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TECHNICAL REPORT

# The Value and Impacts of Alternative Fuel Distribution Concepts

## Assessing the Army's Future Needs for Temporary Fuel Pipelines

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# Summary

The Army maintains the capability to employ temporary petroleum pipelines. With the fiscal year (FY) 08–13 program objective memorandum (POM) force, the Army proposes to retain two Active and twelve Reserve Petroleum Pipeline and Terminal Operating (PPTO) companies. There is the potential to convert up to four of the PPTO companies to a unit design centered on the in-development Rapidly Installed Fuel Transfer System (RIFTS) technology, with the remaining companies retaining the existing Inland Petroleum Distribution System (IPDS) system.

But this temporary pipeline capability has been put into operation in just one of the two major combat operations of the past 30 years. Moreover, as the Army transforms, the question arises whether this single pipeline deployment was feasible only because of a unique set of circumstances unlikely to recur in anticipated future expeditionary and nonlinear warfare. If so, there is a further question of whether the Army should reallocate the resources associated with the pipeline force structure to fill other force structure needs. This report attempts to answer these questions, starting with a review of historical and anticipated requirements for temporary pipelines and then moving on to an assessment of existing and future unit designs to meet future requirements.

The review of historical pipeline use since Vietnam is summarized in Table S.1. Looking at these instances together as a group, an interesting pattern emerged. Pipelines tended to be used at discrete groups of distances:

- Short cases of 25 miles or less;
- Middle distances of about 50 miles; and
- Long distances of over 100 miles.

Further, the short-distance uses were the majority, with a few middle-distance occurrences, and just a single long-distance employment.[1]

A review of future pipeline requirements incorporated into war plans and security planning scenarios revealed a pattern very similar to the historical one. As shown in Table S.2, there are several short-distance requirements from less than 3 up to 25 miles, some mid-distance requirements around 50 miles, and again a single long-distance requirement of 160 miles.

There are several fluid transfer systems with the potential to meet the anticipated future requirements. As already mentioned, the existing (legacy) system is the IPDS. It is primarily comprised of 19-foot-long aluminum pipe sections that are 6 inches in diameter. It is high pressure, 740 pounds per square inch (psi), and capable of delivering up to 1 million gallons per

[1] The other long-distance case in this list was only partially complete at the end of hostilities and therefore not counted.

**Table S.1**
**Summary of Historical Cases from Vietnam to OIF**

| | Short Distance Up to 25 Miles | Medium Distance ~50 Miles | Long Distance 100 Miles + |
|---|---|---|---|
| Vietnam | DONG NAI–LONG BIN AB<br>• 4 miles: 6″ LWST (3 parallel)<br>POL PIER–CAM RANH BAY AFB<br>• 6 miles: 6″ LWST (2 parallel)<br>SAIGON–TAN SAN NHUT AFB<br>• 6 miles: 6″ LWST (2 parallel)<br>PHAN RANG–PHAN RANG AFB<br>• 10 miles: 6″ LWST (2 parallel)<br>QUI NHON–PHU CAT AFB<br>• 17 miles: 6″ LWST<br>VUNG RO BAY–TUY HOA<br>• 18 miles: 6″ LWST (2 parallel) | QUI NHON–AN KHE<br>• 50 miles: 6″ LWST<br>AN KHE–PLEIKU<br>• 59 miles: 6″ LWST | |
| Desert Shield | **RAS TANURA–KING FAHD APT**<br>**• 25 miles: 6″ IPDS (contaminated, not used)** | | **ADDAMMAM-HAFIR AL BATIN**<br>**• 260 miles: 6″ IPDS (partially complete at time of cease fire)** |
| Somalia | MOGADISHU: PORT–AIRFIELD<br>• 2.5 miles: 6″ IPDS | | |
| Iraqi Freedom | | USMC: BP WEST–LSA VIPER<br>• 54 miles: 6″ HRS | UDARI–TALLIL<br>• 160 miles: 6″ IPDS |
| **Total** | **7 (8)** | **3** | **1 (2)** |

NOTES: HRS = Hose Reel System, AB = air base, AFB = Air Force Base, LWST= lightweight steel tubing, IPDS = Inland Petroleum Distribution System.

day. A PPTO company is the Army unit designed to operate up to 90 miles of IPDS pipeline.[2] Emplacement of 90 miles of pipeline would take about a month using the planning factor of 2 to 3 miles per day. The IPDS system also contains organic storage capacity up to 3.78 million gallons in fabric bags.

The developmental replacement for IPDS is the RIFTS. Two key differences from IPDS are that (1) the RIFTS uses a flexible 6-inch hoseline that is expected to be as capable as IPDS in terms of throughput; and (2) the emplacement rate is projected at 20 miles per day. In testing to date, the RIFTS hose has not yet achieved high-enough pressure to make it as capable as IPDS, and its unit design does away with the organic storage capability.

Similar to the RIFTS concept is the Marine Corps' Hose Reel System (HRS). It, too, is based on a flexible 6-inch hoseline that can be rapidly emplaced. HRS operates at low pressure but is a proven system already used in combat. It has the organic capability to store over 1.1 million gallons. A fourth delivery capability, a 7,500-gallon tanker truck company, was included in the comparative analysis, as this is an alternative to employing temporary pipelines.

[2] An Engineer Pipeline-Construction Support Company is the unit doctrinally tasked to emplace temporary pipelines, as described in Headquarters, Department of the Army, Field Manual 5-482, *Military Petroleum Pipeline Systems*, Washington, D.C.: Department of the Army, August 26, 1994, p. 1-8.

**Table S.2**
**Future Scenarios**

| Requirement | Length (miles) | Event | Unclassified Description | Time Sensitive? |
|---|---|---|---|---|
| A | 25 (likely requiring multiple lines) | ISB | Permissive but remote location, time sensitive, very high throughput required | Yes |
| B | 50 | MCO | Time-sensitive requirement to move POL | Yes |
| C | 50 | MCO | Time-sensitive requirement to move POL | Yes |
| D | 10 | NEO | Austere environment, potential requirement to support other nations' forces as well | Yes |
| E | 10 | HA/HLD | Austere environment, respond to an environmental disaster | Yes |
| F | 160 | MCO | Long distance pipeline, not time sensitive | No |
| G | 35 (likely requiring multiple lines) | MCO | Not time sensitive, very high throughput | No |
| H | 10 | MCO | Short distance, not time sensitive | No |

These four systems, IPDS, RIFTS, HRS, and tanker trucks, were assessed in their performance against four key future scenario types: intermediate staging base (ISB), noncombatant evacuation operation (NEO), time-sensitive major combat operation (MCO), and non-time-sensitive MCO. The evaluation metrics are strategic deployability, number of soldiers required, time to emplace,[3] and potential investment cost. This analysis yields no clear winner among the four systems. IPDS does well in cost and soldiers required but is slow to emplace. Trucks are deemed an infeasible solution for two of the scenarios and are much less efficient as the fuel delivery distance increases. RIFTS is the fastest to emplace but the most expensive and with technical performance development hurdles still to be overcome. Finally, the HRS is economical and fast to emplace but becomes, like trucks, more inefficient as delivery distance increases in that an increasing number of pump stations and associated personnel are required.

Therefore, the overall recommendation is to proceed within the context of the decision maker's most important concern, as shown in Table S.3. If cost, for example, is the most pressing issue, then the best choice is to retain the IPDS system, perhaps supplemented by some limited acquisition of HRS hoseline. Alternatively, if strategic mobility of pipeline assets is the most important issue, then acquisition of RIFTS or the selective prepositioning of IPDS assets are the best options.

Temporary pipelines remain an attractive capability to retain in the force structure, but the question is how much. Unlike many support requirements, though, temporary pipelines do not appear to have a rotational requirement. It is generally not cost-effective to employ a pipeline unit if the fuel requirement is small or infrequently required. And as they pose an

[3] The use of "time to emplace" as a key measure may be seen as less compelling than other measures, such as "gallons delivered per unit time." In the context of this research, though, the alternative newer system the Army was seriously considering, RIFTS, was promoted primarily due to its promised speed of emplacement while holding delivery volume essentially constant. This was to be the overriding "selling point" and most-often-cited parameter in various war plans (which often do not make reference to a required number of gallons of fuel to be delivered over time).

**Table S.3**
**Choice in Light of Most Pressing Concern**

| If highest concern is . . . | . . . then choose |
|---|---|
| Cost | IPDS (maybe HRS) |
| Mobility | RIFTS (or prepo IPDS) |
| Time to employ | RIFTS |
| Personnel | IPDS + RIFTS |
| Technical risk | IPDS + trucks |

obstacle to maneuver of both military and indigenous traffic and, in contested areas, present an inviting target for enemy mischief or theft and pilferage, it is not desirable to keep them in place too long. And by their temporary nature in design and materials, they degrade over time, leaking or failing.

So one approach to take to estimate the total amount of temporary pipeline equipment and units needed is to assess how much might be needed simultaneously based upon which future scenarios might occur simultaneously. Figure S.1 indicates that about 500 miles of pipeline capability could cover all requirements at the same time, providing one estimate. Naturally, a rational case can be made for lesser totals or for dividing totals by capability. For example, if the Army decides to continue acquisition of a hoseline-based system, a reasonable amount could be 220 miles, an amount to cover the more time-sensitive scenarios, leaving the legacy IPDS systems to cover the remaining 275 miles of less time-sensitive contingency requirements.

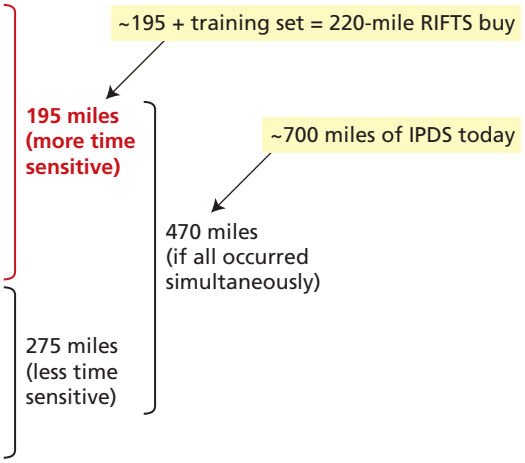
## The Way Ahead for the Army

Temporary pipeline capabilities do not come without costs. Pipelines take time and resources beyond the petroleum pipeline units, notably engineer support, to set up and operate. Allocating acquisition dollars to new technology, primarily flexible hoseline, and improved pumping stations can lessen emplacement time and the engineering support required. The Army should consider focused investments in these areas. Similarly, the need to protect the pipeline against pilferage or sabotage also remains, a task the Military Police are doctrinally expected to perform but one typically beyond their ability to cover due to other demands in theater.[4] Reorganization of the personnel allotted to the existing PPTO Company can make that unit more capable of self-protection, again, a step the Army should consider taking, as is the possibility of merging PPTO, Assault Hoseline, and Tactical Water Distribution System teams into one fluid-transfer-capable unit type (that is, a multi-function unit capable of operating either POL or water equipment but not defined by its equipment type).

[4] While the numbers of Military Police (MP) units that could potentially be needed to support pipeline operations may be of interest, this study does not address this question for the following reasons. Of the scenarios surveyed, several are in permissive environments, which indicates that MP support is not always necessary. Further, the rules of allocation for MP units in the current Total Army Analysis process include no direct link between units, such as the Military Police Combat Support Company, and a requirement to protect a distance of pipeline.

**Figure S.1**
**Sizing Total Pipeline Requirement by Simultaneity**

| Requirement | Length (miles) | Event |
|---|---|---|
| A | 75 (3 × 25) | ISB |
| B | 50 | MCO |
| C | 50 | MCO |
| D | 10 | NEO |
| E | 10 | HA/HLD |
| F | 160 | MCO |
| G | 105 (3 × 35) | MCO |
| H | 10 | MCO |

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