Voliris airships

Peter Lobner, updated 29 January 2024

1. Introduction

Voliris is a small French firm that has been designing and building airships since it was founded in 2001. Acquired in 2008 by New York Finance Innovation (NYFI), the company has established its research and development effort at Aérodrome de Moulins - Montbeugny, Yzeure, France. The company's website is here: http://voliris.com

Except for their first airship, the V900, all Voliris designs have had variable volume gas envelopes invented by Alain Bernard and patented. The design has evolved from the slender three-lobe gas envelopes on the V901 and V930 series, to the current, broad five-lobe buoyant wing designs on the V902 and V932 NATAC airships.

The target market for the Voliris V930 and the V932 NATAC cargo airships is to transport a 30 metric ton (33 ton) standard shipping container between an intermediate depot, with access to one or more modes of heavy cargo transportation, and a remote site with little or no infrastructure up to about 500 km (311 miles) away.

2. The V900 – the first Voliris airship

The first Voliris airship was a conventional non-rigid blimp known as the V900, which was built using the first Russian Au-12 blimp gas envelope manufactured in Moscow by CJSC Augur Aeronautical Center (later Augur RosAeroSystems). This envelope was produced under a joint Russian-French project named "Voliris-900," which was commissioned by the French National Aeroclub. The first Au-12 gas envelope for the Voliris V900 had a length of 31 m (102 ft) with a cruciform tail.

The V900 airship was assembled in the historic former exhibition Hangar Y at Chalet Meudon near Paris. The suspended gondola was made from a converted helicopter cockpit with a stern-mounted piston engine driving a pusher propeller. The V900, with French registration F-03VS, first flew on 26 June 2003 from the Clermont-Ferrand airport. It operated for about four years, but was not developed into a commercial airship.

General characteristics of the Voliris V900 blimp

Parameter	**Voliris 900**
Length	31 m (102 ft)
Diameter, max	8 m (26.2 ft)
Volume	996 m^3 (35,173 ft^3)
Propulsion	1 x 74.6 kW (100 hp) stern-mounted piston engine driving a three-bladed pusher propeller
Speed, cruise	75 kph (46.6 mph)
Speed, max.	85 kph (52.8 mph)
Altitude, max. operating	1,000 meters (3,281 ft)

Voliris V900 in flight. Source: Eric Faure, "The scientific use of airships"

The aerostatic center of Meudon was created in 1793 for hydrogen balloons. Hangar Y originally was built for an international exhibition and hosted the airship La France in 1884. Thereafter, Hangar Y was disassembled and rebuilt at Meudon.

V900 profile view (above). Source: Airshipworld Blog (31July 2007)

V900 bow view (right). Source: Thierry Detable via Airport-Data.com (28 July 2007)

Voliris V900 two-seat suspended gondola with stern-mounted pusher propeller. Note the landing gear. Source: Thierry Detable via Airport-Data.com (28 July 2007)

3. The V901-series prototypes

The V901 was the first hybrid airship created by Voliris. The 33 meter (108 ft) long, three-lobe gas envelope, with a nominal volume of 906 cubic meters (31,995 cubic feet), was designed to vary its volume by up to 20% with a patented mechanical “tightening module” inside the envelope. This gave the airship the ability to mechanically control shape and buoyancy. It was trimmed to be heavier-than-air on the ground. The gas envelope for this hybrid airship was designed to generate significant aerodynamic lift in flight.

In this section, we’ll take a look at three different hybrid airship configurations, V901C, V901RC and V901D, and the variable volume patents for the V901-series airships. All are classified in France as ULM (ultra-light motorized) airships and are limited to 100 hp.

V901C

The 901C made its first flight on 3 July 2012. You can watch a short (4:15 minutes) video of this flight here: https://www.youtube.com/watch?v=SB5ySwh9Uv4&feature=emb_logo

Voliris 901C at takeoff. Source: Voliris

Close-up of the Voliris 901C gondola and tailplanes at takeoff.

V901C at takeoff.

V901C in-flight profile view. Source, three photos: Voliris.

Voliris 901C head-on view highlighting the tri-lobe envelope design and the tailplane configuration. Source: Naval Airship Assoc., Noon Balloon, Winter 2012

V901C suspended two-seat gondola. Source: Voliris.

V901RC

The small, remotely controlled V901RC made its maiden flight in 2012, followed by a two year test program to continue developing the automation features needed for future unmanned cargo airships. One goal of the 60 m^3 (2,119 ft^3) V901RC was to gather flight data to support Voliris in determining the flight characteristics and performance of the 900 m^3 (31,783 ft^3) V901D airship. The testing program also enabled Voliris to refine the aerodynamic, mechanical and automatic piloting features of the planned larger V930 container transport airship. The V901RC remains in operation as a flying testbed.

You can watch a short (1:47 minutes) Voliris video of a V901RC test flight here: https://www.youtube.com/watch?v=qT_SwI2-XZo&t=4s

The following views on the V901RC in flight are screenshots from that video.

V901RC in flight. Source: Screenshot from Voliris video

V901RC. Source, both photos: Screenshots from Voliris video.

V901D

The V901D is readily identifiable by its cruciform tail fins. Its early testing program included operational tests of an automated flight system of airship piloting. It remains in operation as a flying testbed. You can watch a short (9:08 minutes) video of a V901D flight here: https://www.youtube.com/watch?v=wxMeyAu_n2s

Manned V901D, with a cruciform tail at takeoff. Source: Voliris.

V901D on landing approach. Source: Voliris.

Voliris patents for the V901-series airships

Patents US9108712B2 and US2014/0054421A1, both of which are titled, “Airship with a controlled variable profile,” describe an airship design and a means to control a variable-volume gas envelope, enabling various configurations to be achieved on the ground and in flight. European patent EP2686237B1, “Lighter than air aircraft with actively controlled shape,” is similar in scope.

The variable volume design feature enables an airship to be optimized in flight for ascent, descent and cruise. On the ground, this feature can enable an airship to be placed in a restricted-height hangar. The patent states, “The resulting hybrid aircraft can thus perform according to various flight configurations, sometimes like an aerostat (lighter-than-air) and sometimes like an aerodyne (heavier-than-air). Furthermore, the streamlined profile of the envelope, in the shape of a wing, makes it possible to reach speeds that are considerably higher than for a conventional, ‘cigar’-shaped aerostat.”

This patent was implemented in the tri-lobe Voliris V901-series of small airships and in the larger V930 cargo airship concept.

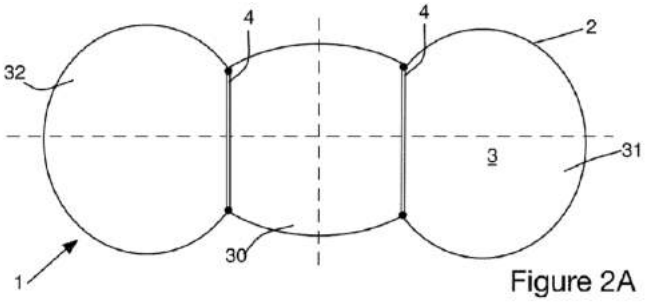


Figure 2A

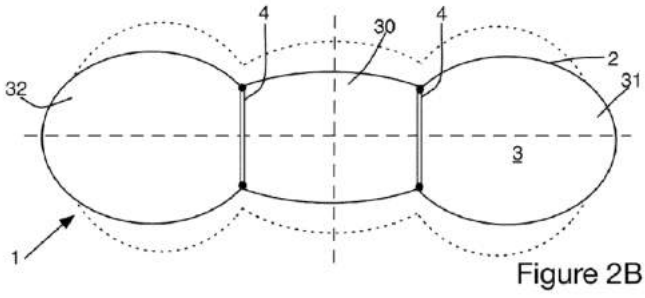


Figure 2B

Patent Figures 2A and 2B are transverse sections of a three-lobe gas envelope showing one example of geometry variation. In order to

control the volume variations, two “adjustment regions” (4) are provided in this example, at the intersections between the central lobe (30) and the lateral lobes (31 and 32) of the envelope. In Figure 2B, the “adjustment regions” are tightened down relative to Figure 2A.

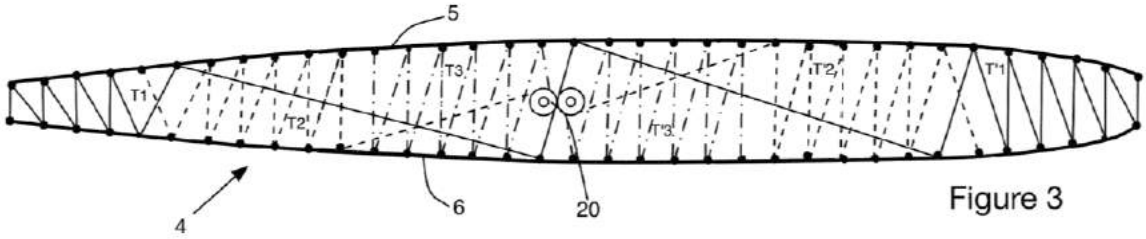


Figure 3

Patent Figure 3 is a longitudinal cross section of an “adjustment region” (4), showing the top and bottom longitudinal adjustment elements (spars 5 & 6), the zig-zag cable assembly and the tightening module (20). The tightening module (20) takes a tension on the cables to draw the rigid adjustment elements (5 & 6) closer together, decreasing volume and buoyancy, or relaxes the tension on the cables to allow the adjustment elements to spring farther apart, driven by the internal pressure in the gas envelope, and increasing volume and buoyancy.

Voliris tested the variable volume principle on a V901-series tri-lobe gas envelope of 900 m^3 (31,783 ft^3), 33 meters (108 ft) long.

Test of the variable volume system on a tri-lobe envelope.
Source: Voliris

4. The V930 cargo airship concept

In this section, we'll take a look at the large V930 airship design concept and the patent for the airship, its variable volume envelope and modular cargo handling system.

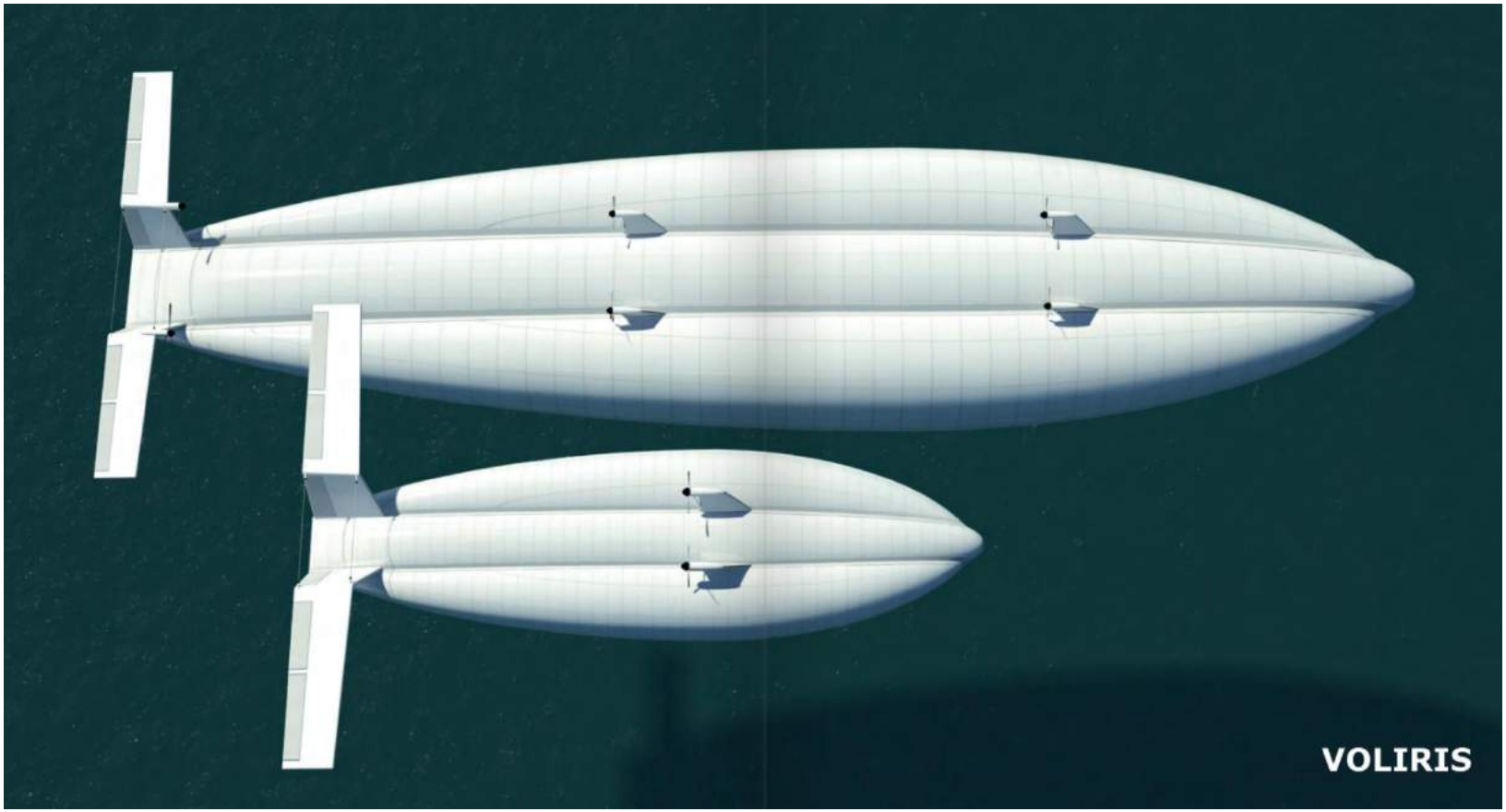
V930

In 2012, Voliris unveiled the design of a family of scalable, optionally-piloted, hybrid cargo-carrying airships based on the general planform of the V901's long, three-lobe, variable volume gas envelope. The V930 was dubbed the "flying container project."

Basic characteristic of this cargo airship are as follows:

- Gas envelope nominal volume: 25,000 m^3 (882,867 ft^3), which corresponds to the capacity of one liquid helium container.
- Envelope volume is adjustable by about 20% to manage buoyancy.
- Designed to transport a standard 40 foot (12.2 m) long 32T container weighing up to 30 metric tons (33 short tons)
- A Container Mover and Landing Gear (CMLG) module provides simple cargo container ground handling, loading and unloading. The CMLG also serves as the landing gear after it has been secured to the airship.
- No ballast exchange is needed when loading or unloading cargo.
- Maximum takeoff weight: 35 metric tons (38.5 short tons)
- Six propellers; maximum 1,491 kW (2,000 shp)
- Airspeed: maximum 150 kph (93 mph)
- Short takeoff and landing (STOL) on unprepared runways of approximately 800 m (2,625 ft) length

The entire V930 airship was designed to be transported in ten ISO 40 foot (12.2 meter) containers and assembled at the destination.



(Top) Overhead view of the Voliris 930 30 metric ton cargo airship, (Bottom) A smaller variant. Source: Voliris

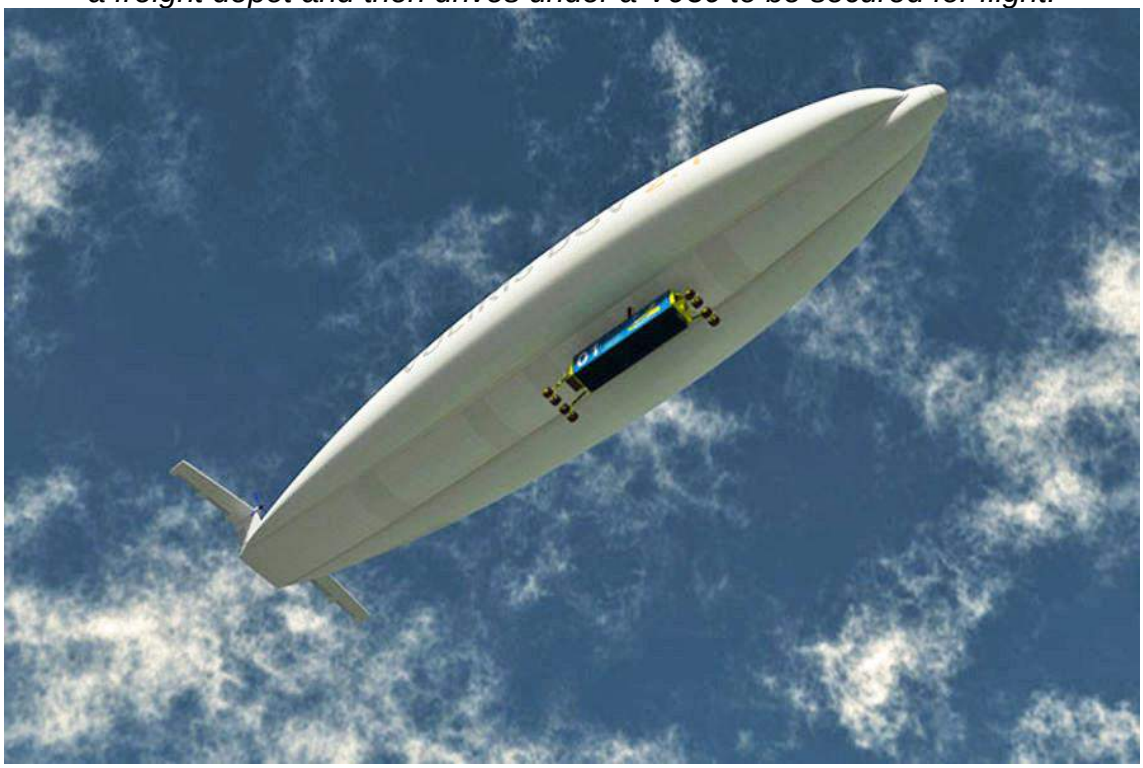
You can watch a short (5:16 minutes) animated video of V930 cargo handling at an intermediate freight facility and flight toward its final destination here: https://www.youtube.com/watch?v=0ZkeEO9tQ1k

Voliris later discontinued work on the V930 and focused its heavy-lift design work on the more promising V932, which is based on the V902 buoyant delta wing planform.

V930 general arrangement. Source: adapted from Voliris.

Rendering of a V930 on landing approach, carrying a cargo container. Source: Screenshot from Voliris video

A Container Mover and Landing Gear (CMLG) unit picks up a cargo container in a freight depot and then drives under a V930 to be secured for flight.

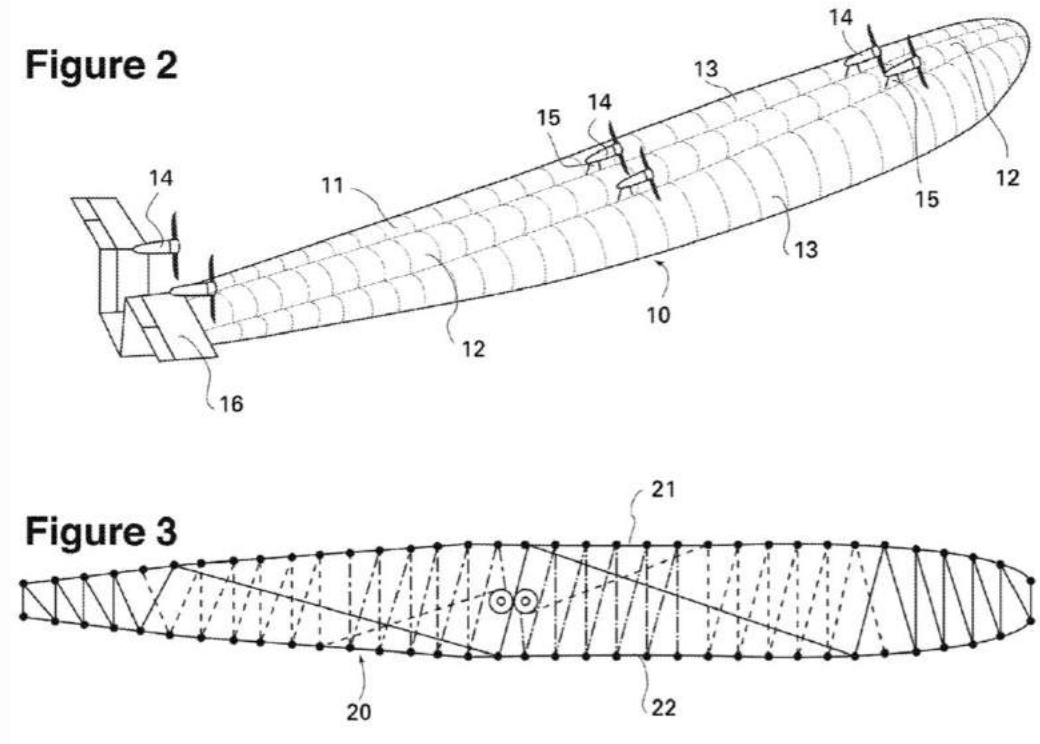


Rendering of a V930 in flight showing a CMLG and cargo container supported under the central lobe of the gas envelope.
Source, both graphics: Screenshots from Voliris video

Voliris patent for the V930 airship and modular cargo system

Patent US2014/0255139A1, “Method and system for transporting containers by modular aircraft,” describes a variable volume airship that can serve as a fuel-efficient, pilot-optional cargo vehicle for transporting a standard shipping container and enabling goods to be delivered in large quantities to sites that are not serviced by conventional modes of transportation such as road transport, train, or where no airport infrastructure is available. This patent was filed on 1 October 2012 and was published on 11 September 2014.

This patent describes the scaleable design and operation of the Voliris V930 three-lobe hybrid cargo airship, which is shown in Figure 2. The airship is a long, slender lifting body that contributes substantial aerodynamic lift in flight. Patent Figure 3 shows the same type of variable volume control “adjustment regions” as Voliris used on its V901-series of airships.



Legend

The hybrid airship (10) has three lobes (11) made up of a central lobe (12) and two side lobes (13) that form a single inflation chamber (24) inside the multi-layer fabric hull (23). The lobes in the hull are formed by top and bottom longitudinal spars (21, 22) that are connected by “adjustment regions” (20, aka “skeletons”). Engines (14) can be mounted to the hull on pylons (15) supported from the longitudinal spars or mounted directly to the tail assembly (16).

Patent Figure 5 is a transverse cross-section of the hull at an engine (14, 15) location, highlighting the three-lobe gas envelope and the positions of the adjustment regions (20) between the lobes. The lobes are connected internally and form a single inflation chamber (24).

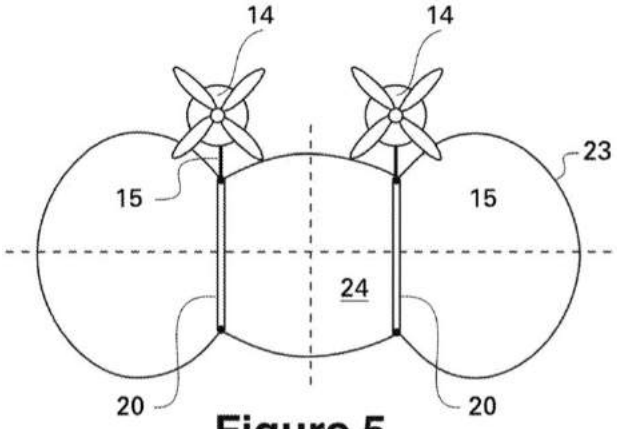


Figure 5

Patent Figure 4b shows a shipping container (30) held in place under the central lobe (12) of the airship by a Container Mover and Landing Gear (CMLG) unit (17, known in the patent as a “gripping” module). The combined CLGM and cargo load is supported from the adjustment regions (20), which distribute this load broadly into the envelope.

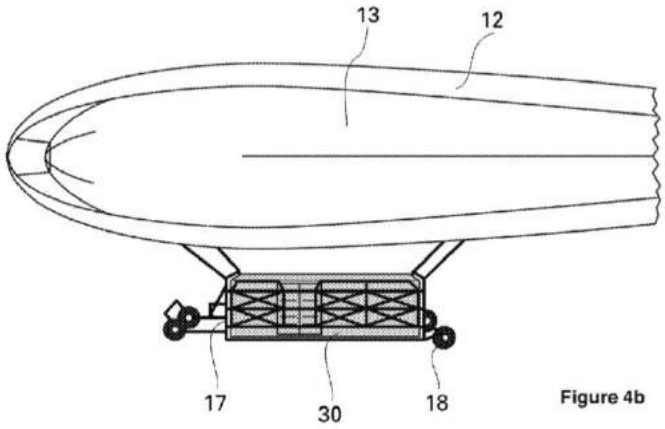


Figure 4b

The wheels (18) attached to the CMLG enable the unit to pick up a cargo container and then position itself under the airship before being secured for flight. During takeoff and landing, the CMLG wheels function as the landing gear for the airship.

A manned gondola could be carried in place of the cargo container.

5. The V902 buoyant wing

The next step in Voliris airship development was the V902, which was a small, hybrid, semi-buoyant airship with a broad gas envelope that resembled an inflated delta wing. This design offered greater aerodynamic lift than the slender V901. In this section, we'll take a look at two variants of the buoyant wing airship design: the manned V902ULM and the remotely-piloted V902RC.

V902ULM

The piloted V902ULM, with an 80.816 m^3 (2,853.9 ft^3) gas envelope, holds the Guinness World Record as the world's smallest airship. You can watch a short (2:27 minutes) video of this Guinness record flight by pilot Arnaud Siegel on 7 October 2016 here: https://www.youtube.com/watch?v=xOJvtaiNp5c

The piloted Voliris V902ULM.
Source: Mooceur via Wikipedia

The piloted Voliris V902ULM, bow view.
Source: Mooceur via Wikipedia

V902ULM on Guinness record flight, 7 October 2016.
Source, two photos: Screenshots from Voliris video

V902RC / Mini-NATAC

The V902RC is an 80 m^3 (2,825 ft^3) remotely-controlled adaptation of the V902ULM design for use in testing cargo-carrying configurations. It became a 1/7-scale demonstrator known as the Mini-NATAC, which was used to validate the design of a future large cargo airship to be known as the V932 NATAC.

The propulsion and cargo handling systems and landing gear were integrated in a rigid framework that was suspended under the buoyant gas envelope. A container gripping module (CGM) on this framework was developed to facilitate attaching and carrying a 1/7-scale cargo container along the centerline of the framework. The Mini-NATAC made its first flight on 30 August 2017. It demonstrated stable flight and confirmed the utility of the twin nacelle design and the cargo suspension system. You can view a short video of a Mini-NATAC test flight here:
https://www.youtube.com/watch?v=lQ86ytiuT70

V902RC 1/7-scale Mini-NATAC demonstrator. Source: Voliris

The V902RC remains in operation as a flying testbed.

V902RC configured as the 1/7-scale Mini-NATAC demonstrator. Source, three photos: Screenshots from Voliris video

6. The V932 NATAC (Automatic Container Transport by Air Shuttle)

The V932 is a significant scale-up of the V902 design. Voliris currently is focused on developing the V932 as an optionally-piloted, autonomous cargo airship designed to carry a maximum 30 metric ton (33 ton) payload in one 40-foot (12.2 m) long, standard 32T international freight shipping container. Such containers are widely used in ground transportation. However, there are areas where logistical infrastructure does not exist or does not offer satisfactory quality and safety for ground transportation. For such cases, Voliris is developing the buoyant wing Automatic Container Transport by Air Shuttle (NATAC) hybrid airship to ferry a shipping container between two locations up to about 500 km (311 miles) apart and return to base without refueling.

The unmanned NATAC V932 hybrid airship, shown in the following graphic, and the V902 Mini share the same general configuration.

Concept drawing of an NATAC V932 hybrid airship on the ground, connected to a mooring mast. Note the suspension lines connecting the engine and landing gear nacelles to the buoyant envelope. Source: Voliris

The NATAC system offers the following operational characteristics:

- Uses about 25% of the helium lifting gas required by a conventional airship to transport a 30 metric ton (33 ton) payload.
- The Container Gripping Module (CGM) on the airship enables simple cargo container loading and unloading.
- No ballast exchange is needed during a load exchange.
- On the ground, only a single operator is needed to provide assistance during takeoff and landing approach.
- Designed primarily for autonomous flight on designated routes operating above light planes and below airliner routes.
- “Unhijackable” autonomous control system.
- The entire V932 airship was designed to be transported in ISO 40 foot (12.2 meter) containers and assembled at the destination.
- Designed to operate with helium or hydrogen lifting gas.

General characteristics of the V932 NATAC hybrid airship

Parameter	**Voliris V932 NATAC**
Length	80 m (262.5 ft)
Width, max.	60 m (197 ft)
Height, overall	25 m (82 ft)
Volume	Variable volume, 5-lobe envelope with proprietary pressure control system, nominally 25,000 m^3 (883,000 ft^3) of helium at STP
Lifting gas	Helium, but can operate with hydrogen
Payload	30 metric tons (33 tons) in one standard 40 foot (12.2 m) long 32T shipping container supported by a Container Gripping Module (CGM)
Propulsion system	2 x 3,728 kW (5,000 hp) turboprop engines, each driving a 5-bladed propeller
Wind speed limit for ground operations	30 knots (55.6 kph, 34.5 mph)
STOL takeoff & landing field length	800 m (2,625 ft), unprepared field
Speed, cruise	100 to 150 kph (62 to 93 mph)
Altitude, operating	488 to 1,524 m (1,600 to 5,000 ft)
Altitude, max.	3,000 m (9,843 ft)
Range	1,000 km (621 miles, 540 nautical miles)
Endurance	About 5 hours on a 500 km (311 mile) flight segment.

NATAC 5-lobe gas envelope, top view.
Source: Voliris

Voliris describes the design of the NATAC 5-lobe gas envelope as follows:

> "The truly original component of this flying machine is the 5-lobe envelope wing and its dynamic pressure regulation system. With a variable volume between 22,000 and 40,000 m^3, it provides aerostatic lift of approximately 25 tonnes and aerodynamic lift, with a fineness (ratio) of 5.5, allowing 55 tonnes to be lifted with 10 tonnes of thrust (from the engines).
>
> The twin beam and its payload are attached below by hangers, (with loads being) taken inside by a lacing system controlled by servomotors.
>
> As the atmospheric pressure decreases with altitude, and therefore the volume of gas is multiplied by 1.45, the shape drag increases with the volume. At low altitude, it is therefore important that the envelope is as thin as possible."

Voliris plans to ground test a full-size NATAC gas envelope installed next to its hangar at the Aérodrome de Moulins. Estimated cost for this ground test is about 4 million Euros.

Rendering of the inside of a five-lobe gas envelope showing the lacing in the adjustment regions between lobes (left) and a servomotor (right) Source: Voliris

Details of the NATAC engine and landing gear nacelles and a centerline mounted standard 32T shipping container engaged by a Container Gripping Module (CGM).
Source, both graphics: Screenshots from Voliris video

Truck unloading a standard 32T shipping container directly onto the airship's CGM. Source: Screenshot from Voliris video

Voliris describes an NATAC mission as follows:

> "Once NATAC has been programmed, it is limited to back and forth journeys from a given departure base to a given destination base. NATAC adapts to different wind directions as long as weather condition are within the limits defined by the test pilot who did the programming. On arrival, the operator needs to check that the runway is clear. He can order the machine to make 360° rounds above a safety altitude to clear the runway if necessary.
>
> NATAC sends its position by satellite, but is not radio-controlled during the flight. This is an important feature to prevent misuse or terrorist hijack. The trajectory is defined according to a license granted by the government. As many waypoints as necessary can be programmed on the trajectory which does not necessarily need to be a straight line."

You can watch a video of an animated NATAC mission here:
https://www.youtube.com/watch?v=yt0HVg9Pky4&t=3s

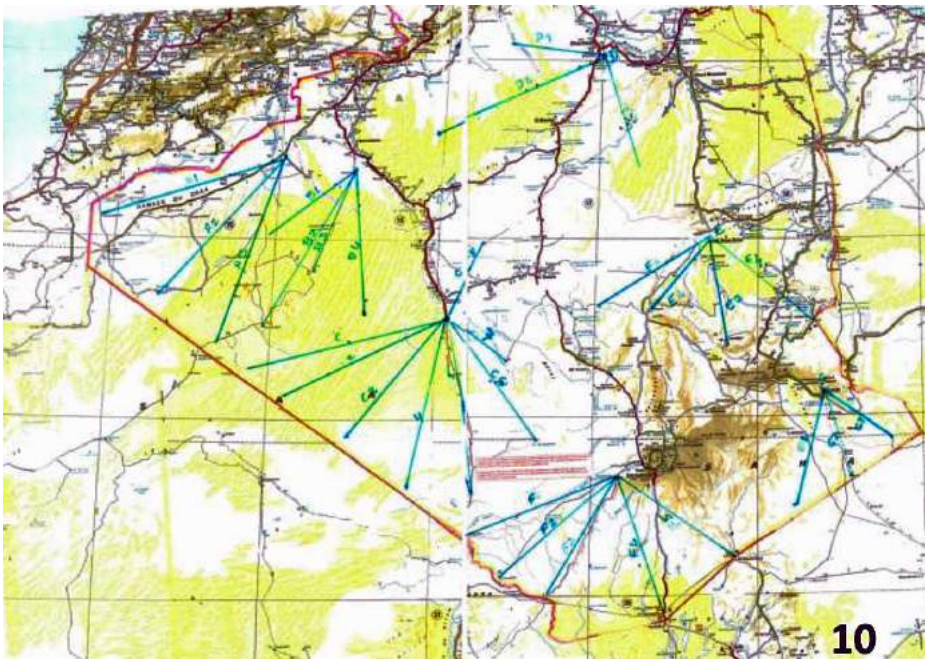
In May 2018, the Voliris team made a presentation on the NATAC concept to the French Army. As of early 2024, French military has not yet placed an order for this hybrid airship.

In their coverage of the June 2019 Paris Air Show, Flight Global reported that Voliris was seeking €30 million ($34 million) in new funding to bring the NATAC to market, and a further €300 million to industrialize the product for series production to supply an estimated market for 2,000 NATACs over the next 20 years. If investment is forthcoming, possibly for interested logistics companies, Voliris indicated that it could bring the NATAC to market in 2026. Reflecting the importance of NATAC as a future product line, Voliris has a version of their corporate logo with a profile view of an NATAC-style inflated wing hybrid airship.

Voliris is offering a version of the NATAC called the NATAC H2, which uses hydrogen lifting gas. As hydrogen becomes a more widely available commodity in aviation, it should be possible to power NATAC-class airships with hydrogen-fueled engines.

Rendering of NATAC H2 hybrid airship.
Source, both graphics: Voliris

As a medium-range, heavy logistics airship designed for serving remote undeveloped sites, the Voliris NATAC could have an key role in an international project known as Render the Desert Habitable (https://rendreledeserthabitable.com). In a 2016 Algeria case study, Voliris demonstrated how 50 to 100 NATAC airships could be deployed from seven logistic hubs on 30 to 50 routes to support remote settlements and other activities in currently undeveloped desert regions within a 2,000,000 km^2 (772,000 mi^2) area of the country.



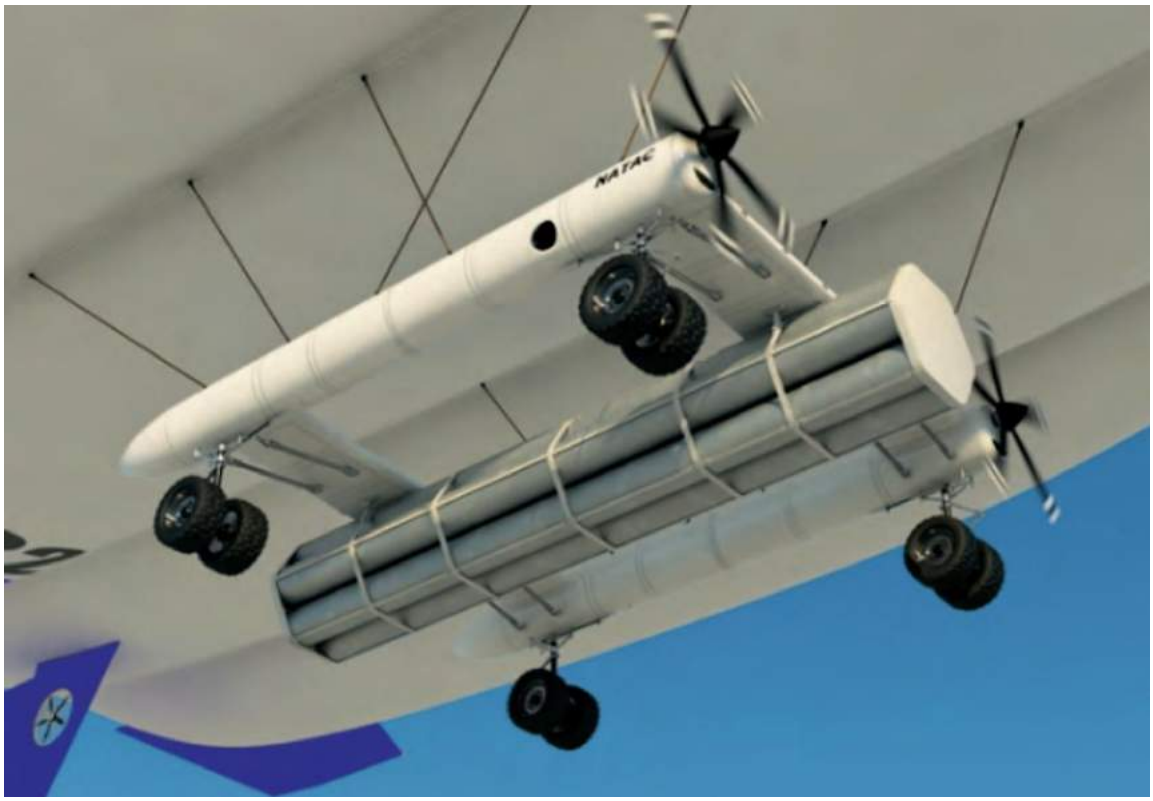
Algeria case study hub and route map.

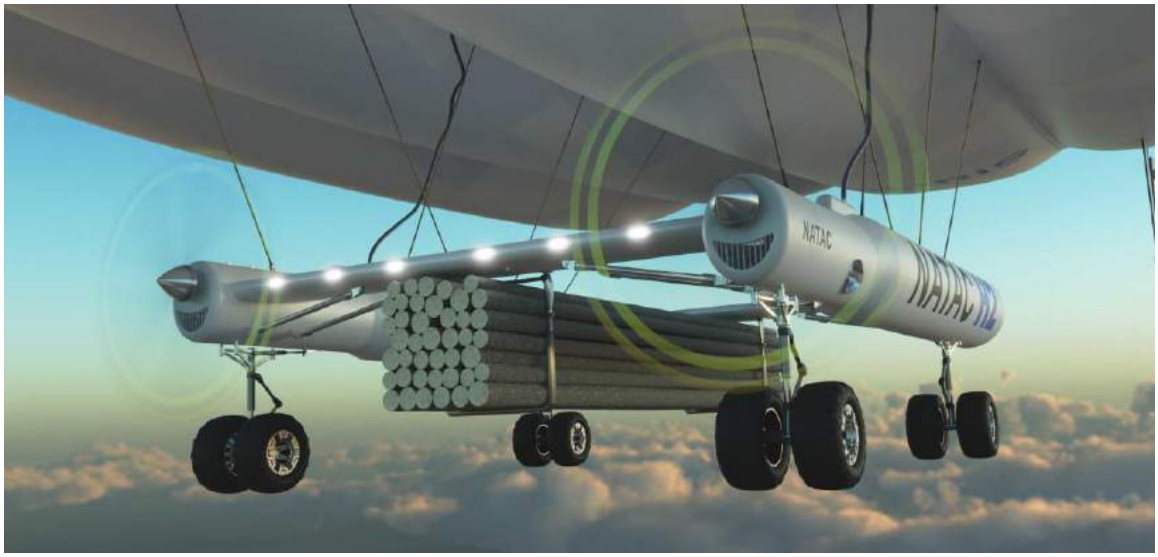
Rendering of a V932 NATAC moored at a remote desert site.
Source, both graphics: Voliris

You'll find the NATAC H2 and other autonomous and piloted NATAC versions described in the Voliris NATAC brochure, circa 2022, which is available online here (in French):
https://rendreledeserthabitable.com/natac-h2/

Renderings of NATAC piloted cargo modules.
Source, both graphics: Voliris

The NATAC twin boom suspended gondola is capable of carrying 30 metric ton (33 ton) payloads in form factors other than a 40-foot (12.2 m) long, standard 32T shipping container; for example, bundled piping segments and timber as shown in the following graphics.





Source, both graphics: Voliris

7. The SeaBird – a maritime adaptation of the NATAC

Seabird is a marine adaptation of the NATAC V932 hybrid airship. It was unveiled at the Monaco Yacht Show in September 2019. As shown in the following sequence of Voliris graphics, the slow flight capability of the SeaBird enables it to approach and land on a small deck on an underway ship at sea and then be moored to the ship.

Renderings of SeaBird carrying a piloted passenger module.
The Seabird is shown on final approach for a shipboard landing, below.
Source, both graphics: Voliris

Renderings of SeaBird carrying a piloted passenger module on final approach (above) and secured aboard ship (below). Source, both graphics: Voliris

Renderings of the piloted passenger module.
Source, four graphics: Voliris

Front view (left), back view (right), interior view (below)

8. For more information

V900

- "Ultralight Airship from France," (Voliris 900), Airshipworld Blog, 31 July 2007: http://airshipworld.blogspot.com/2007/07/ultralight-airship-from-france.html
- Thierry Detable, "Aircraft F-03VS," Airport-Data.com, 2007: https://www.airport-data.com/aircraft/photos/F-03VS:1.html

V902

- "Smallest Airship," Guinness World Records, 7 October 2016: https://www.guinnessworldrecords.com/world-records/443025-smallest-airship

V932

- Keith Loria, "Voliris Plans to Bring Airships to the Desert," LTA Flight Magazine, 7 February 2017: http://www.ltaflightmagazine.com/voliris_natac/
- Kate Sarsfield, "PARIS: Voliris seeks investment for cargo airship," Flight Global, 19 June 2019: https://www.flightglobal.com/business-aviation/paris-voliris-seeks-investment-for-cargo-airship/133230.article

Patents

- European patent EP2686237B1, "Lighter than air aircraft with actively controlled shape," Filed 7 March 2012, Granted 16 August 2017, Assigned to Voliris SARL: https://patents.google.com/patent/EP2686237B1/en
- US patent US9108712B2, "Airship with a controlled variable profile," Filed 7 March 2012, Granted 18 August 2015, Assigned to Voliris SARL: https://patents.google.com/patent/US9108712B2/en
- US patent US2014/0054421A1, "Airship with a controlled variable profile," Filed 7 March 2012, Granted 18 August 2015,

Assigned to Voliris SARL: https://patents.google.com/patent/US20140054421A1/en

- US patent US2014/0255139A1, “Method and system for transporting containers by modular aircraft,” Filed 1 October 2012, Published 11 September 2014, Assigned to Voliris SARL: https://patents.google.com/patent/US20140255139A1/en
- Canadian patent CA2851050A1, “Method and system for transporting containers by modular aircraft,” Filed 1 October 2012, Published 11 April 2013, Assigned to Voliris SARL: https://patents.google.com/patent/CA2851050A1/en

Videos – V901C, V901D, V901RC, V930

- “Premier vol du prototype Voliris V901C (First flight of the prototype Voliris V901C),” (4:15 min), posted by FAAM moulins, 5 July 2012: https://www.youtube.com/watch?v=SB5ySwh9Uv4
- “V901D: Man piloted hybrid airship. Test flights,” (9:08 min), posted by Voliris, 21 February 2014: https://www.youtube.com/watch?v=wxMeyAu_n2s&t=43s
- “V901RC: Hybrid Airship. Test flights,” (1:47 min), posted by Voliris, 21 February 2014: https://www.youtube.com/watch?v=qT_SwI2-XZo&t=4s
- “Container Mover and Landing Gear on the Voliris Hybrid Airship V930,” (5:15 min), posted by Voliris, 21 February 2014: https://www.youtube.com/watch?v=0ZkeEO9tQ1k

Videos – V902ULM, V902RC / Mini-NATAC & V932 NATAC

- “Hybrid Airship V902RC,” (3:37 min), posted by Voliris, 17 September 2014: https://www.youtube.com/watch?v=YBfLxLUPeqM&t=64s
- “Automatic Air Shuttle for Containers,” (2:56 min), posted by Voliris, 17 May 2016: https://www.youtube.com/watch?v=yt0HVg9Pky4&t=3s
- “World's smallest electric hybrid Airship,” (1:53 min), posted by Voliris, 1 August 2016: https://www.youtube.com/watch?v=n784qHE5R7c

- “NATAC project demonstrator,” (5:41 min), posted by Voliris, 5 January 2017: https://www.youtube.com/watch?v=Gpnabeb4WP4&t=2s
- “Film Voliris pour l’Aeroclub de France 2017,” (3:24 min), posted by Voliris, 30 November 2017: https://www.youtube.com/watch?v=H0Z1-hn3xTI

Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
- *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/