ARPA - Silent Joe and Silent Joe II

Peter Lobner, 6 February 2025

1. Introduction

In the late 1960s, the Advanced Research Projects Agency (ARPA, predecessor of DARPA) funded two projects, *Silent Joe* and *Silent Joe II*, to develop unmanned, silent drone blimps for the purpose of covertly detecting and reporting the nighttime movements of truck convoys and troops in Southeast Asia during the Vietnam War. This article provides an overview of both projects.

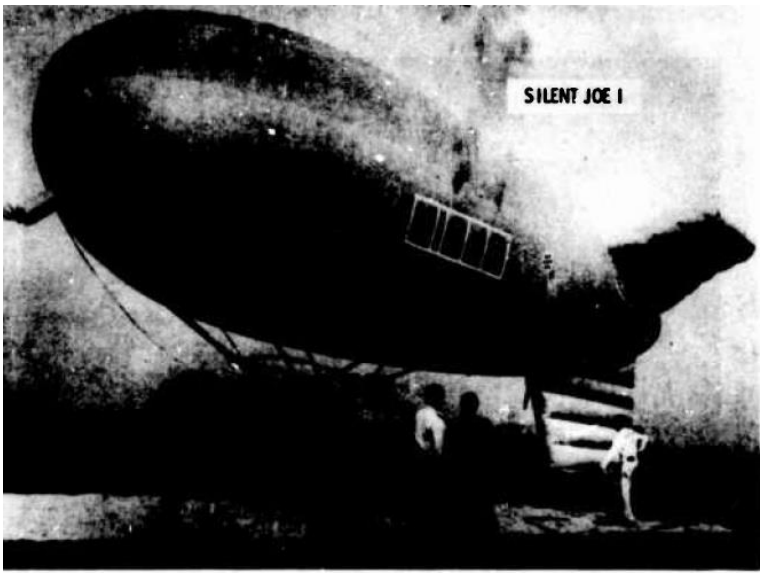
2. *Silent Joe*

Starting in the late 1960s, the Range Measurements Laboratory (RML) at Patrick Air Force Base in Florlda led the ARPA-funded *Silent Joe* project to develop a small, remotely-controlled, silent blimp that was equipped with microphones for covertly detecting the movements of truck convoys and troops in the jungles of Southeast Asia at night.

RML selected the G.T. Schjeldahl Company's "*Baldy*" tethered aerostat as the lighter-than-air platform for developing the free-flying, powered *Silent Joe* blimp. The "*Baldy*" aerostat had a streamlined Class C (blimp) hull shape with a 3:1 fineness ratio, a volume of 5,300 ft^3 (150 m^3) and a static lift capacity of 206 lb (93.4 kg). The aerostat hull was 45 ft (13.7 m) long, with a maximum diameter of 14 ft (4.3 m).

The basic *Baldy* aerostat was adapted by RML for the *Silent Joe* mission by the addition of a small propulsion system driving two fixed propellers attached transversely to a small gondola suspended under the gas envelope. The vehicle's flight path was controlled by differential control of the two propellers. A transceiver added to the *Silent Joe* blimp provided the command and telemetry channels needed for remotely operating the blimp and transmitting real-time mission data to the ground station.

Initial testing was done with two 3 hp (2.2 kW) McCulloch chain saw engines, each driving an individual propellers. These were replaced by two 2.5 hp (1.9 kW) electric motors powered by NiCd (nickel-cadmium) batteries for a planned flight duration of two hours.



Silent Joe blimp, a powered, free-flying adaptation of a G.T. Schjeldahl "Baldy" tethered aerostat. Source: Dynoman via Secret Projects (2019)

The *Silent Joe* system was deployed and flew successfully on several missions in Southeast Asia.

In its 8 January 1973 issue, Aviation Week and Space Technology magazine reported:

> "The difficulty of shooting down a balloon was unintentionally demonstrated several years ago in South Vietnam during ARPA tests of a small, non-tethered balloon, which was being used as a platform for acoustic sensors to detect enemy ground troops. The balloon carried a small battery powered propulsion unit and bore the code name of '*Silent Joe*'".
>
> "When *Silent Joe* failed to respond properly to ground commands, and started heading for Cambodia, armed helicopters were dispatched to shoot it down lest its classified payload fall Into enemy hands. Despite the best efforts of the armed helicopters, the *Silent Joe* balloon was last seen flying unscathed into Cambodia."

3. *Silent Joe II*

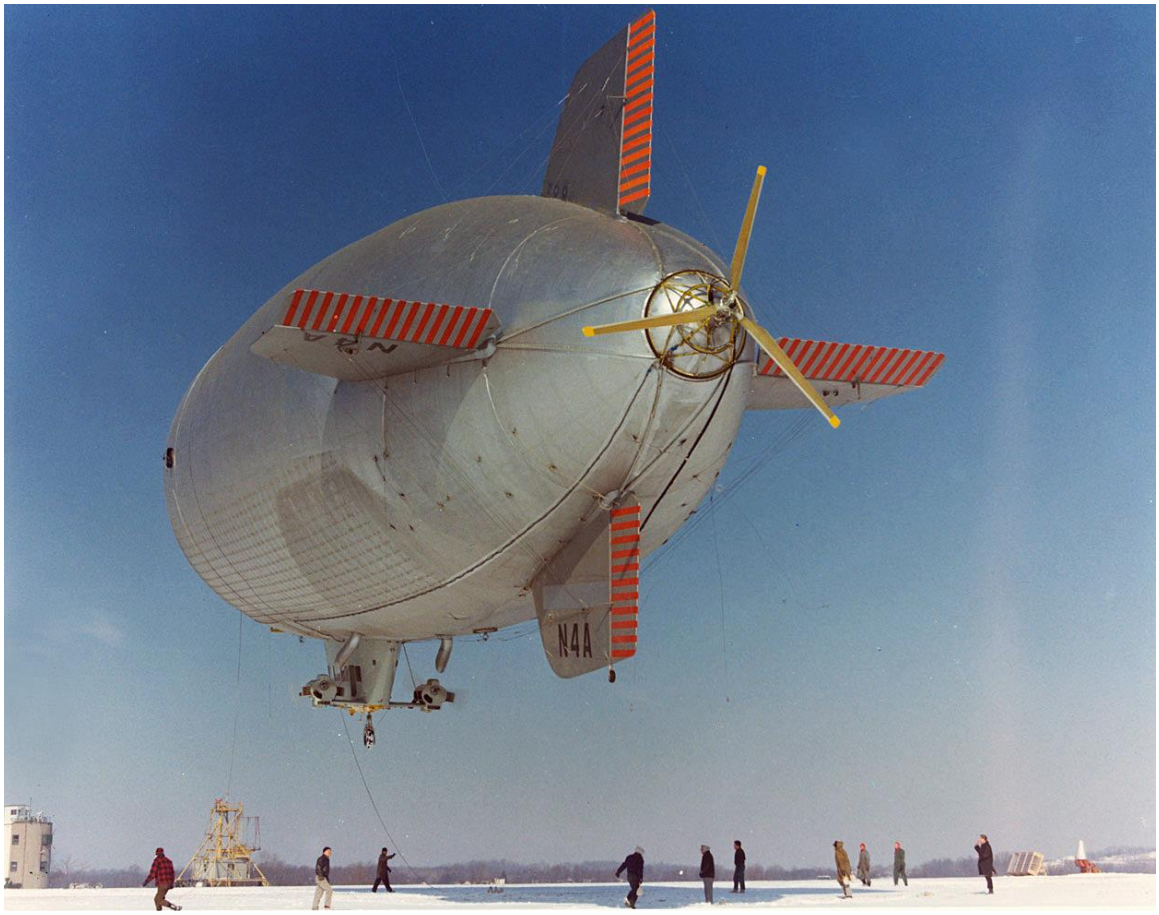
Also in the late 1960s, Goodyear modified and tested their GZ-19A *Mayflower* with a quiet, low-speed stern propeller under an ARPA-funded project called *Silent Joe II*. This modified blimp also was intended for nearly silent, low altitude, covert night surveillance missions in Viet Nam. The blimp was designed to be inaudible to the human ear when flying at an altitude of 500 ft (152 m) or more.

The original GZ-19A Mayflower. Source: Goodyear

Flight control system

The *Silent Joe II* flight-control system enabled normal piloted operation as well as uncrewed operation with the blimp flown by remote control or by an onboard system programmed with the needed flight path information for the intended mission and the capability to return to base in case of a malfunction. For manned flight, the *Silent Joe II* pilot's control panel, located just above the original *Mayflower* instrument panel, contained all controls needed for positioning the stern gimbal and visually indicated the stern propeller position.

Remote control beyond line-of-sight from a ground station was enabled by an airborne S-band radio relay flying at an altitude of 14,000 feet (2,467 m) above the ground station and up to 150 miles (241.4 km) for the *Silent Joe II* airship.



GZ-19A Mayflower with stern propeller for Silent Joe II missions. Source: Dynoman via SecretProjects (2022)

Surveillance payloads

The video and audio surveillance payloads were government-furnished equipment (GFE).

Gyrodyne Corporation supplied and operated a visual surveillance package comprised of a low light level television (LLLTV) camera and an infra-red (IR) spotlight attached at the nose of the blimp. The linkage between the LLLTV mount and IR light was mechanical in the tilt mode and electrical in the pan mode. This system proved to be

operationally unsatisfactory. Gyrodyne factored this *Silent Joe II* experience into more advanced systems for later applications.

Georgia Institute of Technology (GIT) supplied and operated the acoustic monitoring package, with seven strategically located sets of acoustic sensors mounted around the blimp's hull. The design and operation of the *Silent Joe II* acoustic monitoring package are discussed in GIT/ESS Report A1183/P1.

Propulsion system

For the *Silent Joe II* mission, a single, 3-bladed, 20 foot (6.1 m) diameter propeller, driven by a lightweight, geared, reversible hydraulic motor, was added at the tail. The original gondola-mounted propulsion system was retained and could be used during transits. During a *Silent Joe II* mission, the original propulsion system would be shut down.

This stern propulsion unit was mounted on a hydraulically-controlled gimbal assembly the provided ±45º pitch and yaw thrust vectoring for flight path control. The entire stern propulsion unit was attached to the hull via support rings laced to the hull. The support rings also were bolted to eight battens installed in a Vee-strut arrangement around the stern. The battens were curved to fit the airship contour and laced to the envelope. Each of the four Vee-struts terminated at, and were attached to, the base of one of the four tail fins. This battens configuration was designed to prevent compression buckling at the tail and distribute the stern propulsion system loads over a large area of the blimp envelope.

The hydraulic system was battery powered. The hydraulic reservoir, DC electric motor-driven, piston-type hydraulic pump, fan to cool the motor, and flow and pressure controls were located in the control car (gondola). The pump and fan were noise sources that required silencing as described in the *Silent Joe II* Final Report:

> "The air inlet and exhaust for the fan were routed through tuned duct work, with foam insulation used for quieting. The pump also was enclosed with foam. The entire hydraulic power (system) then was enclosed with a leaded vinyl sheeting and

was mounted on shock absorbers attached to the airship floor in order to dampen and reduce acoustic noise."

Closeup of the Silent Joe II stern propeller, the gimbal mount, the support rings and the Vee-battens.
Source: Adapted from NAA Noon Balloon, #111 (2016)

The closed-loop hydraulic power system was completed with flexible hydraulic supply and return lines and electrical control cables fastened to the outside of the envelope between the control car and the stern-mounted propeller (about 125 ft / 38.1 m apart).

This system was able to drive the *Mayflower* at speeds up to 10 mph (16 kph).

Ground and flight tests

Ground and flight tests were conducted on the modified *Silent Joe II* airship between 20 February and 4 April 1969. The first flight was made on 13 March 1969 and the final flights were made on 3 – 4 April.

The ground tests determined that the maximum propeller speed was a function of deflection angle. With no deflection, maximum propeller speed achieved in ground testing was 270 rpm. As the propeller was deflected, maximum speed decreased to 210 rpm @ 5º , 170 rpm @ 8º and 150 rpm @ 12º. Excessive vortex shedding noise and a blade resonance were observed at 150 rpm with the higher blade deflection angles. As a result, no further ground performance testing was conducted at the higher blade deflection angles. The final ground test was a series of endurance tests at various stern rotor speeds to run-in the system. A total of 20 hours of operating time was obtained on the stern propulsion system during the laboratory and ground tests.

During flight testing, Goodyear Aerospace conducted the airship performance tests. The tests demonstrated that the airship can be controlled during low-speed flight from a remote ground station using available equipment.

The acoustic design target for airship-generated noise was the 35-phon curve from the Robinson-Dadson curves [a set of equal-loudness (phon) contours for the human ear, determined experimentally]. During flight tests, loudness level was measured as the airship flew at 500 ft (152 m) directly over a microphone on the ground. This technical requirement was satisfied. However, the airship could still be heard in a very quiet environment.

GIT researchers reported that the as-tested airship should not be audible in the very quiet environment (5-phon curve) if it is flown at an altitude of from 800 to 900 ft (244 to 274 m) at 140 rpm or at an altitude of 500 ft (152 m) at 40 rpm.

Silent Joe II conducted nine flights in 1969. It was not deployed operationally in Southeast Asia. The project was terminated on 30 June 1970.

4. For more information

- Arthur Korn, “Unmanned Powered Balloons,” paper N76-15064, (Silent Joe & Silent Joe II, p. 588-589), 1976: https://ntrs.nasa.gov/api/citations/19760007976/downloads/19760007976.pdf

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- Philip Klass, “Balloons provide stable platforms,” Aviation Week & Space Technology, pp. 36 - 39, 8 January 1973: https://archive.aviationweek.com/issue/19730108#!&pid=36 (subscription required)
- Walter Menning, “A Summary of Tethered-Lighter-Than-Air Development Conducted by the Range Measurements Laboratory,” paper presented at Proceedings AFCRL Scientific Balloon Symposium (8th), 30 September to 3 October 1974, AD-A008-489, (see note on Silent Joe, p.61), 2 December 1974: https://apps.dtic.mil/sti/tr/pdf/ADA008489.pdf

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- “*Silent Joe II* Final Report,” GER-14328, Goodyear Aerospace Corp., 14 May 1969: https://www.secretprojects.co.uk/threads/classified-project-silent-joe-ii.10236/
- F. Dixon, “Research Project No. A-1183, Monthly Technical Summary Report No. 1, 2 – 30 June 1969,” Georgia Institute of Technology, GIT/EES Report A1183/P1, Project title: “*Silent Joe II* Acoustic and TV Sensor Evaluation Flight Test Program,” June 1969: https://lynceans.org/wp-content/uploads/2025/02/GIT_a-1183_327197.pdf
- Philip Klass, “Balloons provide stable platforms,” Aviation Week & Space Technology, pp. 36 - 39, 8 January 1973: https://archive.aviationweek.com/issue/19730108#!&pid=36 (subscription required)
- F.A. Tietzel et al., “Summary of ARPA-ASO, TTO Aerial Platform Programs: Volume II, Remotely Piloted Helicopters” (and *Silent Joe II*), Battelle Columbus Laboratories report for

DARPA, July 1975: https://apps.dtic.mil/sti/tr/pdf/ADB007793.pdf
- Mark Lutz, “Four Airships With Stern Propulsion,” Noon Balloon, #111, p. 18, Naval Airship Association, Fall 2016: https://650a8e8c-0be3-466b-9728-1ece39a725e3.filesusr.com/ugd/fbd712_c3041c1eab9143d4a7da7b3160941522.pdf

Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
    - Goodyear - civilian blimps
    - Sheldahl Inc. (G.T. Schjeldahl Company)
- *Modern Airships - Part 2*: https://lynceans.org/all-posts/modern-airships-part-2/
- *Modern Airships - Part 3*: https://lynceans.org/all-posts/modern-airships-part-3/