U.S. Shipboard aerostats - U.S. Army SASS and USCG SBA / MIST programs

Peter Lobner, 16 June 2023

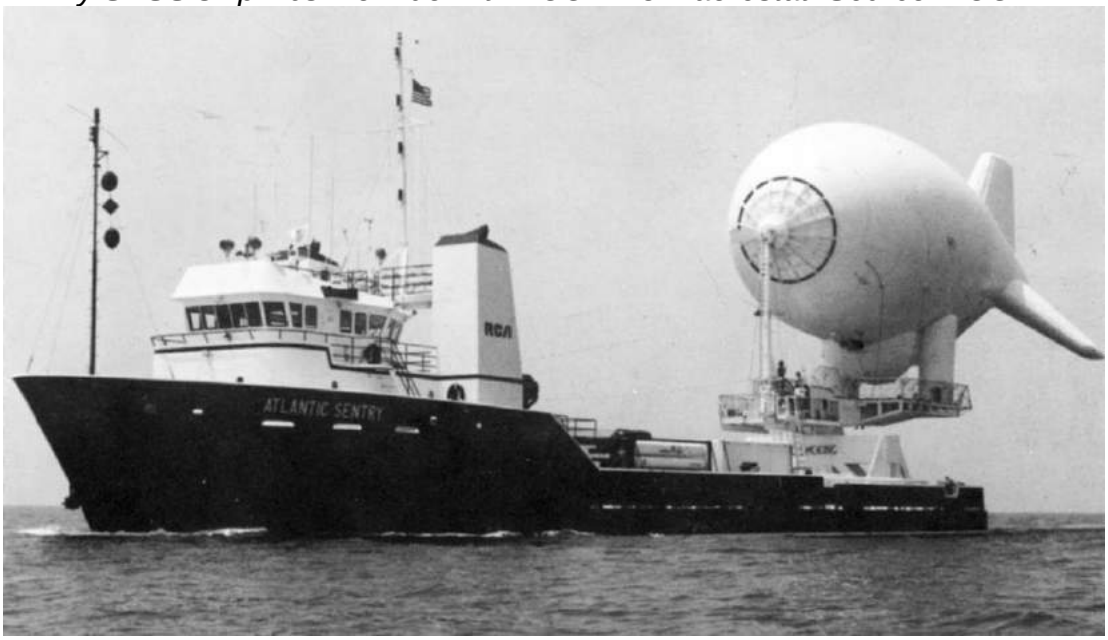
1. Introduction

Between the early 1980s and 1994, the U.S. operated two shipborne aerostat surveillance programs in the Gulf of Mexico: the U.S. Army's Small Aerostat Surveillance System (SASS) and the U.S. Coast Guard's Sea-Based Aerostat (SBA) / Maritime Interdiction and Surveillance Team (MIST). Following is a timeline for these two programs, abstracted from several sources:

- **Early 1980s – 1989:** U.S. Army operated four Small Aerostat Surveillance System (SASS) ships in the Gulf of Mexico to support its military counterinsurgency mission in the Caribbean and Central America. These commercial offshore supply vessels were built and converted to the SASS configuration between 1983 and 1984.
- **1987 - 1991:** U.S. Coast Guard (USCG) operated five Sea-Based Aerostat (SBA) ships in the in the Gulf of Mexico under the Maritime Interdiction and Surveillance Team (MIST) program. These commercial offshore supply vessels were converted to the SBA configuration between 1987 and 1989.
- **1989:** DoD reassigned the Army's SASS ships to detecting and monitoring ships and aircraft suspected of drug smuggling in the Caribbean.
- **December 1991:** As directed by Congress, the USCG transferred operational control of its five SBA ships to DoD, where they were put under Army operational control, along with the SASS vessels.
- **Summer 1992:** Army determined that the former USCG SBA ships were a better value than the Army's SASS ships and opted to retire the SASS ships.
- **Spring 1993:** Army terminated the operation of all SASS ships, transferred military communications equipment to the SBA ships and, in 1994, all former SASS ships returned to commercial service.
- **Spring 1993 – Summer 1994:** The Army continued supporting the USCG's counterdrug mission in the Caribbean.
- **August 1994:** All former USCG SBA aerostat carriers were decommissioned, ending seaborne aerostat support for the USCG's counterdrug mission in the Caribbean.

The SASS and SBA / MIST ships were small, approximately 61 meter (200-foot) long, leased commercial vessels that were modified to serve as “motherships” for a tethered aerostat that could be deployed and operated at altitudes up to 762 m (2,500 ft) while the ship was underway at less than 10 knots. Radar carried aloft by the aerostats was capable of detecting and monitoring small ships and low flying aircraft at distances up to about 96 km (60 miles), which is much greater than could be monitored with a radar on the surface ship itself.

Army SASS ship Abshire Tide with TCOM 25M aerostat. Source: TCOM LP



USCG SBA / MIST ship Atlantic Sentry with RCA aerostat.
Source: Rob Crimmins

2. U.S. Army Small Aerostat Surveillance System (SASS) (early 1980s to 1991)

The Army conducted its SASS military counter insurgency mission in the Caribbean and Central America from the early 1980s to 1989, after which the SASS ships were reassigned to conduct a counter-drug smuggling mission in the Caribbean, in parallel with the USCG SBA / MIST program. In 1992, the two programs were combined under Army leadership. All former SASS ships were retired in 1993.

Tide-class SASS ships

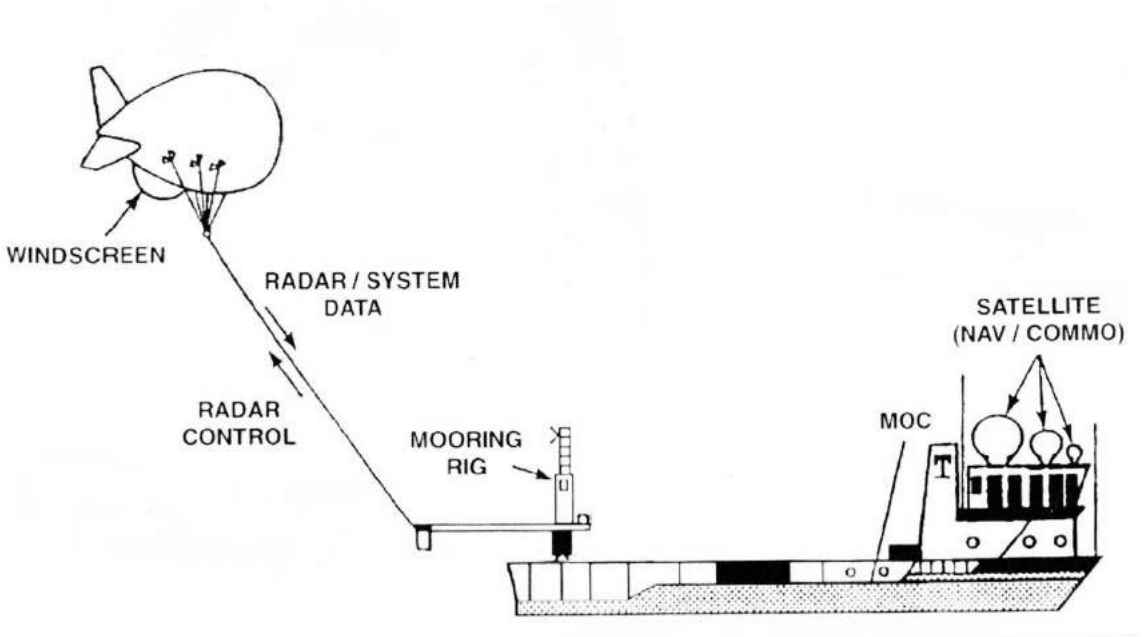
The U.S. Army operated the following four SASS ships in the Gulf of Mexico to support its military counter insurgency mission.

- Jan Tide, modified in 1983
- Abshire Tide modified in 1983
- Dickerson Tide, modified in 1984
- Carlson Tide, modified in 1984

The SASS ships were modified from their original commercial configuration with the addition of an aerostat mooring rig at the stern of the vessel, and a below-decks operations center with workstations and a communications center to conduct the SASS mission. The SASS ships were generally quite similar, forming a loosely-defined ship class, which will be referred to as the “Tide-class.”

General characteristics of Tide-class SASS ships

Parameter	U.S. Army SASS aerostat carriers
Displacement (gross tonnage)	876 to 978 MT (966 to 1,078 tons)
Length	54 to 59 m (177 to 193.6 ft)
Beam	12 to 12.9 m (39.4 to 42.3 ft)
Propulsion	1 x CAT D399 diesel @ 1,700 kW (2,280 bhp) (Dickerson Tide, other ships not specified)
Speed, max	7 to 11 knots
Aircraft	1 x TCOM 25M aerostat
Armament	None



SASS shipboard configuration with the mooring rig at the stern of the vessel and an operations center (MOC) below decks, amidships. Source: adapted from Info Age (2016)

Aerostat ship Jan Tide and TCOM 25M aerostat at Truman Annex, Naval Air Station Key West, in July 1988. Source: Photo by Raymond L. Blazevic via Wiki Commons

The aerostat

In the late 1970's, TCOM initiated a company-funded project to design and build a small aerostat system called the Small Tethered Aerostat Relocatable System (STARS). The resulting system was the 25-meter (82-ft) long TCOM 25M aerostat with a powered / fiber optic tether and a mooring system that could be installed on a relatively small ship or a flatbed tractor-trailer. One of the first applications of the TCOM 25M STARS aerostat was aboard an off-shore oil drilling resupply vessel operating in the Beaufort Sea in the Arctic.

TCOM 25M aerostat tethered to the Abshire Tide docked at the Naval Air Station Key West outer mole pier.
Source: Photo by Dale McDonald (25 Jan 1992) via Florida Memory

The STARS aerostat carries a radar system payload installed under the gas envelope and protected by an inflatable windscreen. The windscreen is slightly inflated with air drawn from the aerostat's ballonet air supply system. The windscreen can be deflated and opened for shipboard maintenance and repair of the radar system without affecting the ballonet.

For the SASS mission, the TCOM 25M aerostat's mission payload initially consisted of a Westinghouse AN/APG-66 pulse-Doppler, planar array airborne radar (similar to an F-16 fighter's radar) and later added a forward-looking infrared (FLIR) sensor for video surveillance and signal intelligence (SIGINT) sensors for communications intercept and signal source direction finding. Three fiber optic data cables were available in the powered tether to provide two-way secure communications between the aerostat and the Coast Guard detachment (the MAPDET) in the operations center on the SASS ship.

General characteristics of the TCOM 25M STARS aerostat

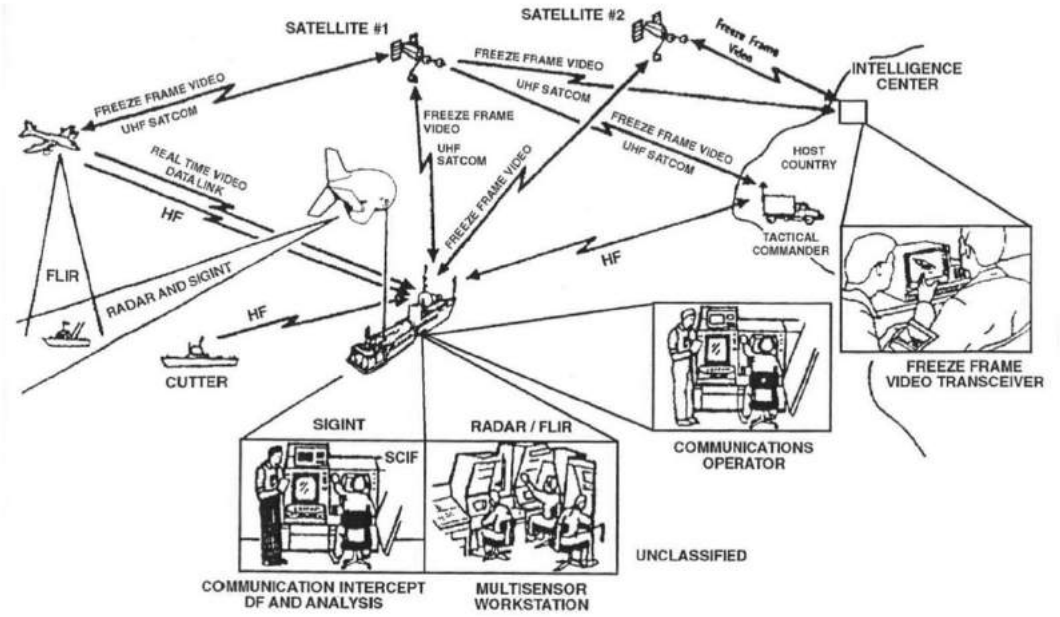
Parameter	**TCOM 25M STARS aerostat**
Length	25 m (82 ft)
Diameter, max	About 8.8 m (28.9 ft)
Volume	708 m^3 (25,003 ft^3), including 170 m^3 (6,003 ft^3) ballonet
Payload capacity	125 kg (lb) to 750 m (about 2,500 ft) on a hot day (30ºC / 86ºF)
Radar system	For the SASS mission: Westinghouse AN/APG-66 pulse-Doppler, planar array airborne radar
Altitude	• Operating: 750 m (about 2,500 ft) • Max: 900 m (2,953 ft)
Nominal line of sight to horizon at altitude	110 km (68.4 miles)
Area coverage at altitude	38,000 km^2 (14,672 mi^2)
Tether	• Powered tether with 3 x fiber optic data lines (only one used) • Radio backup for fiber optic data links
Power source	50 kW diesel electric generator on ship
Wind limits	• Launch / recover: 35 knots • Operational: 70 knots at altitude
Shipboard aerostat handlers	• 1 x control console • 1 or more deck crew
Winch system	• Stores 1,099 m (3,605 ft) of tether • Inhaul speed of 55 meters/min (180 fpm) with 815 kg (1,797 lb) of line tension • Capable of holding peak line load of 4,535 kg (10,000 lb)
Endurance	7 days aloft w/o helium replenishment

Source: Most data from TCOM BT-2955 (1982)

SASS Concept of operation

The MPADET analyzed aerostat radar, FLIR and SIGINT data, and collected data sent from other assets in the region to make a comprehensive assessment of targets that required further investigation. The MAPDET passed actionable target information to the appropriate asset and the Tactical Commander located on-shore.

The SASS ship was equipped with HF (high-frequency) communications and UHF (ultra-high-frequency) satellite communications (SATCOM) systems. The SASS ship communicated with other assets in the region and with the on-shore Tactical Commander via HF radio and used the SATCOM link to transfer freeze-frame FLIR video files among users of the network.



Above: Army SASS Concept of Operations.

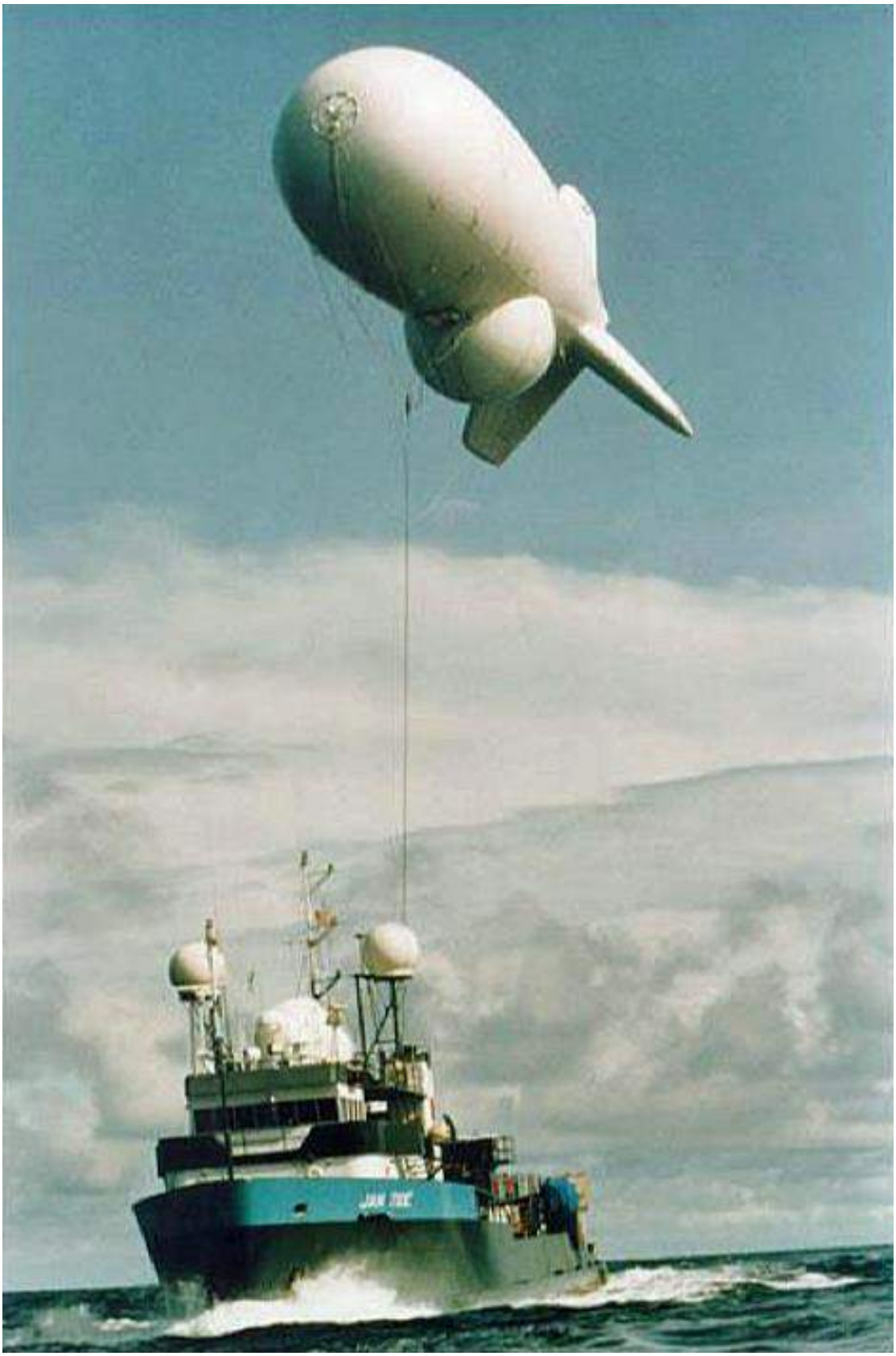
Left: Radar operator consoles operated by the MAPDET

Source, both graphics: Info Age (2016)

Photo gallery of SASS ships

Dickerson Tide underway with a moored aerostat. Source: TCOM LP

Carlson Tide with aerostat deployed. Source: TCOM LP



Jan Tide underway with aerostat deployed. Source: NRAC (2005)

3. The U.S. Coast Guard's Sea-Based Aerostats (SBA) / Maritime Interdiction and Surveillance Team (MIST) program (1987 and 1991)

In 1987, the SBA program was initiated from two shore-based Coast Guard units located in Key West and Miami, FL. By 1989, the program operated five MIST platforms, each of which consisted of an SBA ship known as a Mobile Aerostat Platform (MAP) equipped with a tethered RCA aerostat. In 1992, SBA / MIST was transferred to Army operational control. All SBA / MIST ships were retired in 1994.

Sentry-class aerostat carriers / Mobile Aerostat Platform (MAP)

The five SBA ships were converted from standard oil field supply tugs. A large superstructure block containing berthing and command spaces was located in the forward part of the original working deck. An aerostat mooring gantry was fitted at the extreme stern.

- SBA-1: Atlantic Sentry, conversion complete Nov 1989
- SBA-2: Caribbean Sentry, conversion complete Dec 1988
- SBA-3: Gulf Sentry, conversion complete Dec 1988
- SBA-4: Pacific Sentry, conversion complete Mar 1989
- SBA-5: Windward Sentry, conversion complete Apr 1987

SBA / MIST ships were generally quite similar, forming a loosely-defined ship class, which will be referred to as the "Sentry-class."

General characteristics of Sentry-class SBA / MIST ships

Parameter	USCG SBA aerostat carrier
Displacement (gross tonnage)	1,633 to 1,814 MT (1,800-2,000 tons)
Length	58.4 m (192 ft)
Beam	12.2 to 13.3 m (40 to 44 ft)
Propulsion	2 x diesel engines rated @ 1,864 to 2,908 kW (2,500 to 3,900 bhp) driving two shafts
Speed, max	12 knots
Speed, aerostat deployed	10 knots
Crew	10 civilian + 9 military
Aircraft	1 x RCA aerostat
Armament	None

Source: World Aircraft Carriers List: Miscellaneous US Aviation Vessels

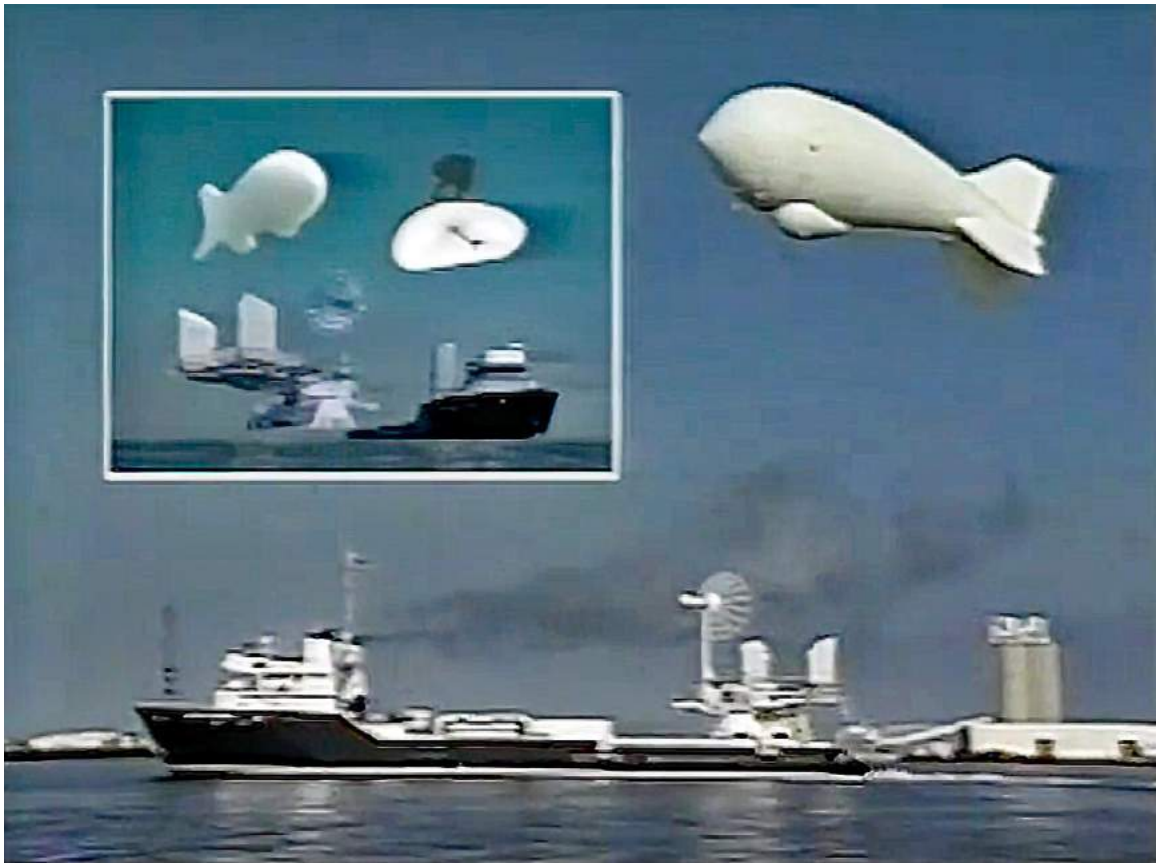
The Coast Guard assigned two crews per SBA vessel to operate the surveillance, communications and other mission systems. The teams alternately deployed aboard the SBA vessels, which were operated by civilian crews.

The SBA ships typically has bunk space for 32 persons, and could provide temporary living space for the crews of smaller support boats operating at sea with the SBA ships, which also carried additional fuel and water to resupply the smaller boats.

Atlantic Sentry underway without an aerostat. Note the RCA logo on the engine exhaust stack. Source: Rob Crimmins (2013)

The RCA aerostat and aerostat radar system (ARS)

Each SBA ship served as the "mothership" for a 33.5 m (110 ft) RCA tethered aerostat equipped with an Eaton AN/APS-128 X-band long-range air and surface surveillance radar. This 10 kW, frequency agile radar was capable of detecting a 10 m^2 (107 ft^2) target at a range of 111 km (60 naut. miles). RCA was selected as the SBA aerostat radar system provider after a competition with TCOM.



Elements of the RCA Mobile Aerostat Platform (MAP): The SBA ship, the mooring platform, the RCA aerostat and the Eaton surveillance radar. Source: Screenshot from Rob Crimmins RCA SBA System video (2013)

The RCA aerostat. Source: RCA via Rob Crimmins

General characteristics of RCA aerostat radar system

Parameter	RCA aerostat and radar system
Length	33.5 m (110 ft)
Diameter, max	11.3 m (37 ft)
Volume	1,586 m^3 (56,000 ft^3), with ballonet
Payload capacity	136 kg (300 lb)
Radar system	• Eaton AN/APS-128, 10 kW X-band radar • Capable of simultaneously tracking 30 targets • Capable of detecting a 10 m^2 (107 ft^2) target @ 111 km (60 naut. miles)
Operating altitude	More than 762 m (2,500 ft)
Nominal line of sight to horizon at altitude	110 km (68.4 miles)
Area coverage at altitude	38,000 km^2 (14,672 mi^2)
Tether	• Powered tether with 3 x fiber optic data lines (only one used) • Kevlar load-bearing component with Zytel jacket, strength > 4,536 kg (10,000 lb) • Radio backup for fiber optic data links
Shipboard aerostat handlers	• 1 x control console • 2 x deck crew
Winch system	• Inhaul / outhaul rate: 91.4 meters per min (300 fpm)
Endurance	• 14 days aloft w/o helium replenishment • Can add helium while aloft

Source: Most data from Rob Crimmins RCA SBA System video (2013)

The aerostat is deployed and recovered at a rotating mooring platform installed at the stern of the SBA ship. A crew of three is needed to deploy and recover the aerostat, one at a control console and two deck crew. The redundant winch system operated at a maximum speed of 300 feet per minute. The aerostat could be at its 762 m (2,500 ft) operating altitude in less than 10 minutes.

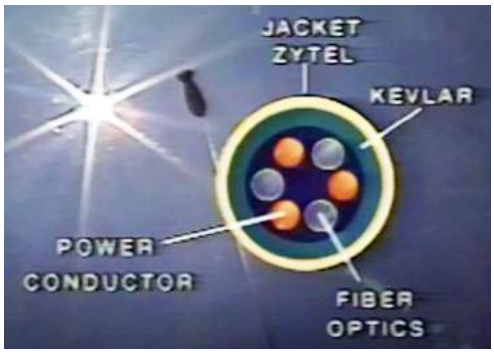
The radar and associated electronics and communications systems were housed within an inflatable windscreen under the aerostat's gas envelope. The windscreen can be deflated and opened for shipboard maintenance and repair of radar systems.

The AN/APS-128 radar system was designed for "box" level component replacement by shipboard personnel. The SBA ships

carried 100% spare parts for the radar system and the crew could restore the system to operation in as little as 20 minutes after reeling in the aerostat and opening the windscreen.

AN/APS-128 radar antenna visible with windscreen open for maintenance.
Source, both graphics: Screenshot from Rob Crimmins
RCA SBA System video (2013)

The powered tether has a Kevlar load-bearing component with a Zytel jacket, and also includes three fiber optic data cables for communications between the aerostat systems and the SBA ship (only one fiber optic line is used at a time). If the fiber optic data links are unavailable, communication automatically switches over to a backup radio data link.



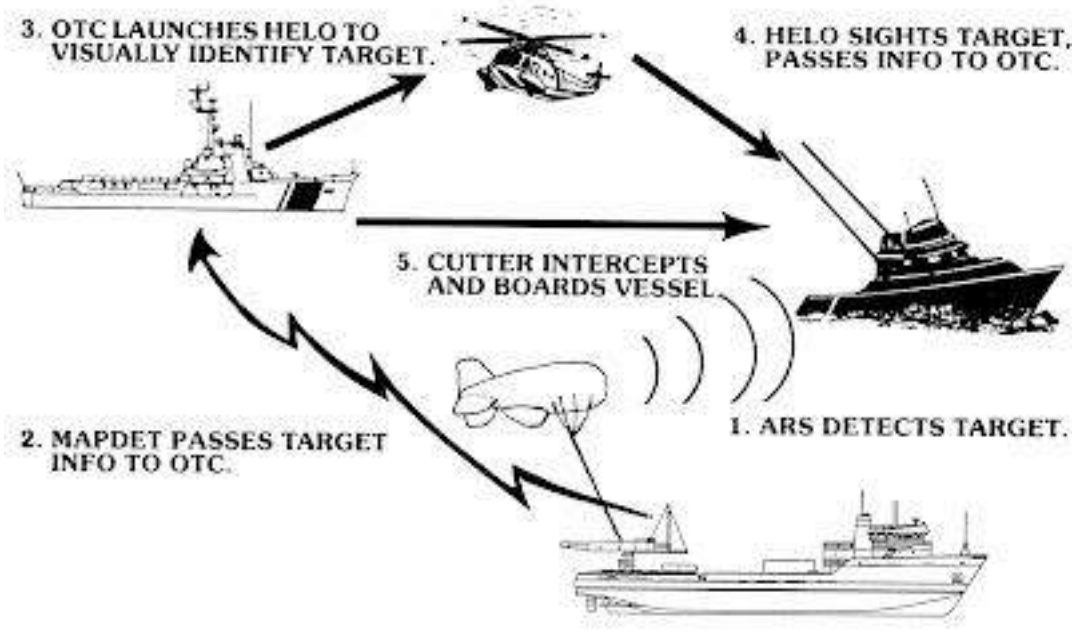
RCA was acquired by General Electric in 1986, and RCA Aerostat Systems became General Electric Aerostat Systems, which was acquired, along with other GE aerospace assets, in 1993 by Lockheed Martin.

SBA Concept of operation

The radar-equipped SBA ships served as the seaborne leg of an aerostat patrol line that was responsible for detecting illegal drug and immigration traffic across the southern approaches to the U.S. border.

The SBA ships provided continuous air and surface surveillance and passed actionable contact information to other law enforcement units working in the same geographic area. The SBA ships normally worked in conjunction with high- and medium-endurance Coast Guard cutters and patrol boat class vessels. Successful operations also were conducted with other U. S. and foreign naval forces.

Each SBA ship had a Mobile Aerostat Platform Operations Center (MAPCEN) where the embarked Coast Guard team analyzed incoming data from the radar system and passed target information to USCG and/or other units responsible for interception. The basic concept of operation is shown in the following diagram.



Coast Guard SBA / MIST concept of operations. Source: USCG

Photo gallery of SBA / MIST ships

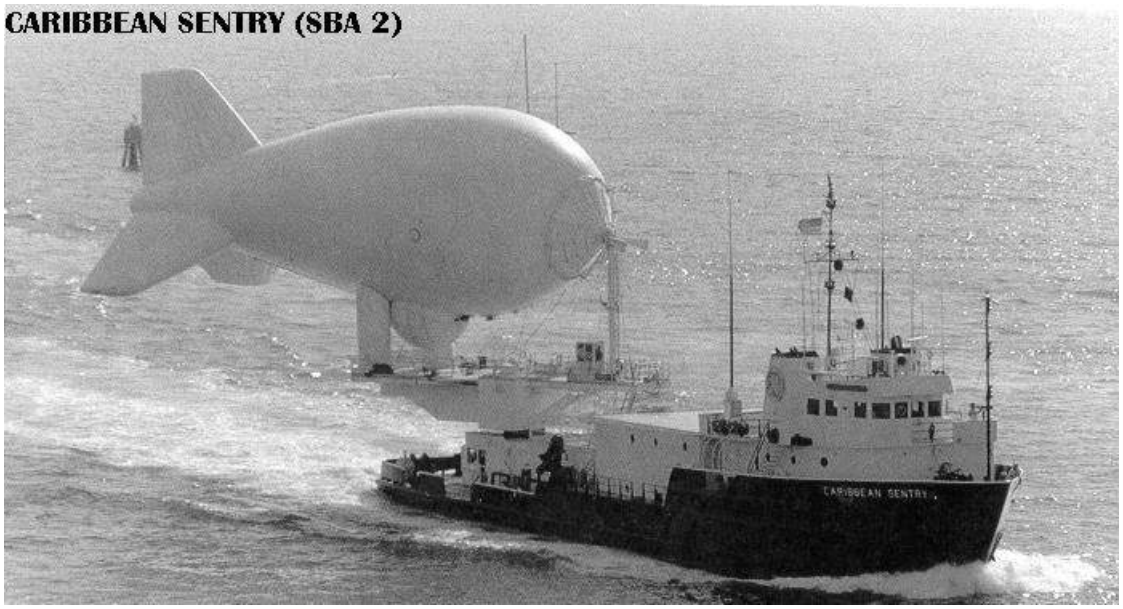
SBA-3 Gulf Sentry and SBA-5 Windward Sentry docked in the old Key West Naval Base outer mole pier, with a third ship flying its aerostat in the background. Oliver Hazard Perry class frigate USS Nicholas is on the left side of the pier. Photo by Dale McDonald (25 Jan 1992) via Florida Memory

SBA-5 Windward Sentry with moored aerostat docked in the old Key West Naval Base outer mole pier. Source: Photo by Dale McDonald (25 Jan 1992) via Florida Memory

SBA-3 Gulf Sentry and SBA-5 Windward Sentry docked in the old Key West Naval Base basin at Key West. Source: Photo by Dale McDonald (25 Jan 1992) via Florida Memory

SBA-3 Gulf Sentry at the pier in Key West.
Source: Photo by Raymond L. Blazevic (June 1993) via Wikimedia Commons

SBA-1 Atlantic Sentry at Mallory dock in Key West.
Source: Photo by Raymond L. Blazevic (Sept 1987) via Wikipedia



SBA-2 Caribbean Sentry. Source: Chuck Hill's CG Blog (2012)

Head-on view of the aerostat moored aboard SBA-1 Atlantic Sentry at Mallory Dock. Source: Photo by Raymond L. Blazevic (September 1987) via Wikimedia Commons

Aerostat on SBA mooring platform viewed from bridge. Source: Rob Crimmins

RCA aerostat aloft. Mooring tower at lower left. Source: USCG

Aerial view of deployed RCA aerostat. Source: Screenshot from Rob Crimmins RCA SBA System video (2013)

4. USCG SBA / MIST merged with Army SASS and the end of both shipboard aerostat surveillance programs (1992 – 1994)

In the fall of 1991 (fiscal year 1992), Congress directed the Department of Defense (DoD) to transfer the Coast Guard's five SBA ships to DoD operational control, with the Army continuing to support Coast Guard operations. That transfer took place on 31 December 1991. While Congress approved funding for the operation of the five SBA ships, they approved funding for only two of the SASS ships.

DoD decided to operate four ships: three SASS ships and one SBA ship in support of the Coast Guard mission. It placed the three other SBA ships in storage and used one SBA ship for an SBA/SASS comparison test of operational capabilities.

After comparing both the cost and operational effectiveness of the USCG SBA and Army SASS ships, the Army concluded that the SBA ships were a better value than the SASS ships and opted to retire the SASS ships. By the spring of 1993, the Army terminated the operation of all SASS ships and by 1994 these ships returned to commercial service.

The Army improved the communications capabilities of the SBA ships by removing the military radios from the retired SASS ships and installing them on the SBA ships. Thereafter, the Army supported the Coast Guard counterdrug mission in the Caribbean for only a short period of time. The seaborne aerostat counterdrug mission ended and all SBA ships were decommissioned in August 1994 and subsequently returned to commercial service.

The SBA and SASS programs demonstrated the feasibility of operating aerostats on slow speed ships and the feasibility of carrying sensors aloft to detect small, high-speed boats and low-flying aircraft at long range. However, frequent bad weather in the Gulf of Mexico and limited availability of aerostat carrier ships contributed to the demise of both the combined SBA / MIST and SASS programs.

5. For more information

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Videos

- "RCA's Sea Based Aerostat System," (11.50 min), posted by Rob Crimmins, 31 October 2013: https://www.youtube.com/watch?v=A2GjAi1Iy8I&t=2s

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