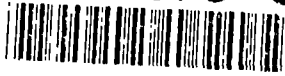
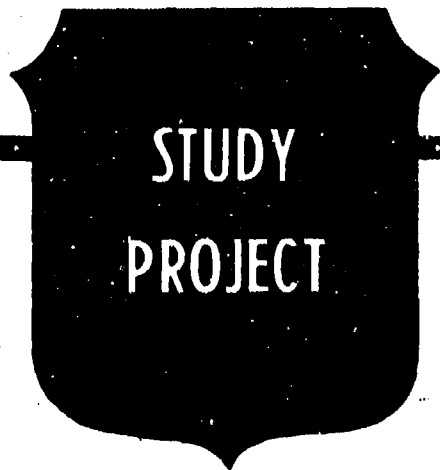


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**PETROLEUM OPERATIONS IN THE GULF WAR
AN OPERATION DESERT STORM
PERSONAL EXPERIENCE MONOGRAPH**

BY

**LIEUTENANT COLONEL JOSEPH T. THOMAS
United States Army**

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by

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ABSTRACT

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The supply of petroleum fuels to forces engaged in combat is one of the most critical logistics functions carried out in a Theater of War. During the Gulf War, U.S. forces consumed more than two billion (2,000,000,000) gallons of fuel within the Theater of War. The provisioning of this fuel and the inland distribution to more than 43 operating locations, throughout seven nations in the Middle East were monumental undertakings. Using more than 2,000 commercial tank trucks, provided through Host Nation Support (HNS), along with 13 U.S. military tank truck companies, the petroleum organizations of the U.S. Army provided up to 18 million gallons of fuel each day to the U.S. forces. The Theater managers had at their disposal the sum of the outputs from three of the world's largest petroleum refineries, and constructed tactical or managed existing commercial pipelines with a combined length of more than 300 kilometers. This personal experience monograph attempts to put the most significant efforts and accomplishments of the petroleum organizations of the U.S. military into perspective and draw conclusions as to their successes and failures. After the chronology of the petroleum operations in the Gulf War, a series of lessons learned and recommended solutions are presented.

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INTRODUCTION

Petroleum distribution in a Theater of Operations is big business. According to the U.S. Army Field Manual 10 - 67, the petroleum required to support forces engaged in combat could account for more than 50 percent of the total tonnage introduced into a Theater of Operations¹. During World War II, Patton's famous Third Army consumed slightly more than 400,000 gallons of gasoline each day². In 1944, petroleum managers considered a daily requirement to distribute 400,000 gallons to be a very difficult, if not impossible, task. The petroleum officers of World War II were scarcely able to meet the demand placed on them by Patton's highly mobile forces. During the ground combat campaign of the Gulf War, the Third Army consumed 2,400,000 gallons each day.

During the war in the Middle East, Operations Desert Shield and Desert Storm, the total amount of petroleum fuel consumed during the eight month period was slightly less than 2,000,000,000 (2 billion) gallons³. This figure represents only the fuel used in the theater of operations. It does not include the fuel used to support deployments or transportation within the Continental United States and Europe, nor does it include the fuel required for transportation to the theater of operations. The consumption of 2.0 billion gallons during the period between 7 August, 1990 and 1 April, 1991 represents an average daily requirement of just under 8,500,000 (8.5 million) gallons

throughout the entire period.

While the total amount of fuel consumed is a staggering quantity, it says little of the management required to distribute the correct amount of fuel to the proper locations at the right time.

To demonstrate the magnitude of the distribution mission, consider that the distribution, in one lift, of only one million gallons using standard 5,000 tank trucks requires five Transportation Medium Truck Companies with a 75 percent availability rate. On the most demanding day of the Gulf War, petroleum managers were required to distribute 18 million gallons.

Thankfully, in the Middle East, the U.S military found thousands of available commercial fuel hauling trucks, and diverted almost 2,500 to military use. For fuel supplies, the military had full use of three of the world's largest refineries. Finally, the military had an enemy which allowed U.S. forces to make detailed preparations prior to its attack.

THE STATUS OF THE PLAN AND THE CONDUCT OF IL-90

On 2 August 1990, the Nation of Iraq invaded and conquered the tiny Emirate of Kuwait. While repercussions were felt around the world, nowhere were they felt more directly than at the Headquarters of the United States Central Command (CENTCOM), located at MacDill Air Force Base, Florida.

One of several missions of the Central Command was the expulsion of aggressor forces anywhere on the Arabian peninsula, located in the Middle East. While the planners at CENTCOM had indeed begun to prepare for such potential action in the command's Middle Eastern Area of Responsibility (AOR), through the preparation of Operational Plan (OPLAN) 1002-90, they had not finished the plan. The OPLAN, then in its second draft, had no finalized actions necessary to insure that appropriate logistical support was in place to allow for the implementation of the plan.

Nevertheless, some seven months and just over 2,000,000,000 gallons of fuel later, the legitimate government of Kuwait would be back in power and the military machine of Iraq would be in shambles. The forces of the United States and those of 27 other nations would unite under the auspices of the United Nations and the leadership of the United States, to right a grievous wrong.

In July of 1990, the Commander in Chief (CINC) of the USCENTCOM, his staff, and his subordinate service component commands, the U.S. Navy Central Command (NAVCENT), the U.S. Army Central Command (ARCENT), the U.S. Marine Corps Central Command (MARCEN), the U.S. Central Command Air Forces (CENTAF), and the Special Operations Command Central (SOCCENT) conducted a Joint Command Post Exercise called "Internal Look 90 (IL-90)", to work through any problems existing in the draft OPLAN 1002-90.

For a host of reasons, the logistics simulations exercised during the Internal Look 90 exercise were, at best, topical. In fact, the results of the logistical operations during IL-90 had

led many of the staff logisticians at CENTCOM to conclude that the plan was, at the very best, marginally supportable. One of the biggest problems encountered during the conduct of IL-90 was the provision of adequate petroleum fuels to support combat operations.

RESPONSIBILITIES FOR PETROLEUM OPERATIONS WITHIN DOD

The Defense Department organization for strategic petroleum operations in a Theater of War is designed to support combat operations through the assignment of specific petroleum functions to the separate services and Defense Department Agencies. The mission of procuring petroleum fuels is the sole responsibility of the Defense Logistics Agency (DLA). The transportation of the fuel to the Theater of War and the refueling of ships at sea is the responsibility of the Department of the Navy. The inland Distribution of fuel to all users is the responsibility of the Department of the Army⁴.

The DLA accomplishes its portion of the petroleum mission through the actions of the Defense Fuel Supply Center (DFSC)⁵. The DFSC maintains regional offices throughout the world to assist combattant commanders in specific fuel and fuel related matters. These regional entities, called Defense Fuel Regions (DFR), serve a dual function. While serving as the DFSC representative to petroleum contractors, world wide, they also serve the several CINCs, in each AOR, by assisting in the maintenance of Pre-positioned War Reserve Materiel Stocks (PWRMS)

of fuel and in the development of potential contract sources for various fuels which may be available in time of war.

In the CENTCOM AOR, DFSC had established the DFR Middle East (DFR-ME), located on the tiny island emirate of Bahrain, in the Arabian Gulf, just off the east coast of Saudi Arabia. The DFR-ME is a combined military and civilian organization which also conducts quality assurance testing to insure that all fuels procured meet the specifications of the Department of Defense (DOD)⁶. Additionally, the members of the DFR-ME serve as the DFSC Contracting Officer's Representative (COR) in the area.

Fuel for the military, once procured by DFSC, is transported to the requiring location in tanker ships under the control of the U.S. Navy⁷. The Navy exercises its control through the Military Sealift Command (MSC). The MSC operates a fleet of contract tanker ships and, in coordination with DFSC, delivers fuel to special Navy fleet refueling ships referred to as "oilers", selected storage locations within the AOR of a combattant command, called Defense Fuel Support Points (DFSP), and in the event of hostilities to the high water mark (the point on the beach which is under water during high tide)⁸ in the Theater of War.

To accomplish this last mission, the Navy, or MSC, has the capability to dispatch to a Theater of War, a fleet of highly specialized tanker ships. These ships are outfitted with a unique fuel distribution system which allows the discharge of petroleum fuel through hoses from the ship to waiting Army

units on shore, without the benefit of ports or harbors. Tanker ships so outfitted are referred to as Offshore Petroleum Discharge System (OPDS) vessels. These OPDS vessels represent half of the military's capability to distribute fuel in an undeveloped Theater of War. The other half is operated by the Army and is called the Inland Petroleum Distribution System (IPDS).

From the high water mark, it is the Army's responsibility to further distribute the fuel inland to all authorized users. The Army accomplishes this mission through the employment of a tactical unit called a Quartermaster Group (Petroleum) or QM Petroleum Group or simply a QM Group⁹. The Quartermaster Group (Petroleum) in turn accomplishes its mission through its subordinate battalions. The battalions normally associated with a QM Group (Petroleum) are Quartermaster Battalions (Petroleum Pipeline and Terminal Operating), and Transportation Battalions (Medium Truck, Petroleum).

In a Theater of War, the QM Group must coordinate its desired pipeline routes and terminal locations closely with another Theater Army element called the Army Engineer Command (ENCOM). The ENCOM, through its subordinate Engineer Companies (Pipeline Support) is the element which actually constructs or emplaces¹⁰ the pipelines and terminals which the QM Group will operate.

The Quartermaster Battalions (PPTO) assigned to the QM Group operate the pipelines and associated storage locations from the

high water mark inland through tactical six-inch pipelines collectively referred to as IPDS¹¹. These battalions can operate either fixed storage terminals or the specialized terminals called tactical petroleum terminals (TPT). These TPT's consist of, among other things, collapsible fabric tanks, each capable of holding 2,100,000 gallons of fuel, and high capacity petroleum pumps which provide the capability to push fuel further along a pipeline.

The Transportation Battalions assigned to the QM Group consist of several Transportation Medium Truck Companies (Petroleum) which are currently equipped with 60 organic petroleum tank trucks, each with a capacity of 5,000 gallons of petroleum fuel¹². These Transportation Battalions will distribute fuel to general support (GS) units¹³ which are not near enough to the pipeline terminals to pick up their own fuel, and to other designated users throughout the Theater.

The QM Group accomplishes the inland fuel distribution mission assigned to the Theater Army Commander by DOD and effectively, performs this cross-service mission for the CINC, in this case CINC Central Command (CINCCENT). The QM Group serves as the strategic distributor of fuel to all inland users to include the Army, Air Force, Navy (ashore), Marines, DOD agencies, and other designated users throughout the theater. The QM Group is a "purple" organization with both a strategic and operational mission. The Army forces in the theater are just another customer of the QM Group.

Finally, each combattant CINC has on his staff an organization which is designed to oversee the totality of the petroleum mission from procurement to final distribution to each of the subordinate component commands. This staff element is the Joint Petroleum Office (JPO)¹⁴ and is normally allocated to the CINC's Director of Logistics or J4. The JPO is staffed with senior officers from each of the services and coordinates directly with each of the elements of the DOD petroleum community.

OPLAN 1002-90 VERSUS THE ACTUALITY OF EARLY DEPLOYMENT

In the conduct of the logistics simulations during IL-90, the CENTCOM logistic planners portrayed the QM Group as one of the first Army elements to arrive in the Theater of War. Further, as DOD doctrine prescribed, the QM Group was employed by the CENTCOM JPO to plan for and accomplish the effective inland distribution of fuel and during the exercise. In fact, representatives of the 475th QM Group, an Army Reserve unit from Pennsylvania, developed a notional Petroleum Distribution Plan¹⁵ to support the notional forces.

However, on 2 August 1990, OPLAN 1002-90 was not complete, and its associated Time Phased Force Deployment List (TPFDL) had not been finalized. As a consequence, the flow of forces into the Theater, after CENTCOM ordered execution of the plan, was conducted on a modified first come, first deployed basis. The individual services were responsible, within the constraints of

their apportioned strategic air and sea lift, for the deployment of their required forces. The CENTCOM JPO and transportation managers could only monitor and advise the services as they deployed forces into the Theater, unless one of the services required strategic lift assets beyond those allocated. Only then could they make recommendations to the CINC as to the best alternatives for the deployment.

It is worthy of note that while a draft TPFDL had been developed to support OPLAN 1002-90, the draft was predicated on several days of advanced warning and substantial deployment time prior to the actual beginning of hostilities. The fact that hostilities had begun prior to the commencement of any deployment had relegated the draft TPFDL to a position of little if any value.

On 7 August 1990, CENTCOM received a warning order from the Joint Chiefs of Staff. The order directed that CENTCOM prepare for the deployment of forces into the Middle East to support U.S. policy and prevent Iraqi incursions into the Kingdom of Saudi Arabia. Later that night the execution order came to CENTCOM and CENTCOM published an order to its subordinate commands which directed them to begin deployment. For what ever the reason, ARCENT elected not to put the 475th QM Group on their list as an early deploying unit.

With the onset of deployment, the JPO immediately began to assess the existing capability to support operations in the Kingdom of Saudi Arabia and surrounding Middle Eastern states.

Inventory levels at the various DFSPs were verified with the personnel of the DFR-ME and telephonic contact with the 475th QM Group and DFSC was made. The invasion of Kuwait had a double impact on the JPO and its petroleum mission. One, it required that the office begin immediately to prepare for possible combat operations and fuel support for these operations. Two, it meant that the source for the specific type of jet fuel required for Navy aviation operations from on-board aircraft carriers, JP-5¹⁶, had just dried up. The Kuwait Petroleum Company (KPC) had been the successful bidder for over 90 percent of all the JP-5 required for the U.S. forces in the greater Pacific Basin.

Further, on 7 August 1990 when the deployment was ordered, the CENTCOM JPO was in the process of transition. The JPO had assigned at the time, one Navy O5, two Army O5's, one Air Force O5, one Army O4, and one Marine CWO4. Of the six officers assigned, only two had been in the command for over three weeks. Of the two officers with over three weeks experience, one Army O5 and the Air Force O5, neither had ever been to the AOR.

To add to their personnel difficulties, just prior to their deployment on 7 August, ARCENT had requested that CENTCOM support early Army deployment with a petroleum officer from the J4 staff. The J4 approved the request and sent one Army O5 to ARCENT headquarters, on temporary duty, to deploy with the Army element and manage initial petroleum support for inland forces. Concurrent with the attachment of one Army officer to ARCENT, the J4 directed the establishment of a J4 forward, in Saudi Arabia,

and directed the deployment of the other Army O5 to establish a forward base. Both Officers deployed with the first elements of ARCENT and CENTCOM.

Upon arrival in the Theater, the complexity of the mission to provide fuel to the deploying forces became apparent. The only U.S. force in the Kingdom was the small, non-tactical, U.S. Military Training Mission in Saudi Arabia. On the rest of the Arabian Littoral there were only the small Security Assistance Offices (SAO) and Offices of Military Cooperation (OMC), there to provide military assistance to the local governments and U.S. Embassies. The JPO made immediate contact with the DFR-ME headquarters, located in Bahrain. Bahrain is connected to the east coast of the Kingdom of Saudi Arabia by a single 20 kilometer long bridge. The DFR-ME had already contacted its higher headquarters at DFSC and had made arrangements for personnel augmentation to assist with the almost certain increase in operational requirements.

DFSC deployed additional personnel to DFR-ME immediately and they began arriving in Bahrain on 9 August 1990¹⁷. Among others, the additional personnel included a uniformed Navy contracting officer authorized to contract locally for any required petroleum products. Concurrently, the DFR-ME dispatched a liaison officer to Riyadh, Saudi Arabia to co-locate with the CENTCOM J4 forward element. The JPO officer attached to ARCENT deployed initially to Riyadh and within two days deployed to Dhahran, Saudi Arabia, where he again established contact with the JPO element in

Riyadh.

With these elements in place, detailed planning began in earnest, to set up a structure to satisfy the fuel requirements of the U.S. forces which would soon arrive. For even then, U.S. forces were making their way toward the desert Kingdom of Saudi Arabia, the Sultanate of Oman, the United Arab Emirates, the tiny island in the Indian Ocean called Diego Garcia, and dozens of other locations within the CENTCOM AOR to support potential combat operations.

THE DECISION ON DEPLOYMENT OF SUPPORT FORCES

The political situation between Iraq and the United Nations continued to worsen, or at least failed to improve during the middle part of August, 1990. As time passed, concerns for the security of the still small contingent of U.S. forces increased and doubts about their ability to stop successfully an Iraqi incursion began to plague the ARCENT Commander Lieutenant General Yeosock. As a consequence, the ARCENT commander determined that priority of deployment would be given to combat forces, at the expense of combat service support (CSS) forces. This decision, while eminently logical, further exacerbated the problems confronting the fledgling petroleum system.

As the deployment of forces continued, the absence of a TPFDL dictated that the deployment of combat forces begin according to the draft TPFDL and that the deployment of combat support (CS) and combat service support (CSS) forces take place

as transportation became available. Further, CS and CSS units were being deployed according to emerging priorities within the Theater. The most urgent needs within the AOR dictated the sequence of deployment for those CS and CSS units which could satisfy the need. The early arriving combat forces from the various services were being furnished with fuel, albeit through nothing less than heroic efforts by the personnel of the DFR-ME. As a consequence, the requirement for the deployment of the QM Group seemed to pale in comparison to the need for logistical units with the capability to manage seaports and airports, receive forces, provide for forward movement, and provide for the physical needs of the deploying soldiers.

As a direct result of the apparent ease with which the JPO and the DFR-ME were providing fuel, and the decision by the ARCENT Commander, the 475th QM Group now found itself relatively far back in the long line of CSS units vying for position in deployment race.

The short term needs dictated that long term petroleum distribution planning be conducted by other than the QM Group. Without the presence of the QM Group, the distribution of fuel was being accomplished on a case by case basis, as units arrived into the Theater. The petroleum personnel in the Theater found themselves reacting to the current situation, with precious little time left to conduct long range planning. The seeds of disarray were being sewed.

The petroleum officers at ARCENT (rear) at Fort MacPherson, in Atlanta, Georgia, however, were cognizant that long term difficulties would certainly arise without an overall manager for the inland petroleum distribution mission. They alerted the first available petroleum unit, the 240th Qm Battalion (PPTO) from Fort Lee, Virginia, to be prepared to function as a QM Group upon its deployment to the Theater. The Quartermaster School, at Fort Lee, began to assist the 240th in its preparations to perform this vital mission.

Upon its arrival in the Theater in late September 1990, the 240th QM Battalion, began to serve ARCENT as the "in loco" QM Group in Dhahran, Saudi Arabia. Without additional personnel, the battalion began to establish small teams consisting no more than one or two persons to act as liaison teams in the various nations where the Army would have the mission of inland petroleum distribution. The battalion sent these liaison teams to Bahrain, the United Arab Emirates, and the Sultanate of Oman. These teams, headed by either a First or Second Lieutenant, in conjunction with the personnel of the DFR-ME, began to arrange for both bulk petroleum and petroleum distribution services.

Additionally, the Battalion sent liaison officers to the CENTCOM JPO and the headquarters of the DFR-ME. The efforts of the 240th QM Battalion to tie together the already disjointed distribution system were well intentioned and well executed, but were in actuality too little, too late. The Battalion found itself without either the staff or equipment to perform the

functions of fully functional Quartermaster Group (Petroleum) to the degree required in this Theater of War, which stretched from Egypt to Oman and included all or part of the territories of seven different nations.

The unit worked diligently, but to little avail. The requirements placed on the small headquarters company stretched the unit almost to the breaking point. From the very beginning, the unit was assigned to the 22nd Theater Army Area Command (TAACOM) (Provisional), not directly to the Theater Army as dictated by doctrine. This assignment had the effect of burying the unit within the hierarchy of ARCENT, it diminished the relative authority of the unit with the other services and greatly reduced its ability to affect the emerging inland distribution system.

Further, the commander of the newly established TAACOM, to which the 240th was assigned, directed that there would be only one daily logistical status report generated by his command. This resulted in the non-submission of two reports required by the CENTCOM JPO to insure the development of an adequate Theater Petroleum Distribution System. These reports were the Theater Petroleum Capability Report (POLCAP) and the Daily Petroleum Status Report (REPOL).

To make matters worse, in addition to the late deployment of the QM Group, there was no deployment of a Theater Army Material Management Center (TAMMC) to the Theater. This oversight or error by ARCENT resulted in the absence of the only unit which

had the doctrinal capability, within its Directorate of Petroleum, to maintain visibility over the precious stocks of petroleum within ARCENT and the other services. The Directorate of Petroleum was to have been the bookkeepers and accountants for the petroleum stocks in the Theater. The absence of a TAMMC resulted in the already strained battalion attempting to account for petroleum stocks, another mission for which it was neither staffed nor trained.

Another difficulty facing the fledgling distribution system was amorphous nature of the early requirements. The various services were changing their requirements for petroleum support literally on an hourly basis. As the CENTCOM component service forces arrived and new operating bases were established, new requirements were made known to the 240th. The modest number of locations requiring fuel in September, approximately 10, grew to more than 40 separate locations throughout 7 different nations by the middle of October. As the services began to disperse their forces to avoid concentrating too many assets in any single location, the number of Air Force locations requiring fuel support grew from three to 23¹⁸. The number of Army locations grew from only five locations in September, to 15 prior to the end of October.

It was at this point that the lack of service experience in collecting and submitting fuel forecasts became manifestly apparent. Each service is required to submit a daily report to the Army's TAMMC through its own service dictated channels.

These reports (REPOLs) detail that service's requirements for fuel for the next day and the following three days. They serve as the basis for the development of a distribution plan for daily distributions throughout the Theater. These reports also serve as the basis for the submission, from the JPO to DFSC, of a bulk fuel request or requisition called a "slate", detailing the Theater's total fuel requirements. DFSC uses these submissions from the JPO to schedule tanker ships and make in-theater procurements of fuel.

The absence of these reports resulted in a disjointed, uncoordinated, uniformly inefficient and ineffective distribution effort. Even when the services submitted reports to either the 240th QM Bn or the JPO, the accuracy was uniformly poor. It was not uncommon for stated requirements to be two to three hundred percent greater than actual needs. Efforts to establish liaison with the services by the 240th revealed that fuel forecasts, when submitted, were routinely developed at the service component headquarters, and did not reflect a summation of the requirements at each requiring unit or location.

No service had established and exercised, prior to the deployment, any methodology or mechanism for collecting and submitting the necessary feeder reports upon which the service headquarters could base its consolidated forecast. Petroleum officers at each service headquarters were doing their best and applying the best methods available to guess what their actual requirements would be, but the results were abysmal.

During mid-October, the advanced party of the 475th QM Group began to arrive into the Theater and began to displace the 240th as the manager of the inland petroleum distribution system. In the following months, all necessary petroleum units, except for the Directorate of Petroleum in the TAMMC, which would not be brought into the Theater at all, arrived. The planning for future operations and the execution of current missions began in earnest. The QM Group began trying to organize the jumble of existing commercial contracts, receive additional petroleum units, and establish a management structure for inland distribution. It would never be completely successful.

THE LODGEMENT PERIOD

After the arrival of the 475th QM Group into the Theater, the group's staff began to assess the petroleum situation and plan for whatever missions would come to them. The situation began, for the first time to look, despite the late arrival of the QM Group, their assignment to the wrong level of ARCENT command, the lack of a TAMMC, and poor fuel forecasts from the services, promising.

The personnel at the JPO had "discovered", a newly formed quasi-governmental agency in Saudi Arabia, called the Saudi Arabian Marketing and Refining Company (SAMAREC) which had kingdom wide operations. This company had a fleet of more than 5,000 tank trucks, which they either owned outright or had under continual contract. Additionally, SAMAREC operated three of the

world's largest and most modern refineries. The JPO began to coordinate with SAMAREC in an effort to simplify the Host Nation Support (HNS) of petroleum fuels to the U.S. forces.

SAMAREC was able to provide both bulk fuel and distribution assets within the Kingdom of Saudi Arabia, and proved to be a superb asset to the JPO, and in turn to the 475th QM Group. Elsewhere in the Theater of War, the JPO, DFR-ME, and the liaison teams had begun to negotiate with other oil companies, state owned and private, to arrange for both fuel and distribution assets to support U.S. forces in the individual states. It was during this period that the JPO and DFR-ME began negotiations with the management of SAMAREC to have the Saudis provide fuel to the U.S. forces free of charge.

These negotiations finally led, during November of 1990, to the provision of fuel, without cost, to the U.S. forces operating within and in the waters around Saudi Arabia. This agreement was made retroactive to the first day of the deployment of U.S. forces to Saudi Arabia.

This free fuel was indeed a boon to CENTCOM, since the requirements for fuel to support U.S. forces during the period between mid-September and the end of October 1990, in the absence of combat operations, had doubled from some 4 million gallons of petroleum per day to just over 8 million gallons per day. Additionally, the forecast provided by the JPO to SAMAREC outlining the daily requirements, in the event combat operations were required, had increased from just over 11 million gallons to

just under 14 million gallons.

SAMAREC's ability to provide this quantity of fuel was, according to its management, assured. However, the location of the three refineries supporting the Coalition forces precipitated great concern within the JPO over the likelihood of their continued survival should hostilities occur. The Ras Tanura refinery, operated by the Saudi Arabian, American Oil Company (ARAMCO) was near Dhahran on the east coast. The Yanbu refinery, operated as a joint venture between the Saudi's and Mobile Oil, was on the east coast of the Red Sea, in northwestern Saudi Arabia. The Al Jubail refinery, operated as a joint venture between the Saudi's and Shell Oil, was near Al Jubail on the west coast of the Gulf. At least two, the Al Jubail refinery and the Ras Tanura refinery were well within range of Iraqi ballistic missiles and probably on the direct line of march should the Iraqi military attack into Saudi Arabia.

The management of these refineries by military petroleum officers, through the Saudi management structure, was at best a difficult proposition. Not one of the petroleum officers assigned to either the JPO, DFR-ME, or the 475th QM Group had ever managed a petroleum refinery. The military petroleum community was forced to learn every lesson, on the ground, with an armed conflict imminent. This made the task all the more difficult. As the refineries began to produce to levels necessary to support the requirements of the Coalition forces, the management challenges grew.

The JPO, DFR-ME and the 475th QM Group began to form contingency plans for petroleum support should any or all of the refineries be denied to the Coalition forces. Without either the refineries or the distribution assets of SAMAREC, the ability of the in-theater petroleum organizations to support combat operations with military vehicles and imported fuel was certainly questionable.

The number of tanker ships required to transport fuel from safe sources outside the Middle East began to grow as Theater requirements grew. The time required to make the tanker ship deliveries from the continental United States was at least 35 days after the loading of the fuel. And probably most importantly, the time and ability of the military forces, even if petroleum ports were available, to offload the fuel from tanker ships made the prospect of successful petroleum support for combat operations without the support of the Saudi infrastructure questionable.

Here too, the lack of a single interface with the Navy on the totality of the Navy mission to deliver fuel to the high water mark made planning difficult. The Navy has not established a unit or element similar to the Quartermaster Group (Petroleum), in the Army, to provide a single source for the management of its petroleum mission.

Like the questions about the number of tanker ships, the number of commercial tank trucks required to distribute fuel to the many geographically dispersed operating locations in use by

the Army, Marines, Air Force, and Navy forces ashore, led the planners to conclude that any attempt to perform the distribution mission with only military tank trucks would be difficult, if not impossible.

The availability of the SAMAREC tank trucks during this period was already proving to be critical to the defense effort. ARCENT and the 475th QM Group had begun to relearn a lesson that petroleum officers had been teaching for years. That lesson was that all Army petroleum truck companies are not identical in capability. Significant problems had begun to surface as petroleum truck companies arrived in the theater and were attached to either the Army Corps or the Echelons Above Corps, 475th QM Group.

Some of the truck companies attached to the 475th had M818 or M52 tactical tractors pulling the 5,000 gallon semi-trailers. These tractors were not suited to the mission of long hauls on hard surface roads at relatively high speeds (in excess of 20 MPH), and significant maintenance problems began to occur. Conversely, some of the companies assigned to the ARCENT Corps were equipped with M915 tractors, which have minimal, if any, capability to operate off road, making them almost useless to the tactical units which they were intended to support.

Efforts to sort out which companies should be assigned to which echelons met with very little success. The ARCENT element tracking inbound units cared little about the specific type of equipment organic to the inbound units, and were concerned only

with the type unit. The 475th, which was intimately concerned with the type equipment within each unit, had no ability to track unit flow and little influence with the elements which did track them. The final solution was to wait until the units arrived in the Theater, determine which units were equipped with which tractor, and then begin efforts to assign the proper units to the proper echelon. Frankly, few units were ever reassigned and the problem was never really resolved.

Additionally, during this period, there was much debate about the number of different fuel types which would be made available to the CENTCOM forces. The JOD policy at the time was, that to the extent possible, each CINC would designate a single fuel for use in his AOR¹⁹. The CENTCOM plan (OPLAN 1002-90) called for the exclusive use of commercial jet fuel, as an acceptable substitute for the military fuel JP-8, for all applications, except for aircraft operations from on-board aircraft carriers and fuel for the boilers of the Navy ships. These requirements would be met through the use of the Navy's special jet fuel, JP5, for carrier operations and diesel fuel (diesel fuel, marine) for use in ship boilers.

The debate over the type fuel to be provided was sparked by concerns, primarily in the Army component, over the safety of jet fuels as compared to diesel fuel, when used in ground vehicles and equipment. There were also concerns about the ability of the M1 main battle tank to produce adequate smoke using its on-board smoke generators, when fueled with the commercial jet fuel.

Finally, there were concerns about the lubricating ability of jet fuel when compared to diesel. The JPO made an initial decision to allow for the use of diesel fuel by those commanders who demanded it, but jet fuel for those who did not. This debate would not be concluded until mid-December.

Another problem concerning fuel management had also begun to surface at this time. The CENTAF approached the JPO about the provisioning of a special jet fuel, Jet Propellant, Thermally Stable (JPTS). The CENTAF required this special fuel for use in its high altitude reconnaissance aircraft. Since CENTAF was the sole user of the fuel, the JPO directed them to manage the product. CENTAF appealed this decision to the CENTCOM J4 and after much debate, the J4 directed the JPO to manage this product on an exception basis. The underlying reason for the request from CENTAF was almost certainly the fact that if they managed the product, they would have to use their apportioned strategic lift to transport the fuel into the Theater. With the JPO managing the fuel, the CENTAF lift was spared.

THE ESTABLISHMENT OF A MILITARY INFRASTRUCTURE

As more and more petroleum units began to arrive in the Theater, the 475th QM Group decided, that in keeping with the 22nd TAACOM commander's desire to support combat forces through the use of Logistical bases far forward, near the anticipated Forward Edge of the Battle Area (FEBA), that commercial tank trucks would be used to support these log bases and other using

locations. This would leave the Group with 13 military truck companies, with some 780 tactical trucks, to support locations forward of the log bases.

Arriving into the Theater along with the Transportation Medium Truck Companies (petroleum) were Quartermaster Companies (Petroleum Pipeline and Terminal Operating). These companies were selected to operate Tactical Petroleum Terminals (TPT) to be located at each log base. They would also be called on to operate tactical pipelines and terminals which were to be built to connect the refineries to each of the log bases. These pipelines were to be constructed by the ENCOM troops.

The pipelines and TPT's were part of an operational project specifically designed and procured for use in the Southwest Asia. The operational project was referred to as the SouthWest Asia Petroleum Distribution Operational Project (SWAPDOP). The pipelines contained in the SWAPDOP were constructed of six-inch in diameter light weight aluminum tubing with quick connect/disconnect couplings. The terminals along the pipeline would, in fact, be the TPT's at each of the logistics bases.

Plans for the use of the SWAPDOP required that the materials be dispatched from storage depots in the continental United States for early arrival in the Theater. The SWAPDOP pipeline was specifically designed to help solve the already known problem of attempting to distribute fuel inland solely by tank truck. The nominal throughput of the pipeline was over one million gallons daily. Each use of the pipeline could reduce the

requirement for petroleum trucks by up to 200. But, as had been the case for other petroleum units and equipment, the SWAPDOP materials did not arrive in the Theater on time. The actual arrival into the port of Dammam, in eastern Saudi Arabia was early December 1990.

This lengthy delay in the material arrival had been matched by the process used by ARCENT in gaining approval from the Saudi government for the right-of-way necessary to assemble the pipelines. Once the materials were in the Theater and the approval was gained from the Saudi government, ARCENT plans called for two parallel pipelines to be constructed from the Ras Tanura refinery to the sprawling airbase which had been established at the not yet completed King Fahd International Airport northwest of Dhahran.

There was also a plan for the construction of initially one, and later two parallel pipelines connecting the Ras Tanura refinery and the Al Jubail refinery to the log bases. Finally a pipeline was to have been constructed to connect the Ras Tanura Refinery to the Al Jubail refinery, in case one of the refineries was destroyed.

The usefulness of the SWAPDOP to the Theater, was greatly enhanced through the farsightedness of the Army Materiel Command (AMC) manager for the project. He had been successful in the awarding of a contract to a civilian company to provide on the ground technical advice and expertise to the military personnel from both the ENCOM, who would construct the pipelines and

terminals and the QM Group, whose personnel would operate the facilities. Without the assistance of these contractor personnel, the inexperience of the uniformed personnel, could have easily rendered the SWAPDOP useless.

Additionally, another often overlooked, but nonetheless critical capability of the Quartermaster Petroleum Battalions was their capability to provide petroleum laboratory services to both inland petroleum users and the QM Group as the distributor. The 240th QM Bn brought its laboratory to the Theater, and later the only active duty Quartermaster Petroleum Supply Battalion, the 260th Quartermaster Battalion (Petroleum Supply), would arrive in Theater with its laboratory. These two units were the only units with such laboratory elements in the Active Component, and the demand for their laboratory services quickly exceeded their capability.

With only two tactical laboratories available, the only timely and routinely available Quality Surveillance capability available to the services would be the commercial services contracted for by the DFR-ME. Other than the two tactical labs and the contract services, the services had only their organic small specialized kits for detecting water and solid particles in fuels. In the Army units, these kits are organic only to certain aircraft operating units, others depend on the distributor. Quality Surveillance became and remained a major concern to the petroleum community throughout the operation.

THE DOUBLING OF FORCES AND RESULTANT ACTIONS

In November of 1990, the inland petroleum distribution situation, with respect to the number of forces on the ground in the Theater of War, began to stabilize. The petroleum planners, having planned for maximizing of HNS fuel and distribution capabilities as well as the deployment of effectively all the petroleum units in both the active component and the reserve component, now could begin to see the possibility of successful fuel support to combat operations. It was at this time that the President of the United States announced that he would double the number of combat forces in the Middle East. This announcement came as the United Nations authorized the use of force to expel the Iraqi's from Kuwait.

The impact of this decision was to say the very least, significant to the petroleum officers at the JPO and the 475th QM Group. Having already planned on the deployment of almost every Petroleum Truck Company and Petroleum Pipeline and Terminal Operating Company in the Army force structure, Active, National Guard, and Reserve, there was no possibility for the increase in petroleum force structure to support these additional troops.

The first and most significant impact of the announced troop strength doubling was an increase in the daily fuel requirement to support combat operations from just over 15 million gallons to almost 25 million gallons²⁰. The already straining petroleum system seemed destined to break under the weight of these astronomical requirements. ARCENT requested the immediate

deployment of the remainder of the Petroleum storage and distribution units from both the Active and Reserve Components of the Army. With the exception one truck company stationed in Europe, ARCENT received permission for the deployment of every unit to support the growing number of forces in Southwest Asia.

The planners determined that even with the deployment of the rest of these forces, that their ability to support the kind of operations which were being discussed was at best marginal. The JPO and the 475th QM Group hosted conferences with the customer units of all the inland forces to determine what was the optimum methodology to be used for combat. The JPO began to look at inventory levels and determine which units could be allowed to go below mandated storage levels in order to free distribution assets to support higher priority forces. By the end of December, plans were in place to support what was shaping up to be one hell of a fight.

SAMAREC, which had been certain of its ability to support combat operations during the period prior to the doubling of forces, now began to subtly modify its unqualified confidence in its ability to provide either fuel or distribution assets to support this new requirement. In conjunction with the JPO, plans were drawn up for SAMAREC to buy some 112,000,000 gallons of jet fuel on the open market and hold the fuel off the coast of Oman until needed. The fuel was stored in tanker ships on lease to the Saudi government. Concurrently, the JPO established a National level petroleum council. This council, composed of

members from the Saudi Ministry of Petroleum and Minerals, the Ministry of Defense and Aviation, the CENTCOM J4, and representatives from the other coalition forces, met whenever there were petroleum issues which required immediate, national level resolution. It effectively became the JPO's tool for the integrated management of the totality of the Saudi petroleum infrastructure. Its value would prove to be immeasurable.

During this same period, the JPO received an offer from the Kuwait Government offering the use of two Ultra-large Crude Carriers (ULCC) for use in transporting and storing jet fuel. The vessels which would carry over 3,000,000 barrels (42 U.S. gallons per barrel) each, were cleaned and made ready for use. Several factors, including the brevity of the conflict and the danger of putting so much fuel in one ship, precluded their use in the Theater.

It was also at this time that the JPO began to finalize plans to bring to the Theater all of the Off-Shore Petroleum Distribution (OPDS) capable tanker ships in the U.S. inventory. These vessels, each of which carries more than 250,000 barrels of fuel, have the capability to merge with Army on-shore equipment at the high water mark to allow for the distribution of approximately one million gallons of petroleum products from the ship to the shore, each day. Two of the ships were in the theater, and two more were being readied in the U.S. The third was enroute by the onset of hostilities, but the last fell victim to an accident prior to dispatch and spent the war under repairs.

It was during December that the question of whether or not to allow for the use of diesel fuel came to a head. The Army component commander, listening to the concerns of his Corps commanders, formally asked the CENTCOM J4 to modify officially the policy of allowing only jet fuel to be used in the Theater. Based on the advice of his JPO, an Army team of petroleum experts who had been sent to the Theater to investigate problems with the use of jet fuel in ground equipment and vehicles, and the concerns of the combattant Corps commanders, the J4 formally modified the Theater fuel policy and allowed for the unrestricted use of diesel fuel by those elements which desired.

THE COMBAT PERIOD

On 17 January 1991, the air operations against Iraq began. Petroleum planners had dreaded the arrival of this day for at least two reasons. This was to be the most demanding period to date as far as fuel and fuel distribution requirements were concerned. Further, this would be the final test for the small army of third country nationals who were driving the commercial tank trucks, distributing fuel to the air bases and the recently finished log bases in the north-central area of Saudi Arabia.

After the initiation of air operations, the commander of the 22nd TAACOM had intimated²¹ that the QM Group commander, along with his other subordinate commanders, should reserve their tactical vehicles for use when the ground operations began. As a consequence, almost one-hundred percent of the fuel consumed by

the Army, Marines and Air Force during the air campaign was delivered by host nation, commercial conveyance²².

As had been feared, on the first day of the air operation, the third country national drivers stayed away from work in great numbers. On 17 January, the fleet of commercial trucks which had been numbering around 1600 at each morning's dispatch, shrank to only 150²³. This news from the 475th was not received well at CENTCOM headquarters. The JPO ordered that the Army trucks be dispatched immediately to make up for the lack of commercial trucks. The commander of the 475th was hesitant to follow these orders due to his perception of the guidance given by the TAACOM commander.

The repercussions at the Headquarters of the Joint Forces Air Component Commander (JFACC) were predictably great. Telephone and message traffic increased as the air bases consumed nearly 14 million gallons and were replenished with less than 1.5 million. However, before the controversy over who could direct the Army trucks to resupply the air bases had been resolved, the third country nationals returned to work and began to distribute sufficient fuel to allay the concerns of the JFACC. The question as to whether the small number of Army tank trucks could have replaced the missing 1450 commercial trucks was never fully addressed.

Thirteen (13) Petroleum Truck companies, consisting of 60 trucks each, were available to the 475th QM Group commander. Additionally, he had formed two provisional truck companies from

tank trucks which had been provided to the U.S. forces from the countries of Germany and Czechoslovakia. These companies had been organized and staffed with uniformed personnel, without regard to Military Occupational Specialty, who had been deployed from various U.S. installations to drive trucks in Saudi Arabia.

A significant and unexpected problem began to surface at this time. The problem was how to most effectively and efficiently use the range of fuels being produced by the Saudi refineries. With the heavy demand for jet fuel, the JPO had directed that the refineries maximize their runs for jet fuel. But even with them turning out the maximum amount of jet fuel, there were sizeable quantities of lighter and heavier products produced with each run²⁴.

With the onset of hostilities, the availability of commercial tanker ships to haul away these "unwanted" products went effectively to zero, and the available storage at each refinery soon became filled with the unwanted diesel fuels and motor gasoline by-products. With their tankage full, the ability of the refinery to produce any additional refined petroleum products was threatened. The decision to allow for the use of diesel fuel by the ground forces, in addition to jet fuel, greatly assisted in the resolution of this problem.

Further, the JPO took immediate action, in coordination with the Navy and SAMAREC, to arrange for Navy protection of commercial tanker ships which would be escorted to the refineries to carry away the by-products, and allow for the continued

production of jet fuel. In somewhat of a reversal, the JPO also began to lobby intensely for greater use of the diesel fuels by the ground forces. These efforts paid off in the short run, and the refineries were kept in operation. The consequences of a longer war on the ability of the refineries to produce jet fuel was not addressed.

During the air operations, prior to the commencement of combined air and ground operations, the 475th QM Group, finally using all its military assets as well as the HNS tank trucks, was able gradually to increase the inventories at both the air bases and the forward logistic bases. By the beginning of the ground operations phase, the combined inventory level at the logistic bases was over 36 million gallons, and the days of supply of jet fuel at the air bases had grown to seven.

Many discussions between the 475th and SAMAREC went on during the period of the air operations as to the best way to insure that the third country national civilian drivers would work when the ground phase of the war started. Ideas ranged from placing an armed guard in the cab of each vehicle to extra payments for completed deliveries. The only ideas implemented, however, were the ones concerning bonuses for timely completion of missions. In addition, each civilian driver was provided with a chemical protective mask. Receiving personnel at each of the delivery locations, air bases and log bases, were instructed to treat these drivers as they would any soldier. The drivers were to be provided with food and water, and allowed to rest prior to

returning with the empty tank truck. The military personnel at the delivery points responded well, and reports of driver satisfaction began to surface, for the first time.

Nevertheless, on the day the ground operation began, the same thing happened as happened the first day of the air operation. The third country nationals failed to report for driving duty. The number of drivers failing to report for duty, however, was smaller and the length of time before they returned was shorter. The consensus of opinion, both in the JPO and at SAMAREC, was that the drivers waited long enough to discern that the coalition forces were successful, prior to returning to work. The question as to whether or not they would have returned if the battle had gone poorly was left unanswered.

Shortly after the onset of ground operations, the inability of the Army forces to manage their internal petroleum distribution operations became important to the JPO. Of the 13 truck companies assigned to the 475th for the Theater's inland distribution mission, nine were dispatched forward on 24 February, to fill ullage at newly established forward logistic bases. Three days later, none had returned to replenish their tankers. The four truck companies not forward with the Army forces were those assigned to the 240th QM Bn, operating in direct support of the Marine Corps. The JPO and the 475th knew that there was a significant bubble forming in the resupply pipeline to the CINC's Army forces. By 27 February, the situation facing ARCENT was becoming critical.

One instance was reported at logistics base "Charlie" of an Army officer, offering an "official letter" to assist "volunteer" third country national truck drivers should they make application for U.S. citizenship, sent "volunteer" drivers and their commercial trucks forward into Iraq to resupply Army forces. It was manifestly apparent to the JPO that ARCENT had lost complete control of its internal resupply of fuel, and was in very great danger of grinding to a halt if the conflict continued. In the opinion of the personnel at the JPO, there was no doubt that the retention of the EAC tank trucks would have soon led to an effective end to resupply operations to the ARCENT forces.

The other result of the 475th trucks remaining forward with ARCENT forces was that the total Theater resupply mission, as well as the redistribution of fuel between the log bases, was now exclusively dependent on the SAMAREC commercial trucks. These trucks, now numbering over 2000, had been working around the clock to satisfy the requirements at the air bases. By minimizing turn-around times and using trailer transfer procedures at the receiving locations, they had been reasonably successful in keeping pace with demand²⁵, prior to this new unplanned requirement to provide total support to all Theater users. The Army was at that time using every petroleum truck assigned to ARCENT solely for the support of Army forces, without the commercial trucks, no deliveries could have been made to any other customers, save the Marines.

The tactical pipelines were proving to be of little help. The fact that they were started late and rushed to a degree of completion was now becoming apparent. The line which had been planned to supply diesel fuel to the western logistics bases was now complete to logistics base Bastogne and had been extended half way, some 75 miles, from Bastogne, toward logistics base Alpha. It was of little use to the more westward logistics bases. The two parallel pipelines which connected King Fahd International Airport to the Ras Tanura refinery had been inadvertently filled with contaminated fuel when the feeder lines, which had previously contained natural gas, added great amounts of sulfur to the fuel, rendering it useless for aircraft use. The pipelines had to be shut down.

The pipeline which had been constructed from the refinery in Jubail to the Jubail airport was not in use due to multiple significant leaks. As each of these pipelines had to be closed, the demand on the limited number of commercial trucks increased.

With potential mission failure at almost every turn, senior petroleum personnel, under the direct guidance of the JPO, applied patch-work solutions and quick fixes in desperate attempts to insure that the combat forces of the several component commands were successful, or at least not unsuccessful due to a lack of fuel. When combat operations on the ground were terminated after only 100 hours, the entire petroleum community in the Theater breathed a sigh of relief.

The war had provided a test of both doctrine and individual wills, and both had proven relatively sound. The problems encountered during the seven months of "combat" operations for the petroleum units were inclusive of almost all possible problems.

MAJOR LESSONS LEARNED AND RECOMMENDED ACTIONS

The great majority of the lessons learned by the petroleum community are directly applicable to any war. Unlike many of the other functional areas, the petroleum community can glean many critical lessons and with the proper resources, initiate many fixes which would better assure success in future conflicts.

In the following paragraphs, the most critical strategic petroleum lessons learned from the Gulf War are grouped by major heading and summarized with a recommendation as to possible corrective action which should be taken to correct the problems.

FORCE STRUCTURE

To satisfy fuel requirements generated in a modern conventional war effort, it is essential that all military organizations with responsibilities for the provision of petroleum be present in the Theater of War. Further, it is absolutely necessary that they arrive in the Theater of War in the order called for in doctrine. The element responsible to the CINC for the inland distribution mission, the Quartermaster Group (Petroleum), must be assigned to a level of command where it is

able to function as a theater asset with a theater perspective. The Quartermaster Group (Petroleum) must finally be organized and equipped with transportation and communications assets to support operations which may take place in several nations and along a front hundreds of miles long.

In order to insure a satisfactory interface between the Army, with its strategic responsibility for inland distribution, and the Navy, with its strategic responsibility for delivery of fuel, via tanker ship, to the Theater from sources outside the theater, it is critical that the Navy form an entity similar to the Army's Quartermaster Group. This entity would serve as the single point of contact for the Navy in their discharge of their petroleum distribution mission.

Much of the success during the Gulf War can be directly attributed to the commander and personnel of the DFR-ME. It is absolutely imperative that these small elements be maintained in each CINC's Area of Operation. These personnel have a uniquely "petroleum" perspective and provide the critical links between the local petroleum infrastructure and the personnel of the JPO and later, the deploying personnel of the Quartermaster Group.

Not only must the ability to contract for fuel and associated services, such as distribution and laboratory testing be maintained, but the single purpose petroleum expertise must be present. Absent the DFR-ME, the CENTCOM JPO would not have been nearly as successful during the early periods of deployment and the reception of forces could easily have been delayed.

The staffing of JPO at the time of the conflict was excellent. The fact that it was at 200% of authorization was a fortunate accident of timing. It is important that the JPO of each CINC be staffed by absolute experts from each of the four services, Air Force, Army, Navy, and Marine Corps. The Joint Petroleum Officer slot must, in time of war, be filled by an officer in the grade of O-6, in order that he be able to provide visibility on petroleum matters at the same level as the other division chiefs on the J4 staff.

The Gulf War also graphically demonstrated that the petroleum force structure in the Army is woefully inadequate to perform its mission of inland distribution to all services. While less than half of the Army's combat strength was present in the Gulf War, almost 100 percent of the Army's petroleum capability was present. It is imperative that the Army relook its capability to support not only itself with petroleum in time of war, but the other land based services as well. With the tremendous amount of fuel required on today's battlefield, the Army must insure that this strategic mission can be accomplished.

Finally, the issue of host nation or third country national drivers must be examined in detail. The Army's reliance on host nation support drivers and trucks worked during the Gulf War, but if the initial stages of the war had gone poorly, the results could have been much different. With a reliance to the degree exercised during the Gulf War, the Army could well be asking for mission failure in future conflicts. Certainly the answer to the

problem lies not in the dispatching of infantry and artillery soldiers to the Theater to serve as drivers, as was done during the Gulf War.

FORCE TRACKING

It is of paramount importance that the organic equipment within the Transportation Medium Truck Companies be known prior to their arrival into a Theater of War. The knowledge of which tactical tractors are present in each unit is critical to insure that they are assigned to the appropriate theater echelon, depending on the unit's capability to distribute fuel cross-country or on hard surface roads. To this end, it is critical that Army force trackers have sufficient information on TPFDL documents so that they can make the determinations both as to what type tractors are in each of the deploying Transportation Medium Truck company and later, as certain companies are outfitted with the Army's new 7,500 gallon semi-trailers, the type trailer organic to the each company.

PIPELINE OPERATIONS

It is also critical that the pipelines and TPT's in the Army's operational project stocks be available to petroleum operators early on in any conflict to insure the most effective and efficient modes of distribution are established. The Army must decide, prior to any deployment, whether or not to use tactical pipelines for the discharge of its inland distribution

mission. If the answer is yes, the training of Army officers must be modified to include significantly more instruction on pipeline operations and specifically, hydraulics.

TRUCK OPERATIONS

The Army must develop some automated procedure for use in the selection and utilization of truck assets. The Gulf War demonstrated conclusively that efficient use of tank truck assets is essential to successful combat operations and that the manual methods for selection and tasking of truck companies cannot continue in theaters where truck assets are limited.

POLICY

Department of Defense and service guidelines on fuels and fuel use must be modified immediately to prescribe the use of every fuel type available in the Theater of War. While the concept of a single fuel for use by all services makes sense in the abstract, the realities of a given Theater of War may dictate the use of two or more fuels for a whole host of reasons.

Special petroleum products, such as the Jet Propellant, Thermally Stable (JPTS), required for very specialized Air Force aircraft, should be managed within the individual service, using the strategic lift allocated to that service. Much time and effort were expended by the JPO in the Gulf War managing affairs which affected only one service. The JPO should maintain its joint outlook wherever possible and not insert itself into

individual service matters which do not affect the Theater as a whole.

Each service must re-look its forecasting techniques. Many shortfalls in the distribution system during the Gulf War were only figments of an individual service's imagination. Fuel forecasts, when received, were uniformly overstated from the initial deployment to the final stages of re-deployment. Services must train personnel in fuel requirements forecasting and mandate the submission of necessary reports. The Department of Defense must develop, and/or adopt a service-wide forecasting algorithm, and mandate its use throughout the services.

TRAINING

Each service must provide for sufficient training and education of its petroleum officers to allow for informed quick fixes in the field. Mere technical training is insufficient. Petroleum officers must be well grounded in fuel characteristics and logic behind the directives promulgated by the various Petroleum centers of each service, so that when alone, in a combat environment, the officers can make informed decisions about such things as fuel substitutions, pipeline modifications, fuel intermingling, and conversion of tank trucks from one product to another.

QUALITY SURVEILLANCE

The Army, and each service internally, must provide for sufficient laboratories to allow for the proper monitoring of fuel quality. The requirement for quality surveillance throughout the distribution network, down to the air base or tactical user must be met. Tactical laboratories, while allowed for in the Army's doctrine, were not present in sufficient numbers in its force structure during the Gulf War.

CIVILIAN CONTRACTORS

The use of civilian contractor personnel in a Theater of War should be reinforced. The presence of knowledgeable civilians to supplement the Army officers' lack of in-depth knowledge of commercial petroleum operations is absolutely critical. During this conflict, the presence of these civilian advisors (and sometimes liaison personnel) was invaluable in day to day dealings with host nation commercial companies, refineries, and local civilian suppliers.

STRATEGIC LIFT

The Navy must intensify its efforts to either procure, or identify for potential use, sufficient numbers of commercial tanker ships to provide for trans-oceanic lift of petroleum fuels, to support a force the of the size and composition of the one which fought the Gulf War. Had local source of petroleum fuels not been available to support this war, the ability of the

Military Sealift Command would have been severely tested. The tanker ships must also have the capability of mating with the Army at the high water line, via the Off-Shore Petroleum Distribution System. Without petroleum ports, the ability to provide the quantities of fuels required for the Gulf War would have been impossible. Today, each of the MSC OPDS vessels have the capability to discharge just over one million gallons of fuel per day. Recall that the daily requirement for the forces during the combined air-ground operations was forecasted to be some 25 million gallons daily.

CONTINUATION OF OPERATIONS

Finally, it is essential that the capability for Theater Ballistic Missile Defense be extended to include the petroleum group and its operating elements. During the Gulf War, the Headquarters of the 475th Quartermaster Group was attacked by an Iraqi SCUD missile, and the results could have been catastrophic for the petroleum distribution mission. While the attack was costly in terms of human life lost and personnel wounded, the fact that the group operations element had displaced from the main location, certainly allowed for the continuation of the distribution mission despite the attack. These specialized organizations are one deep in each Theater. Should a significant portion of the unit be lost, the mission which they perform is in grave jeopardy. Ballistic missile protection, along with dispersion of operating elements, and specific, workable plans

for continued operations in case of attack, are absolute necessities.

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