 250-1	Tanker/Barge Material Inspection and Receiving Report

**Latest Revision*

Related STANAGS: STANAGs 2135, Procedures for Requesting and Providing Logistics Assistance to Allies; 3149, Minimum Quality Surveillance of Petroleum Products; and 3756, Equipment for Receipt and Delivery of Liquid Fuels, contain subject matter related to materials in this field manual.

APPENDIX B

P E T R O L E U M
DISTRIBUTION PLAN

(Note: This outline is suggested as a guide only.)

(Classification)

Copy No _____
Issuing headquarters
Place of issue
Date-time group of signature
Message reference number

Appendix _____ Petroleum Distribution
Note. May be issued as Appendix (Petroleum Distribution) to Annex__ (Logistics) to Operation or Campaign Plan; or may be issued as Annex__ (Petroleum Distribution) to Operation or Administrative Plan _____
References: Maps, charts, and relevant documents.
Time Zone: Used throughout the plan; if unnecessary, omit.

1. MISSION

A simple statement of the what, where, when, how, and why of the petroleum distribution system to be developed--do not confuse this specific mission of the theater army with the overall mission of the entire command, which should be set forth under paragraph 2. "General Information").

2. GENERAL INFORMATION

a. Tactical situation.

(1) Enemy. (Enemy capability to influence or impede the execution of the petroleum distribution plan.)

(2) Friendly. (Sufficient to provide a concept of the overall situation, including U.S. and allied command organization, plans of higher headquarters, and the operations of friendly troops that may influence the execution of the petroleum distribution plan; may make reference to operation plan, letter of instructions, or campaign plan.)

(a) Objectives

(b) Tactical concept.

(Classification)

(Classification)

(Short title identification)

(c) Tasks. (Include responsibilities for development of the petroleum distribution system.)

(d) Scheme of maneuver.

1. Phases.

2. Timing.

b. Static intelligence data. (Maybe in tab or appendix.)

(1) Political factors.

(2) Physical and economic features of the area.

(a) Natural resources (including availability of construction materials and self-sufficiency of local population).

(b) Existing facilities. (Include assumptions on extent of destruction and/or operability.)

(c) Climate and terrain. (Features such as severe climate or unusual soil or terrain conditions that have a significant effect on development of the petroleum distribution system.)

c. General concept and scope of the petroleum distribution system. (Describe briefly the general character, approximate size and extent of the system, throughput capacity by time phases, and phases of development.)

d. Degree of permanence of construction. (Policies and standards for construction of petroleum distribution facilities.)

e. General limitations. (On the use of facilities, personnel, materials, equipment, and construction effort.)

f. Protective construction policy.

g. Utilization of displaced persons, prisoners of war, and indigenous personnel.

h. Pertinent directives and publications.

i. Instructions regarding changes in petroleum distribution plans and submission of reports.

3. COMMAND RELATIONSHIPS

a. Command structure.

b. Organizational charts.

c. Responsibility for petroleum distribution planning, including preparation, approval, and issue of plans.

(Classification)

(Classification)

(Short title identification)

4. OPERATIONS

(Contains information pertaining to the organization, construction, and operation of the petroleum distribution system to include responsibilities; locations; missions; scheduled completion dates; number, types, and arrival dates of troops and equipment; size and type of facilities; and allocation of services functions, and areas.)

a. Forces to be supported.

(1) Force requirements--D+ days	Total Strengths	Major Units
(a) Army.		
(b) Naval.		
1. Navy.		
2. Marine Corps.		
(c) Air Force.		
(d) Other.		

(This is a statement of the forces that the petroleum distribution system will be supporting when it has been built up to its desired operating capacity. A system may be assigned succeeding tasks (for instance, to support a particular operation and subsequently to provide a base for further operations) in which case this paragraph should be broken down to show task A and task B. In some cases, a simple statement of the strengths to be supported may not give the information desired; in such cases, this paragraph should be expanded to show major types of forces and strengths.)

(2) Force buildup tables. Phased deployment schedules.

	Strengths (D+)
(a) Army.	
(b) Naval.	
1. Navy.	
2. Marine Corps.	
(c) Air Force.	
(d) Other.	

(This is the buildup of *a(1).* "Force requirements" above and shows the forces to be supported by critical phases. It does not show the buildup of petroleum distribution units except that these units are included in those forces requiring support.)

b. Petroleum supply.

(1) General organization for petroleum supply.

(a) Responsibility for petroleum supply.

(Classification)

(Classification)

(Short title identification)

(b) Procurement.
(c) Supply levels.
(d) Distribution.
(e) Request procedures.
(f) Quality surveillance.
(g) Disposal (excesses, captured products, unusable products).

(2) Installations. (May be in tabular form to show, for example, location, mission, time of opening, operating troop units, quantity and type of products stored, and basic facilities required.)

5. SCOPE OF REQUIREMENTS

a. Transportation.

(1) General organization and information. (US and indigenous organizations responsible for development, rehabilitation, operations and maintenance of the transportation systems in the theater army. Also show the organization responsible for transportation policies, movement priorities, and operation of facilities and equipment). (Information coordinated with the transportation officer, the USAF, and Navy, as appropriate).

(a) Motor transport.
(b) Air transport.
(c) Water transport.
(d) Rail transport.
(e) Pipelines.

(2) Terminal facilities.

(a) Assault landing areas.
(b) General organization of water terminal facilities.
(c) Beaches. (Required throughout capacity of each and units and equipment required).
(d) Port A. (Organization, units assigned to operate and maintain the port POL facilities, throughput capacity by time phase.)
(e) Air terminal POL facilities. (Includes required capacity by time phase.)

(3) Roads, railroads, waterways, and pipelines. (For each mode *(a)* through *(d)* below, show location overlay; describe characteristics of existing facilities and development to be performed, and required capacity of each segment of the transportation net by time phase.)

(a) Roads.
(b) Railroads.

(Classification)

(Classification)

(Short title identification)

(c) Waterways.

(d) Pipelines. (Includes discharge facilities, pumping stations, terminals, tank farms, laboratories, and control facilities.)

b. Security requirements.

(1) Fencing (lineal feet and type).

(2) Sentry houses (number and size).

(3) Alarm systems (number and description).

(4) Firefighting facilities (description).

c. Administrative facilities--square feet.

d. Supply requirements.

(1) Open and covered storage facilities required (number and size).

(2) POL storage (number and size of tanks).

e. Communications--electronics requirements.

f. Port POL facility requirements (piers, pier utilities, warehousing, boat ramps, beach preparation, small-craft facilities, moorings).

g. Airfield POL requirements (Include petroleum storage and distribution facilities by time phase for receipt of fuel from aircraft and subsequent delivery to ground forces.)

h. Housing requirements (quarters and mess).

6. DETERMINATION OF FACILITY DEFICIENCIES

a. Mission requirements.

b. Available existing assets.

(1) Indigenous facilities.

(2) Petroleum stocks on hand.

c. Net deficiencies.

7. CONSTRUCTION REQUIREMENTS

a. General layout plan. (Maps or overlays usually included as tabs or appendixes.)

b. Summary of real estate requirements, showing dates required.

c. POL facility projects. (Include here or in a tab or appendix, as appropriate, all information needed to give a complete outline of each construction project.)

(Classification)

(Classification)

(Short title identification)

(1) Security facilities.
(2) Administrative facilities.
(3) Storage facilities.
(4) Pipeline.
(5) Laboratories.
(6) Communications--electronics facilities.
(7) Port/harbor development (POL facilities).
(8) Airfield POL facilities.
(9) Personnel facilities.
(10) Camouflage.
(11) Rehabilitation or reconstruction of local petroleum facilities.
(12) Construction manpower requirements.

d. Priority of development of POL facilities.

(1) General priority for development of the petroleum distribution system.
(2) General echelonment of units, materials, and equipment by time phases.
(3) Specific priority for construction of petroleum facilities.

e. Construction schedule. Describe the schedule for starting work on each project, the rate of progress or expenditure of effort, and operational target dates (minimum operational and fully operational) for each project. Identify that part of the construction effort that the civilian economy is capable of providing.

f. Special camouflage requirements.

g. Construction material requirements (after considering local materials available). (Include shipping schedule for materials.)

8. RESPONSIBILITIES FOR CONSTRUCTION

a. Theater army.

b. Theater communications command (Army).

c. Engineer command.

9. MISCELLANEOUS

a. Effective date and implementing procedures.

b. Instructions regarding changes in plans and submission of exports.

Acknowledgment instructions.

(s) _____
Commander

(Classification)

APPENDIX C

BASIC FUEL DISTRIBUTION FACILITIES

(Extracted from 5-301-series technical manuals.)

Facility Description	Facility Number
Drum and can cleaning and filling equipment and yard facilities for cleaning 5,000 drums and 20,000 cans per 20-hr day.	120113
Supplementary fittings and valves for reversing pumping from collapsible tank farm with capacity of 100,000,50,000, or 40,000 gal.	120410
Reversing manifold for booster pump station for shore-to-ship loading using 6-in pipeline.	120411
Collapsible 10,000-gal storage tanks and equipment with total capacity of 40,000 gal,	120412
Shallow-water mooring (25 ft) for barges with 4,160-bbl capacity or small vessels with 11,500-bbl capacity. Includes anchors, chains, and 4 mooring and marking buoys.	120413
Reversing manifold for booster pump station for shore-to-ship loading using 8-in pipeline.	120414
Reversing manifold for booster pump station for shore-to-ship loading using 12-in pipeline.	120415
Submarine pipeline for unloading barges and small vessels in shallow water, Includes 6-in API pipe, heavy hose, weights, and buoy.	120426
Air-transportable hydrant refueling system, 100,000-gal storage capacity, 600-gpm pressure-controlled pumping capacity.	121000
Tactical marine terminal, 50,000-bbl storage capacity, 600-gpm receiving and transfer capacity.	121201
Pressure-reducing station for 4-, 6-, or 8-in main trunkline. Includes gate valves, plug valves, and reducing bypass line valves with adapters, couplings, gaskets, and nipples.	122004
Tanker mooring:	
3 legs, 60-ft depth	122104
3 legs, 90-ft depth	122105
3 legs, 120-ft depth	122106
5 legs, 60-ft depth	122107
5 legs, 90-ft depth	122108
5 legs, 120-ft depth	122109
7 legs, 60-ft depth	122110
7 legs, 90-ft depth	122111
7 legs, 120-ft depth	122112

Facility Description	Facility Number
Submarine pipeline	
6-in diameter, 60-ft depth, 2,750-ft length, API pipe with weights, heavy hose, and buoys.	122201
6-in diameter, 90-ft depth, 2,750-ft length, API pipe with weights, heavy hose, and buoys.	122202
6-in diameter, 120-ft depth, 2,750-ft length, API pipe with weights, heavy hose, and buoys.	122203
8-in diameter, 60-ft depth, 2,750-ft length, API heavy-wall pipe with weights, heavy hose, and buoys.	122206
8-in diameter, 90-ft depth, 2,750-ft length, API heavy-wall pipe with weights, heavy hose, and buoys.	122207
8-in diameter, 120-ft depth, 2,750-ft length, API heavy-wall pipe with weights, heavy hose, and buoys.	122208
12-in diameter, 60-ft depth, 2,750-ft length, API pipe with weights, heavy hose, and buoys.	122211
12-in diameter, 90-ft depth, 2,750-ft length, API pipe with weights, heavy hose, and buoys.	122212
12-in diameter, 120-ft depth, 2,750-ft length, API pipe with weights, heavy hose, and buoys.	122213
8-in diameter, 60-ft depth, 5,300-ft length, API heavy-wall pipe with heavy hose and buoys.	122314
8-in diameter, 90-ft depth, 5,300-ft length, API heavy-wall pipe with heavy hose and buoys.	122315
8-in diameter, 120-ft depth, 5,300-ft length, API heavy-wall pipe with heavy hose and buoys.	122316
12-in diameter, 60-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122317
12-in diameter, 90-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122318
12-in diameter, 120-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122319
16-in diameter, 60-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122320
16-in diameter, 90-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys,	122321
16-in diameter, 120-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122322
20-in diameter, 120-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys,	122323

Facility Description	Facility Number
20-in diameter, 60-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122324
20-in diameter, 90-ft depth, 5,300-ft length, API concrete-coated pipe with heavy hose and buoys.	122325
Riverbed-crossing welded pipeline:	
8-in diameter with alternate bypass for 750-ft crossing.	122501
8-in diameter with alternate bypass for 1,000-ft crossing.	122502
8-in diameter with alternate bypass for 1,250-ft crossing.	122503
8-in diameter with alternate bypass for 1,500-ft crossing.	122504
Booster station:	
1,400-bph capacity with two 2-stage pumps.	123101
2,800-bph capacity with two 2-stage pumps.	123102
7,000-bph capacity with four 2-stage pumps.	123103
Loading pump and manifold:	
700- to 1,400-bph capacity, 6-in pipe.	123104
2,000- to 2,500-bph capacity, 8-in pipe.	123105
Tank-farm switching manifold:	
4-in pipe with fittings, without pump.	123201
6-in pipe with fittings, without pump.	123202
8-in pipe with fittings, without pump.	123203
12-in pipe with fittings, without pump.	123204
Flood pump:	
785-bph capacity with 6-in manifold and two single-stage pumps.	123211
1,355-bph capacity with 8-in manifold and two single-stage pumps.	123212
1,355-bph capacity with 12-in manifold and two single-stage pumps.	123213
Tank pump:	
700-bph capacity with 6-in manifold and one single-stage pump.	123221
1,400-bph capacity with 8-in manifold and one single-stage pump.	123222
2,800-bph capacity with 12-in manifold and one 2-stage pump.	123223
Distribution manifold:	
6-in pipe for drum and can loading installation.	123231
8-in pipe for 10-station tank car loading installation.	123232
Transfer pump:	
700-bph capacity with 6-in manifold and one single-stage pump.	123301
1,400-bph capacity with 8-in manifold and one single-stage pump.	123302
2,800-bph capacity with 12-in manifold and one 2-stage pump.	123303
Tank:	
100-bbl capacity with 4-in pipe and fittings.	123401
250-bbl capacity with 4-in pipe and fittings.	123402
500-bbl capacity with 4-in pipe and fittings.	123403
500-bbl capacity with 6-in pipe and fittings.	123404
1,000-bbl capacity with 4-in pipe and fittings.	123406
1,000-bbl capacity with 6-in pipe and fittings.	123407

Facility Description	Facility Number
3,000-bbl capacity with 6-in pipe and fittings.	123408
3,000-bbl capacity with 8-in pipe and fittings.	123409
10,000-bbl capacity with 6-in pipe and fittings.	123411
10,000-bbl capacity with 8-in pipe and fittings.	123412
10,000-bbl capacity with 12-in pipe and fittings.	123413
50,000-bbl capacity with 8-in pipe and fittings.	123416
50,000-bbl capacity with 12-in pipe and fittings.	123417
Petroleum base laboratory building:	
Steel frame bldg with interior, 50 ft by 60 ft, tropical and desert zones.	123511
Steel frame bldg with interior, 50 ft by 60 ft, temperate zone.	123512
Wood frame bldg with interior, 48 ft by 48 ft, tropical and desert zones.	123521
Wood frame bldg with interior, 48 ft by 48 ft, temperate zone.	123522
Pump station fuel supply:	
for 2-pump facilities without tank or pump.	124201
for 4-pump facilities without tank or pump.	124202
Loading facility:	
for loading 2 tank trucks simultaneously.	124302
for loading 5 tank trucks simultaneously.	124304
for loading 10 tank trucks simultaneously.	124306
Collapsible tanks, with equipment:	
five 10,000-gal tanks with one centrifugal pump and fittings.	124501
ten 10,000-gal tanks with one centrifugal pump and fittings.	124502
Forward area refueling equipment (FARE) system with tanks:	
1,000-gal storage capacity.	124601
5,000-gal storage capacity.	124602
10,000-gal storage capacity.	124603
Refueling system for rotary and fixed-wing aircraft.	
support area refueling system, 30,000-gal storage capacity.	124604
rear area refueling system, 300,000-gal storage capacity.	124606
support area refueling system, 30,000-gal storage capacity with 12-point flight-line manifold.	124607
rear area refueling system, 300,000-gal storage capacity with 24-point flight-line manifold.	124608
support area refueling system, 50,000-gal storage capacity with 12-point flight-line manifold.	124609
Fuel transfer facility for unloading tank car (2 products, 5 stations)	124701
Pipeline--pipe and accessories:	
1,000 ft of 4-in grooved lightweight tubing.	125001
1,000 ft of 6-in grooved lightweight tubing.	125002
1,000 ft of 8-in grooved lightweight tubing.	125003
1,000 ft of 12-in grooved lightweight tubing.	125004
1 mile of 4-in grooved lightweight tubing.	125006
1 mile of 6-in grooved lightweight tubing.	125007

Facility Description	Facility Number
1 mile of 8-in grooved lightweight tubing.	125008
1 mile of 12-in grooved lightweight tubing.	125009
5 miles of 4-in grooved lightweight tubing.	125011
5 miles of 6-in grooved lightweight tubing.	125012
5 miles of 8-in grooved lightweight tubing.	125013
5 miles of 12-in grooved lightweight tubing.	125014
1,000 ft of 4-in grooved API pipe.	125016
1,000 ft of 6-in grooved API pipe.	125017
1,000 ft of 8-in grooved API pipe.	125018
1,000 ft of 12-in grooved API pipe.	125019
1 mile of 4-in grooved API pipe.	125021
1 mile of 6-in grooved API pipe.	125022
1 mile of 8in grooved API pipe.	125023
1 mile of 12-in grooved API pipe.	125024
1,000 ft of 4-in beveled API pipe.	125031
1,000 ft of 6-in beveled API pipe.	125032
1,000 ft of 8-in beveled API pipe.	125033
1,000 ft of 12-in beveled API pipe.	125034
Pump station:	
for 4-in pipeline, 2 pumps with accessories.	125201
for 6-in pipeline, 4 pumps with accessories.	125202
for 8-in pipeline, 4 pumps with accessories.	125203
for 6-in coupled pipeline, 1 pump.	125204
for 6-in coupled pipeline, 2 pumps.	125205
Foam firefighting system, complete with 10,000-gal storage capacity, pump, and dispensing equipment.	125207
Collapsible 4-in assault hoseline system with pump and accessories.	125208
Electrical generation and distribution system for 6-in pipeline pump station.	125212
Pipeline suspension for 8-in line:	
200-ft span.	125301
400-ft span.	125302
Drum washing, repairing, and testing facility:	
interior for washing, repairing, and testing plant, 80 ft by 80 ft.	125501
interior for power plant with 2 generating units, 2 boilers, and welding shop.	125502
drum washing and testing bldg, steel frame, 80 ft by 80 ft; spray bldg, 10 ft by 20 ft, temperate zone.	125511
power plant bldg, wood frame, phase 1, 32 ft by 80 ft.	125520
drum washing and testing bldg, wood frame, 80 ft by 80 ft; spray bldg, 10 ft by 20 ft, temperate zone.	125521
power plant and welding shop, with interior, 32 ft by 80 ft, temperate zone.	125522
Jetty, 14-ft by 1,000-ft walk and pipeway with 40-ft by 70-ft wharf.	125701
Tanker watering service facilities with 42,000-gal water storage tank and 245-gpm centrifugal pump.	125702

Facility Description	Facility Number
Hose derrick parts for wharfs.	125703
Pipe and accessories for tanker discharge at dock:	
4-in diameter, 1,000-ft length API pipe for T-1 tanker discharge.	125801
6-in diameter, 1,000-ft length API pipe for T-1 tanker discharge.	125802
8-in diameter, 1,000-ft length API pipe for T-2 tanker discharge.	125803
12-in diameter, 1,000-ft length API pipe for T-2 tanker or supertanker discharge.	125804
16-in diameter, 1,000-ft length API pipe for supertanker discharge.	125805
Pressure regulator station for 6-in and 8-in military pipelines.	125901

APPENDIX D

EXTRACT
FROM STANAG 2115,
FUEL CONSUMPTION UNIT

NATO UNCLASSIFIED

Agreed English/French texts

STANAG 2115
(Edition No. 3)

NAVY/ARMY/AIR

NATO STANDARDIZATION AGREEMENT (STANAG)

FUEL CONSUMPTION UNIT

Related Documents: STANAG 1135 (F+L) - Interchangeability Chart of Fuels, Lubricants and Associated Products used by the Armed Forces of the North Atlantic Treaty Nations
STANAG 3150 (MIS) - Codification of Equipment - Uniform System of Supply Classification

AIM

1. The aim of this agreement is to standardize, for the use of the NATO Forces when engaged in land operations, the basis of calculation to be used in:

a. Determining a common unit of fuel consumption for military units or formations.

b. Expressing fuel stock levels and requirements.

AGREEMENT

2. Participating nations agree to apply the basic "Fuel Consumption Unit" (FCU) described below in:

a. Determining fuel requirements for a standard performance to include:

(1) Land operating vehicles.

(2) Army aircraft.

(3) Stationary and mobile fuel-consuming engines, machines and equipment when operating on land.

b. Reporting supply levels and requirements.

DEFINITION

3. The following definition is used for the purpose of this agreement.

Fuel Consumption Unit (FCU). The basic unit for fuel calculations. It represents the quantity of fuel required by a unit/formation for operations under assumed operating conditions for a standard performance. The fuel quantities for each FCU are to be expressed in the metric system (such as litre or cubic metre).

STANDARDS OF PERFORMANCE

4. The following standards of performance apply to the computation of one FCU. (For better identification of the consumer categories listed under paragraph 2.a. above, the NATO supply classification groups are given for nations using this system.) (See STANAG 3150.)

a. Tracked and Wheeled Vehicles. (Commodity groups 23, 24, 42, 54). 100 kilometres on solid, level, dry roads at nationally rated speeds and loads.

b. Army Aircraft. (Commodity group 15). Three flying hours at medium operational height and cruising speed.

c. Engineer Motor Boats, Assault Boats, and Other Boats of the Army. (Commodity group 19). Normal operating time of twelve hours at nationally rated speeds and loads.

d. Stationary and Mobile Fuel Consuming Equipment. (Commodity groups 10, 17, 24, 34, 36, 38, 39, 42, 43, 44, 49, 61, 62, 69). Normal operating time of twelve hours.

e. Locomotives. (Commodity group 22). Normal operating time of twelve hours.

f Pre-heating, Cooking and Heating Equipment. (Commodity groups 25, 45, 73). Normal operating time of twelve hours.

DETERMINATION OF FCU

5. The participating nations are to determine FCUs for the following types of fuels. (See STANAG 1135, Annex C).

a. Automotive Gasoline:

(1) F-46, Gasoline Automotive	:	Combat (91 RON)
(2) F-49, Gasoline Automotive	:	Combat (95 RON)
(3) F-50, Gasoline Automotive	:	(91 RON)

b. Aviation Gasoline:

(1) F-12, Gasoline Aviation	:	Grade 80/87
(2) F-18, Gasoline Aviation	:	Grade 100/130
(3) F-22, Gasoline Aviation	:	Grade 115/145

c. Diesel Fuels:

(1) F-54, Diesel Fuel	:	Regular
(2) F-56, Diesel Fuel	:	Sub-zero
(3) F-75 Diesel Fuel	:	Naval (zero pour)

d. Aviation Turbine Fuels:

(1) F-34, Turbine Fuel Aviation : Kerosene Type + (S-748)
(2) F-40, Turbine Fuel Aviation : Wide Cut Type + (S-748)

e. Fuel Oil. F-82 Fuel Oil, Naval : Boiler

LUBRICANTS

6. No FCU is to be determined for lubricants. Stockpile/storage/ transportation requirements for lubricants will consider appropriate lubricants in nationally determined quantities.

ADDITIONAL CONSIDERATIONS

7. Additional considerations are:

a. One FCU may be considered one standard day for stockpile planning purposes at higher echelons.

b. For operations planning, additional factors should be considered. Examples of such factors are: (National data and/or factors may be more suitable and should be used when calculating fuel requirements).

(1) Combat Factor:

(a) Attack	2.5
(b) Delay/Withdrawal	2.0
(c) Defence (Mobile & Static)	1.5
(d) Non-Tactical Movement	1.0

(2) Terrain Factor:

(a) Flat	1.0
(b) Hilly	1.2
(c) Mountain	1.5
(d) Cross Country	1.5

(3) Climatic Factor:

(a) Hot	0.9
(b) Temperate	1.0
(c) Cold	1.3

IMPLEMENTATION OF THE AGREEMENT

8. This ST.ANAG is considered to be implemented when a nation has issued the necessary orders/instructions to the forces concerned putting into effect the procedures detailed in this agreement.

APPENDIX E

SIGNIFICANCE OF TESTS

Knock Values

Knock values indicate whether a fuel will burn uniformly and evenly in a cylinder without preignition or detonation. The knock values are expressed as octane numbers for automotive-type engine gasolines and as a combination of octane and performance numbers for aviation gasolines. These values are determined by comparing the knocking tendency of fuel samples to those of standard test fuels of known knock values in a standard test engine. Fuel of inadequate knock value will reduce the power output of all types of engines. If used for more than brief periods, it can cause overheating of the engine, burned or melted pistons and cylinders, and lubrication failure.

Cetane Number

The ignition quality of a diesel fuel, which is based on a scale resembling that of octane number, is expressed in terms of cetane number. This number indicates the length of time (ignition lag) between injection of the fuel and combustion, The cetane number requirement varies with the type of diesel engine. Large, slow-speed units in stationary installations do not require diesel fuel with cetane ratings above 40. Smaller, high-speed engines (1,000 rpm or more) require fuel of high cetane number. In the absence of test engines, cetane numbers are approximated from the calculated cetane index (ASTM D975).

Color

Color serves primarily as an aid for identifying fuels such as aviation and automotive gasolines which have characteristic colors. Failure of a fuel to meet its color requirement may indicate the possibility of contamination or deterioration. Darkening of the color of jet fuel may indicate the formation of insoluble gums.

Corrosion

Quantitative and qualitative tests for corrosion indicate whether products are free of corrosive tendencies. The quantitative test determines total sulfur content, which is important particularly when a product is to be burned in lamps, heating appliances, or engines. The qualitative test, usually made with bright copper strips, shows if fuel will corrode the metal parts of fuel systems.

Existent Gum

As the name implies, gum is the sticky, tacky, varnish-like material that is objectionable in fuel systems. Existent gum is the nonvolatile residue present in gasoline or jet fuels after they have been tested. The results indicate the quantity of gum deposit that may occur if the product is used immediately but do not indicate the possibility of gum formation when the product is stored. When present in excess, gum clogs fuel lines, filter and pump screens, and carburetor jets; causes manifold deposits and sticky intake valves; and reduces the knock value of gasoline.

Potential Gum

Potential gum (sometimes called oxidation stability) is determined by a test that indicates the presence of gum forming materials and the relative tendency of gasolines and jet fuels to form gums after a specified period of accelerated aging. This value is used as an indication of the tendency of fuels to form gum during extended storage. Retention of the original properties of a fuel after prolonged storage is known as the stability of the fuel. When added to fuels, chemical inhibitors retard gum formation but will not reduce gum that has already been formed. The effects of potential gum are similar to those described for existent gum.

- For automotive gasolines, the potential

gum may be expressed as the "induction period" (sometimes called the breakdown time). This is a measure of the time (in minutes) elapsed during the accelerated test until the fuel absorbs oxygen rapidly.

• For aviation gasoline and jet fuel, the potential gum may be expressed as the "potential or accelerated gum." This is the gum plus lead deposits (from leaded fuels) measured at the end of a specified accelerated aging (oxidation) period.

Flashpoint

The flashpoint is the lowest temperature at which vapors rising from a petroleum product of a flame under specified conditions will ignite momentarily (i.e. flash) on application.The flashpoint of a petroleum product indicates the fire hazard in handling and storing it. It applies to fuel oils, diesel fuels, JP5, kerosene, and solvents. (It is not used for JP4.) The flashpoint test also indicates the contamination of a product. For example, the presence of very small quantities of gasoline will make the flashpoint of a diesel fuel considerably lower than the minimum safe operating level. The flashpoint of a new lubricating oil is used primarily for identification and classification. The flashpoint of the oil must be above the operating temperature of the engine in which it is to be used.

Cloud and Pour Points

• The cloud point is the temperature at which wax crystals (normally held in solution or water) in an oil separate, causing the oil to appear cloudy or hazy. In wick-fed systems, the wax crystals may clog the wick. Both wax crystals and water may block filter passages in fuel systems.

• The pour point of an oil indicates its behavior at low temperatures. The fact that an oil has a specific pour point is no guarantee that it can be handled or is a satisfactory lubricant at that temperature.

Distillation

This process is used to measure the volatility of a petroleum product. The lower boiling fractions of gasoline indicate the starting ability of a gasoline engine at a given temperature and the engine's ability to warm up quickly. An excessive amount of highly volatile constituents in gasoline may cause vapor lock. Conversely, a gasoline with an excessive amount of "heavy ends" may not completely burn in the combustion chamber. This may cause damage through excessive dilution of crankcase oil. Specifications designate minimum and maximum percentages of fractions to be evaporated at specified temperatures, as well as initial and final boiling points. A gasoline with a high end point and a high percentage of residue may be contaminated with fuel oil or other oils. A fuel oil with a considerably lower initial boiling point or flashpoint than normal may be contaminated with gasoline.

Viscosity

Viscosity is the measure of a liquid's resistance to flow. Specified minimum and maximum flow rates are required for all fuel oils and lubricating oils. A fuel oil's viscosity shows how the oil will flow to the burners, the extent to which it will be atomized, and the temperature at which the oil must be maintained to atomize properly.

Reid Vapor Pressure

The vapor pressure of a fuel, which indicates the tendency of the fuel to vaporize, is determined by the Reid vapor pressure test. For any given gasoline, vapor pressure increases with temperature. Gasolines must have a certain vapor pressure to insure adequate starting and accelerating qualities. Too high a vapor pressure for the particular operating condition may cause vapor lock, which prevents the fuel from reaching the engine.

Carbon Residue

The carbon residue test indicates the carbonizing properties of lubricating or burner oil. However, carbon residue from lubricating oils is not directly related to carbon formation in an engine. This test gives an indication of the type of carbon formation (loose and flaky

or hard and flinty). It is used primarily as an identity and control test in conjunction with other specification tests. After distilling off 90 percent diesel fuel, the carbon residue in the remaining 10 percent must be low enough to avoid large carbon deposits. Coking in the injector of a diesel engine will seriously affect the fuel spray. High carbon residue fuels should be carefully checked for carbon formation.

Bottom Sediment and Water

Petroleum products may gain sediment and water during storage and handling. This can adversely affect the performance of equipment in which the products are used.

• *Aviation Fuels.* Contamination by bottom sediment and water (BS&W) can often be detected visually because such contamination is not miscible with the fuel. As a general rule, aviation fuel must be clean and bright and contain no free water. The terms clean and bright do not refer to the natural color of the fuel; the various grades of aviation gasoline have dyes added. Jet fuels are not dyed and may be any color from water-white to amber. Clean means the absence of any cloud, emulsion, readily visible sediment, or entrained water. Bright refers to the shiny appearance of clean, dry fuels. A cloud, haze, specks of sediment, or entrained water indicate that the fuel is unsuitable, pointing to a breakdown in fuel-handling equipment. Steps should be taken to find the trouble source and correct it immediately. The following information is also applicable to automotive fuels.

• *Cloudy or hazy fuel.* Usually a cloud indicates water, but it may also indicate excessive amounts of fine sediment or finely dispersed stabilized emulsion. Fuel containing a cloud from either cause is not acceptable. When clean and bright fuel cools, a light cloud may form indicating that dissolved water has precipitated out. This precipitation cloud represents a very slight amount of fresh water. However, even a slight amount is not desirable in aviation fuel. Fuel that shows a precipitation cloud may not be clean and should not be accepted. The filter/separator elements should be replaced and water and emulsion should be removed from the source tank. A properly operating filter/separator can be used to remove the precipitation cloud by recirculation or by draining the fuel upstream.

• *Sediment in fuel.* Specks or granules of sediment indicate particles in the visible size range, i.e., greater than 40 microns. An appreciable number of such particles in a sample indicate a failure of the filter/separator, contamination downstream of the filter/separator, or a dirty sample container. Even with the most efficient filter/separators and careful fuel handling, an occasional visible particle will be noted. These stray particles are due to particle migration through the filter media and may represent no particular problem to the engine or fuel control. The sediment ordinarily noted is an extremely fine powder, rouge, or silt. In a clean sample of fuel, sediment should not be visible. If sediment continues to be noted, appropriate surveillance tests and corrective measures must be applied to the fuel handling system.

• *Diesel Fuels and Burner Oils.* In order to avoid fuel pump and injector difficulties, diesel fuels must be clean and should not contain more than a trace of foreign substances. Excessive sediment and rust in burner oils will plug the burner tip, and the fuel will not atomize properly. Water can cause ragged operation and may corrode the fuel handling system. The types of equipment and burner oils will determine the amount of sediment permissible in the fuel.

• *Lubricating Oils.* Care should be taken to avoid contaminating lubricating oils with water. Water will hasten the decomposition of many oils, washout additives, cause the oil to emulsify, and lead to engine failure. In used lubricating oils, sediment and water may have been caused by poor maintenance, failure of screens, or by condensation of combustion products.

Ash

The ash in oil is determined by burning off

the organic matter and weighing the remaining inorganic matter, Straight mineral oils usually contain only a trace of ash. Oils containing metallic salts as additives will have larger amounts of ash. Increased ash indicates contamination with inorganic matter such as sand, dust, and rust. Increased ash in straight mineral oils may indicate contamination with additive-type oils. The ash in diesel fuels must be very low because any abrasive substances may damage the internal metal surfaces of engines and injectors or plug injection nozzles and may also form deposits on working surfaces, Residual fuel oils should also have low amounts of ash to prevent corrosion or embrittlement of fire boxes and boiler tubes.

Foam Stability

All oils will foam to some extent when agitated. The foam that is formed in oils that contain additives is often very stable. Instead of breaking up quickly, the foam tends to build up, and oil is lost through the breather outlets and other openings in the engine crankcase. Therefore, additive-type motor oils are frequently treated with antifoam agents to eliminate potential foaming problems. The foam test requires agitating the oil until a large amount of foam is formed and then noting the time required for the foam to break up and disappear.

Gravity

Accurate determination of the gravity of petroleum products is necessary for converting measured volumes to volumes at the standard temperature of 60° F. Gravity is a factor governing the quality of crude oils. However, the gravity of a petroleum product is an uncertain indication of its quality. Combined with other properties, gravity can be used to give approximate hydrocarbon composition and heat of combustion. The gravity scale most used in the United States is the API (American Petroleum Institute) gravity. A change of gravity may indicate a change of composition caused by mixing of grades of products.

Water Reaction

This test determines the presence of water-miscible components in aviation gasolines and turbine fuels, and the effect of these components on the fuel-water interface.

Fuel System Icing Inhibitor (FSII) Test

This is a quantitative test used to determine the concentration of fuel system icing inhibitor in jet fuel. The FSII additive (ethylene glycol monomethyl ether-glycerol) prevents ice formation in aircraft fuel systems. Testing is performed by several methods; i.e., colormetric, seiscor refractometer, freezing point, and titration. The potassium bichromate-sulfuric acid titremetric procedure is the method preferred by the Air Force.

Water Separometer Index Modified (WSIM)

The WSIM test measures the ease with which a fuel releases dispersed or emulsified water. Fuels having a low WSIM rating will prevent filter/separators from functioning properly.

Particulate Contaminant

Excessive sediment (particulate contaminant) will clog fuel lines and internal fuel filters on aircraft. Sediment may also cause wear on metal parts and, when burned, may form deposits causing premature engine failure. The two tests for particulate contaminant in aviation turbine fuels are the Millipore test and the color comparison standards test (commonly called the Air Force method).

- The Millipore test, ASTM D-2276, is used primarily to test aviation turbine fuels for particulate contaminant. However, specifications for aviation gasoline and some diesel fuels also require the Millipore test.

- The color comparison standards test as outlined in USAF TO 42 B-1-1 is authorized for use by the Army. The procedures are outlined in Appendix A3 of ASTM D-2276. The color standards are available under NSN 6640-00-326-7684. The color comparison standards may be used in addition to laboratory

testing, but are not authorized as a substitute for laboratory testing. If the fuel passes the color test, it may be used while awaiting laboratory test results. If the fuel fails the color test, it must not be used and a sample must still be sent to the laboratory.

Undissolved Water

Undissolved (free) water in aviation fuels can encourage the growth of microorganisms and subsequent corrosion in aircraft tanks and can also lead to icing of filters in the fuel system. Free water is controlled in ground fueling equipment by filter/separators. The Aqua-Glo testis a quick and accurate way to determine the amount of free water in liquid petroleum products. The procedure is found in ASTM D-3240. Water in fuel can cause the following severe problems:

- Corrosion of tanks, equipment, and lines due to the formation of hydrogen sulfide, an extremely corrosive compound.
- Removal of FSII from aviation turbine fuels.
- Clogging of fuel lines and filters, partitularly at high altitudes.
- Support of microbiological growth, sometimes found in the water and fuel interface in jet fuel tanks.

APPENDIX F

CONVERSION CHART FOR TANK CARS AND TANK VEHICLES

CONVERSION CHART FOR TANK CARS AND TANK VEHICLES

LAST PRODUCT CARRIED / PRODUCT TO BE LOADED →	AVGAS MIL-G-5572.	MOGAS MIL-G-3056, VV-G-76, L/L VV-G-001690	JET FUEL MIL-T-5624, JP-4, MOGAS, U/L, VV-G-001690	JET FUEL MIL-T-5624, JP-5.	PETROLEUM SOLVENT OR PAINT THINNER.	KEROSENE VV-K-211
NATURAL GASOLINE	Drain Empty	Drain Empty	Drain Empty	Steam Dry	Steam Dry	Steam Dry
AVGAS MIL-G-5572	Drain Empty	Drain Empty	Drain Empty	Steam Dry	Steam Dry	Steam Dry
MOGAS MIL-G-3056, VV-G-76, L/L, VV-G-001690	Drain Empty	Drain Empty	Drain Empty	Steam Dry	Steam Dry	Steam Dry
JET FUEL, MIL-T-5624, JP-4, MOGAS, U/L VV-G-001690	Drain Empty	Drain Empty	Drain Empty (4)	Steam Dry	Steam Dry	Steam Dry
JET FUEL MIL-T-5624, JP-5.	Drain Empty	Drain Empty	Drain Empty	Drain Empty	Drain Empty	Drain Empty
PETROLEUM SOLVENT OR PAINT THINNER.	Steam Dry	Drain Empty	Drain Empty	Drain Empty	Drain Empty	Drain Empty
KEROSENE VV-K-211.	Steam Dry	Drain Empty	Drain Empty	Drain Empty	Drain Empty	Drain Empty
DIESEL FUEL MIL-F-16884, VV-F-800.	Steam Dry	Drain Empty	Steam Dry	Steam Dry	Steam Dry	Steam Dry
BURNER FUEL OIL VV-F-815, GR. 1 & 2	Steam Dry	Drain Empty	Steam Dry	Steam Dry	Steam Dry	Steam Dry
BURNER FUEL OIL VV-F-815, GR. 4, 5 & 6	NO LOAD	NO LOAD	NO LOAD	NO LOAD	NO LOAD	NO LOAD
LUBRICATING OILS.	NO LOAD	NO LOAD	NO LOAD	NO LOAD	NO LOAD	NO LOAD
JET FUEL MIL-T-25524, JPTS, MIL-T-38219, JP-7.	Drain Empty	Drain Empty	Drain Empty	Drain Empty	Drain Empty	Drain Empty

NOTES:

(a) Applicable only when loading compatible oils; otherwise steam and dry.

(b) To be loaded only in aluminum, stainless steel equipment lined with an approved epoxy coating. If equipment is coated, clean with hot fresh water not exceeding 135^{0} F. and dry thoroughly.

1. Equipment carrying lubricating oil must be dry and free from loose rust, scale, and dirt. Equipment carrying other products must be substantially free from loose rust, scale, and dirt.

CONVERSION CHART FOR TANK CARS AND TANK VEHICLES

LAST PRODUCT CARRIED ↓ / PRODUCT TO BE LOADED →	DIESEL FUEL MIL-F-16884 VV-F-800.	BURNER FUEL OIL VV-F-815. GR. 1&2.	BURNER FUEL OIL VV-F-815, GR. 4, 5&6.	LUBRICATING OILS.	JET FUEL MIL-T-25524, JPTS, MIL-T-38219, JP-7. (b)
NATURAL GASOLINE	Steam Dry	Steam Dry	Steam Dry	Steam Dry	Steam Dry
AVGAS MIL-G-5572	Steam Dry	Steam Dry	Steam Dry	Steam Dry	Steam Dry
MOGAS MIL-G-3056, VV-G-76, L/L, VV-G-001690	Steam Dry	Steam Dry	Steam Dry	Steam Dry	Steam Dry
JET FUEL, MIL-T-5624, JP-4, MOGAS, U/L VV-G-001690	Steam Dry	Steam Dry	Steam Dry	Steam Dry	Steam Dry
JET FUEL MIL-T-5624, JP-5.	Drain Empty	Drain Empty	Drain Empty	Drain & Flush if Required	Steam Dry
PETROLEUM SOLVENT OR PAINT THINNER.	Steam Dry	Drain Empty	Drain Empty	Steam Dry	Steam Dry
KEROSENE VV-K-211.	Drain Empty	Drain Empty	Drain Empty	Steam Dry	Steam Dry
DIESEL FUEL MIL-F-16884, VV-F-800.	Drain Empty	Drain Empty	Drain Empty	Drain & Flush if Required	Steam Dry
BURNER FUEL OIL VV-F-815, GR. 1 & 2	Drain Empty	Drain Empty	Drain Empty	Drain & Flush if Required	Steam Dry
BURNER FUEL OIL VV-F-815, GR. 4, 5 & 6	NO LOAD	NO LOAD	Drain Empty	NO LOAD	NO LOAD
LUBRICATING OILS.	Drain Empty	Drain Empty	Drain Empty	Drain Empty (a)	Steam Dry
JET FUEL MIL-T-25524, JPTS, MIL-T-38219, JP-7.	Drain Empty	Drain Empty	Drain Empty	Steam Dry	Steam Dry

2. Saran lined equipment should not be steam cleaned; water wash should suffice.
3. Petroleum products will not be loaded into transportation equipment that previously carried liquid fertilizers, caustic or acid.
4. When JP-4 is to be loaded after gasolines, conveyance should be "Steam and Dry" because some additives in gasoline affect WSIM.

★ APPENDIX G

B L A N K F O R M S

This appendix provides blank copies of two petroleum product report forms—DA Form 5464-R (Petroleum Products—Pipeline Leakage Report) and DA Form 5463-R (Petroleum Products—Tank Farm Outturn Record). These forms are not available through normal supply channels. They may be reproduced locally.

PETROLEUM PRODUCTS PIPELINE LEAKAGE REPORT (For use of this form see FM 10-67. Proponent agency is TRADOC.)	DATE	TIME
TO:	FROM: *(Unit)*	
REPORTED BY *(Name and Grade)*	PLATOON AND SECTION	
LOCATION OF LEAK PUMPING STATION JOINT NUMBER	APPARENT CAUSES OF LEAK	
FUEL LOST *(Gallons)*	DISPOSITION	
PRECAUTIONS TAKEN		
SIGNATURE AND GRADE OF SECTION CHIEF	SIGNATURE AND GRADE OF PLATOON LEADER	

DA FORM 5464-K, Oct 85 REPLACES DA FORM 10-242, SEP 57, WHICH IS OBSOLETE.

PETROLEUM PRODUCTS PIPELINE LEAKAGE REPORT (For use of this form see FM 10-67. Proponent agency is TRADOC.)	DATE	TIME
TO:	FROM: *(Unit)*	
REPORTED BY *(Name and Grade)*	PLATOON AND SECTION	
LOCATION OF LEAK PUMPING STATION JOINT NUMBER	APPARENT CAUSES OF LEAK	
FUEL LOST *(Gallons)*	DISPOSITION	
PRECAUTIONS TAKEN		
SIGNATURE AND GRADE OF SECTION CHIEF	SIGNATURE AND GRADE OF PLATOON LEADER	

DA FORM 5464-R, Oct 85 REPLACES DA FORM 10-242, SEP 57, WHICH IS OBSOLETE.

PETROLEUM PRODUCTS
TANK FARM OUTTURN RECORD
(For use of this form see FM 10-67. Proponent agency is TRADOC.)

UNIT | STATION | DATE

LINE	SHIPMENT NO	SHIPPED TO	VESSEL OR CAR		CAPACITY (U.S. Gallons)	OUTAGE OR INNAGE		WATER OR SEDIMENT		GROSS TOTAL (U.S. Gallons)	AVERAGE TEMP F	MULTIPLIER OR COEFFICIENT EXPANSION	NET U.S GALLONS 60° F	PRODUCT OR GRADE	SAMPLE NO
			INITIALS	NUMBER		INCHES	GALLONS	INCHES	GALLONS						
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
									TOTALS:						

REMARKS

NAME AND GRADE OF OPERATOR (Print or Type)

SIGNATURE OF OPERATOR

NAME AND GRADE OF GAGER (Print or Type)

SIGNATURE OF GAGER

DA FORM 5463-R, Oct 85

REPLACES DA FORM 10-235, SEP 57, WHICH IS OBSOLETE.

GLOSSARY

SECTION I
ACRONYMS AND ABBREVIATIONS

ABFDS - aerial bulk fuel delivery system
ACR - armored cavalry regiment
ADC - area damage control
AFCS - Army Facilities Components System
AIM - armored, infantry, mechanized
API - American Petroleum Institute
ASTM - American Society for Testing and Materials
AVGAS - aviation gasoline
CIMIC - civil military cooperation
COMMZ - communications zone
CONUS - continental United States
COSCOM - corps support command
DFSC - Defense Fuel Supply Center
DISCOM - division support command
DLA - Defense Logistics Agency
DOD - Department of Defense
DOS - days of supply
DS - direct support
DWT - deadweight tons
EAC - echelons above corps
ENCOM - engineer command
FCU - fuel consumption unit
GS - general support
JP - jet propulsion
JPO - Joint Petroleum Office
LAPES - low altitude parachute extraction system
LOC - lines of communications
LOTS - logistics over the shore
MAC - Military Airlift Command
MBBLS - mike barrels
MMC - materiel management center
MOGAS - motor gasoline
MOPP - mission-oriented protective posture
MRO - materiel release order
MSC - Military Sealift Command
NATO - North Atlantic Treaty Organization
NBC - nuclear, biological, chemical
NICP - national inventory control point
NIGA - neutron induced gamma activity
POL - petroleum, oils, and lubricants
psi - pounds per square inch
RAOC - rear area operations center
RAP - rear area protection

SECTION II

DEFINITIONS

Additive An agent for improving existing characteristics or for giving new characteristics to petroleum products.

Assault Hoseline System A fuel transport system composed of hoses, collapsible fuel cells, and portable pumps which can be readily installed to supply fuel to rapidly advancing combat forces.

Aviation Gasoline (AVGAS) A fuel for reciprocating aircraft engines. AVGAS has a low vapor pressure and distillation range and a high tetraethyllead content. It is obtained by the military under specification MIL-G-5572. Aviation gasoline 115/145 was replaced by 100/130 effective 1 June 1976.

Barrel A common unit of measurement of liquids in the petroleum industry. It equals 42 US Standard gallons.

Base Terminal The initial facility for receiving, storing, and distributing fuel entering a theater of operations.

Batch A quantity of product pumped into a pipeline.

Batch Change A change or transition from one product to another in a pipeline, shown by a change in product color or gravity or both.

Batching The sequence in which two or more products are to be pumped that will result in the least waste of interfacial material.

Batch Head The downstream or leading end of a batch.

Batch Tail The upstream or trailing end of a batch.

Blank Flange A pipe-connecting flange supplied without bolt holes but otherwise ready for use. The fitting is intended to be drilled to suit the application. The blank flange is not the same as a blind flange.

Blanking Cap A metal cap used to close a pipe or pipe section.

Blanking Off Closing the end of a pipe or pipe fitting with a blank cap or a blind flange.

Blending Mixing refinery products to suit market conditions; mixing on-specification fuel with off-specification fuel to bring the latter to specification or use limits (a method of reclamation); mixing an interface with either or both adjacent products (or with a third product) without degrading any of them beyond use limits.

Blind Flange A flange used to close the end of a pipe or to close a pipeline to insure that there will be no movement of product.

Blinding Off See Blanking Off.

Block Valve Any valve in the main line of a pipeline used to sectionalize a line.

Booster Station A pump station used to boost the discharge from tanker pumps to base terminal storage, or used along the pipeline for added throughput.

Branch Station A pump station on a branch or lateral pipeline.

Buffer A liquid, usually kerosene or solvent, inserted in a pipeline to separate different products with a minimum of product degradation (contamination).

Bulk Petroleum Products Petroleum products (fuels and lubricants for example) which are normally transported by pipeline, rail tank car, tank vehicle, barge, or tanker and stored in tanks or containers having a capacity of more than 55 gallons. Fuel in 500-gallon collapsible containers is considered to be packaged.

Bulk Reduction Packaging bulk petroleum products in cans, drums, and 500-gallon collapsible containers.

Bull Plug A rounded cap or similarly shaped piece of pipe used to close the end of a pipeline section or pipe fitting.

Capacity See Throughput.

Caustic A corrosive capable of eating away or destroying matter. The term is applied to the destructive action of powerful alkalies such as hydroxides.

Centrifuge A whirling instrument for separating liquids or liquids and solids of different specific gravity by use of centrifugal force.

Check Valve A one-way or nonreturn valve that permits fluids to pass in one direction only. The valve closes when the pressure causing flow stops.

Chromometer An instrument, also called a colorimeter or tintometer, for determining the color of petroleum products.

Clarifier Any apparatus or device for removing the color or cloudiness of an oil by separating the foreign material through mechanical or chemical means. It may embody the principle of centrifugal action, filtration, simple heating or treatment with acid or alkali, or several of these principles.

Class III Supplies Petroleum fuels: lubricants, hydraulic and insulating oils, preservatives, liquid and compressed gases, chemical products, coolants, deicing and antifreeze compounds, together with components and additives of such products and coal.

Color Change An alteration in appearance that occurs when two different colored products join or commingle in a pipeline. This change helps determine the location of batch heads in the stream flow.

Commingling Spread The distance of the stream flow in a pipeline that comprises the extent of mixing at the tail of one batch and the head of the succeeding batch.

Cone-Roof Tank A tank with a fixed-roof that is slightly higher in the center than at the side walls, best adapted to storage of less volatile fuels such as kerosene and diesel oil.

Contamination The addition of material not normally present in a petroleum product. Common contaminants are water, dirt, sand, rust, mill scale, and other petroleum products.

Corrosion The deterioration of a material, usually metal, resulting from chemical or electrochemical action.

Crude Unrefined petroleum.

Cubic Meter 1,000 liters of fuel at 15° C.

Cut A fraction obtained by a separation process. Product withdrawn from a pipeline and routed into tankage. Product withdrawn from the middle of a batch is referred to as a heart cut.

Dehydrating The removal of water by a filtering or settling process. Water in most light petroleum products will settle out if product is allowed to stand undisturbed for 12 to 24 hours. If the light product is in a storage tank, the excess water may be withdrawn through a water drawoff valve. If the product is in a small container, the water may be separated by siphoning or by filtering and decanting the water into another container.

Density Specific weight or mass of a substance per unit volume (pounds per cubic foot or gallon or grams per cubic centimeter). Specific gravity is the ratio of the mass of any volume of a substance to the mass of an equal volume of some standard substance (water in the case of liquids and hydrogen or air in the case of gases) at 40° C.

Developed Theater An area where petroleum equipment and facilities are established and operating prior to designating the area as the theater of operations.

Discharge Pressure The pressure at which fluid is discharged from a pumping unit or pumping station.

Dispatcher The person who coordinates and controls the flow of product through the pipeline system according to schedules and directives.

Dispensing Transferring fuel to drums, cans, and vehicles.

Downgrading Assigning a lower grade to an off-specification product if it meets the requirements of the lower grade.

Downstream The direction of pipeline flow.

Drum A collapsible or rigid container for fuels. Capacities range from 55 to 500 gallons. Containers less than 55 gallons are usually referred to as cans.

Dye Plug A dye, insoluble in petroleum products, injected into the stream between two like products with gravities that do not vary more than 2 degrees API. The color change indicates a new batch head.

Explosimeter An instrument for determining the explosibility of a gas-air mixture.

Feeder Station A pump station used at tank farms to supply the required suction pressure between tank farm installations and mainline (trunk) pump stations, or to feed fuel through short branch lines to dispensing tankage installations.

Feet of Head The measure of pressure in terms of the height in feet of a column of a given fluid. This measurement is used in the hydraulic design of pipelines, since it can be applied directly to terrain elevations. It is also called head.

Fittings Devices that may be attached to pipes to make connections or outlets.

Flange A protruding rim, edge, rib, or collar, as on a wheel or pipeshaft, used to strengthen an object, hold it in place, or attach it to another object.

Flashpoint The lowest temperature at which vapors rising from a petroleum product will ignite momentarily (flash) when a flame is applied under specified conditions.

Flexible Joint Any joint between two pipes that permits one to be deflected without disturbing the other.

Floating Hoselines Hoselines, buoyed by empty oil drums, used as a standby for pipeline or used in an emergency for short distances in calm water.

Floating-Roof Tank A tank with a roof that floats on the surface of the liquid contents. The roof, which has a tight seal of synthetic rubber around its perimeter, rises and falls with changes

in product level. When the roof falls to a certain distance from the bottom, it rests on supports. Because there is no vapor space between the surface of the product and the roof, breathing and filling losses are almost eliminated.

Flood Station See Feeder Station.

Flow Meter A device that measures the quantity of product flowing through a pipeline. It provides data for controlling products in a pipeline and for accounting purposes.

Gage Table A table prepared to show the contents of a tank for each 1/8 or 1/16 inch of product contained in the tank. After the tank has been gaged with a steel tape or pole and the height of the liquid determined, the contents of the tank can be found by referring to this table.

Gaging Measuring the contents or capacity, as of a tank.

Gallon A unit of volume used in liquid measure. A US gallon contains 231 cubic inches or 3.785 liters; it is 0.83268 times the imperial gallon. One US gallon of water weighs 8.3374 pounds at 60° F.

Gasket Material inserted between metal surfaces and kept under pressure so that the joint remains tight.

Gate Valve A valve in which the line-closing element is a gate consisting of discs or wedges that are raised or lowered to regulate flow.

Globe Valve A valve with a rounded chamber containing a beveled valve disc that is pressed against a seat to allow closure used for throttling flow of fuel.

Gravity, API A scale expressing the gravity or density of liquid petroleum products in terms of degrees API. The API gravity of any petroleum product corrected to 60° F may be calculated as follows:

$$\text{Degrees API gravity at } 60^\circ \text{ F} = \frac{141.5}{\text{sp. gr.}} - 131.5$$

The formula for converting degrees API to specific gravity is as follows:

$$\text{Specific gravity} = \frac{141.5}{\text{API} + 131.5}$$

Gravity, Specific The ratio of the weight of any quantity of matter to the weight of an equal quantity of water.

Head Terminal A bulk facility at the downstream end of the pipeline for receipt, storage, transportation, and issue of petroleum products. The terminal consists of a tank farm or tank farm complex, tank farm manifold, and a central pump station area.

Heart Cut A narrow-range cut, usually taken near the middle portion of the stock being distilled or treated; a delivery of pure product from the middle of a batch at some intermediate point on the pipeline.

Hoseline See Assault Hoseline System.

Incremental Pressure The difference between the suction and discharge pressure of a pump or of a multipump pump station.

Inhibitors Substances added in small amounts to a petroleum product to prevent or retard undesirable chemical changes from taking place in the product or in the condition of the

equipment in which the product is used. In general, the main function of inhibitors is to prevent or retard oxidation or corrosion.

Innage The height or volume of liquid in a storage tank, measured from the bottom of the tank to the top of the liquid.

Interface A mixture of adjacent products in a multiproduct pipeline.

Jet Fuel Fuel that meets the required properties for use in jet engines and aircraft turbine engines. Jet fuels are obtained for the Armed Forces in several grades. The most important grades are JP-4 (low vapor pressure) and JP-5 (high flashpoint). Both grades are produced under specification MIL-T-5624 and are designed for use in aircraft turbine engines. Jet fuel is usually called JP (jet propulsion) fuel.

Joint The intersection of two pieces of pipe; a standard length of pipe.

Line The pipe and supporting structures of a pipeline between installations.

Line Pressure The pressure generated by pump station pumps and transmitted to the line so products will move through the line.

Logistical Pipeline System A semipermanent or permanent pipeline system that delivers petroleum fuel to the using elements.

Looped Line A doubled pipeline constructed for the purpose of increasing capacity or reducing pressure losses. An alternate section of pipeline built around a break or a point of potential damage, such as at a river crossing, to restore or maintain operations during repairs.

Manifold A piping arrangement which permits a stream of liquid or gas to be divided into two or more streams, or which permits several streams to be collected into one.

Midpoint Gravity The point in the commingling spread where the specific gravity is midway; an average of the specific gravities of the two products concerned.

Motor Gasoline (MOGAS) A hydrocarbon fuel in the approximate composition range $C_5 H_{12}$ to $C_9 H_20$ for use in internal combustion engines and procured by the military under three specifications. Federal specification VV-G-76 provides for two grades (regular and premium) and for three classes (A, B, and C). Another specification for leaded and unleaded gasoline is VV-G-001690. Specification MIL-G-3056 specifies combat grade types I and II.

Octane Number Term used to indicate numerically the relative antiknock value of automotive gasolines and of aviation gasolines having a rating below 100. It is based on a comparison with the reference fuels, iso-octane (100 octane number) and normal heptane (0 octane number). The octane number of an unknown fuel is the volume percent of iso-octane in a blend with normal heptane which matches the unknown fuel in knocking tendencies under a specified set of conditions. Above 100, the octane number of a fuel is based on the engine rating, defined in terms of milliliters of tetraethyllead in iso-octane, which matches that of the unknown fuel.

Outage (Ullage) The volume of unoccupied space in a storage tank or other container, measured or gaged from a reference point above the product to the surface of the product; the difference between rated capacity and actual contents; some space will always be left unoccupied for expansion of product.

On-Stream A term indicating that a pump or pumping station is moving the product.

Packed Line A petroleum pipeline packed with product, under pressure from the pump station, against a closed line valve.

Parallel Connection Pumps are said to be connected "in parallel" when they receive product directly and simultaneously from the line; contrasted with connected "in series," in which the product goes through first one unit and then the other. Pumps in parallel deliver the cumulative volume of all pumps at the pressure of one pump; pumps in series deliver the volume of one pump at the cumulative pressure of all pumps.

Petroleum Crude oil. Petroleum is a mixture of gaseous, liquid, and semisolid hydrocarbons varying widely in gravity and complexity. Petroleum can be removed as a liquid from underground reservoirs and can be separated into various fractions by distillation.

Pipehead The downstream end of the pipeline with facilities for storing, distributing, or forwarding petroleum products.

Pipeline System One or more pipelines operated by the same controlling headquarters.

Plug Valve A valve with a revolving plug with an opening to permit passage of liquid when the opening is alined with the bore of the pipe. These valves are characterized by their rapid opening and closing capability (usually by turning a quarter turn with a removable handle), though some models have a control wheel with a worm gear. Most models do not permit passage of scrapers.

POL Petroleum, Oil, and Lubricants. Products included within the meaning of this term are petroleum, fuels, lubricants, hydraulic and insulating oils, temporary protectives, liquid coolants, deicing and antifreeze compounds, and components and additives of such products.

Pressure Gage An instrument used to measure and indicate pressure in a fluid.

Pressure Head The pressure produced by a pump or by the weight of a column of liquid.

Product Refined crude oil, generally restricted to fuels.

Product Color In pipeline operations, the color artificially imparted to the product or the natural color of the refined product, used as a basis for testing or identification.

Pump An apparatus for lifting or transferring fluids.

Pumping Station The combination of two or more pumps used to boost the discharge from tanker pumps to base-terminal storage, or used along the pipeline for added throughput.

Pumps in Series See Parallel Connection.

Purifying The procedure by which contaminating agents are removed by filtering, inhibiting, dehydrating, or blending.

Rack, Loading A structure with one or more risers, loading valves, arms, and drop tubes built along railroad tracks for loading railroad tank cars; a structure built in a tank vehicle loading area for transferring product into tank trucks. It is also known as a fill stand or loading stand.

Rapidly Deployable Pipeline A pipeline that is grooved at the ends of each section to connect with victolic couplings. It is sometimes referred to as victolic pipeline.

Rate of Flow The volume of product per unit time passing through a fixed point in the pipeline, usually expressed in barrels per hour or gallons per minute.

Reclamation Restoring or changing a contaminated or off-specification petroleum product so that it will either meet specifications completely or will be within use limits.

Regulating Tankage Tankage sometimes built at intervals along the pipeline, in addition to storage tanks, to receive throughput in the event of a downstream linebreak or other emergency and to provide throughput in the event of an upstream linebreak or other emergency.

Sample A quantity of product taken as prescribed in ASTM D-270 for examination and testing.

Sample Tap A point in the pipeline, usually at a pump station or terminal, from which a sample may be drawn.

Scheduler The person who plans the operational activities of the pipeline system in advance so that requirements are met efficiently.

Scraper A device propelled by the moving stream in a pipeline intended to scrape out or dislodge corrosion, wax, sediment, or other deposits that tend to increase friction loss, reduce throughput, or contaminate product. Scrapers are dispatched from and received in scraper traps. The outgoing trap is on the discharge side of a pump station, and the incoming trap is on the suction side. The sandtrap is intended to catch the material removed by the scraper. Other terms for scraper are "pig" or "go-devil."

Series Connection See Parallel Connection.

Slack Line A pipeline that has been shut down under static pressure only.

Slate A report used by the military services for listing requirements for petroleum. The petroleum products written slate is a stock status and planned requirements report compiled monthly by an oversea commander for requisitioning bulk petroleum products and certain packaged fuels. The petroleum products message slate is an advanced requirements report submitted monthly by electrical transmission from the Joint Petroleum Office and later confirmed by a written slate.

Submarine Pipeline A pipeline constructed for use in submerged water crossings. It may consist of weight-coated or concrete-anchored pipe available in various sizes.

Suction Pressure The pressure at which fluid is delivered to the suction side of a pump or pump station.

Swing Line An adjustable assembly of piping used to load product into or withdraw product from a tank in such a way that the open end of the assembly is kept at a selected depth below the surface of the product in the tank.

Switching The operation of valves to change from one storage tank to another when pumping product into or receiving product from the pipeline.

Tactical Marine Terminal Tactical petroleum storage system used for on-shore storage when fixed petroleum storage facilities are not available. It has a storage capacity of 2,100,000 gallons (50,000 barrels) and consists of forty-two 50,000-gallon collapsible bags, eight 600-gpm pumps, six 600-gpm filter/separators, and related hoses and fittings.

Tactical Pipeline System A temporary or semipermanent pipeline system constructed of readily coupled pipe or tubing sections and rapidly erected or placed storage tanks to furnish fuel to advancing units in corps and division areas.

Tank Farm A group of storage tanks connected by pipe and manifold.

Throughput The rate of flow or the quantity of product transported per unit of time; barrels per day or gallons per minute.

Transmix See Interface.

Trunk Station A pumping station on the mainline of a pipeline, required at intervals along the line to maintain throughput.

SAPO - subarea petroleum office
SOP - standing operating procedure
STANAG - standardization agreement
STD - standard
TAACOM - theater army area command
TAMMC - theater army materiel management center
TMT - tactical marine terminal
TOE - table of organization and equipment
TRANSCOM - transportation command

Ullage See Outage.

Undeveloped Theater Geographical area where few, if any, fixed petroleum storage and distribution facilities are available.

Upstream Opposite to the direction of pipeline flow; contrasted with downstream or the direction of pipeline flow.

USACC - United States Army Communications Command
USAGMPA - United States Army General Materiel and Petroleum Activity

Vapor Lock A condition in a fuel or pumping system that occurs when vaporized fuel or product blocks or retards the flow of fuel to the carburetor or the flow of product through the pump.

INDEX

By Order of the Secretary of the Army:

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Chief of Staff

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