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WORLD TANKERS SURVEY

SHARP DOWNTURN IN CANADA'S ENERGY ACTIVITY

Third World oil development

SPECIAL REPORT

The military demand for oil (Part 3)

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Vulnerability of sea transportation

by Tom Cutler

Central to the concept of a nation's energy security is its military oil supply vulnerability, i.e. *the probability that oil supplies might be disrupted on a scale sufficient for it to be impossible to fulfil minimum requirements. The availability of oil from producing and refining companies in wartime is of no help unless military fuels can be transported into combat zones by pipeline, barge, rail, and truck as well as by ocean tanker. Although refuelling at sea by militarily unique oilers has proven to be an important aspect of naval power, it is evident that under a variety of wartime scenarios a number of countries would have to call upon the assistance of commercial oil shipping interests in order to deliver fuel to military users.*

NAVAL demand for energy in most countries is confined to consumption by ships and shore facilities, but some of the world's major naval powers also operate aircraft which consume considerable amounts of jet fuel. For example, aviation fuels account for 40% of total petroleum product consumption by the US Navy, while in other nations, naval oil consumption is for marine diesel and fuel oil only. What is common to all navies, however, is that petroleum is their primary fuel[1].

The military significance of petroleum in the naval context is two-fold: it is both a fuel essential to the conduct of ship operations, and a commodity that is transported by military-owned oilers and commercially chartered tankers.

The notion that oil-fired ships could be faster than their coal-fired counterparts first inspired consideration of petroleum as a naval ship fuel. In 1912, the UK established the Royal Commission on Oil and the Oil Engine which subsequently recommended the construction of the first battleship with boilers designed solely to burn fuel oil. While some British Admirals advocated bypassing oil-fired steam boilers and proceeding directly to internal combustion engines which were seen to offer even greater power with less exhaust smoke, Germany was reluctant to build oil-fired surface combatants since it needed to conserve scarce petroleum fuel for its submarines. Meanwhile, upon the outbreak of World War I, France experienced shortfalls in ocean tankers by which it could receive imported oil, having only 14 tankers sized 3 000-6 000 dwt. Shortages of tankers and the threat posed by German U-boats to tanker convoys crossing the Atlantic gave way to the widespread carriage of fuel in the double-bottoms of ordinary merchant vessels, including over one million tons to the UK alone by this method between the summer of 1917 and the end of the war. Since then, changes in naval tactics and the advent of new weapons technologies, such as surface-to-surface and air launched over-the-horizon missiles, have made the specialised military tankers which form the backbone of naval petroleum activities even more vulnerable to attack.

Military significance of tankers

The pattern of naval ship movements differs from the network of trade routes sailed by commercial vessels. Naval functions encompass routine logistical support and patrol in peacetime, localised cruising at key choke points, and combat operations in wartime on the ocean surface and in the depths below. Naval ships often stay at sea for months and in doing so require a constant flow of logistic support by supply ships to maintain operations. For this reason many navies supplement their fleets of combatant vessels with specialised tankers (oilers) that make the final transfer/delivery of fuel. In the case of the world's largest navies, notably those of the Warsaw Pact and NATO countries, access to bunkers in foreign ports is secured by prior political arrangement.[2]

The key difference between tankers and oilers is that commercial tankers are designed to discharge their cargo in port or while at anchor by offshore buoys, while military tankers (oilers) are also able to transfer fuel to other ships while underway at sea. the Soviet Union has the world's largest military tanker fleet, consisting of 59 vessels, followed by the US (51), China (36), Japan (25), the UK (21) and Spain (13) — (see Table). Many of these military-type tankers have specialised equipment and safety features and have ship speeds and cruising range in excess of commercial standards. In addition to these tankers, some major fleet combatants, such as aircraft carriers and cruisers, can refuel their screening destroyers while at sea.

The ideal military tanker is a clean, handy-sized (20-25 000 dwt) product carrier capable of loading and unloading its cargo under difficult circumstances such as in rough weather, under combat conditions, or offloading to shore users where there are no port facilities. Shallow ship drafts are necessary when unloading is conducted at beaches or in military ports where there are no deep water facilities. Tank coatings must be acceptable for carrying military grade petroleum products. Proper attention to the rotation of product grades and the cleaning of cargo tanks is also very necessary since tankers in military service often carry specialised military fuels uniquely susceptible to contamination. For these reasons, for example, the US Military Sealift Command (MSC) designates specific tankers with special tank coatings for the transport of sophisticated aerospace fuels such as JP-7 to overseas bases for use by high-performance US Air Force 'Blackbird' SR-71 reconnaissance planes.

Mr Tom Cutler, of the US Department of Energy, is currently chairman of NATO's Petroleum Planning Committee. The views expressed in this article do not represent the official positions or policies of the US Department of Energy, the US Government, or the North Atlantic Treaty Organisation (NATO). The final article in this series will be published later.

Criss-crossing the three-quarters of the globe covered by water are several thousand commercial tankers carrying volumes of oil and oil products estimated to be equivalent to over two-thirds of international oil trade. Military demand for tankers represents a negligible part of this market. Occasionally the military will charter ships on a spot-basis, but they generally prefer longer-term charters, including bareboat (long-term leasing) arrangements, to ensure security of support, even if it entails paying a premium rate. Smaller sized ships are often preferred even though there can be greater economies in the larger sized ships.

Commercial pipelines affect the need for tankers, particularly coastal vessels which are ideally suited for military operations. A US perspective on this point, for example, includes the irony that the Colonial Pipeline, built along the US East Coast to avoid the threat to domestic fuel supplies posed by German U-Boats in World War II, now works against the US military since it displaces the handy-sized tankers that would otherwise be commercially employed in coastal trade. Indeed, surplus quantities of ships are desired by military planners for the purposes of redundancy. For example, attrition rates as high as one-third have been estimated for a North American reinforcement of Europe across the Atlantic during the first weeks of a conventional NATO war.

Under many hypothetical war scenarios, merchant shipping interests would be subjected to unprecedented demands by the military for oil tankers which would be requisitioned and directed along routing patterns uncommon in peacetime. Using the instance of a NATO-Warsaw Pact conventional conflict in Europe as an example, there would likely be a shut-off of Soviet natural gas exports to Western Europe as well as the closure of oil and gas production platforms and pipelines in the North Sea. This would result in a significant loss in energy that would somehow have to be replaced by the affected countries in near equivalent amounts, most likely by imported oil. This oil would have to be first obtained and then transported, inevitably, by ship. This, in turn, would create an incremental demand for tankers. Increased volumes of oil and the likelihood of longer voyage distances would further increase the need for ships above peacetime levels. Thus, oil shipping issues could be more severe and intractable than challenges of gaining the initial access to sources of crude oil and petroleum products.

It is clear that in the case of some nations, it may be necessary to call upon commercial shipping interests to make ships available in support of defence efforts. Although military requirements in war for petroleum and estimates of the number of ships needed to provide the necessary transport under alternative, hypothetical war scenarios are classified by governments, it can be presumed that in some cases it will be necessary to convert commercial tankers for military service (*i.e.* installing rigs for refuelling at sea) so that they might serve as naval fleet oilers and/or convoy escorts.

MILITARY TANKER FLEETS OF THE WORLD

		World Military Tanker Fleet		
	Country	**Large**	**Small**	**Total**
1	Soviety Union	28	31	59
2	United States	48(7)(10 res)	3	51
3	People's Republic of China	6	30	36
4	Japan	1	24	25
5	United Kingdom	10	11	21
6	Spain	1	12	13
7	East Germany (GDR)	0	10	10
8	West Germany (FRG)	8	2	10
9	Turkey	1	9	10
10	Italy	2	7	9
11	France	3(1+1)	4	7
12	Peru	0	7	7
13	Poland	0	7	7
14	Taiwan	0	7	7
15	Greece	0	6	6
16	India	2	4	6
17	South Korea	0	6	6
18	Yugoslavia	0	6	6
19	Brazil	1	3	4
20	Bulgaria	1	3	4
21	Chile	2	2	4
22	Indonesia	1	3	4
23	Portugal	1	3	4
24	Sweden	0	3	3
25	Thailand	0	3	3
26	Argentina	2	0	2
27	Denmark	0	2	2
28	Mexico	0	2	2
29	Philippines	0	2	2
30	Saudi Arabia	2	0	2
31	Australia	1(1)	0	1
32	Bangladesh	0	1	1
33	Canada	0	1	1
34	Pakistan	0	1	1

Source: Captain John Moore, editor, *Janes Fighting Ships, 1985-86* (London, Jane's Publishing Co, 1985), pp. 160-161.

Note: Designation of ships into the military tanker category necessarily includes ships with wide variations in capability; more precise descriptions can be found in the source referenced for this table. Figures presented as follows: 7 = active; (7) = building; (+7) = proposed; (7 res) = in reserve; and (7+7) = building and proposed.

Refuelling at sea

At the present time, refuelling at sea is conducted by one of two methods: (1) the astern method, and (2) the along-side (or abeam) method.[3] When fuelling astern, the supplying ship trails a buoyant fuel hose over the stern which the receiving ship following behind brings onboard and connects to its fuel system. Everything being equal, this is both more cumbersome and slower than the abeam method. If a tanker is properly equipped on both sides, the abeam method has the advantage of being able to fuel two ships simultaneously. Under the US Navy's abeam procedure, the two ships travel in parallel at the same speed, about 120 feet apart, connected by tensioned wire ropes and hoses. The fuel hose is passed over by a special rig which suspends it between the two ships with sufficient slack so that minor variations in the distance between the two ships do not disrupt refuelling. However, the abeam method is considered more hazardous in terms of ship collisions since ships engaged in refuelling must reballast as they give up or take on fuel.

Fleet oilers normally steam at speeds of 12-16 knots while transferring fuel underway. (Conditions permitting, fast combat support ships and major combatants can transfer fuel at higher speeds). Modern US fleet oilers can rig up to five separate transfer stations for delivery of ship and aircraft fuels. Lube oils are either carried in the ship's tanks for bulk delivery by alongside transfer (hose/rig) or in drums which are transferred between ships by helicopter or high-line transfer. These oilers are usually rigged to port for fuelling large ships down to the size of cruisers, and rigged to starboard for destroyers and smaller ships.

One of the lessons learned by the US during its military involvement in Southeast Asia was that it was possible for merchant tankers equipped with astern refuelling rigs to refuel destroyers and aircraft carriers in addition to just military convoy escort oilers. Astern refuelling rigs were used instead of along-side equipment since merchant

tankers could be outfitted in a much shorter period of time. The tanker would trail through a stern roller assembly a single 6-inch hose rig to the receiving ship, generally following slightly to starboard at 12 knots. The transfer of a full fuel load from a tanker underway instead of a fleet oiler might take 16-20 hours or more but it still saved time since returning to port for supplies and then rejoining the fleet would take even longer.

It was also during the View Nam war that the broader military logistical requirement of delivering other items of supply, such as ammunition and food, to naval ships deployed at sea motivated the US to develop uniquely designed replenishment ships capable of carrying and simultaneously offloading fuel, ammunition and other essential supplies while underway at sea.[4] The introduction of these ships in the US fleet reduced the complexity and time of replenishment for aircraft carriers from three supply ships in ten hours to one replenishment vessel in three hours pumping fuel at 3 500 barrels/hose/hour.

More recently, the Soviet Union has begun replacing its military oilers and World War II vintage astern systems with replensihment ships modelled after Western designs so as to more efficiently support its rapidly expanding scope of naval operations. Invariably painted in merchant colours, these replenishment ships can deliver fuel by both the astern and alongside methods, thereby allowing for up to three ships to be provisioned at the same time. It is standard Soviet practice that all its merchant ships and tankers be configured with standardised sea refuelling systems compatible with those of Soviet naval combatant and support vessels.

Commercial tankers in the Falklands War

The relatively short duration of the April 1982 Falklands (Malvinas) War — fighting lasted only three weeks — can be partially attributed to the ability of the British Navy to establish and support military operations over long distances and in remote ocean areas. In deciding to recapture the disputed islands seized by Argentina, the UK was confronted with the military task of mounting an amphibious assault on islands 8 000 miles away. The closest military facility available to the UK for staging forward operations was at Ascension Island, 3 500 miles northeast of the Falklands. South American ports were not expected to offer bunkering and replenishment facilities to the Royal Navy and the closest African port to the Falklands available for bunkering was Freetown in Sierra Leone, 4 100 miles away. It was obvious that the naval task force would need to carry substantial amounts of fuel to sustain itself and to support its attacking air and ground forces.

The provision of merchant ships from the commercial sector was imperative. Tankers would play four separate roles. First came the convoy escort oilers which already had a designated role in existing war plans for the North Atlantic; they would sail with naval combatants. Second came the auxilliary support tankers and third were the base storage tankers who would move fuels from commercial oil terminals to UK Ministry of Defence storage farms and depots. Lastly, there were tankers used for water suppy.[5]

Tankers were needed so badly to fuel the fleet that an ex-British fleet tanker, already sold to Chile, was urgently re-acquired. Under the necessary authority dating back hundreds of years the Queen declared all British flag shipping to be subject to requisition in support of the war effort. Although this was complicated by the market reaction of doubled war risk insurance, the administrative process was remarkably swift under the project code-named by the military as 'Operation Corporate'. The magnitude of the strategic significance of these tankers is illustrated best by the fact that at one point there were over 450 000 tonnes of petroleum in transit for British forces in and around the Falklands.

Laid-up ships were requisitioned wherever possible to minimize the disruption of ongoing commercial trade. Vessles from the offshore oil industry were also called upon. Ocean salvage tugs were called away from the North Sea and brought into service, as were mooring vessels engaged in offshore oil production activities. Multi-purpose diving and surface support vessels were also required, such as the *Stena Seaspread* which was at work on offshore rigs in the North Sea Thistle Alpha field when she was requisitioned. Her departure from commercial duties was so sudden that a diver was still in the decompression chamber when she arrived in Portsmouth to be readied for military duty. Modified in 4½ days by crews working around the clock, she sailed immediately for Ascension to serve as a fleet repair ship.

Eventually, the number of merchant ships exceeded the number of naval vessels in the Task Force, including fourteen tankers from the Royal Fleet Auxilliary (RFA) and fifteen from commercial sources. Eight BP tankers were requisitioned in the first fifteen days, and refitted with specialised refuelling equipment. Two of the BP ships — 25 498 dwt *British Tamar* and 25 905 dwt *British Esk* — were already earmarked by longstanding NATO plans for military support and therefore their conversion was almost immediate since astern refuelling equipment had been designated for their use as convoy escort oilers. Shell and other firms also provided tankers equipped with special hoses to provide along-side refuelling for certain RFA tankers. There were some ships which could only be rigged to receive fuel from astern and their pumping rates were exasperatingly slow. For example, it took the passenger liner *Queen Elizabeth II* serving as a troop carrier nine hours to take on 4 000 tons of fuel upon her departure from an area off the island of South Georgia.

Sometimes having to conduct operations at night under atrocious weather conditions, these tankers would pump fuel while zigzagging to minimize their exposure to submarine attack. The longest refuelling at sea was by the *British Tamar* which supplied 18 000 tonnes of bunkers in 52 hours and 40 minutes to the RFA *Plumbleaf* in gale force weather so strong that the ships were forced to turn to a downwind course in order to complete the task. Occasionally, fuel lines would freeze or break in the cold and heavy seas. The tanker *British Dart* performed its first refuelling at night (the men used torchlights) in a rainstorm with winds reaching 55 knots. The Shell tanker *Eburna* transferred both fuel and lube oil in drums in weather of hurricane force amid icebergs. For this reason, some tankers had their hulls strengthened for Arctic waters. Other tankers were bombed by Argentine forces or shot at. Despite all these hardships, there were only a few instances of minor ship collisions during refuelling-at-sea.

The task was further complicated by the variety of fuels required, although some oilers were capable of mixing additives onboard. The Royal Navy's ship turbines ran on marine diesel while some of the older ships, including the *HMS Hermes* aircraft carier, burned fuel oil. Non-military grade marine fuels were needed by the merchant ships and it was also necessary to transport fuel for aircraft and

helicopters. Therefore, dry cargo ships ferrying VTOL Harrier aircraft were modified to carry up to 270 tonnes of extra aviation fuel in flexible tanks stored on deck, and in some cases pumping systems were installed to refuel helicopters while at sea. Ground fuels and lube oils were transported in 200-litre drums.

In order to maximize the operating range of ships in the Task Force, ballast tanks normally filled with salt water to maintain stability were filled with fuel instead. This created ship handling problems while underway as the volume of liquids stored in these tanks could not be routinely ballasted in the ship's fuel storage and distribution system. Even the repositioning of draught marks to allow for the carriage of additional fuel failed to avert stability problems. Another problem was that the British Navy's most modern frigates and destroyers had been designed such that they needed to carry 50% of their fuel capacity in order to maintain stability. As a consequence, they had to refuel every three or four days. This meant that deployment of the Task Force could not exceed the speed of the fastest tanker, 19 knots, and in fact for this reason the Fleet's average speed while being deployed to the South Atlantic has been estimated to have been reduced to only 15 knots.[6/] Notwithstanding these difficulties, the UK experience in the Falklands War demonstrated the value of emergency planning for the use of commercial tankers by the military in war.

Military oil supply vulnerability

Governmental authority and the establishment of legal means by which political leaders can impose emergency decrees requisitioning commercial ships for military use varies by nations. In some cases national plans are coordinated through multilaterally-devised and agreed upon arrangements (*e.g.* the NATO merchant shipping pool and war-risk insurance arrangements under the Interallied Insurance Organization). However, in spite of the fact that such contingency plans would certainly have some degree of success, conditions in the tanker market today are such that concerns have arisen as to whether the private sector is in a position to mobilise successfully and provide the oil shipping resources and services deemed necessary for national defence purposes.

Trends in today's depressed tanker market have military implications leading to possibilities of wartime shortages of suitable ships to transport military fuels, or function under militarily unique circumstances. A substantial portion of the world's tanker fleet is laid up because of depressed market conditions, leading to widespread scrapping of ships otherwise suited for military use in wartime. In many instances, small tankers suited for military use are older than the larger, more modern tankers in commercial fleets and therefore, because they are less efficient, it is the smaller vessels which are the first to be scrapped.

Oil companies' divestiture of their tanker fleets to varied independent interests expands the military's complicated problem of developing cooperative arrangements with private tanker owners in emergencies. While increased product trading on world markets might ease the situation through the new construction of long-haul product carriers, the availability of surplus VLCC's rendered obsolete by increasingly scarce long-haul voyages for which they are economically sized and suited has relatively little direct utility for the military in wartime.

Close cooperation and planning among civil, commercial and military authorities in peacetime is essential to ensuring that military oil activities in war can be conducted as successfully as possible. In some countries, peacetime declines in their national fleets and increased foreign flag competition (and not limited to just flags of convenience but including Soviet bloc shipping as well) raise the question as to whether or not governmental subsidies to the shipping industry in general or to tanker owners in particular would be effective in stemming erosions in that nation's merchant marine's ability to support anticipated defence requirements in war. The issue of whether or not, and, if so, at what point governments should offer subsidies or other financial incentives is a controversial issue. In principle, it is an uncertain panacea since it addresses but one facet of the broad task of safeguarding the security of a nation's military oil supply vulnerability. □

Footnotes

1/ In the case of the United States, petroleum products account for 70% of naval consumption of conventional energy, followed by electricity (about 20%), natural gas (about 5%), coal (1%) and a negligible proportion for miscellaneous sources, including renewables. Ships account for around 47% of energy consumption, aircraft 38%, and the remaining 15% is consumed by onshore installations including 'cold iron' (*i.e.* steam and electricity generated on-shore that is used by ships tied up in port to conserve their on-board fuel supplies). O the petroleum products used, diesel fuel (marine) accounts for roughly 45%, JP-5 30%, shore heating oil 12%, JP-4 10%, Navy Special Residual Fuel Oil 2%, motor gasoline 2%, and avaiation gasoline 1%.

2/ NATO civilian plans for obtaining and providing bunkers in the event of military shortages in an actual war are developed by NATO's Petroleum Planning Committee (PPC) in conjunction with the Planning Board on Ocean Shipping (PBS). These plans would be implemented in a NATO war under the cooperative arrangements of the PPC's NATO Wartime Oil Organisation (NWOO) and the PBOS's Defense Shipping Authority (DSA), both of which are stand-by emergency organisations staffed primarily by experts seconded from industry.

3/ Design of an underway fuel-replenishment system at sea was initiated by the US Navy in 1898, after its blockade operations off the Port of Santiago de Cuba during the Spanish-American War nearly failed due to insufficient supplies of coal for the ships' boilers. A system of rigging and winches was introduced in 1904 to transfer coal in canvas bags between colliers and combatants while underway at sea and by 1913 a single tensioned highline system was able to transfer 80 tons per hour at 400-foot ship separation at ship speeds up to 12 knots. At around the same time the Imperial Russian Navy was confronted with the task of fuelling its coal-fired Baltic Fleet for an 18 000 mile voyage into the Pacific to fight the Japanese. The Czar contracted the US Navy to outfit ten Russian warships with the American coaling at sea system and subsequently chartered 60 merchant colliers for the journey. Notwithstanding the success of their assistance to the Russians, the US Navy halted engineering development for coaling at sea in 1914 as petroleum was fast becoming the primary ship fuel. Primary references for the events cited here and descriptions of refuelling at sea include: Marvin O. Miller, "Standby for Shotline," *US Naval Institute Proceeding*, April 1985, pp. 75-79, and Marvin O. Miller, "Mobile Logistic Support for Aircraft Carriers", *Naval Engineers Journal*, August 1977, pp.53,64.

4/ Sealift of fuel and other supplies to support ground forces, air units, and naval operations was essential to the conduct of US military operations in Southeast Asia during the 1960s and 1970s. For instance, all the fuel used by US forces in Viet Nam, Thailand, and at the Western Pacific island bases was provided by tankers. In Viet Nam alone, requirements went from less than 3 million barrels in 1964 to over 8 million barrels in 1965, to 25 million in 1966, 38 million in 1967 and later on, even higher. See Vice-Admiral Edwin B. Hoover, USN (Ret.) *Mobility, Support, Endurance: A Story of Naval Operational Logistics in the Vietnam War 1965-1968* (Washington, Dept. of the Navy, 1972), p. 255.

5/ Captain Roger Vilar, *Merchant Ships at War: The Falklands Experience* (London, Lloyds of London Press, 1984), especially chapter five.

6/ Captain John Moore, editor, *Janes Fighting Ships, 1985-86* (London, Janes Publishing Co, 1985), p. 21.