UPship™ – Jesse Blenn's semi-rigid airships

Peter Lobner, updated 9 November 2023

1. Introduction

UPship is a small airship firm founded in 1989 by Jesse Blenn in Elba, Alabama. Blenn developed several beautifully streamlined, semi-rigid, scaleable airship designs with a hull shape based on his customized aerodynamic formula and characteristic inverted V-tails (and later X-tails) based on his patented airship tail fin design for improved control.

In 2007, Blenn moved to Costa Rica and continues promoting his semi-rigid, scaleable UPship airship designs for a variety of passenger and cargo applications.

This article compiles information from a variety of sources, including Blenn's posts on LinkedIn (https://www.linkedin.com/in/jblenn/) and his Da Vinci Costa Rica website (https://davincicostarica.com), and attempts to develop a comprehensive history of the UPship.

I am grateful to Jesse Blenn for his input for this article.

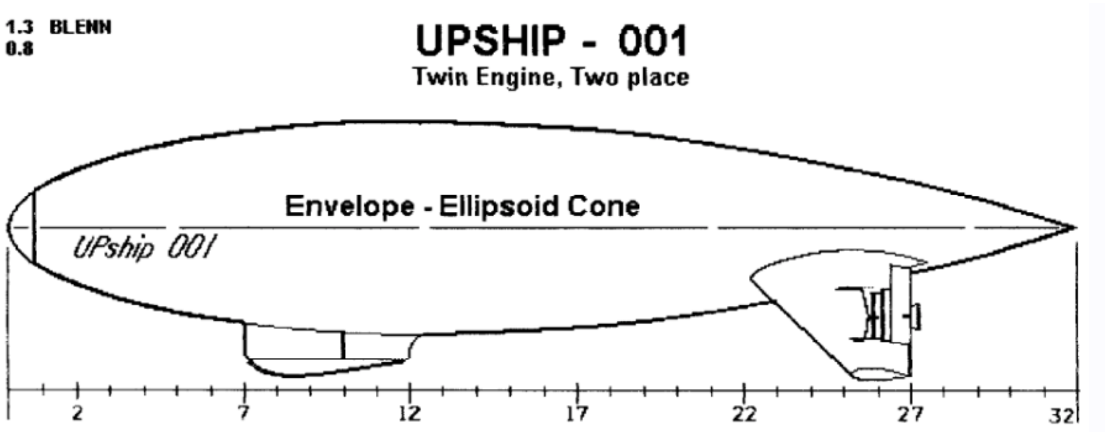
2. Early UPship semi-rigid airship designs

2.1 UPship 100 (circa 1990s)

On his website *Airship and Blimp Resources*, Roland Escher describes the UPship 100 semi-rigid airship as follows:

> "Design work for the UPship prototype began under Jesse Blenn in 1989. The UPship 100 is a two passenger, homebuilt, helium airship intended to become a commercial venture. In 1996, UPship was incorporated in Elba, Alabama. Design was completed in 1997 and construction is expected to begin during 1998. Completion of the UPship 100 prototype and a first flight are planned for 2000.

The UPship 100 is intended as a test bed for innovations that will be applicable to airships of all sizes in the future. Design features of the UPship include a shape of minimum resistance, two propulsion engines in inverted "V" tail fins and a nose mounted thruster for control at all speeds. Two patents are pending for technologies used in the UPship 100."



Profile view of the UPship 100-001. Source: Robert Recks (1997)

General characteristics of the UPship 100 airship

Parameter	UPship 100
Length	32 m (105 ft)
Diameter, max	6.4 m (21 ft)
Envelope volume	630 m^3 (22,250 ft^3)
Seats (pilot + pax)	Pilot + 1 passenger
Speed, max	111 kph (69 mph)
Range	528 to 828 km (327 to 516 miles)
Endurance	6 to 12 hours

The design and operation of the inverted V-tail and tail-mounted propellers are described in patent US6019312A, which was granted in 2000. The tail fins are designed so that, under the influence of a very large aerodynamic load or a ground impact during landing, the tail fins will deflect, and not break. This design feature reduces the transient energy imparted to the hull.

The control surfaces on the inverted V-tail function as ruddervators (combined rudder and elevator) in the propeller slipstreams and can maintain control authority even at low speed. The placement of the propellers near the stern, in the inverted V-tail, is expected to yield a very quiet flight environment for the pilot and passengers in the forward-mounted gondola.

The UPship 100 prototype was not built and flown.

2.2 Three-passenger UPship (circa 1990s)

Russian author and aeronautical engineer Michael Boyko (2001) reported:

> "The company UPship planned to build by the end of 1999 a three-seater semi-rigid airship, in the cockpit of which the pilot and two passengers are located in tandem. The airship is expected to be easy to operate. The starting ground crew will be no more than three people, and in some cases the pilot will be able to dock and anchor the airship on his own….. The cost of building and certifying the airship is $500,000. The cost of operation is $2,000 / day."

Like the Upship 100, this larger airship had the characteristic inverted V-tail with fixed propellers in the tail fins, and ruddervator control surfaces in the propeller slipstream.

Also like the UPship 100, the airship included an automatic pitch stabilization system. A thrust vectoring jet at the nose, driven by a separate engine inside the nose section of the hull, could direct its jet left-right, up-down and straight ahead (i.e., reverse thrust). The thrust of the jet device was 75 kg (165 lb). Similar jet devices were used in the designs of the much larger Airship Industries R.150 and the Wren Skyships R.30 and RS.1 rigid airship designs in the early 1980s.

This semi-rigid airship had a hinged keel made of steel and carbon fiber. The keel was supported by an internal suspension system that distributed loads into the upper part of the envelope.

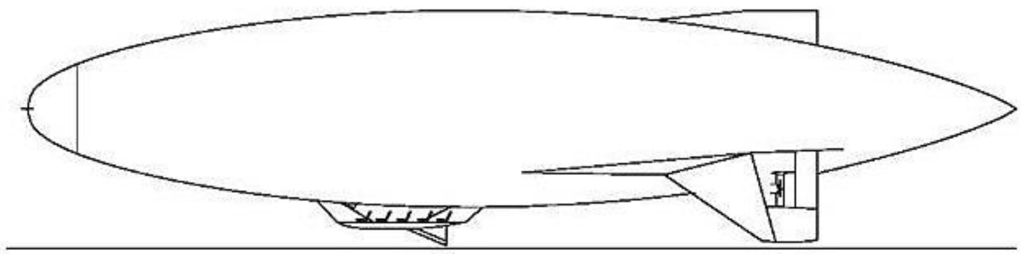
The König engines that power this airship are lightweight, compact, radial aircraft engines commonly used in powered paragliders and parachutes. The model SD 570 most closely fits the power output stated for the three-passenger UPship. Earlier versions of the SD 570 four-cylinder, two-stroke engine are reported to have produced 21 kW (28 hp) at 4,200 rpm. The engine originally was produced in Germany. Currently that engine business is owned by Compact Radial Engines of Surrey, British Columbia, Canada. However, the casting molds were destroyed in a foundry fire and this engine is no longer available.

General characteristics of the three-passenger UPship airship

Parameter	**UPship three passenger airship**
Length	35 m (114.8 ft)
Diameter, max	7 m (23 ft)
Envelope volume	825 m^3 (29,135 ft^3)
Ballonet volume	247 m^3 (8,723 ft^3) (30% of envelope volume is in fore & aft ballonets)
Aerostatic lift	720 kg (1,587 lb)
Weight, empty	432 kg (952.4 lb)
Payload	288 kg (634.9 lb)
Gondola dimensions	5 L x 1 W meters (16.4 x 1.3 ft)
Seats (pilot + pax)	Pilot + 2 passenger in tandem
Propulsion and low speed control	• 2 x König engines rated @ 20.5 kW (27.5 shp) installed in the inverted V-tails for propulsion • 1 x König engine is installed in the bow of the hull to generate electrical power for on-board systems and power the thrust-vectoring jet device in the nose.
Speed, max	110 kph (68.4 mph)
Speed, cruise	70 to 88 kph (43.5 to 54.7 mph)
Range & endurance	• 10 hours @ 88 kph, range 880 km (547 miles) • 20 hours @ 70 kph, range 1,400 km (870 miles)

2.3 60 meter passenger airship (circa 1990s)

Jesse Blenn produced the following elegant design for a 60 meter (196.9 ft), 10 passenger semi-rigid UPship airship, with an overall configuration directly traceable to the original homebuilt UPship 100-001 design. This airship was not built.



UPship 60 m 10 passengers Jesse Blenn, BlennTEC derechos reservados

2.4 274 meter sightseeing airship (circa 1990s)

In the August 1991 issue of *Popular Mechanics*, it was reported that UPship was developing plans to build a 274.3 meter (900 foot) semi-rigid sightseeing airship in time for the 1996 summer Olympics in Atlanta. This airship was not built.

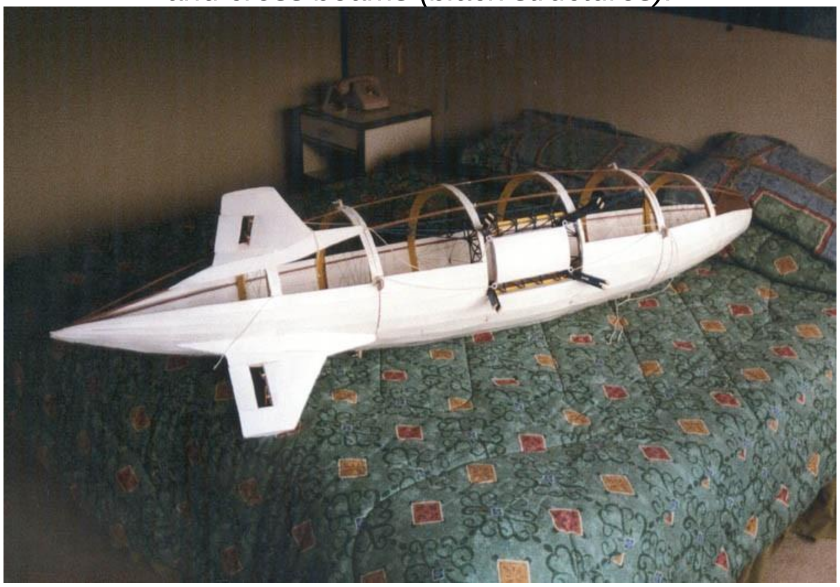
A related UPship design concept at that time was for a large, semi-rigid airship for harvesting timber in rain forests while minimizing the collateral damage to sensitive environments from logging access roads.

2.5 UPship 2320 50 ton cargo airship for TCC, Bogotá, Columbia (circa 2001)

Transportadora Comercial Colombiana (TCC) in Bogotá, Columbia, is a large truck operating company, with about 30,000 trucks in service in 2001. That year, Jesse Blenn submitted a proposal to TCC to develop a semi-rigid, 180 meter (590 ft), 50 metric ton (55 ton) cargo capacity airship to supplement their extensive logistics operations, particularly in areas that were difficult to reach by road.

Like all other UPship models, the 2320 is a semi-rigid airship. The rigid structure is installed along the bottom of the airship hull and extends 45 degrees up the sides from bottom center. The structure is fabricated from corrugated aluminum tube trusses, with flexible suspension to prevent damage. This rigid structure supports the loads from the cabin and the tail fins. Six transverse fabric rings establish the overall shape of the gas envelope, divide the envelope into the 7 replaceable gas cells (reduced to 6 in newer UPship versions), take longitudinal lift loads when the airship is pitched, and house gas valves and rip panel actuators, as well as allow internal access on the larger airships.

1/100 scale model, view along the starboard side, showing the six internal fabric suspension rings and the placement of two rigid “side girders” and cross beams (black structures).



1/100 scale model rotated, view from beneath the airship. Note the slots in the inverted V-tail fins for the propellers. Source, both photos: Jesse Blenn

General characteristics of the UPship 2320, 50 ton cargo airship

Parameter	**UPship 2320, 50 ton cargo airship**
Length	180 m (590 ft)
Diameter, max	36 m (118 ft)
Height, overall	40 m (131 ft)
Envelope volume	111,750 m^3 (3,946,414 ft^3), with six internal suspension rings and seven gas cells.
Helium volume	95,000 to 100,000 m^3 (3,354,893 to 3,531,466 ft^3), depending on altitude
Ballonet volume	16,750 to 11,750 m^3 (591,521 to 414,947 ft^3)
Aerostatic lift	• 95 metric tons (209,439 lb) @ 1,000 m (3,281 ft) • Decreases by 1% per 100 meters, or about 10 metric tons per 1,000 meters
Dynamic lift from propellers	3 metric tons (6,614 lb)
Weight, empty	45 metric tons (99,208 lb)
Payload, max	50 metric tons (121,254 lb) up to 1,000 m (3,281 ft) (equivalent to 2 to 3 semi-truck loads)
Internal cargo platform	• 20 L x 10 W x 4 H meters (65.6 x 32.8 x 13.1 ft) cargo platform • Lowered for loading interchangable load modules & retracted into the hull for flight
External sling load	Larger or irregularly shaped cargo can be carried under the hull on an external sling
Accommodations (crew)	• 2 x pilots + 2 to 4 crew for cargo loading / unloading • Crew cabins provided
Propulsion, low speed control & auxiliary power	• 2 x Zoche radial diesel engines rated @ 224 kW (300 hp) mounted in each fixed tail fin provide propulsion • 2 x Zoche radial diesel engines rated @ 224 kW (300 hp) mounted in the nose power the bow thrusters • 2 x Zoche radial diesel engines rated @ 52 kW (70 hp) power airship hydraulic and electric systems
Speed, max	100 kph (62 mph) % 70% power
Speed, cruise	89 kph (55 mph) @ 50% power
Range & endurance	• Typical mission, up to 10 hours • 7 hours @ max. speed • Up to 133 hours @ cruise speed

In the proposal, Blenn explained the cargo handling system and load transfer process as follows:

> “Uses a … system of hydraulically operated lift cables to raise and lower the loading platform, of typically 10 by 20 meters size. This operation is facilitated by four guide cables temporarily connected to ground. These guide the load to an exact point despite movements of the airship, which maintains (an altitude) of 50 to 100 meters. Cargo swapping can also be done easily on permanent bases, with the airship at ground level…..”

> “Airship balance requires a constant weight, normally within 5%, and thus requires that an unloaded cargo be replaced by another cargo or by ballast water.”

Jesse Blenn also developed a design concept for a passenger version of the TCC 50 ton cargo airship. The passenger compartment, which would include seating for 270 passengers and a restaurant with seating for 60 persons, was designed to fit along the bottom centerline of the airship, between the side girders.

The following cross-section drawing, shows a possible seating arrangement for passengers on two levels. The passenger compartment would attach above the level of the upper windows (ventanas), to the side girders, which are not shown in the cross-section drawing, but are in the triangular areas above the side windows.

Source: Jesse Blenn via LinkedIn

Blenn said, “They (TCC) said they would buy one if we made it, but no funding was available.”

Blenn’s proposal included building and flight testing a manned, sub-scale demonstrator.

> “We propose the construction of a 1/5 scale demonstrator, 36 meters (118 ft) long and with a capacity of three people, while carrying out the final studies and tests for the large prototype. This, with a relative size index of 93, that is, 1/125 the volume of 2320, will serve to minimize the economic risk and at the same time train Colombian personnel in all aspects of this little-known field. The demonstrator can both test and refine the performance and the most efficient construction and operation methods for the 2320.”

2.6 150 meter natural gas carrier for Reparando SA, Bolivia (circa 2006)

In May 2006, an article by the Green Car Congress reported on a project by the Bolivian company Reparando SA to develop, with Jesse Blenn, a preliminary design of an airship for delivering natural gas (NG) to remote areas of the country. The article is reproduced below.

> “A small Bolivian company, Reparando SA, is exploring the delivery of natural gas (NG) to remote areas by using an airship, rather than a pipeline. Reparando is a heavy equipment repair and road construction company that moved into selling and installing bifuel natural gas conversion systems for heavy-duty diesels (running the engines on 70% NG).
>
> The company worked with Jesse Blenn, a US airship expert, on a preliminary design for a 150-meter (492-ft) airship capable of carrying about 35,000 m^3 (1,236,000 ft^3) of natural gas. The basic design is extensible up to a length of around 300 m (984 ft), which would result in a ship capable of carrying about 300,000 m^3 (10.6 million ft^3).

At 35,000 m^3, the volume is approximately equivalent to the compressed gas carried by three natural gas tank trucks. But in many areas of Bolivia, as in many parts of the developing world, roads are so bad that it could take a truck up to one week to go 500 miles (805 km).

The ship as designed uses twelve internal inflatable gasbags: six for helium (the ship requires about 40% helium volume to lift the empty structure) and six for natural gas. The upper six bags hold the helium, the lower six the natural gas.

This, Blenn points out, is very similar to the design of the system used by the Graf Zepplin I (LZ 127), in which the lower bags carried fuel gas, which weighed nearly the same as air, and deflated as the fuel was used. The LZ 127 racked up nearly 1.7 million kilometers (nearly 1 million miles) in flight.

With the natural gas on board, the ship has additional lift to carry diesel fuel, although the goal is to convert the airship engines to run primarily on natural gas. The diesel fuel serves as ballast and backup (and is a needed commodity for bifuel NG/diesel power plants, road vehicles and industries in isolated areas that can be served by the airship). When running on natural gas, the four engines would consume about 3% of the natural gas payload in a round trip of 1,000 kilometers (621 miles) at a speed of 100 km/h (62 mph).

Discharge of the natural gas occurs through the mooring tower. The airship carries a normal operating pressure of about 35 mm water column, which will push the natural gas out within about 20 minutes through the twin NG valves.

The twin nose engines supply the pressure and the 35,000 cubic meters of replacement internal air volume). (Four other natural gas engines provide propulsion.)

The mooring tower will include a proprietary automatic valve connection (purged with CO_2), and a seal and bearing system, which conduct the gas down to a duct where an auxiliary fan maintains the flow to storage. The reverse process handles the filling, but the inflation pressure is supplied from the tower base, not the engines.

Blenn estimates that the airship could be built for around $US3 million (in South America). Airships, according to Blenn, have an operational life of about 10 years to first replacement of the outer fabric, and several decades for hard structures if refurbished."

Engines for the Bolivia project were to be US made V8 engines used on airboats, readily available at reasonable cost and easy to convert to natural gas fuel."

This natural gas transport airship was not built.

2.7 Solair Quest (2009 - 2011)

Jesse Blenn developed the design concept for the Solair Quest, an all-electric, solar-powered airship that was designed to make an around the world flight on solar power.

This graceful semi-rigid airship followed the basic lines of earlier UPship designs, but with modifications to incorporate a large solar array on the upper surface of the gas envelope, an X-tail and a large, tail-mounted propeller. Solair Quest was not built.

The feat of flying around the world on solar power was first achieved in 2016 over a 16-1/2 month period by the fixed-wing, solar-powered aircraft Solar Impulse.

Rendering of Solair Quest semi-rigid, all electric, solar-powered airship. Source: Jesse Blenn

Top view of a scale model of Solair Quest showing the extent of the solar array, X-tail configuration and single tail-mounted propeller. Source: Jesse Blenn

2.8 Natural Gas Airships for Brazil (circa 2012)

In 2012, Jesse Blenn developed a proposal for a client in Brazil for a very large, 440 m (1,444 ft) unmanned, natural gas (NG)-carrying cargo airships that used helium and/or natural gas for lift, and also used NG as fuel. This airship was designed to pick up a load of NG at an offshore well and transport that cargo up to 300 km (186 miles) to an offshore pipeline connection or to a shore facility. While the low-altitude, over-water flight between the two endpoints was expected to be autonomous, the more complex mooring and loading / unloading operations were expected to be visually supervised and controlled remotely by an operator. This concept of operations would be proven and refined with a smaller 250 m (820 ft) demonstrator airship.

Jesse Blenn noted, "…similar systems could be used worldwide, both over water and over land, where pipelines are not economically viable or not yet functional, or as emergency supply vehicles in the event of damaged pipelines."

General characteristics of Natural Gas Airships for Brazil

Parameter	250 meter NG airship	440 meter NG airship
Length	250 m (820 ft)	440 m (1,444 ft)
Diameter, max	50 m (164 ft)	88 m (289 ft)
Fineness ratio	5.0	5.0
Volume, total	• 304,340 m^3 (10,748,000 ft^3) • 6 internal sections	• 1,659,200 m^3 (58,594,000 ft^3) • 6 internal sections
Helium volume	82,000 m^3 (27%) (2,896,000 ft^3)	0
NG volume, total	190,000 m^3 (63%) (6,710,000 ft^3)	1,493,000 m^3 (90%) (52,725,000 ft^3)
NG volume, deliverable cargo	180,000 m^3 (6,357,000 ft^3)	1,000,000 m^3 (35,315,000 ft^3)
NG volume, remainder	10,000 m^3 (353,100 ft^3)	493,000 m^3 (17,410,000 ft^3)
Helium lift @ 1kg/m^3	82,000 kg (180,779 lb)	0
NG lift, total @ 400g/m^3	76,000 kg (167,551 lb)	597,000 kg (1,316,160 lb)
NG lift, remainder	4,000 kg (8,818 lb)	197,000 kg (434,311 lb)
Weight, empty	76,000 kg (25%) (167,551 lb)	197,000 kg (33%) (434,311 lb)
Ballast water, max @ 1kg/liter	85,000 kg * (187,393 lb)	420,000 kg * (925,942 lb)
Propulsion	2 x 1,118 kW (2 x 1,500 shp) NG-fueled engines	4 x 1,118 kW (4 x 1,500 shp) NG-fueled engines
Speed, cruise	100 kph (62 mph)	96 kph (60 mph)

The 250 meter demonstrator airship

The 250 meter (820 ft) demonstrator airship uses helium lifting gas, which would eliminate the danger of flammable NG in the hangar during assembly and initial testing. The low-permeability fabric needed for the helium lifting gas cells is more expensive than the fabric that can be used for the NG cells.

The 250 meter demonstrator airship could be assembled in the existing Zeppelin hangar at Santa Cruz. The airship would be constructed in six sections for ease of handling and replacement of any damaged sections. The 190,000 cubic meters (6,710,000 cubic feet) of NG payload would be carried in the center four sections.

The 440 meter operational airship

On the 440 meter (1,444 ft) airship, all aerostatic lift is derived from NG (no helium). Fully loaded, the gas envelope contains almost 1.5 million m^3 (58.6 million ft^3) of NG, about 1 million m^3 (35.3 million ft^3) of which is the NG cargo that will be delivered at the end of the flight. The extra lift from this cargo is offset by seawater ballast. As the cargo is delivered, the seawater ballast is discharged. The 500,000 m^3 (17.7 million ft^3) of NG remaining in the gas envelope provides adequate aerostatic lift for a return flight with no NG cargo or ballast.

Using NG as the lifting gas enables less expensive fabric to be used for the gas cells than on a helium airship. For example, the outer envelope was to be made from off-the-shelf inflated stadium cover material, which has the required strength, and with which the customer had extensive experience. The airship would be more economical to operate since it would be independent of volatile world helium prices.

3. Current UPship airship designs (2023)

On LinkedIn (https://www.linkedin.com/in/jblenn/), Jesse Blenn provides basic specifications for three current, all-electric models: UPship 3300, 5500 and 11000. He notes, "Our patented designs offer improved control, mooring and load sharing, making our aircraft more adaptable and cost effective than competitive offerings."

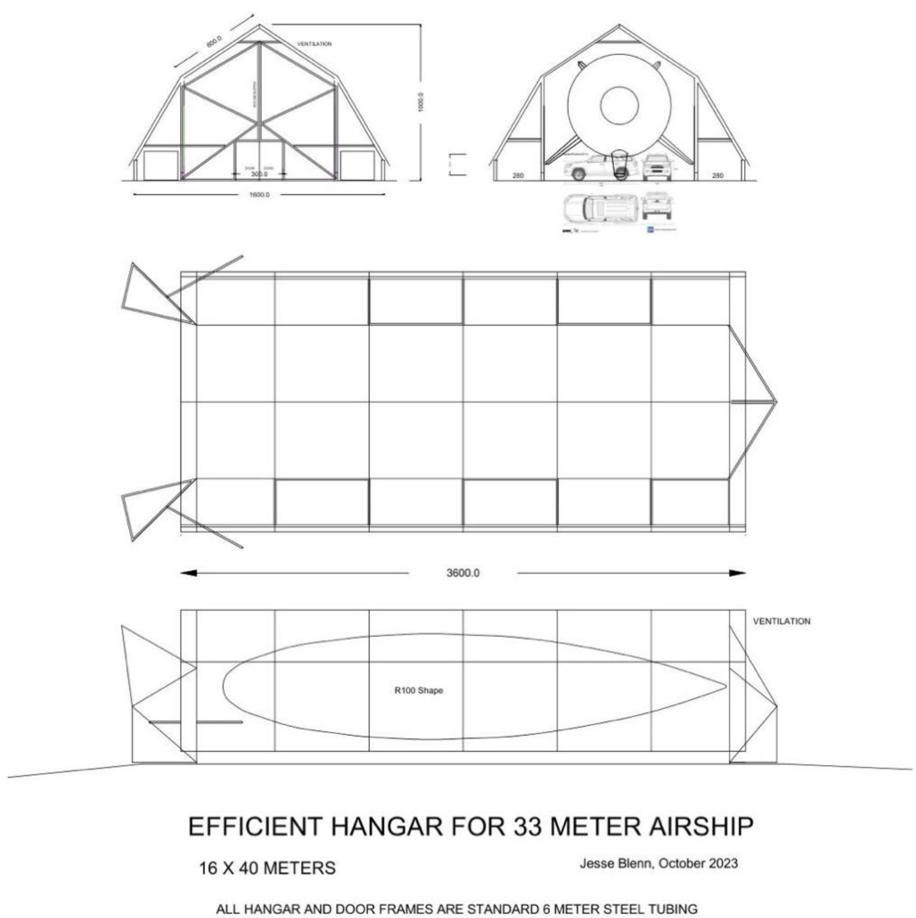
Key features of the current semi-rigid UPship designs include:

- All models have counter-rotating, thrust vectoring, twin stern propellers. This is a feature not seen in previous UPship designs. Similar to the stern-mounted propeller on the Zeppelin NT, these propellers can be vectored to provide propulsion in forward flight as well as lateral and vertical thrust for low speed control.
- All models can be used commercially and offer a gondola with a rear section that can be reconfigured for a variety of missions.
- All models have a "unique and patentable load exchange system that can safely deliver packages or cargo, quickly and safely to the ground from 50 meters (164 ft) or more in the air."

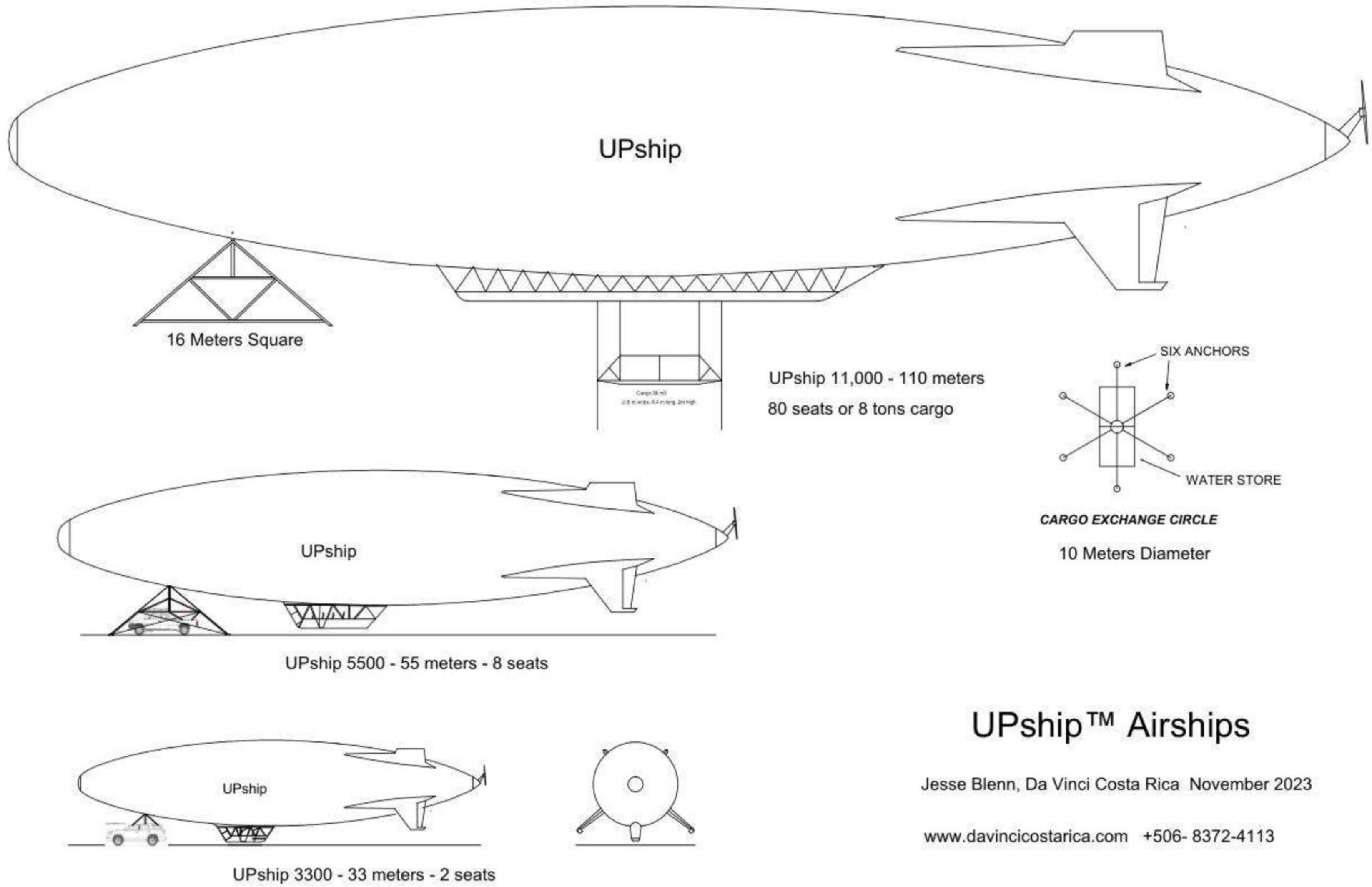
- Airship buoyancy control requires a constant weight, normally within ±5%, thus, unloaded cargo must be replaced by another comparable cargo or by ballast water.
- All models are capable of landing at a small site on land or on water.

The smallest of the current UPship designs is the 33-meter, 2-seat UPship 3300, which will be used to demonstrate and refine the control, mooring and cargo delivery systems that will be found on larger UPship models. This versatile airship also can be used for pilot training or as an air ambulance.

Blenn designed an “efficient hangar” for the 33-meter airship, which uses readily-available 6 meter (20 ft) steel tubing and roof purlins (i.e., roof framing members that span parallel to the building eave, and support the roof decking or sheeting).



Source: Jesse Blenn, October 2023



UPship design concepts. Source: Jesse Blenn, November 2023

General characteristics of UPship 3300, 5500 & 11000

Parameter	UPship 3300	UPship 5500	UPship 11000
Length	33 m (108.2 ft)	55 m (180.4 ft)	110 m (360.9 ft)
Diameter, max	6.9 m (22.6 ft)	10.8 m (35.4 ft)	21.6 m (70.9 ft)
Fineness ratio	4.78	5.09	5.09
Volume, total	740 m^3 (26,133 ft^3)	3,018 m^3 (106,580 ft^3)	24,140 m^3 (852,496 ft^3)
Volume, helium	630 m^3 @ 85% (22,248 ft^3)	2,444 m^3 @ 81% (86,309 ft^3)	19,554 m^3 @ 81% (690,543 ft^3)
Weight, empty	420 kg (926 lb)	1,400 kg (3,086 lb)	11,000 kg (24,251 lb)
Weight, takeoff	620 kg (1,367 lb)	2,400 kg (5,291 lb)	19,000 kg (41,888 lb)
Useful load	200 kg (441 lb)	1,000 kg (2,205 lb)	8,000 kg (17,637 lb)
Seats (pilot + pax)	2	8	80
Propulsion power, total *	All electric, 12 kW (16 hp)	All electric, 68 kW (91 hp)	All electric, 544 kW (729.5 hp)
Battery capacity	20 kWh	120 kWh	1,000 kWh
Useful battery, 80%	16 kWh	96 kWh	800 kWh
Speed, max	80 kph (50 mph)	105 kph (65 mph)	132 kph (82 mph)
Altitude, max	Typically, 1,000 to 1,500 m (3,281 to 4,921 ft) MSL**		
Endurance *** at 50 kph / 31 mph	5.5 hours / 275 km (170 mi)	13 hours / 650 km (404 mi)	27 hours / 1,350km (840 mi)
Endurance *** at 80 kph / 50 mph	1.3 hours / 104 km (65 mi)	3.1 hours / 240 km (149 mi)	7 hours / 560 km (350 mi)
Endurance *** at 100 kph / 62 mph			3 hours / 300 km (186 mi)

Source: Jesse Blenn, November 2023

Notes:

* *UPship plans to use proven electric motors, for example, from Zero Motorcycles (UPship 5500) and Tesla (UPship 11000).*

** *With less helium and useful load, an UPship can reach a higher maximum altitude. With 35% ballonet capacity, the UPship 5500 could reach an altitude of 4,250 meters (14,000 ft).*

*** *Endurance is based on 200 Wh/kg batteries and is expected to be improved substantially as more advanced batteries become available.*

The 5500 would be a suitable vehicle to complete pilot training for a commercial airship license.

Solar cells currently are not a standard feature of these airships. Blenn expects that solar cells initially will be tested on the tail fins of an UPship 3300 to collect data. They can be used on UPship 5500 or larger models, considering factors such as weight, heat buildup, and the need for human access to the photovoltaic array.

4. Patents

Jesse Blenn was granted patent US6019312A, “Airship tail fin construction for improved control,” in 2000. This patent described the tail fin configuration incorporated in the UPship 100-001 and several later models.

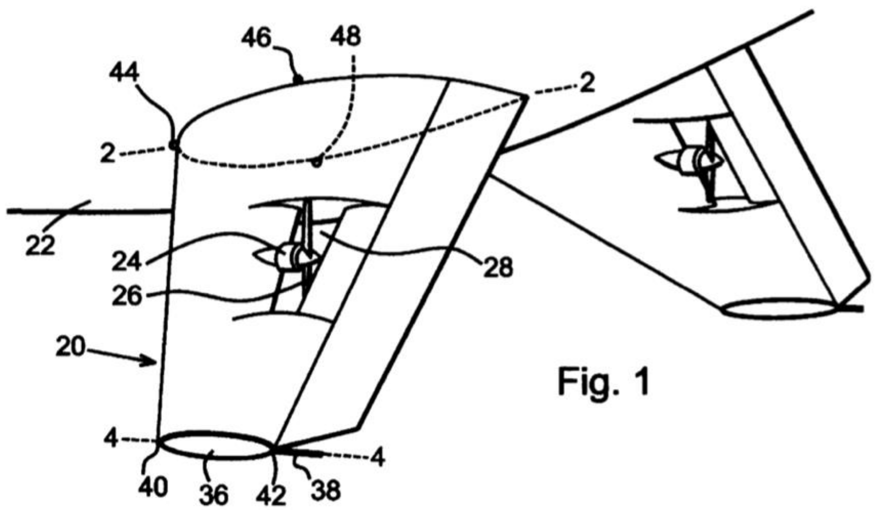


Fig. 1

In patent US6019312A Figure 1, the port tail fin (20) is shown attached to the airship hull at three points (44, 46 & 48). These attachment points are elastic and are designed to stretch and absorb energy by deflecting and rotating the tail about the leading attachment point (44) during a load transient.

A compact driving engine (24) installed in the tail fin drives a pusher propeller (26) that rotates in a gap in the tail fin (28). A landing roller (36) installed at the tip of the tail fin serves as a landing skid in the longitudinal direction and as a roller on axis 4-4 to allow the tail of a moored airship to roll sideways on the ground to keep the nose of the airship pointed into the wind. The tail fin structure is designed to deflect and absorb high tail fin aerodynamic or ground contact forces, while protecting the propellers from ground strikes during takeoff and landing. The starboard tail fin is similar.

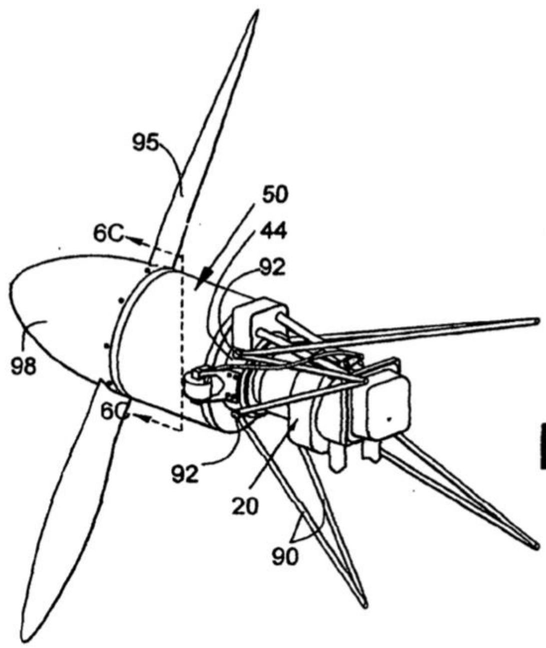


Fig. 1

In 2006, Jesse Blenn filed patent application US2006/0219193, “Optimized linear engine,” for a compact engine that could be suitable for use in the limited space available in an UPship tail assembly. Patent Figure 1 shows this compact engine, which is designed to transform piston linear reciprocating motion to rotary motion for driving the propeller. The reciprocating engine (44) drives a rotor (50) attached to the propeller (95). The compact engine assembly is mounted to the airframe with four supports (90).

5. Concept for use of hydrogen lifting gas in cargo airships

Among his many LinkedIn posts, Blenn proposed the following novel approach for safely using hydrogen as a lifting gas for cargo airships:

> “GIVEN the scarcity and cost of helium for airship use, I propose the following EASY solution for large CARGO AIRSHIPS. I would use hydrogen surrounded by say 20 cm of CO_2 under slightly higher pressure than the local hydrogen lift head pressure. This would be of similar construction to camping air mattresses, and would be divided to run higher pressure near the top (near 1.2 mm water column added per meter above the envelope bottom). Any leaks would be of CO_2 into the hydrogen, easily detected and separated (as done for the ZMC-2 Metalclad filling process). The hydrogen would be also protected from air contamination, and surrounded by a CO_2 fire extinguisher. This can be safe enough for cargo airship use.”

6. For more information

- Jesse Blenn,, "AIRSHIPS: The Airship Homebuilder Bulletin of Airship Design 1993," Volume 1, No. 1, December, 1993: https://davincicostarica.com/airships/airships-the-airship-homebuilder-bulletin-of-airship-design-1993/
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Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
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    - Euro Airship – Solar Airship One
    - H2 Clipper – hydrogen carrier
    - Kiev OKBV - Aerostatic fuel transportation system (SATT)
    - Novosibirsk OKB - Natural gas carrier airship

  Modern Airships - Part 3: https://lynceans.org/all-posts/modern-airships-part-3/