THE SECRETARY OF THE NAVY
WASHINGTON DC 20350-1000

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February, 12 2016

The Honorable John S. McCain
Chairman, Committee on
Armed Services
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

The enclosed report on the Navy's new Fleet Replenishment Oiler, T-AO(X), is submitted to the Senate Armed Services Committee as required by Senate Report 114-49 accompanying S. 1376 for the Fiscal Year 2016 National Defense Authorization Act. As requested, the report describes the requirements for the Fleet Replenishment Oiler.

If I can be of further assistance, please let me know.

Sincerely,

Ray Mabus

Copy to:
The Honorable Jack F. Reed
Ranking Member

# REPORT TO CONGRESS

# ON

# Requirements for the Fleet Replenishment Oiler, T-AO(X)

**February 2016**

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## Table of Contents

## I. Requirement for the Report

The Senate Report accompanying Section 1376 of the National Defense Authorization Act for Fiscal Year 2016 directs the Secretary of the Navy, in coordination with U.S. Pacific Command, to provide the Senate Armed Services Committee a report no later than February 1, 2016, describing the requirements for the T–AO(X).

Excerpt from language:

*Combat logistics fleet*

*As the Navy finalizes the requirements for the new oiler, T– AO(X), the changes in naval operations and threats since its predecessor, the Henry J. Kaiser-class, was designed should be a foremost consideration. Therefore, the Secretary of the Navy, in coordination with U.S. Pacific Command, is directed to provide the committee a report no later than February 1, 2016, describing the requirements for T–AO(X) that addresses the following elements:*

*(1) Ship's capacity for fuel, dry stores, and chilled or frozen stores;*

*(2) Operational concept for fleet resupply that forms the basis for the T–AO(X) requirement, including how T–AO(X) will complement existing T–AKE class logistics ships and how the concept will evolve over the life of the T–AO(X) class;*

*(3) Number of T–AO(X) hulls required, how this requirement addresses a more dispersed fleet and combat losses likely in a modern conflict, and how the requirement may evolve over the next 30 years;*

*(4) How the T–AO(X) will be protected from missile and submarine attack as it supports a more widely distributed fleet; and*

*(5) An analysis of various fleet resupply force structures to meet projected mission needs in the 2025 timeframe, including: the current program of record, an alternative consisting of a larger number of smaller ships with the same overall resupply capacity, and a mixture of the program of record and smaller ships.*

## II. Background

There have been several studies and assessments used to inform the requirements for the Fleet Replenishment Oiler, T-AO(X). The principal assessments include:

- T-AO(X) Analysis of Alternatives (AoA): The T-AO(X) AoA was conducted in 2011 by the Center for Naval Analyses and overseen by the Cost Assessment and Program Evaluation (CAPE) office within the Office of the Secretary of Defense. The AoA reviewed several designs for the T-AO(X), evaluated cost, and made recommendations regarding capacities and the number of ships required to meet demand.

- Combat Logistics Force Sufficiency Assessment: In February 2015, the Deputy Chief of Naval Operations for Integration of Capabilities and Resources (N8) conducted a follow-on review to assess the ability of the Combat Logistics Force (CLF) force structure to meet current and future demand.

The T-AO(X) requirements were validated by the Joint Requirements Oversight Council (JROC) in June 2015. The required capabilities are:

- Cargo Fuel Capacity: 156,000 Barrels
- Dry Cargo: 53,000 Cubic Feet
- Freeze/Chill: 26,000 Cubic Feet

## III. Requirements for the T-AO(X)

The five specific elements, required to be addressed in the report, follow.

### 1. Ship's capacity for fuel, dry stores, and chilled or frozen stores:

The primary mission of the Navy's Fleet Replenishment Oilers (T-AOs) is to provide fuel to the Navy's Carrier Strike Groups (CSGs), Amphibious Ready Groups (ARGs) and surface forces, to enable them to operate worldwide without the need to constantly return to port to refuel. The T-AOs also provide a significant portion of dry cargo replenishment, including freeze/chill, to the Fleet.

The critical factor in determining the Cargo Fuel Capacity of the Navy's new Fleet Replenishment Oiler, T-AO(X), was an analysis of wartime demand. In 2011, the Center for Naval Analyses (CNA) conducted an Analysis of Alternatives (AoA) to determine the optimum cargo fuel capacity. CNA used OSD approved Major Combat Operations scenarios to conduct their analysis.

**Fuel:**

The AoA examined several alternatives designs to meet peacetime and wartime requirements. To facilitate the trade-offs between the number of ships required and the individual capabilities of the ships, CNA analyzed:

- Battle force composition
- Fuel consumption rates of each ship

- Dispersion of the battle force
- Distance from the resupply port

The CNA analysis of wartime demand found little difference in the number of oilers required to meet demand for fuel capacities above 156,000 barrels per ship. For comparison, current T-AO fuel capacities are:

- Single Hull Oiler: 180,000 barrels (12 Ships)
- Double Hull Oiler: 154,000 barrels (3 Ships)

**Dry Cargo and Freeze/Chill Stores:**

The AoA also reviewed the requirement for dry cargo and freeze/chill stores. In addition to delivering fuel, the T-AOs transfer over 20% of all stores to the Fleet. The ability of the T-AOs to deliver cargo, in addition to fuel, is a significant force multiplier. They enable:

- Dispersed operations through the more efficient use of CLF assets.
- Increased operational availability of Battle Force assets by reducing the number of both inport and underway replenishments required.

During the AoA, the Fleet specifically requested that the freeze/chill capacity for the T-AO(X) be increased over the 8,000 cubic feet on the current oilers. Previous analysis showed that over 90% of the time, T-AOs returned to port to replenish dry cargo and freeze/chill stores vice fuel. On average, when they returned, they had about 50% of their cargo fuel remaining.

To determine how much cargo the T-AO(X) should carry, CNA estimated how much cargo a T-AO(X) could transfer to a CSG in the same amount of time it took to deliver its fuel. The intent was to carry only the cargo that could be transferred prior to the T-AO(X) returning to port to refuel.

Based on an analysis of projected demand and interviews with several Military Sealift Command Ship Masters with significant operational experience, CNA recommended the T-AO(X) carry:

- 300 pallets of Freeze/Chill (requires 26,000 cu ft of stowage)
  - Threefold increase over current capacity.
- 500 pallets of Dry Stores (requires 53,000 cu ft of stowage)
  - 20% increase over current capacity.

## 2. Operational concept for fleet resupply that forms the basis for the T-AO(X) requirement, including how T-AO(X) will complement existing T-AKE class logistics ships and how the concept will evolve over the life of the T-AO(X) class:

The Navy's Combat Logistics Force is made up of "station" ships and "shuttle" ships. Station ships are multi-product (fuel, ordnance and dry stores) ships that accompany the CSGs. Shuttle ships are single product ships that transfer a single commodity from the resupply ports to the station ships, after which the station ships resupply the strike group as needed.

- The primary station ship is the Fast Combat Support Ship (T-AOE). The multi-product T-AOE can provide one-stop shopping to the Aircraft Carrier (CVN) and has the speed to maintain station with the CSG even when the CVN is operating at high speed.

– The shuttle ships are the Dry Cargo and Ammunition Ships (T-AKE) and the Fleet Oilers (T-AO). While in the past shuttle ships were single product ships, to increase their flexibility and to better support dispersed battle group operations, both the T-AKEs and T-AOs are multi-product ships.

  - The T-AKE carries dry cargo, ammunition and a limited amount of cargo fuel. Although the T-AKE doesn't have the fuel capacity to refuel a CVN, it carries more than enough fuel to replenish several combatants.

  - The T-AO carries fuel plus several hundred tons of dry cargo, to include freeze/chill. The constraint of the T-AO is opposite to the T-AKE. They don't have the dry cargo capacity to replenish a CVN, but they have enough capacity to replenish numerous surface combatants. Both the T-AO and T-AKE have a sustained speed of 20 knots.

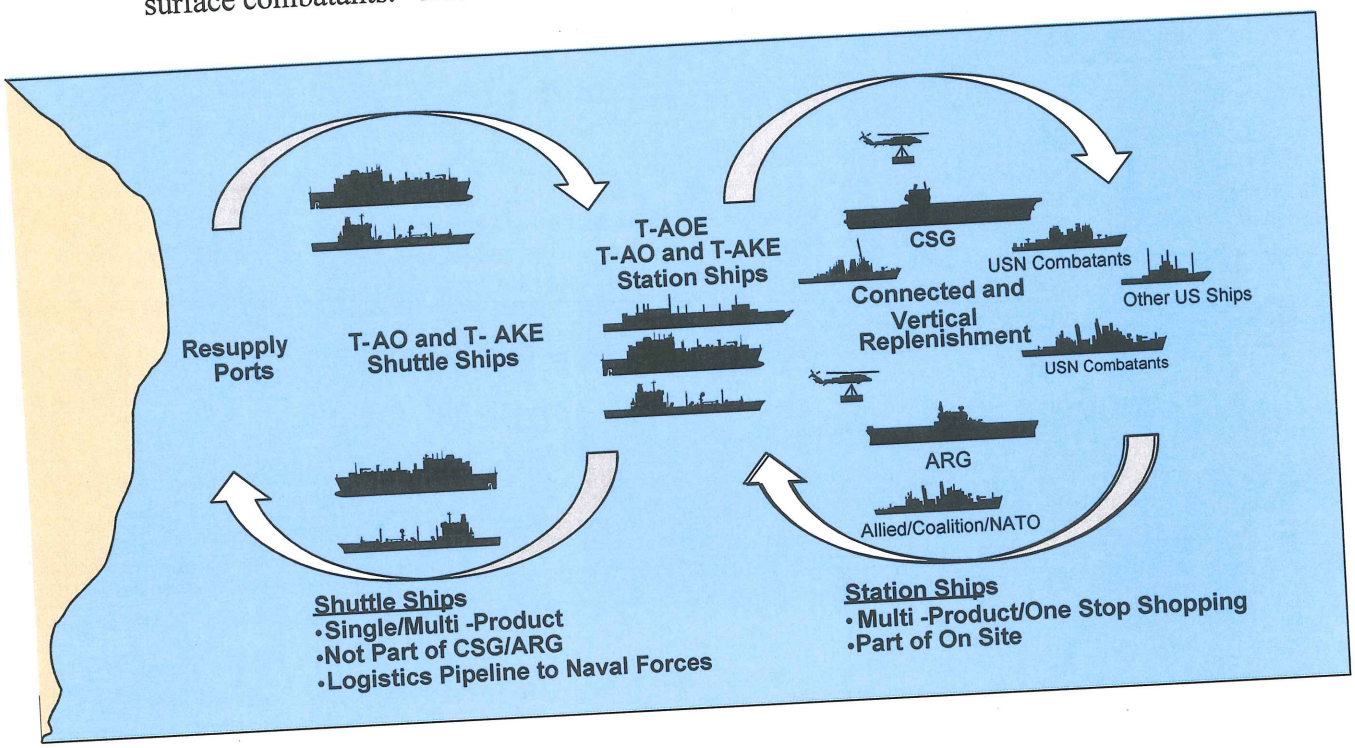


**Figure 1: Concept of Operations**

When available, a T-AOE will accompany each deploying CSG. When one is not available, a pair of CLF ships, a T-AO and T-AKE, will act as a substitute station ship for the CSG. While the T-AKE/T-AO pair can't replenish an individual CVN as quickly as a T-AOE, they can replenish the entire CSG quicker and they can also better support dispersed CSG operations. Additionally, since the cargo capacity of the T-AKE/T-AO pair is greater than the T-AOE, they provide the CSG with increased endurance.

While the T-AKE/T-AO pair doesn't have the same maximum speed as the T-AOE, two separate studies have found that 20 knot CLF ships are not a constraint to CSG operations. Additionally, due to fiscal constraints, the Navy has decided to inactivate 2 of 4 current T-AOEs by 2016. This will result in a future CLF of just two types of ships, T-AKEs and T-AOs, when the remaining T-AOEs inactivate in the mid-2030s. When this happens, the distinction between station ship and shuttle ship will no longer be required.

## 3. Number of T-AO(X) hulls required, how this requirement addresses a more dispersed fleet and combat losses likely in a modern conflict, and how the requirement may evolve over the next 30 years:

The T-AO(X) AoA concluded that 17 fuel delivery ships (T-AOEs and T-AOs) would be sufficient to meet future demand. The AoA looked at both peacetime presence requirements and wartime demand.

**Peacetime Requirement:**

To determine T-AO(X) peacetime presence requirements, CNA developed estimates for future demand and concluded that 17 T-AO(X)s are required to support projected presence requirements. To facilitate the analysis, the following assumptions were made:

1) Combatant Force Levels in the 2030s will be similar to current levels.
   - Based off *Report to Congress on Annual Long Range Plan for Construction of Naval Vessels for FY 11,* it assumed a 167 combatant average (CVN, CG/DDG, LCS, LHA/LHD/LPD/LSD)

2) CSG presence requirement remain unchanged. Fleet primary operating areas will continue to be 5th and 7th Fleets.

3) Littoral Combat Ship (LCS) fuel demand was assumed to be similar to a Frigate (FFG).
   - Assumes LCS operate below 17 knots majority of time and that the number of steaming days per quarter is similar.
   - Higher LCS demand could impact number of T-AO(X)s required.

4) T-AO(X) replaces both T-AO and T-AOE.

**Wartime Requirement:**

Wartime demand was determined by modeling fuel requirements for three OSD approved Major Combat Operations (MCO) scenarios and concluded that 14 T-AO(X)s are required to support the most stressing wartime scenario. The analysis found that the number of T-AO(X)s was dependent on:

1) Number of CVNs required by the scenario. Each CSG had one T-AO(X) assigned as a Station Ship.

2) Distance from the resupply port to the operating area. The greater the distance, the more T-AO(X)s were required to act as Shuttle Ships.

3) Non-Theater Requirements. 6 T-AO(X)s were required to support the flow of forces into theater and to support forces in other theaters.

**Combat Loses:**

The AoA also addressed the impact of wartime attrition, and ways to mitigate.

1) The first way is to work individual T-AOs harder (i.e. longer work days). The AoA assumed each station ship operated 8 hours a day conducting underway replenishments. If the T-AOs worked longer, up to 10 hours per day, the CSGs could still be sustained, even after the loss of two station ships.

2) A second way to mitigate the impact of attrition is to reposition non-theater T-AOs. As the CSGs converge in the area of operations, the non-theater T-AOs could selectively join them to surge into theater to replace loses.

3) Commercial tankers would also supplement the CLF to meet wartime requirements. CONSOL (Consolidation) tankers are specially modified commercial oil tankers that have the ability to replenish T-AOs. While they don't have the equipment to refuel a combatant, they do have the ability to act as a shuttle ship, freeing up a T-AO(X) to act as a station ship.

## 4. How the T-AO(X) will be protected from missile and submarine attack as it supports a more widely distributed fleet:

The T-AO(X) will only have a limited capability to defeat a submarine launched torpedo attack and no capability to defeat a missile attack. When delivered, the T-AO(X) will have:

- NIXIE Torpedo Countermeasure System
- Advanced Degaussing System (Anti-Mine)

When required, the T-AO(X) will also have ability to embark Navy Expeditionary Combat Command Expeditionary Security Teams (EST). The ESTs will embark with several crew served weapons and are designed to provide limited self-defense against a small boat attack.

The T-AO(X) will have Space, Weight, Power and Cooling (SWAP-C) margins for future installations of the following systems:

- Close In Weapon System (CIWS) or SeaRAM (Rolling Airframe Missile)
- Anti-Torpedo Torpedo Defense System (ATTDS)

Even after the installation of a CIWS or ATTDS, if the T-AO(X) was to operate in anything other than a benign environment, the ship will require both air and surface escorts.

The decision to rely on Fleet assets to provide force protection for the T-AO(X) was validated by the JROC.

## 5. An analysis of various fleet resupply force structures to meet projected mission needs in the 2025 timeframe, including: the current program of record, an alternative consisting a larger number of smaller ships with the same overall resupply capacity, and a mixture of the program of record and smaller ships:

As described in the "Background" section of this report, there were multiple assessments used to inform the requirement.

The 2015 CLF Sufficiency Assessment, using updated future ship projections from the Report to Congress on Annual Long Range Plan for Construction of Naval Vessels FY 15, confirmed that 17 fuel delivery ships (T-AO + T-AOE) are sufficient to meet current demand and would be able to support projected presence requirements through 2020. However, the assessment noted that there was still only limited information on actual LCS fuel usage. Therefore the assessment recommended the requirement be revisited in the early 2020s after several LCS deployments to better inform the fuel usage and demand data.

The T-AO(X) AoA did look at using smaller ships to meet the T-AO(X) requirements. The AoA considered a 120,000 barrel design based on the Royal Navy's Military Afloat Reach and Sustainability (MARS) ship and a 75,000 barrel design based on the Joint Support Ship (JSS) being considered by the Royal Canadian Navy.

The AoA concluded that the smaller oilers were not as efficient at delivering fuel as a larger capacity oiler. It found that the smaller ships had significantly less time available on station to deliver fuel to the Fleet because they had to transit back to port more frequently to replenish. This resulted in the requirement for several more ships to meet demand. Additionally, the smaller ships had several inherent operational limitations. The MARS had a sustained speed of 16 knots, too slow to keep up with a transiting CSG. The JSS didn't have the cargo fuel capacity, nor was it large enough to support the number of replenishment stations required to refuel a CVN in the least time possible. Therefore the MARS and JSS were eliminated from further consideration.

The Navy also had previous experience operating smaller Fleet Oilers. In 1981 the Navy commissioned the first of five CIMARRON (AO 177) Class Oilers. All five ships had a cargo fuel capacity of 120,000 barrels. After several years of operational experience supporting the Fleet, the fuel capacity was determined to be insufficient. Therefore, all five ships were "Jumboized" in the early 1990s by being cut in two and having a 100-foot section inserted to increase their fuel capacity to 180,000 barrels.

While the AoA discounted a smaller T-AO, it did highlight the significant contribution T-AKEs make toward satisfying the Fleet's fuel demands. Each T-AKE carries 25,000 barrels of fuel that is available for transfer and they have been playing an increasingly more important role in refueling the Fleet.

With its limited cargo fuel capacity, a T-AKE could not substitute for a T-AOE in its ability to refuel a CVN. However, it carries more than enough fuel to replenish multiple surface combatants. In FY 2015, the 12 CLF T-AKEs refueled 497 combatants, conducting almost 25% of all refueling events for the year. Additionally, the ability to simultaneously deliver both dry cargo and fuel to surface combatants significantly reduces the total amount of time required for an entire Strike Group to replenish. It also enables the T-AKE to support widely dispersed ships, to include the LCS, reducing the number of T-AOs required to support the Fleet operations.

## References:

T-AO(X) Analysis of Alternatives, Center for Naval Analyses, December 2011

Combat Logistics Force Sufficiency Assessment, Deputy Chief of Naval Operations for Integration of Capabilities and Resources (N8), February 2015

Combat Logisitics Force Replenishment Activity for 4th Quarter of FY 21015 and Fiscal Year Summary, Center for Naval Analyses, November 2015

Report to Congress on Annual Long Range Plan for Construction of Naval Vessels for FY 11, Deputy Chief of Naval Operations for Integration of Capabilities and Resources (N8), February 2010

Report to Congress on Annual Long Range Plan for Construction of Naval Vessels for FY 15, Deputy Chief of Naval Operations for Integration of Capabilities and Resources (N8), June 2015