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# Basic Ship Types & Their Uses, Part 3

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Basic Ship Types & Their Uses (Part 3)

Auxiliary Ships:

Tankers, Cargo, and Ammunition Ships

Floating Drydocks

Ocean Surveillance Ships

Naval and Army Tugs

Salvage Ships

Submarine Tenders

Submarine Rescue craft

Research Submarines

Coast Guard Vessels:

Buoy Tenders

Icebreakers

National Security Cutters

High Endurance Cutters

Icebreaking Tugs

Medium Endurance Cutters

Sentinel Class Fast Response Cutters

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Marine Protector Class Cutter

USCGC Eagle

Small Harbor Tugs

Motor Lifeboats

Aids To Navigation Boats

Auxiliaries are support vessels to the military and law enforcement fields. Unlike other naval ships, they are not combatants, but they keep the combatants supplied so they can continue operating. This class covers the various types of auxiliary vessels that one might see on the waterways.

Tankers, Cargo, and Ammunition Ships

Naval fleet resupply auxiliaries are called Fast Replenishment Ships and they come in several varieties, with specialized cargos. Some more recent ships combine cargos to make resupply more efficient. Naval tankers are a special type compared to commercial ones for

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several reasons. They must be fast enough to keep pace with the carrier strike groups and other combatant vessels, because the fleet does not stop to take on fuel when they are at sea. Like the other naval ships, they are painted gray, but instead of a number only on the bow and stern quarters, they have an additional abbreviation, like AOR, which stands for Auxiliary Oiler, Replenishment, or AOE, which stands for Auxiliary Oiler and Ammunition ship. The mission of the AOE ships is to receive ammunition, provision, stores and petroleum products from shuttle ships, and to distribute them to the carrier battle group ships while underway. I worked on the design of the AOR7 as a summer intern in college.

Another difference from commercial tankers is the general layout of the deck. The deckhouse may be forward or amidships instead of aft, and there are a number of masts with outboard-angled upper ends to hold up the hoses that are connected to the ship being fueled during underway replenishment (UNREP in Navy-speak). There is also a helicopter landing platform, self-defense guns, and anti-aircraft missiles aboard. In the photo below, the U.S.S. Eisenhower is taking on fuel from the U.S.N.S. Arctic T-AOE 8, a fast replenishment tanker. Note the hoses hanging from cables suspended between the ships.



Figure 1: Underway Replenishment of an aircraft carrier



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Figure 2: U.S.S. Norfolk, AOR7 underway off Guam before she was scrapped.



Figure 3: Japanese Navy AOE refuels the U.S. Ticonderoga Class cruiser CG68

Another type of auxiliary tanker is the one shown below. This is an Army Fuel Barge, which is a small tanker that the U.S. Army operates for its own fuel needs. The types of tankers shown here carry diesel fuel, jet fuel, gasoline of several octane ratings, and Bunker C boiler fuel, unlike petroleum (crude oil) tankers. These are called barges instead of ships because they have flat bottoms, shallow draft, and are small enough size that they can be loaded onto a larger ship for transport.



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Figure 4: Army Self-Propelled Tank Barge

### Floating Drydocks

Floating drydocks are necessary for the maintenance of all underwater aspect of ships. They are distinctive in that they have two side walls, no end walls, and a submersible flat deck for drydocking ships by de-ballasting the dock and lifting the ship out of the water. This is how the bottoms are cleaned and repainted, and propellers, rudders, shafts, and bearings are checked and serviced. Underwater hull repairs, sonar, water depth, and speed transducers are also serviced here, as well as all the underwater and near-waterline overboard discharges and water intakes.



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Figure 5: U.S. Navy DDG 61 in the floating drydock at Norfolk, VA. Note the large sonar bulb on the bow and the curved bilge keels on the ship



Figure 6: U.S. Navy Floating Drydock AFDL6 preparing to take a ship in on the blocks



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### Ocean Surveillance Ships

Ocean surveillance ships are the surface spy ships of the Navy. Many recent ones have Small Waterplane Area Twin Hull (SWATH) form, which produces minimal reaction to the waves at sea. These ships listen in on foreign countries' radio and radar emissions, and tow large net-type arrays of hydrophones listening for submarines and underwater autonomous vehicles (UAVs).



Figure 7: Ocean Surveillance ship AOS 5203 of the Japanese Self-Defense Force (Navy). This is a SWATH hulled vessel





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Figure 8: U.S. Navy SWATH T-AGOS ship ballasted down to running draft. Note the large air search radar and the towed array deployment and retrieval equipment on the stern.



Figure 9: U.S. Navy T-AGOS 16, U.S.S. Capable, an older ocean surveillance ship which has now been converted to do oceanography research. Note the large air search radar for early warning of incoming aircraft, and numerous tall radio antennas.





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### Naval Tugboats

Our Navy now mostly uses commercial tugboats for assisting in docking and maneuvering large ships, but many foreign navies still operate their own tugboat fleets. Below is a picture of a Japanese Self-Defense Force (Navy) tugboat. These are an older type design, and the main difference between them and older commercial tugs is that they are painted gray with a number in naval identification standard, and they are operated by naval personnel.



Figure 10: Japanese Navy Tugboat



Figure 11: U.S. Army tugboat helping dock an LCU landing craft

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### Salvage Ships

Naval salvage ships go to rescue naval ships that have sunk or run aground and are in need of special diving equipment and cranes to help raise the ship. They support both hard hat and SCUBA diving operations, underwater welding, have large air compressors to help raise and dewater ships, as well as cranes capable of lifting heavy equipment and structures.



Figure 12: U.S. Naval ocean fleet tug USNS Apache on left and U.S. Naval salvage vessel U.S.S. Grapple on right

### Submarine Tenders

Submarine tenders are “mother ships” to a squadron of submarines that provide workshops, ammunition, missile, and torpedo resupply, provisions, quarters for relief crews and offices, food services, a store, and meeting rooms to run submarine mission planning from in foreign ports where shoreside facilities are not available. They are essentially a repair shipyard and operations office that floats. The U.S. Navy has only two submarine tenders now, but it had many during World War II in the Pacific. Current nations operating submarine tenders are the U.S. (2), Canada (1), Chile (1), and the Netherlands (1).



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Figure 13: U.S. Navy submarine tender Emory S. Land AS39 preparing to moor.



Figure 14: Artist rendering of Soviet submarine tender loading ballistic missiles in a Typhoon submarine



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### Submarine Rescue Craft

Submarine rescue craft are vessels specifically designed to be able to support and/or perform diving to a sunken submarine to rescue the trapped crew. The surface vessels have a diving bell or other deep submergence vehicle that can attach itself to the hull over an escape hatch, and rescue the crew of the sub.



Figure 15: U.S. Navy Deep Submergence Rescue Vehicle (DSRV) Rescue Submarine.

The U.S. Navy's DSRV can be air-lifted to a nearby airfield in a cargo plane, then taken to a nearby harbor on the trailer shown. It can also be mounted on deck aft of the sail of any U.S. submarine. There are two of these that are carried piggy-backed on other submarines and can dive to 5000 feet. They can land on the deck of a sunken sub, latch onto a hatch, and rescue the trapped crews, and they can conduct covert missions. But thanks to our safety record, they have never needed to be used for a rescue. The salvage ships can assist in submarine rescues as well.

When the Russian submarine Kursk sank in the Baltic Sea in 2000, our Navy offered to send a DSRV to help, but was declined by the Russian Navy. Their rescue craft was unable to lock onto and make a watertight seal onto the escape hatch because of the settled angle of the submarine, and all the remaining submarine crew perished.

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Figure 16: Singapore Navy Submarine Rescue Ship

The Swift Rescue, above, operates a deep submergence rescue vessel called Deep Submergence and Rescue 6 (DSAR 6), which can dive to a depth of 1600 feet (500 meters). The ship also has a pressurized chamber aboard that can hold 40 people for decompression and surgical procedures, and a Remote Operated Vehicle (ROV) for visualizing, locating, and clearing debris around a sunken sub. The helipad can be used to ferry injured crewmembers ashore for better medical treatment.

NATO also operates a ship and air-portable submarine rescue system with a vehicle, launch and recovery equipment, and a hyperbaric Transfer Under Pressure system primarily for partner navies of Norway, France, and the United Kingdom, but also other member states and countries with matching hatch attachment details.

#### Research Submarines

Research submarines are often commercial, rather than naval vessels, but some navies do build and operate research submarines of their own to further submarine design and deep ocean surveillance and salvage. Two U.S. Navy examples are the U.S. Albacore and the NR-1.

The Albacore was designed for design research and was the first teardrop shaped hulled submarine built by the U.S. Navy, in 1953. It was a diesel submarine with tail fins built in an X configuration and a modern style sail instead of an earlier style conning tower. It was built to test the full-scale hydrodynamics of the hull and appendages in order to match the tank test results and



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develop correlation allowances for future submarine designs. It was found that the teardrop shape would allow the submarine to reach the same speed as postwar GUPPY modified WWII submarines (see Part 1 of this class series), but on half the horsepower. Reconfigurations of the propeller, rear control surfaces, dive planes, different methods of quieting the submarine, and even contra-rotating propellers on the same shaft were studied. She was used for other systems research as well, but as her engines got older and more unreliable, she was decommissioned in 1972 and is now a National Historic Landmark and museum ship near the naval base in Portsmouth, New Hampshire.



Figure 17: U.S.S. Albacore at launching

The U.S. Navy NR-1 was a unique submarine whose missions included searching, object recovery, oceanographic research, geological survey, and installation and maintenance of underwater equipment. Most of her missions are still classified, but she participated in mapping and recovering parts of the Space Shuttle Challenger from the sea floor, and in 1995 Dr. Robert Ballard used it to survey the HMHS Britannic, the sistership of the Titanic that sank in the Aegean Sea during World War I. This submarine was nuclear powered, had a test depth of 3000 feet, had two wheels on the bottom, and manipulator arms as well as downward-facing windows. The sail of the NR-1 has been preserved at the Submarine Force Library and Museum in Groton, CT.



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Figure 18: U.S. Navy Nuclear Research Submarine NR-1. This is a unique nuclear-powered deep submergence research vessel that is also used for deep water salvage and reconnaissance of foreign sunken objects. It was the smallest nuclear submarine in the world.

#### Coast Guard Vessels:

Maritime countries all over the world operate their own Coast Guards to perform various duties such as environmental, safety, federal law and fisheries enforcement, inspections of vessels, keeping navigation channels open, towing disabled vessels, anti-smuggling, rescues at sea and near land, and other duties. The U.S. Coast Guard classifies their vessels as Cutters if the length is over 65 feet, and Boats if they are shorter. They currently operate 25 different classes of Cutters, of which a few are shown here. Some of the Cutters you are likely to see are:

#### Buoy Tenders

Buoy tenders are Coast Guard vessels that maintain waterway aids to navigation. The U.S. Coast Guard uses specialized seagoing and coastal buoy tenders, and the Canadian Coast Guard uses multifunctional vessels, usually icebreakers for the task. American buoy tenders have black hulls with white deckhouses, Coast Guard lettering and emblem, and orange and blue stripes on the side, as below. Canadian Coast Guard vessel hulls are red. Buoy tenders can be recognized by their midship to aft deckhouse, well deck with crane forward of it, and a raised foredeck.



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Figure 19: USCG Juniper Class Seagoing Buoy Tender. Coastal Buoy Tenders are similar but smaller.



Figure 20: Canadian Light Icebreaker/Buoy Tender



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### Icebreakers

Icebreakers are special ships that keep the sea lanes open in winter by breaking ice so commercial and naval ships can operate. The United States Coast Guard has 3 polar class icebreakers currently, with only one operating, 1 more Great Lakes icebreaker, some icebreaking tugs (see below), and some more being designed and built. Canada has 7 icebreakers, and Russia has 53. Light icebreakers are intended to be able to break one winter season ice, and polar class icebreakers can break heavier thicknesses. With global warming and thinning ice in the arctic region, geopolitical tensions are building up with Russia trying to control the shortcut passage across the northern Pacific over Russia to Europe, and both the U.S. and Canada are building icebreakers to be there and compete in freedom of the seas.



Figure 21: Finnish Icebreakers



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Figure 22: Russian Icebreaker



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Figure 23: USCG Polar Star Icebreaker, our only operating heavy icebreaker. This one goes to Antarctica and can break ice up to 21 feet thick!

### High Endurance Cutters

The “Hamilton” Class High Endurance Cutters and “Legend” Class National Security Cutters are the largest and most capable seagoing cutters. The High Endurance Cutters are 378 feet long and were built in the 1960s; there are only two still in operation, with rest having been transferred to Bangladesh, Nigeria, the Philippines, Sri Lanka, and Vietnam. They are being replaced by National Security Cutters, 8 which are planned and are currently under construction. Both can support helicopter operations, are armed with a forward gun, and can operate worldwide



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Figure 24: USCG High Endurance Cutter and Response Boat Medium



Figure 25: New National Security Class Cutter in the background, escorted by a New Fast Response Cutter

### Icebreaking Tugs

The USCG operated a small fleet of 9 icebreaking tugs called the “Bay” Class tugboats. They can break freshwater ice up to 20 inches thick underway, or up to 3 feet thick by ramming. These are model bow tugs with extra strong hulls.





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Figure 26: Bay Class Icebreaking Tug

#### Medium Endurance Cutters

There are 4 classes of Medium Endurance Cutters, but mainly the 270' "Famous" Class and 210' "Reliance" Class are in operation. They are capable of doing 6 to 8 week patrols, performing duties such as maritime law enforcement such as drug and migrant interdiction, defense operations, search and rescue, marine safety, and environment protection.



Figure 27: USCG Medium Endurance Cutter



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Figure 28: USCG Cutter Thetis

### Sentinel Class Fast Response Cutters

The “Sentinel” Class Cutters are based on a Dutch design, and there are plans to build 64 of these. Six of these are slated to patrol in southwest Asia. The South African government operates three similar 154 ft vessels for environmental and fishery patrol. They are 154’ long and will perform various Coast Guard missions which include ports, waterways, and coastal security, maritime law enforcement such as drug and migrant interdiction, defense operations, search and rescue, marine safety, and environment protection. They have a speed of 28+ knots, unlike other cutters, which are not as fast. They have a distinctive low, amidships pilothouse, a mast somewhat similar to the Island Class cutters, and a small launch at the stern.



Figure 29: USCG Fast Response Cutter



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**“Island” Class Cutters**

The 110’ Island Class consists of 37 Cutters of this type. Other nations and entities operating these are the Coast Guard of Georgia, Ukrainian Navy, Pakistani Navy, and the Sea Shepherd Conservation Society. They are used in support of the U.S. Coast Guard’s maritime homeland security, search and rescue missions, drug and migrant interdiction, defense operations, and fisheries enforcement. The new Sentinel Class is being built to replace them. They have a distinctive mast that looks like an oil derrick.



Figure 30: 110’ Island Class Cutter

**Marine Protector Class Cutter**

The “Marine Protector” Class Cutter is 87’ long and 67 are in operation. Missions include combating drug smuggling and illegal immigration, marine fisheries enforcement and search and rescue support. Many also have a homeland security mission of ports waterways and coastal security patrols. These are starting to be replaced by Sentinel Class cutters.





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Figure 31: USCG Marine Protector Class Cutter



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USCG Sail Training Ship “Eagle”



Figure 32: USCG Cutter Eagle

The USCGC Eagle is well known as America’s only sail training ship. She is a 3-masted barque that was built in Germany in the 1930s and we claimed her as a war prize at the end of World War II. Coast Guard Academy officers sail on the Eagle as part of their school training. She can be seen during summer months somewhere along the coasts and overseas at various gatherings of sailing ships.

Small Harbor Tugs

The USCG operates a fleet of (11) 65-foot Small Harbor Tugs for law enforcement, aids-to-navigation work, search and rescue, and light icebreaking. The tugs are capable of breaking 18” of ice with propulsion ahead and 21” of ice by ramming.



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Figure 33: USCG 65' Small Harbor Tug

Motor Lifeboats (MLBs)

The USCG operates a fleet of (227) 47' MLBs for inshore rescue work. The Mexican and Canadian Coast Guards also operate these vessels. They are capable of rolling upside-down and self-righting in under 10 seconds undamaged, and in under 30 seconds with either the pilothouse or survivor's compartment flooded, and it can do this without losing propulsion! I was the Assistant Chief Naval Architect on the design and construction of the first of these and I designed many of the parts you see in the photo. The boat has a hollow box mast platform to provide additional buoyancy when it is upside down. Another Naval Architect and I also did the stability for the design on the first computer program capable of calculation 180-degree rolls.



Figure 34: USCG 47' Motor Lifeboat





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Figure 35: Canadian Coast Guard “Cape” Class 47’ MLB



Figure 36: Royal National Lifeboat Institution (RNLI) Motor Lifeboat (United Kingdom)

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RNLI Lifeboats were the inspiration for the design and construction of the 47' MLB, with modifications to suit or Coast Guard methods of operation. Between them, the RNLI and USCG Motor Lifeboats have saved thousands of lives.

### Aids To Navigation Boats

Aids To Navigation boats are small, light draft, high speed versions of buoy tenders used to service buoys and lights. There are 64', 55', 49', and numerous smaller craft used for this purpose. They all have a forward deckhouse with an aft working deck with crane or A-frame for lifting buoys.



Figure 37: USCG 65' Aids To Navigation Boat



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Figure 38: USCG 49' Aids To Navigation Boat