

**STRATEGY
RESEARCH
PROJECT**

The views expressed in this paper are those of the author and do not necessarily reflect the views of the Department of Defense or any of its agencies. This document may not be released for open publication until it has been cleared by the appropriate military service or government agency.

**THE INLAND PETROLEUM DISTRIBUTION SYSTEM (IPDS):
CAN IT FUEL THE FORCE?**

BY

LIEUTENANT COLONEL KIMBERLY A. WEAVER
United States Army

DISTRIBUTION STATEMENT A:
Approved for Public Release.
Distribution is Unlimited.

USAWC CLASS OF 2001



U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

20010622 078

USAWC STRATEGY RESEARCH PROJECT

THE INLAND PETROLEUM DISTRIBUTION SYSTEM (IPDS): CAN IT FUEL THE FORCE?

by

LIEUTENANT COLONEL KIMBERLY A. WEAVER
Department of the Army

Colonel David M. Cole
Project Advisor

The views expressed in this academic research paper are those of the author and do not necessarily reflect the official policy or position of the U.S. Government, the Department of Defense, or any of its agencies.

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

DISTRIBUTION STATEMENT A:
Approved for public release.
Distribution is unlimited.

ABSTRACT

AUTHOR: LTC Kimberly A. Weaver

TITLE: The Inland Petroleum Distribution System (IPDS): Can it Fuel the Force?

FORMAT: Strategy Research Project

DATE: 10 April 2001

PAGES: 37

CLASSIFICATION: Unclassified

Petroleum is the largest class of supply by volume transported on the battlefield and also one of the most critical logistical operations to execute. In addition to providing fuel where it is needed, when it is needed and in the volume it is needed, any viable bulk petroleum support concept must incorporate the principles of standardization, flexibility, and inter-operability. Considering the war fighting forces' emphasis upon speed, mobility, and agility the Inland Petroleum Distribution System (IPDS) is the most effective method of providing bulk petroleum available today. However, without improvements in its design, capacity and inter-operability, the ability of IPDS to meet future demands of fuel distribution for the total force is questionable. This paper discusses logistics transformation initiatives in the Army Strategic Logistics Plan (ASLP), service responsibilities for bulk petroleum support in general and, specifically the IPDS. It evaluates how effectively IPDS incorporates the principles of standardization, flexibility and inter-operability, discusses the advantages and disadvantages of IPDS in this new strategic environment and also looks at a new bulk petroleum distribution system currently under development, the Rapidly Installed Fuel Transfer System (RIFTS).

TABLE OF CONTENTS

ABSTRACT	iii
LIST OF ILLUSTRATIONS.....	vii
THE INLAND PETROLEUM DISTRIBUTION SYSTEM (IPDS): CAN IT FUEL THE FORCE?	1
TRANSFORMING LOGISTICS	2
THE ARMY STRATEGIC LOGISTICS PLAN (ASLP)	2
THEATER LOGISTICS PLAN (TLP).....	2
SERVICE RESPONSIBILITIES.....	3
THE INLAND PETROLEUM DISTRIBUTION SYSTEM.....	4
INDUSTRIAL PIPELINES.....	5
OFFSHORE PETROLEUM DISCHARGE SYSTEM.....	7
TACTICAL PETROLEUM TERMINALS.....	8
FUNDAMENTAL LOGISTICS CHARACTERISTICS VERSUS THE IPDS	8
IPDS CONSIDERATIONS.....	8
Responsiveness	9
Simplicity	10
Economy	11
Flexibility.....	11
Attainability.....	11
Sustainability	12
Survivability	13
Integration.....	13
FORCE STRUCTURE.....	13
THE FUTURE OF PETROLEUM DISTRIBUTION	14
RAPIDLY INSTALLED FUEL TRANSFER SYSTEM (RIFTS).....	14

Responsiveness.....	15
Simplicity.....	15
Economy	16
Flexibility	16
Attainability	16
Sustainability	16
Survivability	17
Integration	17
FORCE STRUCTURE	17
CONCLUSION.....	18
RECOMMENDATION.....	19
GLOSSARY.....	21
ENDNOTES.....	23
BIBLIOGRAPHY	27

LIST OF ILLUSTRATIONS

FIGURE 1. INLAND PETROLEUM DISTRIBUTION SYSTEM (IPDS) IN A THEATER OF OPERATIONS	4
FIGURE 2. OFFSHORE PETROLEUM DISCHARGE SYSTEM (OPDS).....	7
FIGURE 3. IPDS.....	9
FIGURE 4. RIFTS PROTOTYPE	14

THE INLAND PETROLEUM DISTRIBUTION SYSTEM (IPDS): CAN IT FUEL THE FORCE?

"The transformation of the force that is at the heart of the Army Vision is fundamentally a logistics process. This is because achieving the agility that will be required by the transformed Army will depend greatly on creating an agile logistics structure."

— General Eric K. Shinseki, Chief of Staff of the Army

Transformation is mounting like a tidal wave throughout the entire U.S. Army. It is The Army Vision. Interim Brigade Combat Teams (IBCT) are leading the way as they transform into a smaller, faster, more lethal and agile force with a goal of global force projection within ninety-six hours. Modern, agile logistics support capabilities are the cornerstone to the success of the Army Transformation Strategy. The dynamics of developing logistical support structures and systems that meet the requirements of an IBCT, an objective force and a legacy force of the future are staggering. Fielding a force of tomorrow and maintaining the force of today require logistics support systems that encompass the full spectrum of innovative technologies of the future and obsolescence of the past.

This paper addresses an area of logistics support which has a tremendous impact upon mobility of the entire force – bulk petroleum. Petroleum is the largest class of supply by volume transported on the battlefield and also one of the most critical logistical operations to execute. In addition to providing fuel where it is needed, when it is needed and in the volume it is needed, "any viable bulk petroleum support concept must incorporate the principles of standardization, flexibility, and interoperability."¹ Considering the war fighting forces' emphasis on speed, mobility, and agility the Inland Petroleum Distribution System (IPDS) remains to be the most effective method of providing bulk petroleum available today. However, without improvements in its design, capacity and inter-operability, its ability to meet future demands of fuel distribution for the total force is questionable. This paper discusses logistics transformation initiatives in the Army Strategic Logistics Plan (ASLP), service responsibilities for bulk petroleum support in general and the IPDS specifically. It evaluates how effectively IPDS incorporates the principles of standardization, flexibility and interoperability, discusses the advantages and disadvantages of IPDS in this new strategic environment and also examines a new bulk petroleum distribution system currently under development, the Rapidly Installed Fuel Transfer System (RIFTS).

TRANSFORMING LOGISTICS

THE ARMY STRATEGIC LOGISTICS PLAN (ASLP)

The ASLP involves transforming current logistics systems to meet the demands and challenges of the Army Transformation Strategy. Successful implementation of the ASLP requires technological and systemic changes within every facet of current logistics operational capabilities. An enhanced ability to fuel the force with bulk petroleum is an inherent aspect of the ASLP. Some key objectives of the ASLP are:²

- Joint focused logistics with consolidated, integrated capabilities to achieve efficiencies and improve responsiveness.
- Reduced Combat Support (CS) and Combat Service Support (CSS) demand upon lift to improve force projection capabilities.
- Globally project one IBCT in ninety-six hours, five divisions in thirty days.
- Responsiveness to Commander-in- Chief (CINC) war fighting requirements.
- Establish an agile, smaller in-theater logistics footprint.

THEATER LOGISTICS PLAN (TLP).

The ASLP is incorporated into the CINC TLP as requirements for bulk petroleum are developed for joint operations and consumption estimates are provided for all forces. Availability and distribution of bulk petroleum within a theater of operations is critical to mission success. Essential to theater logistics support as an important component of the TLP is determining bulk petroleum pipeline assets in theater, evaluation of available facilities and conditions of the pipeline. The Army Service Component Command (ASCC) is the DoD executive agent to provide centralized distribution of bulk petroleum products for all U.S. forces in theater.³ To monitor bulk petroleum capabilities within a theater, the CINCs Joint Petroleum Office submits two annual reports, the Bulk Petroleum Contingency Report and the Bulk Petroleum Capabilities Report to the Defense Fuel Supply Center (DFSC) and the Joint Staff via the Joint Reporting Structure. These annual reports provide current data on petroleum operations and contingency support capabilities for a specific theater or country. This information is compiled and analyzed to ensure stockage management of specific products at each location is maintained at minimal inventories to adequately support annual operational requirements. The basic theater stockage objective is to have enough storage capacity to

support the full spectrum of operations, keep the storage as full as possible and efficiently transport/dispatch the product to the user.

If CSS is to be agile and responsive to CINC requirements it must be prepared to beat the strategic lift of the combat force – especially the IBCT when rapid force projection is the goal. Combat Service Support equipment is typically oversized and too large for strategic airlift and in the case of IPDS there is no exception. When rapid force projection of CSS forces and equipment are unavailable, host nation support agreements add speed and agility to theater logistics support operations. Mobility, rapid response and control are key elements in determining the methods of bulk petroleum support in a theater of operations. In a developed theater, infrastructure supports supply and distribution of bulk petroleum and fixed pipeline is the preferred method of inland distribution. Fuel supplies can usually be obtained locally. Portions of the supply system such as sources (e.g. refineries), storage tanks and industrial pipelines may already be in place. In the undeveloped theater, agile infrastructure support is either limited or not available. Joint logistics over the shore (JLOTS) using the Navy's Off-shore Petroleum Discharge System (OPDS) may be the answer for initial bulk petroleum entry in theater until additional distribution systems can be installed. The Navy is tasked to provide bulk petroleum support to the high-water mark for U.S. forces at sea and all DoD land based components while the IPDS assumes responsibility for bulk petroleum distribution from the high-water mark inland.

SERVICE RESPONSIBILITIES.

A thorough understanding of Joint Service responsibilities for petroleum distribution is another element of logistics planning that must be considered when implementing the ASLP. The Army is tasked by DoD Directive 4140.25M, JCS Publication 3 and AR 700-136 to support all U.S. land based forces, including the Air Force, Marine Corps and Naval forces ashore. It is responsible for the forward movement and distribution of fuel via pipeline, hose lines, barges, rail cars, tank trucks, and aircraft. In an undeveloped theater, it is the Army's responsibility to provide a system that transports bulk petroleum inland from the high water mark along the coastline. Additionally, to ensure wartime petroleum availability, the Army is responsible to fund and maintain tactical storage and distribution systems to supplement existing facilities. In addition to providing bulk petroleum support to the high-water mark, the Navy must maintain the capability to provide bulk petroleum support to its own components at sea or ashore. Although the Air Force and Marine Corps have lesser responsibilities for bulk petroleum support, they

have the ability to provide petroleum via air to remote locations and to support their own tactical forces.

THE INLAND PETROLEUM DISTRIBUTION SYSTEM.

In the mid 1970s the U.S. Army recognized that there was no bulk petroleum system to support fuel requirements in an undeveloped theater of operations. By 1977 the U.S. Army Quartermaster School at Fort Lee, Virginia published a study entitled "Bulk Petroleum Fuels Distribution in Theaters of Operation." The study addressed the essential requirements of providing bulk petroleum distribution in wartime. Three significant conclusions were drawn from the study. First, pipelines are the most efficient means of transporting the large quantities of bulk fuels. Second, pipelines should be extended as far forward into the combat zone as possible. Third, a requirement exists for the development of a pipeline system and an over-the-beach ability to resupply fuel from ocean tankers to deployed forces ashore.⁴ As a result of that study, the IPDS was developed in 1980 to provide bulk fuel support to military forces when deployed anywhere in the world. The pipeline consists of tactical petroleum pipeline (each nineteen foot aluminum section is six inches in diameter), tactical storage systems (e.g. tactical petroleum terminals (TPT)), mainline pump stations, and associated support items. (Figure 1)⁵

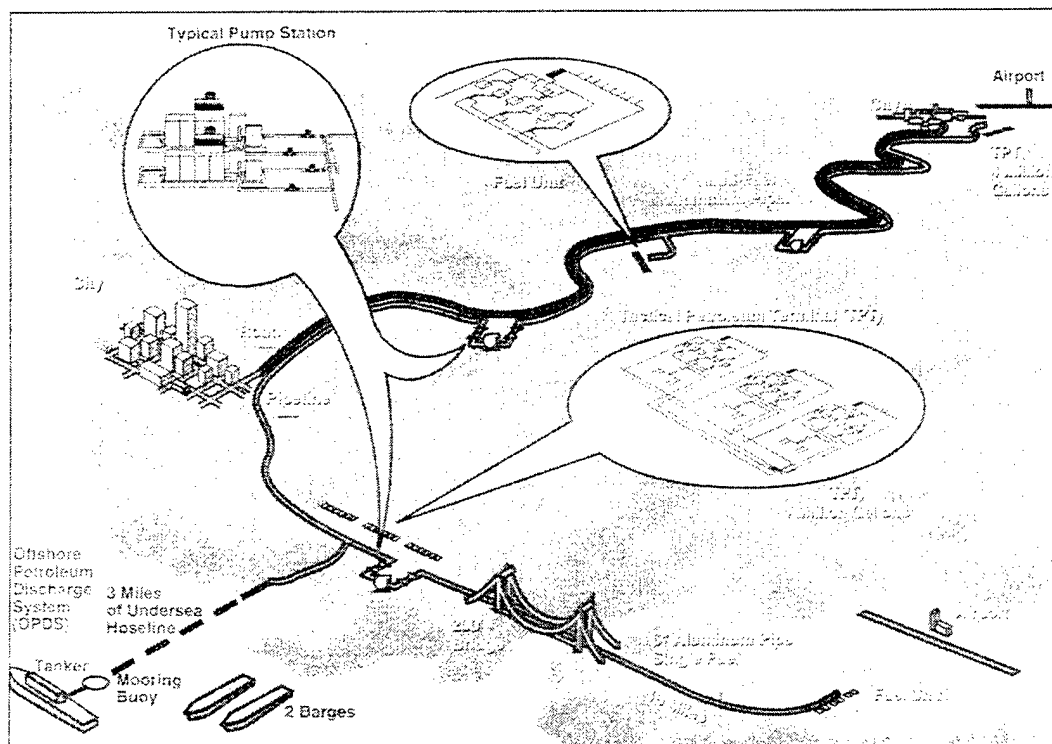


FIGURE 1. INLAND PETROLEUM DISTRIBUTION SYSTEM (IPDS) IN A THEATER OF OPERATIONS

It can be emplaced at an average rate of three miles per day. After deployment of the pipe, a coupling must be manually installed every nineteen feet and requires three personnel to complete the installation properly. The IPDS is an improvement over the pre-1970 steel pipeline, but as will be discussed later in this paper, it is still extremely labor intensive and cumbersome to employ.

Once the IPDS pipeline is deployed, it is only efficient in moving petroleum if there is a source from which to dispatch and store bulk fuels. This paper addresses the most common forms of storing and distributing bulk petroleum through the IPDS pipeline: Industrial pipelines, OPDS and TPTs. Without the support of these systems there would be no need to install IPDS. There would also be no means in which to fuel the force.

INDUSTRIAL PIPELINES.

Though petroleum pipeline systems exist within most developed nations, Europe and South Korea have developed strategic petroleum pipelines designed specifically to support military operations.

The NATO Pipeline System (NPS) was initially developed in the early 1950's, as NATO logistics planners were focused upon sustaining and fueling an occupation force designed to ensure that the requirement for fueling NATO forces could be met at all times. It consists of many independent nation pipeline systems spanning Italy, Greece, Norway, Portugal, Turkey and the United Kingdom: and two multinational systems, the Central European Pipeline System (CEPS) (Belgium, France, Germany, Luxembourg, and the Netherlands) and the Northern European Pipeline System (NEPS) (Denmark and Germany). Today the NPS runs through twelve NATO nations and provides 11,500 km of pipeline that connects key elements of the NATO infrastructure such as storage depots, air bases, civil airports, pumping stations, refineries and entry points.⁶ Military requirements for fueling the force were the key elements behind the NPS design and as a result, its layout, equipment, operation and maintenance differ from its industrial counterparts. Its facilities operate independently from commercial power sources and provide flexibility in both receiving and delivering fuels. Finally the last link in the NPS operation is the bulk petroleum distribution pipeline. Direct spur lines to air bases, many associated with major international airports and other key facilities within the industrial support base provide a web of bulk petroleum support throughout Europe.⁷ Originally built for wartime surge requirements, NPS also supports the civilian infrastructure and contributes to economic stability of the region. Many sections of the NPS are over 35-40 years old, however, and

showing signs of wear. Without technological upgrades and maintenance, it may not have the capacity to support a surge of concurrent civilian and NATO petroleum requirements during time of crisis.⁸ The condition of the pipelines in eastern Europe are already at a deplorable state in most of the region with aging basins, high water-to-oil ratios, severe corrosion problems and inefficient service-supply capabilities.⁹ For example, Romania's energy sector is plagued with poorly maintained and dilapidated facilities and capital is not available for urgent repairs of existing facilities, let alone renovating or building new systems.¹⁰ The IPDS is designed to interface with the NPS to meet bulk petroleum requirements in the European Theater, however, the scope of this paper is such that it does not explore the NPS in great detail. Still, there are two areas that quickly raise concerns and should not be overlooked when developing the TLP. First, what would be the political and military ramifications if a Nation State or State of Concern refused to allow NATO/UN forces access to their pipeline? Second, does the 35-40 year old pipeline still have the ability to provide surge petroleum requirements for the military forces of 2001 and beyond?

The Trans-Korea Pipeline (TKP) is the only petroleum pipeline in Korea and it is a U.S. Army owned and operated system. All military forces on the Korean peninsula get their fuel from this pipeline. With only a limited number of supply routes in the region, the pipeline is the most efficient method of providing fuel to the force. Its operation is absolutely essential to the defense of Korea. The TKP is 283 miles long and in 1987 it had a storage capacity of approximately 67.2 million gallons of bulk petroleum. It is a high-pressure, buried pipeline that begins at the base terminal at Pohang and goes inland, northwest to Uijohgbu, where it ends at the head terminal. Between these two terminals are nine other petroleum terminals.¹¹

As early as 1987, it was realized that the TKP was not sufficient to meet the petroleum requirements of a modern, highly mobile force. It had neither the storage capacity nor the distribution network required to support surge requirements for forces operating on the peninsula. In 1990, General Louis C. Menetrey, Commander of U.S. forces in Korea, told the Senate Armed Services Committee "In country petroleum, oil and lubrication stocks, critical to the sustainment of allied forces in Korea, are partly stored in inadequate, vulnerable facilities. Delivery lead time and exposure to hostile action make dependence on offshore resources an Achilles heel for U.S. Forces."¹² Construction of the Southeast pipeline is still under debate. To offset this shortfall, IPDS pipeline and supporting equipment are maintained as operational project stocks stored at Sagami Army Depot, Japan and afloat in the Indian Ocean. Even with these prepositioned stocks, however, the system is still short approximately twenty-five fuel storage units (31.5 million gallons).¹³

OFFSHORE PETROLEUM DISCHARGE SYSTEM.

Normally used in undeveloped theaters where pier side petroleum discharge facilities are unavailable, the Navy supports theater bulk petroleum requirements via JLOTS operations using the OPDS. These systems deliver fuel to storage terminals ashore. There are five OPDS tankers, three of which are pre-positioned ships afloat: USNS Henry J. Kaiser, Mediterranean, SS Chesapeake, Indian Ocean, SS Petersburg, Guam.¹⁴

The OPDS is designed to provide bulk petroleum to military forces ashore over a sustained period, delivering up to 1.2 million gallons of product per twenty hour pumping day, up to four nautical miles from shore (Figure 2)¹⁵. It is capable of delivering two products up to two nautical miles from shore from a tanker moored offshore. It pumps fuel through the OPDS hose line to a shore based petroleum terminal. There are two beach termination units (BTU) carried aboard the OPDS tanker and depending upon the requirement, one or both BTUs may be installed. Acting as an interface between the hose line and IPDS, it is the high water mark termination of OPDS. Installed and operational within seven days, OPDS does not limit beach access and other tankers deliver fuel to the OPDS tanker by alongside consolidation.

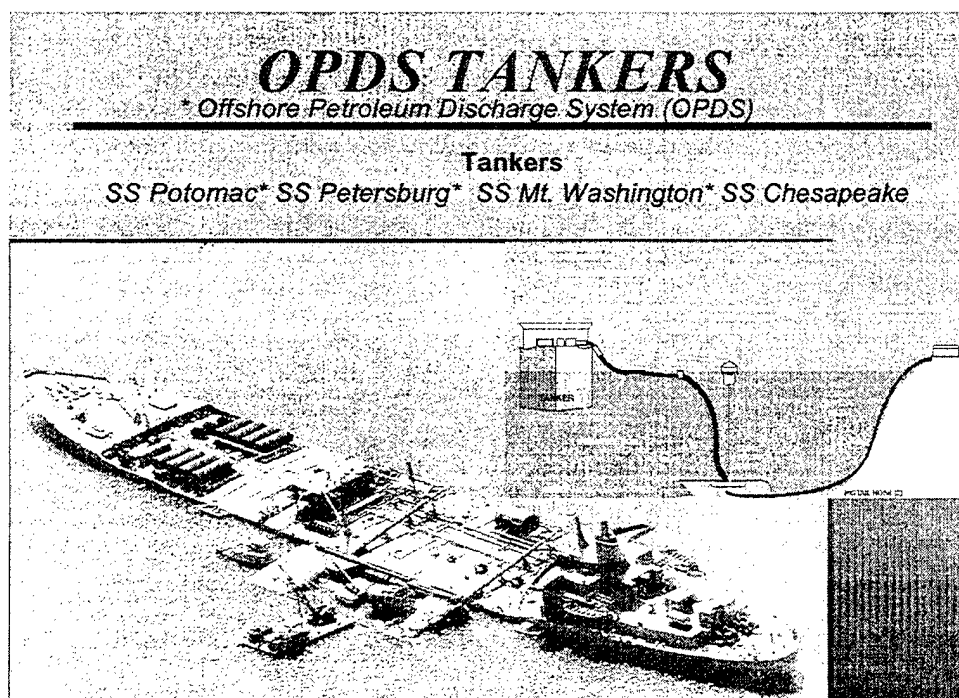


FIGURE 2. OFFSHORE PETROLEUM DISCHARGE SYSTEM (OPDS)

OPDS has its limitations, however. Installation must be conducted at a water depth of at least fifteen feet, the coastal bottom cannot be rocky and the gradient can be no more than 1:25

(e.g. one meter rise over a distance of twenty-five meters). Additionally, high sea states delay or prohibit installation. Oceanic conditions are indicated by "Sea States" that rate the effects of wind and waves at sea on a scale of zero (Sea like a mirror, calm wind, no waves) to nine (Air filled with foam and spray. Sea is completely white with driving spray. Visibility seriously affected, hurricane winds, waves in excess of eighty feet).¹⁶ Sea States must be at three or less to install the OPDS and no higher than six to maintain maximum operations with a Single Anchor Leg Mooring (SALM) which is installed to provide uninterrupted, all weather product delivery.¹⁷

TACTICAL PETROLEUM TERMINALS.

Fuel supplied from the sources just mentioned is pumped inland through the IPDS to storage terminals configured into fuel units. These fuel unit assemblies consist of six 210,000 gallon bulk fuel tank assemblies (BFTA) with a storage capacity of approximately 1.2 million gallons. Three fuel units used together form the TPT. A typical TPT has a storage capacity of approximately 3.75 million gallons and covers one square mile. In an undeveloped theater, the BFTA and TPTs may comprise the entire bulk petroleum storage capability in the area of operation. Developed theaters may provide additional bulk storage from industrial storage tanks, and thereby reduce the TPT storage requirements.

FUNDAMENTAL LOGISTICS CHARACTERISTICS VERSUS THE IPDS

In determining future logistics procedures and systems, the ASLP and TLP incorporate eight fundamental characteristics of effective and efficient logistics support. They are responsiveness, simplicity, economy, flexibility, attainability, sustainability, survivability, and integration. This paper addresses each characteristic to assess how successful the IPDS has actually been in complementing the ASLP and TLP in meeting the bulk petroleum requirements of the force.

IPDS CONSIDERATIONS

In the early 1970s, the IPDS was an innovative concept. It still has some degree of relevance, but when considering the mobility of the future force, there is room for improvement as a review of the fundamental characteristics will show.

Responsiveness

The IPDS was designed to be a lightweight (compared to steel pipe), rapidly deployable bulk fuel storage and distribution system capable of interfacing with host nation refineries or the Navy's OPDS.¹⁸ It is part of operational project stocks stored at Sierra Army Depot (505 miles of pipeline, 18 fuel units and 65 pump stations), Sagami Army Depot, Japan (250 miles of pipeline, 23 fuel units and 12 pump stations) and aboard three Army prepositioned ships (30 miles of pipeline, 5 fuel units and 2 pump stations).¹⁹ Operational project stocks are managed by the U.S. Army Materiel Command and are a common user stockpile of equipment and supplies strategically positioned ashore and afloat to rapidly support the needs of the Army.

Since the IPDS is part of the operational project stocks, it is not on the Table of Organization and Equipment (TOE) of either the Engineer Pipeline Construction Company or the Quartermaster Pipeline and Terminal Operating Company (QPTOC). This means that these units, responsible for the construction and operation of the pipeline, do not have organic IPDS equipment for training or deployment. As part of operational project stocks, the Defense Logistics Agency directs the release of IPDS from the Sierra Army Depot to meet mission requirements and it meets up with the Engineer Pipeline Construction Company and the QPTOC in theater. The system is configured in five-mile sets, packaged in twenty-foot International Standards Organization (ISO) containers and rapidly deployable to support a wide variety of scenarios. Though the IPDS is the most economical means of distributing bulk

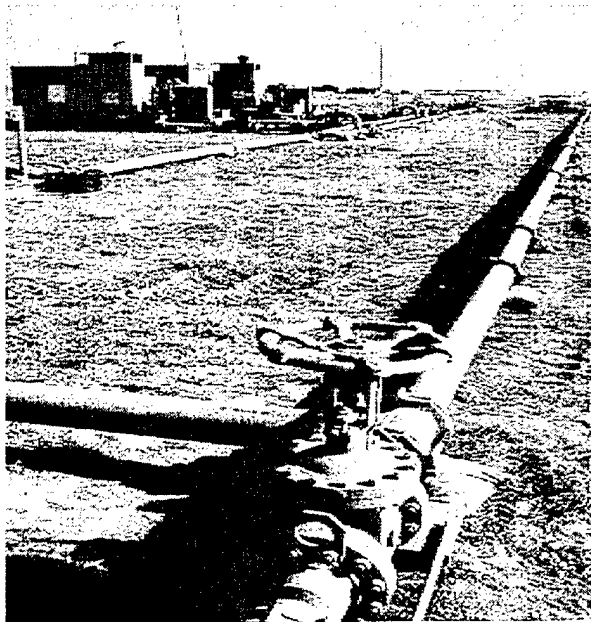


FIGURE 3. IPDS

petroleum it does require significant lift assets to deploy the equipment to a theater of operation. It also requires a significant amount of time and manpower to install, operate and monitor the system (Figure 3)²⁰. Once operational, each pump station must be manned 24 hours a day and all adjustments and operational changes to the pipeline are done manually. Since the IPDS cannot be quickly recovered for redeployment and movement on the battlefield, this lack of agility raises concern over its ability to support two MRCs.

Responsiveness capabilities were demonstrated during Operation Desert

Shield/Storm (1990) when the IPDS was deployed as part of an operational project specifically designed and procured for use in Southwest Asia. It was referred to as the Southwest Asia Petroleum Distribution

Operational Project (SWAPDOP) and its effectiveness received mixed reviews. The benefit of its employment was that valuable lessons were learned in the area of bulk petroleum distribution, planning and execution. Plans called for SWAPDOP pipeline and equipment stored in depots within the continental United States to be deployed early in the Time Phased Force Development List (TPFDL), to alleviate the huge petroleum distribution burden placed upon ground tanker trucks during the initial states of the operation. The nominal throughput of the pipeline would be over one million gallons daily, reducing the need for tanker trucks by up to 200. However, the SWAPDOP materials did not arrive in theater until early December 1990 and the set up of the pipeline was further delayed as ARCENT waited approval from the Saudi government for the right-of-way necessary to assemble the pipeline. Once the SWAPDOP was in theater and authorized for set up, plans called for the construction of several pipeline systems. Two parallel pipelines were to be constructed from the Ras Tanura refinery to the King Fahd International Airport. Another plan called for the construction of another parallel pipeline connecting the Ras Tanura refinery and the Al Jubail refinery to the log bases. Finally, a pipeline to connect the Ras Tanura and Al Jubail refineries was planned in case one of the refineries was destroyed. In addition to the refineries, the Joint Petroleum Officer (JPO) called for all OPDS tankers in the U.S. inventory. Two ships were in theater, two were being readied in the U.S. and one was under repairs and unavailable. Some IPDS limitations and shortfalls adversely effected the execution of the SWAPDOP. The greatest impediment for success was the delay in the initial construction of the pipeline and the rush to complete it when given the approval. Once constructed, the two parallel pipelines connecting King Fahd International Airport to the Ras Tanura refinery were inadvertently filled with contaminated fuel, rendering it useless for aircraft use and it was shut down. The pipeline constructed from the Al Jubail refinery to the Jubail airport had so many significant leaks it was also shut down. Had Operation Desert Storm been a protracted war, bulk petroleum distribution within the theater would have been severely restricted.²¹

Simplicity

IPDS employment concept and doctrine is not extremely complicated. It is a pipeline system developed to provide bulk petroleum support to military forces operating anywhere in the world, under any scenario. The system is a combination of commercially available and military

standard petroleum equipment, designed in modules, packaged in twenty-foot ISO containers and readily available for deployment. Simplicity ebbs, however, during the installation and operation of the IPDS. It requires two separate organizations to install, operate and monitor the IPDS. It is labor intensive and time-consuming to deploy, each pump station must be manned twenty-four hours a day, and all adjustments and operational changes to the operating pipeline must be performed manually.

Economy

One of the most compelling arguments for the employment of IPDS, whether the fuel source is industrial pipeline or OPDS, is the effect it has upon ground transport tankers within a theater of operation. The ability to by-pass intermediate nodes and move huge quantities of bulk petroleum as far forward as possible via the IPDS pipeline significantly reduces the requirement for ground transport tankers. As a result, strategic lift requirements are reduced since fewer fuel tankers are required to move fuel. Main Supply Routes (MSR) are less congested, fewer fuel tankers in operation mean less maintenance requirements and fewer non-mission capable days, there is less demand upon drivers and also a reduction in fuel consumption rates since the fuel tankers do not consume fuel as they deliver it.

Flexibility

Another advantage of the IPDS is its ability to dispatch multi-fuels into TPTs through the same pipeline and/or parallel pipelines. It can be tailored to a variety of locations and transport distances and can be used to meet CINC petroleum requirements in developed or undeveloped theaters of operation. The disadvantage of the IPDS flexibility is that it cannot be rapidly recovered for redeployment, however, it is extremely effective in areas where rapid construction is not required and a stable, long duration operation is anticipated.

Attainability

As with many systems in the DoD, the IPDS is under funded. The Army is responsible to fund and maintain tactical storage and distribution systems for all U.S. forces, however, there is a lack of sufficient Other Procurement Army (OPA) funds in the fiscal year (FY) 2002-2007 program objective memorandum (POM) to support the IPDS in two near simultaneous multi-theaters of war (MTWs). Additionally, there are no overarching requirements documents for the total force. The Eighth U.S. Army is revalidating their requirements and dual MTW plans now call for revised system configuration, but the requirement to reposition some IPDS equipment to

the Army Materiel Command-Southwest Asia lacks sufficient funds and 165 miles of IPDS will not be available to support the force.²²

Sustainability

Storage capacity and stockage policies are a critical element of sustainment. Industrial pipelines and OPDS are tremendous enablers for the IPDS in distributing huge volumes of petroleum throughout the theater. Even these systems have their limitations, however, as was demonstrated during the Persian Gulf War.

“When force levels were increased, in-theater requirements increased proportionately. Even though the 30 Days of Supply (DOS) theater stockage policy did not change with the increase in force levels, the ability to stock the larger quantities required by the increased number of users became more of a challenge...Increasing the share of output from Saudi refineries for jet fuel, bringing tanker ships to safe haven berths as floating storage capacity, and the laying of tactical pipelines to ease movement to forward storage bladders are but a few of the methods used to increase the available usable fuel for the forces....An additional 10 DOS were held in reserve in each country at various depots, bases and refineries, and 15 DOS were maintained by the DFSC in Bahrain, UAE, Oman, Djibouti, Somalia and aboard tankers under way in the Arabian Sea and Red Sea.....the fuel storage was inadequate.”²³

The October 2000 IPDS Overview indicates that system requirements for Central Command (CENTCOM) are 600 miles of pipeline and 16 TPTs and requirements for Pacific Command (PACOM) are 190 miles of pipeline and 16 TPTs. There are 815 miles of pipeline and 17.3 TPTs on hand in operational project stocks.²⁴ While there seems to be sufficient pipeline on hand to support both of those theaters, there is a tremendous TPT storage shortfall. It goes without saying that a mobile force requires fuel. It may be worth mentioning, however, that the Army isn't the only customer and the newly developed Air Force Aerospace Expeditionary Force (AEF) adds a whole new perspective to bulk petroleum storage and distribution. The Air Force reorganized its forces on January 2000, operationally linking geographically separated units to form ten AEFs. Each package consists of a full complement of air and space assets. Fighter, bomber, tanker, airlift, command and control, radar, and electronic warfare aircraft combined with communication, intelligence, surveillance and reconnaissance air and space systems provide customized AEF units to any theater CINC. Depending upon the customized AEF and mission, bulk petroleum requirements could potentially exceed theater capacity to support civilian and military operations. The TPT storage shortfall poses a serious threat to the mobility of the force since the IPDS cannot move large

volumes of fuel if there is not a sufficient source of storage, neither can it support MRC operations.

Survivability

Security of the IPDS is another issue in question. An extensive network of IPDS pipeline consisting of hundreds of miles of pipeline needs some method of security to deter sabotage and identify leaks in the system. The QPTOC is responsible for IPDS operation and maintenance, however, it is not manned to secure the entire pipeline. A separate security force is required to perform this mission. This requirement adds to the theater CINCs manpower ceilings and strategic lift requirements.

Integration

Consolidated and integrated to be compatible with the fuel systems of all U.S. forces, the NPS and OPDS, the IPDS is an effective system for moving bulk fuel in support of joint operations. There is, however, an integration shortfall during NATO and multi-national operations as the system still lacks the ability to interface with NATO and/or coalition forces that do not possess a pipeline system compatible with the IPDS. The United Kingdom has fuel hose lines, but they do not couple with the IPDS and are not inter-operable without adapters.²⁵ For U.S. forces, the Joint Petroleum Office coordinates bulk petroleum requirements in theater, but coalition operations often present huge challenges for bulk petroleum distribution. Without a pipeline distribution system to support multi-national forces, each nation competes with the others for the same scarce resources (contractor support, MSRs, fuel storage) and priority of support.

FORCE STRUCTURE

Responsibility for the construction and operation of the IPDS pipeline rests with the Engineer Pipeline Construction Company and the QPTOC. The Engineer Pipeline Construction Company is responsible for surveying the pipeline trace, laying up to ninety miles of the pipeline, installing the pump stations and preparing the fuel storage sites. There are five Engineer Pipeline Construction Companies in the force structure. All five units are in the Reserve Component. The QPTOC installs the fuel unit and operates the entire IPDS, dispatching fuel down the pipeline, typically to three fuel units. There are eighteen QPTOC in the force structure. Three QPTOC are in the Active Component and fifteen are in the Reserve Component. Having such a heavy reserve force structure for IPDS could affect rapid force

projection of the system. While the engineer pipeline and terminal operating units are trained and capable of surveying, installing and operating the IPDS, they are limited in their ability to rapidly project into the theater. Forces in theater will initially have to rely upon ground tanker trucks (military and contract) for their bulk fuel requirements until the engineer pipeline and terminal operating units arrive.

THE FUTURE OF PETROLEUM DISTRIBUTION

Petroleum based fuels will continue to be the primary fuel for the military for many years to come. Advancements in fuel efficiency and alternative fuels will have an impact upon the total volume of fuel required in the next 20-25 years, but estimates are that petroleum will continue to be the largest class of supply by volume for the military force. It is not a question of whether a pipeline system is needed, it is a matter of how to make the current system (IPDS) complement the ASLP to meet the operational requirements of the future force. The projected size of the battlefield, the distance between the fuel source and the customer, and the volume of fuel necessary to sustain the force requires a pipeline system that is more responsive, flexible, attainable, sustainable and survivable and easier to operate than the current system.

RAPIDLY INSTALLED FUEL TRANSFER SYSTEM (RIFTS)

A new petroleum system currently under development is intended to alleviate the shortcomings of the IPDS. (Figure 4)²⁶ The RIFTS is still in the initial development stages and fielding of the system, if it is approved for production, could not occur for about another five

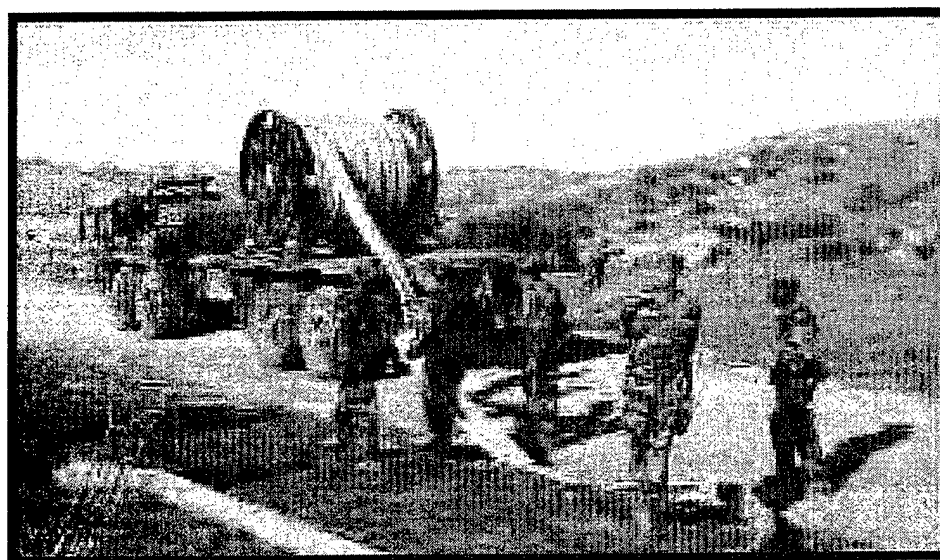


FIGURE 4. RIFTS PROTOTYPE

years.²⁷ The operational requirements document (ORD) has identified some significant design characteristics and operational features that could dramatically improve bulk petroleum distribution. The proposed RIFTS design requirements have addressed the key logistics characteristics and each is discussed in this paper.

Responsiveness

The proposed RIFTS will consist of rapidly installed, rapidly recovered conduit that is capable of deployment across all types of terrain. Installation of the RIFTS is to be at a rate of twenty miles per twenty-hour operational day and recovered at a rate of 10 miles per twenty-hour operational day. This would result in 100 miles of pipeline being available in five days to support initial troops that arrive within 120 hours of conflict, installed and operational at any location in the world. Installation would include crossing rivers, gullies, gaps (up to 200 feet) and any other obstacles that prevent laying the RIFTS on the ground. It will be capable of crossing roads, trails, other pipelines and obstacles without damage to the RIFTS or obstacle. Improved methods of recovery operations will allow the RIFTS to rapidly recover and relocate based upon mission need. The system will be able to move as the battlefield moves. A final requirement for responsiveness is that the proposed RIFTS must minimize strategic lift requirements by a minimum of twenty percent (fifty percent is the objective) over the existing IPDS. Components of the RIFTS will be stored and transported in standard twenty-foot ISO containers and be transportable by all modes of transportation (rail, highway, air) and both fixed and rotary wing aircraft (C-130 and CH-47)

Simplicity

Sensors, motor controls and electronics will provide unattended operations around the clock along with a command and control module capable of controlling at least fifty miles of conduit. The control module will require only one operator and also contain a leak detection system capable of automatically detecting small leaks anywhere along the line. All the components necessary to deploy, operate and recover the system are consolidated. It will not require as much trace development as the IPDS, however, engineer support may be required to remove large obstacles from the trace. Less equipment for installation means less strategic lift requirements and fewer personnel to operate the system.

Economy

The RIFTS has the same elements of economy as the IPDS and that is the effect it has upon MSRs and ground transport tankers within a theater of operation. Since the RIFTS will be capable of moving with the battlefield, however, the benefits will be exponential.

Flexibility

RIFTS will integrate existing hoseline/material technology and future technology with research and development to produce a system that is complete and supportable. It can be tailored to meet any mission requirement in any location, terrain, or distance. Two RIFTS can be deployed parallel to each other to provide even greater volume of fuel and the system can also be joined in series to support distances in excess of several hundred miles. Its flexibility will allow petroleum managers the ability to plan and operate petroleum operations more efficiently.

Attainability

Still in the development phase at the time of this writing, RIFTS is not through the milestone 1 decision stage (concept phase) and faces at least four more decision milestones and funding outlays before the RIFTS could be fielded. Initial operating capability (IOC) will be attained when the first RIFTS systems are in operational stock, training sets are available and they are logistically supportable. Between FY 2004-2008, the estimated initial procurement is 100 miles of fuel conduit. Considering that the IPDS currently consists of nearly 900 miles of pipeline, this initial RIFTS procurement is only enough to augment IPDS when speed and mobility are required in a theater of operations. The objective date for IOC is FY05. Threshold life cycle costs for RIFTS is \$700,000 and this includes twenty years useful life, research and development, procurement and logistics support.

Sustainability

The proposed RIFTS will move an excess of 875,000 gallons of fuel in a twenty-four hour operational day. It is capable of continuous operations and monitoring via sensors, motor controls and electronics and it is mobile enough to rapidly recover and move within the battlefield to provide optimum support to sustain the force.

Survivability

With a minimum shelf life of at least fifteen years and a useful life of at least ten years once filled with fuel, the RIFTS be able to sustain the bulk petroleum requirements of the Army well into its transition. The system will be capable of operating in temperatures that range from -25 degrees to 120 degrees Fahrenheit. Two soldiers will be able to repair damage, to include replacement of conduit sections up to twenty feet in length in thirty minutes or less. Additionally, the RIFTS will be NBC decontamination survivable. It will be capable operations in daylight and darkness by appropriately equipped soldiers wearing the full range of protective gear. The protective gear will range from artic, chemical protective overgarments, and inclement weather.

Integration

The RIFTS will be fully integrated with IPDS and the storage and distribution systems of other services (i.e. the Navy's OPDS), allied nations and commercial sources. It will transport bulk petroleum from any source, military or commercial, to storage locations throughout the theater and be able to use commercial pipelines as an additional source of supply.

Environmental issues can also be considered a factor of integration and the RIFTS includes features that improve its environmental characteristics. This includes a leak detection capability and containment berms for major components which is quite adequate since the RIFTS will have fewer couplings, the risks of fuel leaks are reduced. To allow unattended operation, the RIFTS includes a method of detecting small leaks before a catastrophic failure occurs and endangers personnel or the environment. The ability to locate a leak below a leak rate of 10 gpm allows operators to take corrective action before the leak creates a major environmental or safety issue. The ORD specifically states "the RIFTS shall comply with all safety and environmental requirements involving the transfer of bulk fuel through portable conduits for both continental and foreign operations."²⁸

FORCE STRUCTURE

Unlike the IPDS, the Engineer Pipeline Construction Company is not required to install or recover the RIFTS because installation does not require the extensive preparation of the pipeline trace. Its organizational equipment and manpower requirements are eliminated from RIFTS operations and strategic lift requirements. The QPTOC is capable of installing and operating the RIFTS. RIFTS operations for the QPTOC organic equipment will include all equipment necessary to install the pipeline. Engineer support may be required to move large obstacles and this support would be requested from a heavy engineer unit or IPDS pipeline

construction company. An engineer officer or non-commissioned officer position authorized in the QPTOC TOE would provide assistance in determining the trace locations and directing the construction of small obstacle crossings.

There is no requirement for additional personnel and no new military occupational specialties (MOS) are required to operate or maintain the RIFTS. The fielding of the RIFTS should actually result in a reduction of personnel requirements since less labor is required to install the RIFTS.

CONCLUSION

The IPDS is clearly an effective means of providing bulk petroleum to the total force. Its capacity for transporting huge volumes of fuel is unmatched by any system currently in the inventory and its ability to interface with industrial pipeline and the OPDS enhances its relevance. However, it is quickly becoming a cumbersome CSS legacy system because it is not responsive or flexible enough to respond quickly to fast paced changes on the battlefield. Its relevance lies in its ability to transport bulk petroleum to fixed facilities in a static environment supporting stable, long duration operations.

Since the fielding of the IPDS in the mid-1980s, two detailed analysis of the fuel transfer mission were conducted. First, an analysis which included a baseline investigation of technologies that could affect the installation and operations of a cross-country fuel transfer system. This investigation had three key findings: (1) lightweight collapsible hose is the most practical technology available to meet a pipeline construction rate of 20 miles per day, (2) Manually coupled pipe, such as IPDS, is a proven technology; however, this technology has reached its optimum lay rate and is heavily dependent on personnel. Automation and installation of this type of pipe is difficult and terrain sensitive, and (3) bulk petroleum distribution concepts and doctrine should be reviewed to consider hose or hybrid systems.²⁹ An update of the original analysis was conducted in 1999 to determine if any technological advancements in the manufacture of collapsible hose had occurred since 1989. Six different types of conduit were identified and included in the analysis. An analysis methodology called Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was used to evaluate the various alternatives. Three systems were highly ranked in the analysis, (1) medium pressure hoseline system, (2) high pressure hoseline system, and (3) Aluminum Coupled Pipe, Manually coupled. These systems form the basis for the development of the RIFTS.³⁰

A significant petroleum distribution capability exists with the RIFTS as it can provide bulk petroleum support in a fraction of the time required to deploy the IPDS. It has all of the

advantages of the IPDS and is responsive and flexible enough to move with the battlefield, and operate in any terrain or location concentrating on areas where speed is essential in installing a fuel distribution pipeline. Its operational capabilities make it quite attractive to petroleum planners and war fighting forces at the theater level. With IOC estimated in FY 2005 and only 100 miles of conduit procured during this time, the RIFTS is not capable of replacing the IPDS. Unless several hundred miles of RIFTS are procured, it will only be able to enhance the system already in place.

Force structure changes are premature at this time. As long as the IPDS carries the majority of the bulk petroleum mission, both the Engineer Pipeline Construction Company and QPTOC are required to support the system.

RECOMMENDATION

By the year 2025, Army modernization plans call for a more fuel-efficient force making fossil fuel powered vehicles up to 75 percent more efficient. Alternative fuel research is being conducted in the use of biofuels, Boron, electric motors, hydrogen, hybrid-electric vehicles and liquid nitrogen. This revolution in technology would greatly reduce theater bulk fuel distribution and storage requirements. However, efforts directed toward making this technological revolution a reality within DoD still seem to be more talk than action. Bulk petroleum is still required until a common alternative fuel for all DoD vehicles is developed and we are still over two decades away from meeting AAN plans for fuel efficiency. The leap toward transformation starts with change and innovation. There is currently no faster, more feasible means of petroleum distribution available for production and no other system that comes close to meeting the force projection or mobility requirements for the Army's lighter, more agile force than the RIFTS.

The advantages of the proposed RIFTS system are considerable. Development of the RIFTS should continue at an accelerated pace and the OPA funding allocated for IPDS should be diverted to support RIFTS development. The RIFTS should be programmed to significantly enhance the IPDS by FY 2010 and force structure should be changed accordingly. There is no requirement for the Engineer Pipeline Construction Company to install the RIFTS. That function should be assigned to the QPTOC and their authorization document should reflect personnel and equipment changes to support RIFTS. The active component QPTOC should have the primary RIFT mission since force projection is critical. For the foreseeable future, the IPDS should remain in the inventory in its current configuration. It is still relevant to bulk petroleum operations. The IPDS should be used in areas where rapid installation and operation are not

required and the supporting force structure should remain intact, primarily within the Reserve Component.

WORD COUNT=7058

GLOSSARY

AEF	Aerospace Expeditionary Force
ASLP	Army Strategic Logistics Plan
BFTA	Bulk Fuel Tank Assemblies
BTU	Beach Termination Unit
CENTCOM	Central Command
CEPS	Central European Pipeline System
CINC	Commander-in-Chief
CS	Combat Service
CSS	Combat Service Support
DFSC	Defense Fuel Supply Center
FY	Fiscal Year
IBCT	Interim Brigade Combat Team
IPDS	Inland Petroleum Distribution System
IOC	Initial Operating Capability
ISO	International Standards Organization
JLOTS	Joint Logistics Over the Shore
JPO	Joint Petroleum Office
MOOTW	Military Operations Other than War
MOS	Military Occupational Specialty
MSR	Main Supply Route
NEPS	Northern European Pipeline System
NPS	NATO Pipeline System
OPA	Other Procurement Army
OPDS	Off-shore Petroleum Discharge System
ORD	Operational Requirements Document
PACOM	Pacific Command
POM	Program Objective Memorandum
QPTOC	Quartermaster Pipeline Terminal and Operating Company
RIFTS	Rapidly Installed Fuel Transfer System
SWAPDOP	Southwest Asia Petroleum Distribution Operational Project
TKP	Trans-Korea Pipeline
TLP	Theater Logistics Plan
TOE	Table of Organization and Equipment
TPT	Tactical Petroleum Terminal

ENDNOTES

¹ Department of Defense, Joint Bulk Petroleum Doctrine, Joint Publication 4-03 (Washington, D.C.: U.S. Department of Defense, 25 July 1995), v.

² "Army Strategic Logistics Plan (ASLP) at a Glance," Available from <http://www-acala1.ria.army.mil/LC/LCB/Bp/BPT/website/asipdigest.htm>; Internet; accessed 1 January 2001.

³ Department of the Army, Petroleum Supply Units, Field Manual 10-426 (Washington, D.C.: U.S. Department of the Army, 12 June 1997), 5-1.

⁴ Radian Engineering, "Inland Petroleum Distribution System," briefing slides, Fort Pickett, VA: Radian Engineering, 1999.

⁵ Philip R. LoSchiavo, "Petroleum and Water Systems (PAWS) Inland Petroleum Distribution System (IPDS) System Overview," briefing slides, Warren, MI, Tank-Automotive and Armaments Command, October 2000.

⁶ North American Treaty Organization, "NATO Pipeline System," 1998; available from <http://www.nato.int/docu/handbook/1998/v213.htm>; Internet; accessed 20 January 2001.

⁷ A. J. Hofman, "The Central European Pipeline System: Another Form of Transport," Defense Transportation Journal (June 1983): 32.

⁸ David A. Simpson and Homer D. Smith, "The NATO Pipeline System," Army Logistician (January-February 1985): 19.

⁹ Etienne H. Deffarges, Donald J. Howard and John E. Treat, "Central European Projects Could Alter Oil Movement Patterns," Oil & Gas Journal 89 (19 August 1991): 51.

¹⁰ "Study of Investment Climate in the Energy Setor in the Black Sea Region, Countries Survey – Romania," November 1998; available from <http://www.bsrec.bg/PHARE/Prog95/project2/Romania.html>; Internet; accessed 6 January 2001.

¹¹ Gary W. Bradley, "The Trans-Korea Pipeline – Will There be Enough Fuel?" Army Logistician (November-December 1987): 2.

¹² Congress, Senate, Armed Services Committee, Menetrey Sees No Easing of Tensions in Korea, Senate Panel 900209, 9 February 1990; available from <http://www.fas.org/news/skorea/1990/900209-rok-usia.htm>; Internet; accessed 1 March 2001.

¹³ Philip R. LoSchiavo, "Petroleum and Water Systems (PAWS) Inland Petroleum Distribution System (IPDS) System Overview," briefing slides.

¹⁴ Michael G. Bettez, Army Pre-positioned Stocks: The Key to Our Rapid Force Projection Strategy, Strategy Research Project (Carlisle Barracks: U.S. Army War College, 10 April 2000), 5.

¹⁵ "Joint Logistics Over-the-Shore Operations (S-8A-0004)," briefing slides, JLOTS Operations Course, Transportation Support Command, 13 February 2001.

¹⁶ Pierson-Moskowitz, "Sea State Definition Table," 2000; available from <http://www.oceandata.com/support/Sea%20State%20Table.htm>; Internet; accessed 22 February 2001.

¹⁷ U.S. Department of the Army, Concepts and Equipment of Petroleum Operations, Field Manual 10-67-1 (Washington D.C.: U.S. Department of the Army, 2 April 1998), 5-2.

¹⁸ Keith E. Mattox, "The Army's Inland Petroleum Distribution System," Spring 1998, available from http://www.quartermaster.army.mil/OQMG/Professional_Bulletin/1998/Spring_1998.htm. Internet. Accessed 15 December 2000.

¹⁹ Janet Hall, "The Inland Petroleum Distribution System (IPDS) Operational Project (OP)," information paper, Department of the Army, Deputy Chief of Staff Logistics, DALO-TSE, 18 November 1998.

²⁰ Keith E. Mattox.

²¹ Joseph T. Thomas, Petroleum Operations in the Gulf War: An Operation Desert Storm Personal Experience Monograph, Strategy Research Project (Carlisle Barracks: U.S. Army War College, 15 April 1993), 37.

²² Philip R. LoSchiavo, "Petroleum and Water Systems (PAWS) Inland Petroleum Distribution System (IPDS) System Overview," briefing slides.

²³ U.S. Department of Defense, Conduct of the Persian Gulf War (Washington, D.C., April 1992); quoted in U.S. Army War College Selected Readings, Course 4, vol. III (Carlisle Barracks, PA: U.S. Army War College, 2000), 22-35 and 22-57.

²⁴ Philip R. LoSchiavo, "Petroleum and Water Systems (PAWS) Inland Petroleum Distribution System (IPDS) System Overview," briefing slides.

²⁵ Fred Balling, Petroleum and Water Systems Branch, Tank-Automotive and Armaments Command, telephone interview by author, 22 January 2001.

²⁶ William Perdue, "Rapidly Installed Fuel Transfer System (RIFTS)," October 2000; available from http://www.cascom.army.mil/quartermaster/pol/New_Materiel/RIFTS.htm; Internet; accessed 12 March 2001.

²⁷ William Perdue, "Operational Requirements Document for Rapidly Installed Fuel Transfer System (RIFTS)," Fort Lee, VA: Combined Arms Support Command, 4 August 2000.

²⁸ Ibid.

²⁹ Ibid.

³⁰ Ibid.

BIBLIOGRAPHY

- "Army Strategic Logistics Plan (ASLP) at a Glance (1 of 3)." Available from <http://www-acala1.ria.army.mil/LC/LCB/Bp/BPT/website/aslpdigest.htm>. Internet. Accessed 1 January 2001.
- Balling, Fred. Petroleum and Water Systems Branch, Tank-Automotive and Armaments Command, telephone interview by author, 22 January 2001.
- Bell, Marvin L. "Fuel Transfer System (IPDS II) SOL DAAE0700-Q-RA04." Commerce Business Daily, 20 January 2000.
- Bettez, Michael G. Army Pre-positioned Stocks: The Key to Our Rapid Force Projection Strategy. Strategy Research Project. Carlisle Barracks: U.S. Army War College, 10 April 2000.
- Bradley, Gary W. "The Trans-Korea Pipeline - Will There be Enough Fuel?" Army Logistician(November/December 1987): 2-6.
- Coe, Charles. "American Experts Give Thumbs-Up to Constania – Trieste Pipeline Project." 27 September 1999. Available from <http://www.gasandoil.com/goc/news/nte94869.htm>. Internet. Accessed 20 January 2001.
- Congress. Senate. Armed Services Committee. Menetrey Sees No Easing of Tensions in Korea. Senate Panel 900209, 9 February 1990. Available from <http://www.fas.org/news/skorea/1990/900209-rok-usia.htm>. Internet. Accessed 1 March 2001.
- Das, Chitta. "The Inland Petroleum Distribution System." Information Paper. Tank-Automotive and Armaments Command, Warren, MI., 1 October 1999.
- Deffarges, Hienne H., Donald J. Howard, and John E. Treat. "Central European Projects Could Alter Oil Movement Patterns." Oil & Gas Journal 89 (19 August 1991): 49-54.
- "EU Commission Proposed Strategy to Secure Oil and Gas Supplies." 5 October 2000. Available from <http://gasandoil.com/goc/news/nte04441.htm>. Internet. Accessed 20 January 2001.
- Expeditionary Aerospace Force – Innovating for the Future: A Statement on the Posture of the United States Air Force, Fiscal Year 1999. Posture Statement presented to the 106th Cong. Washington, D.C.: U.S. Department of the Air Force, 1999.
- Gorvett, Jonathan. "Battle Rages Over Pipeline's Price Tag" Boston Globe (9 December 1998): A2. Database on-line. Available from UMI ProQuest Direct, Bell & Howell, UMI publication no. 07431791.
- Hall, Janet. "The Inland Petroleum Distribution System (IPDS) Operational Project (OP)." Information Paper. Department of the Army, Deputy Chief of Staff Logistics, DALO-TSE, 18 November 1998.

- Hasenauer, Heike. "Learning to Fuel the Force." Soldiers 52 (April 1997): 34-36. Database on-line. Available from UMI ProQuest Direct, Bell & Howell, UMI publication no. 00938440.
- Hofman, A.J. Th. "The Central European Pipeline System: Another Form of Transport." Defense Transportation Journal (June 1983): 31-33.
- "Joint Logistics Over-the-Shore Operations (S-8A-0004)." Briefing slides. JLOTS Operations Course, Transportation Support Command, 13 February 2001.
- Lawton, Marc and Tacildayus Andrews. "Fueling the Force in the Army After Next – Revolution or Evolution?" Army Logistician (July/August 1999): 8-12.
- LoSchiavo, Philip R. "Petroleum and Water Systems (PAWS) Inland Petroleum Distribution System (IPDS) System Overview." Briefing Slides. Tank-Automotive and Armaments Command, October 2000.
- Mattox, Keith E. "The Army's Inland Petroleum Distribution System." Spring 1998. Available from http://www.quartermaster.army.mil/OQMG/Professional_Bulletin/1998/Spring_1998.htm. Internet. Accessed 15 December 2000.
- North Atlantic Treaty Organization. "NATO Pipeline System." 1998. Available from <http://www.nato.int/docu/handbook/1998/v213.htm>. Internet. Accessed 20 January 2001.
- Pierson-Moskowitz. "Sea State Definition Table." 2000. Available from <http://www.oceandate.com/support/Sea%20State%20Table.htm>. Internet. Accessed 22 February 2001.
- Perdue, William. Operational Requirements Document for Rapidly Installed Fuel Transfer System (RIFTS). Fort Lee, VA: Combined Arms Support Command, 4 August 2000.
- Perdue, William. "Rapidly Installed Fuel Transfer System (RIFTS)." October 2000. Available from http://www.cascom.army.mil/quartermaster/pol/New_Materiel/RIFTS.htm. Internet. Accessed 12 March 2001.
- Simpson, David A. and Homer D. Smith. "The NATO Pipeline System." Army Logistician (January/February 1985): 16-21.
- "Study of Investment Climate in the Energy Sector in the Black Sea Region, Countries Survey – Romania." November 1998. Available from <http://www.bsrec.bg/PHARE/prog95/Project2/Romania.html>. Internet. Accessed 6 January 2001.
- Thomas, Joseph T. Petroleum Operations in the Gulf War: An Operation Desert Storm Personal Experience Monograph. Strategy Research Project. Carlisle Barracks: U.S. Army War College, 15 April 1993.
- U.S. Department of the Army. Concepts and Equipment of Petroleum Operations. Field Manual 10-67-1. Washington, D.C.: U.S. Department of the Army, 2 April 1998.

- U.S. Department of the Army. Decisive Force: The Army in Theater Operations. Field Manual 3-50. Washington, D.C.: U.S. Department of the Army, July 2000.
- U.S. Department of the Army. Headquarters and Headquarters Units, Petroleum and Water Distribution Organizations. Field Manual 10-602. Washington, D.C.: U.S. Department of the Army, 12 September 1996.
- U.S. Department of the Army. Petroleum Supply Units. Field Manual 10-426. Washington, D.C.: U.S. Department of the Army, 12 June 1997.
- U.S. Department of Defense. Conduct of the Persian Gulf War. Washington, D.C.: April 1992. Quoted in U.S. Army War College Selected Readings, Course 4, vol. III, 52. Carlisle Barracks, PA: U.S. Army War College, AY 2000.
- U.S. Department of Defense. Doctrine for Logistics Support of Joint Operations. Joint Publication 4-0. Washington, D.C.: U.S. Department of Defense, 6 April 2000.
- U.S. Department of Defense. Joint Bulk Petroleum Doctrine. Joint Publication 4-03. Washington, D.C.: U.S. Department of Defense, 25 July 1995.
- Walsh, Shawn P. "Bulk Fuel Support in Bosnia." July/August 1999. Available from <http://www.almc.army.mil/alog/JulAug99/MS436.htm>. Internet. Accessed 14 January 2001.
- Willbros Butler Engineers, Inc. IPDS Overview. Executive Overview. N.P.: 29 April 1994.