Aeros Aeroscraft airships

Peter Lobner, 1 May 2019

Background

Igor Pasternak established a volunteer airship design bureau at Lviv Polytechnic University in Ukraine in 1981. His firm, Aeros, became one of the first private aerospace companies permitted under Mikhail Gorbachev's Perestroika reforms in 1986. In 1994, he relocated to the U.S. and established Worldwide Aeros Corp. (Aeros) in Montebello, CA with the goal of becoming a major manufacturer of lighter-than-air (LTA) craft in the U.S.

Today, Aeros LTA products, such as the non-rigid Aeros 40D *Sky Dragon* airship and advanced tethered aerostatic systems, are used globally in military and civil applications. The firm's website is here:

http://aeroscraft.com/aeroscraft/4575666071

On 28 April 2015, Aeros received U.S. Patent 9,016,622 for its "Flight System for a Constant Volume Variable Buoyancy Air Vehicle," with onboard "Control of Static Heaviness" (COSH) Management. This patent is the key technology incorporated into their Aeroscraft line of airships, the first of which was the *Dragon Dream* prototype airship. You can read the patent here:

https://patents.google.com/patent/US9016622B1/en

Proof-of-concept of variable buoyancy control

In 2005, Aeros and Lockheed Martin were the two contractors selected by the Defense Advanced Research Projects Agency (DARPA) to conduct Phase I of Project Walrus, which sought to develop new technologies and design concepts for a strategic, heavy-lift cargo airship. Under its $3,267,000 Phase 1 contract, Aeros successfully demonstrated the operation of their COSH variable buoyancy system in a ground-based test rig in 2006.

Under a follow-on DARPA contract issued in 2007, Aeros tested a flight-weight prototype of the COSH system in an Aeros 40D Sky Dragon non-rigid airship. Aeros CEO Igor Pasternak explained, “We want to demonstrate we can change the static heaviness enough in a short time to be operationally acceptable.”

As described in Patent 9,016,622, “A low pressure system is required because only a low pressure system can compress lifting gas at high speed and in sufficiently large volumes for practical use.”

General characteristics of the *Dragon Dream* prototype airship

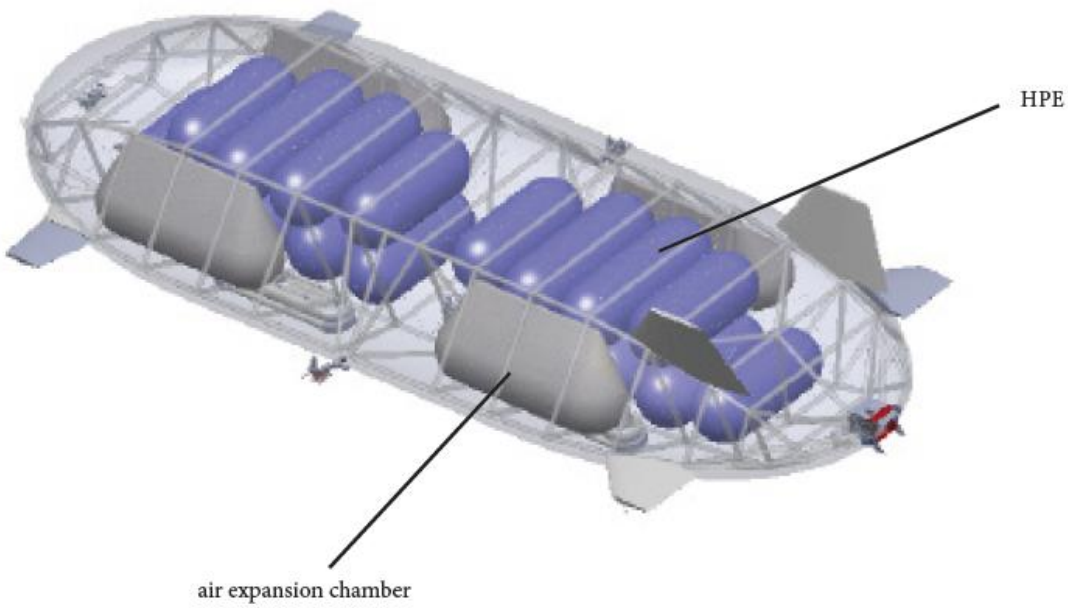
Following the successful proof-of-concept demonstrations, Aeros was awarded a $60 million DARPA contract in 2011 for Project Pelican. Under this contract, Aeros developed their half-scale, proof-of-design vehicle named *Dragon Dream*, which embodied the following design features that also are incorporated on later Aeroscraft airships:

- Control-of-static-heaviness (COSH) system for variable buoyancy control;
- Rigid structure, with hard points for mounting the cockpit, propulsion system, aerodynamic control surfaces, and the cargo compartment;
- Ceiling suspension cargo deployment system for managing cargo with minimal requirements for ground support infrastructure. This system supports cargo containers and pallets from rails in the ceiling of the cargo compartment and adjusts cargo positioning to accommodate changes in center of gravity, such as when other cargo is loaded or unloaded;
- Air bearing landing system (ABLS) for operation on unimproved surfaces, including ice and water. Airflow in the system can be reversed to provide a suction to grip the ground and hold the airship in place;
- Vectored thrust engines that propel the vehicle in forward flight and while taxiing on the ground. The engines can be rotated vertically to improve low-speed maneuverability.
- Low-speed control (LSC) system for managing the engines and maintaining position and orientation during vertical takeoff and landing (VTOL) and hover in low wind conditions.

The Dragon Dream's light weight, rigid airframe.
Source: Aeros

Implementing variable buoyancy control on Dragon Dream

The airship's rigid aeroshell contains the helium envelope. Within the helium envelope, the COSH system manages airship buoyancy using the Helium Pressure Envelopes (HPE, the blue tanks in the following diagram) and Air Expansion Chambers (AEC, the grey bladders).



Aeroscraft cutaway showing HPE and AEC. Source: Aeros

The COSH variable buoyancy system works as follows:

- **To reduce buoyancy**: The COSH system compresses helium from the helium envelope into the HPEs, which contain the compressed helium in a smaller volume. The compression of helium into the HPEs creates a slight negative pressure within the helium envelope, permitting the AECs to expand and fill with heavier environmental air. The greater mass of the air within the aeroshell and the reduced helium lift make the Aeroscraft heavier when desired.

- **To increase buoyancy:** The COSH system releases pressurized helium from the HPEs into the helium envelope. This creates a slight positive pressure within the helium envelope, causing the AECs to compress slightly and discharge some air overboard. With reduced environmental air ballast and greater helium lift, overall buoyancy of the Aeroscraft is increased when desired.

The operation of a variable buoyancy system is illustrated in the following diagrams from Aeros Patent 9,016,622.

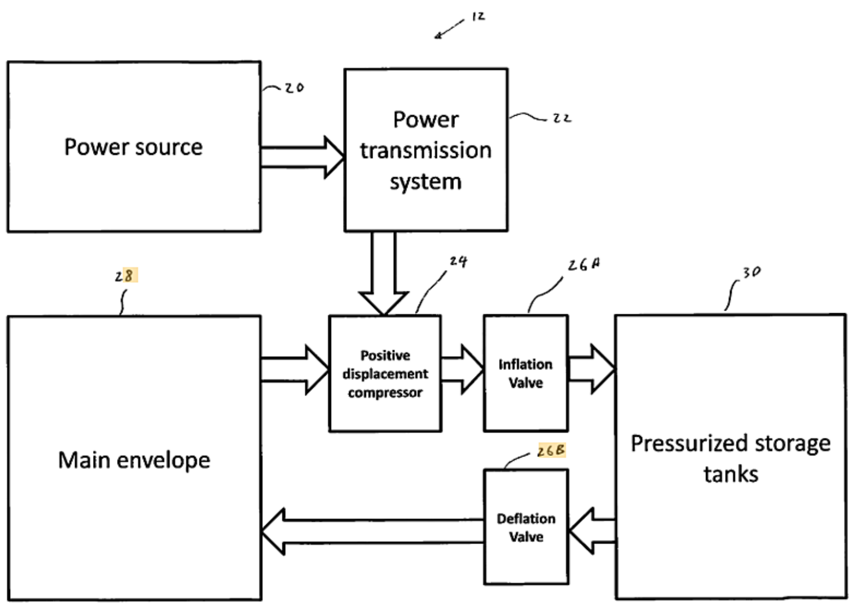


Fig. 9

Simple mechanical process for transferring helium back and forth between the main envelope and the pressurized storage tanks.
Source: Patent 9,016,622

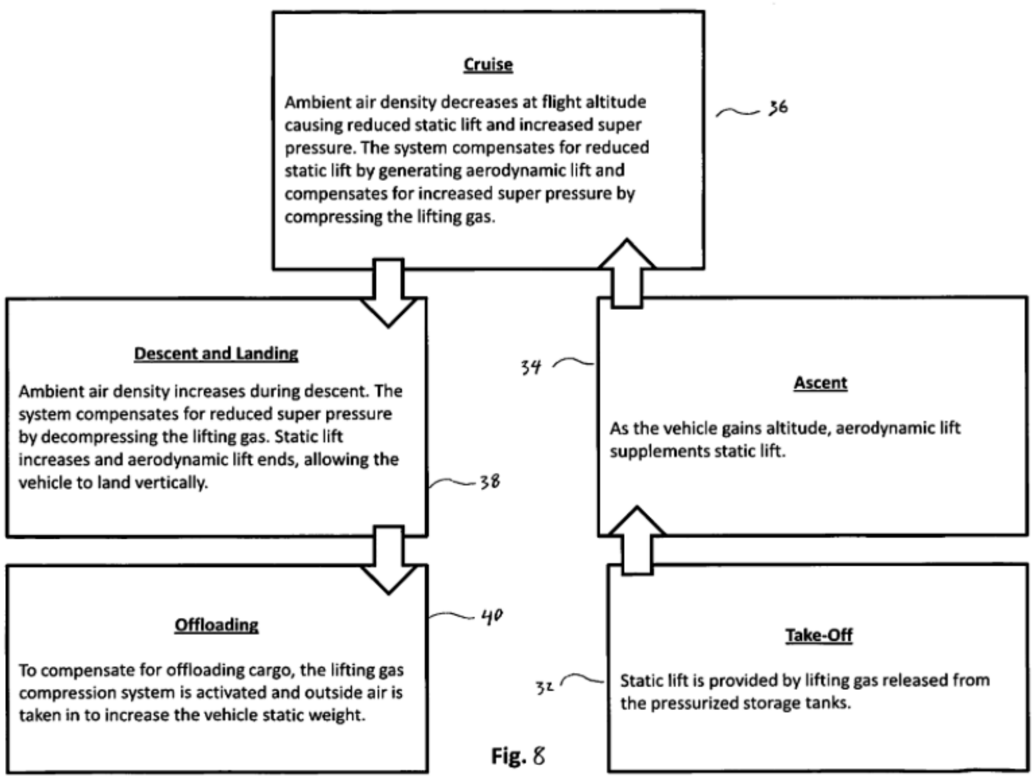


Fig. 8

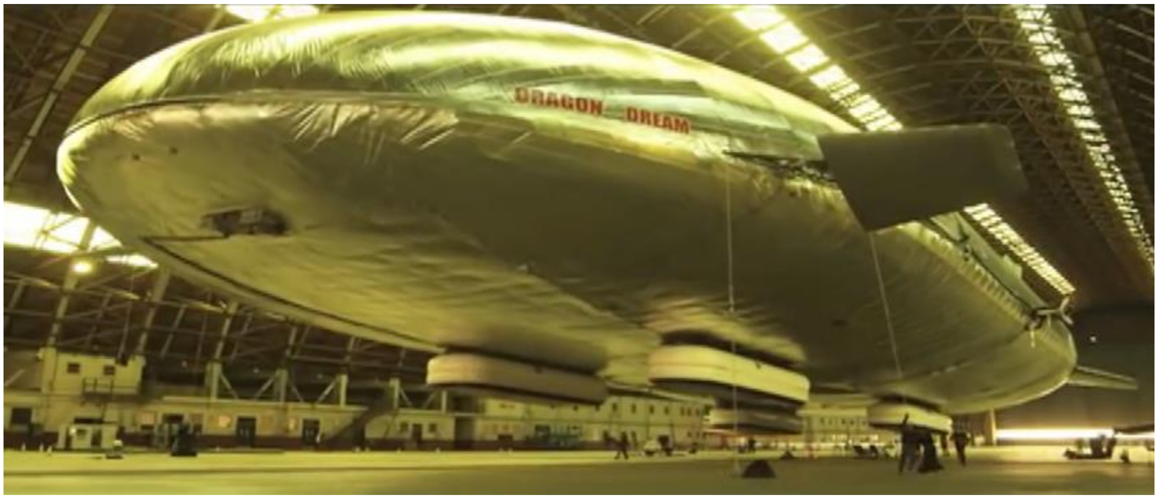
Operation of the variable buoyancy system in different flight modes, from takeoff to landing and off-loading cargo.
Source: Patent 9,016,622

You can view a brief YouTube video describing the operation of the Aeroscraft and its variable buoyancy system here:

https://www.youtube.com/watch?v=8b-qBoFku_o

Testing the *Dragon Dream* prototype

Dragon Dream was first "float tested" on 3 January 2013 inside a former blimp hanger at the Marine Corps Air Station in Tustin, CA. The Pentagon declared that the hanger tests of the *Dragon Dream* were a success, with the craft meeting its demonstration objectives, which were to confirm the operation of the COSH system.



Dragon Dream first "float test." Source: Screenshot from Aeros video

The airship was rolled out of its hangar on 4 July 2013 and taxi tests were conducted. All work under Project Pelican was completed within budget in August 2013.

On 5 September, Aeros announced that the Federal Aviation Administration (FAA) had granted an R&D Airworthiness Certificate for *Dragon Dream*, permitting flight testing in designated controlled airspace. *Dragon Dream* made its first flight on 11 September 2013.

Dragon Dream in flight. Source: Aeros

Dragon Dream in flight. Source: Aeros

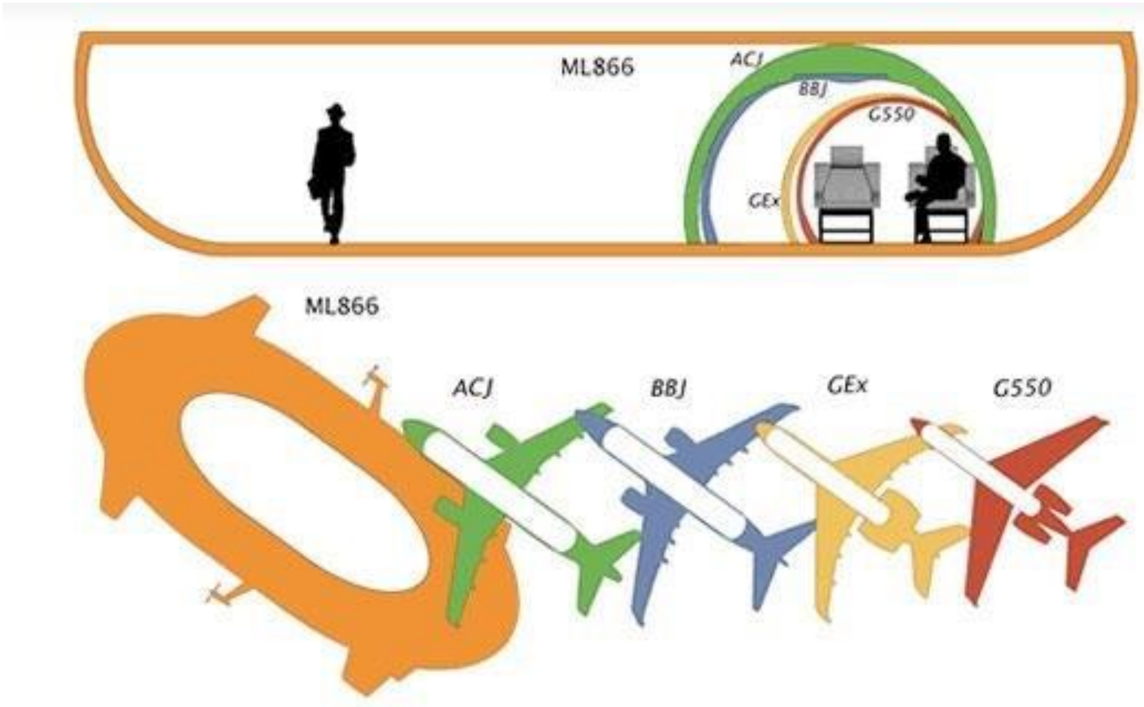
The *Dragon Dream* airship was damaged in October 2013 when a partial roof collapse occurred while the airship was inside the blimp hanger. The airship was not repaired.

The ML866 airship

The first commercial-scale Aeroscraft will be the ML866, which is designed to carry a 66 ton (60 metric ton) payload in a large cargo bay measuring 220 x 40 x 30 feet (67 x 12.2 x 9.1 meters). The ML866 will have a range of 3,100 nautical miles (5,741 km), a cruise speed of 100 knots, and an altitude ceiling of 12,000 feet (3,658 m).

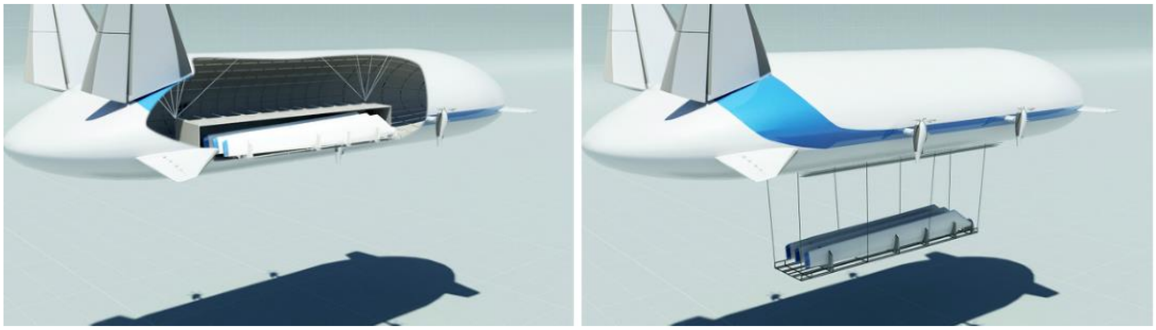
At the October 2007 National Business Aviation Association (NBAA) show in Atlanta, Georgia, Aeros presented a "superyacht" version of the ML866 with more than 5,382 square feet (500 square meters) of floor space in the main cabin, which can be configured to meet customer requirements.

ML866 "Superyacht" concept drawings. Source: Aeros

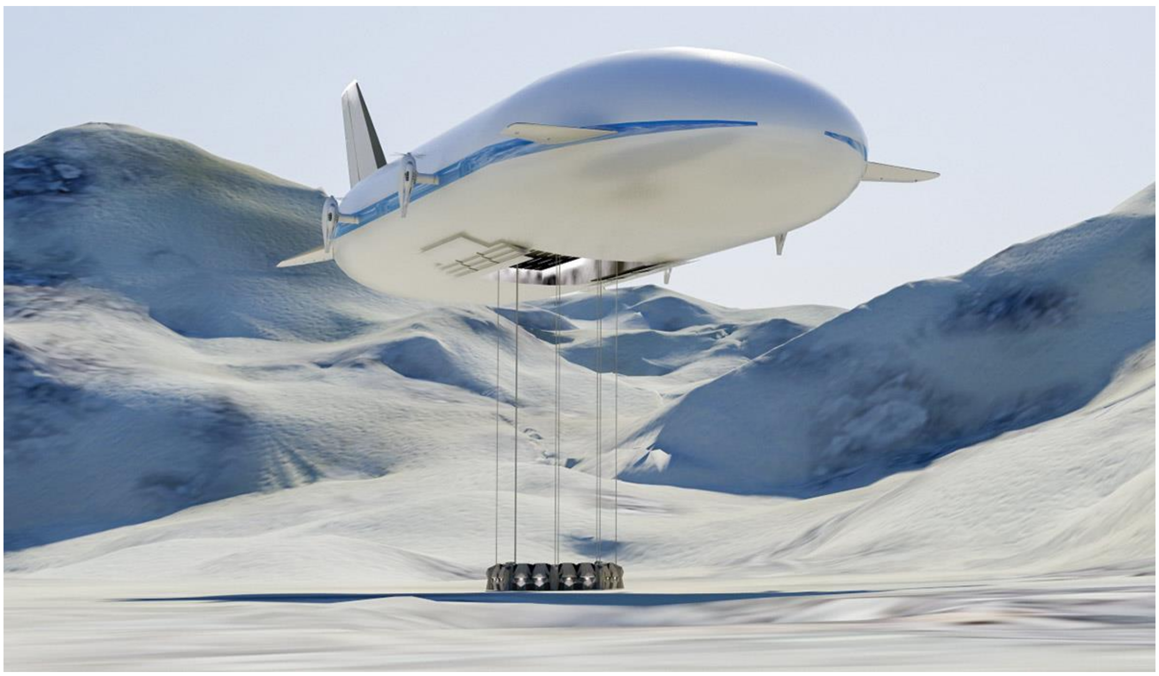


Scale of the ML866 main cabin in comparison to high-end business jets. Source: Aeros

Aeros claims that the technologies demonstrated by the *Dragon Dream* will "enable the Aeroscraft to fly up to 6,000 nautical miles, while achieving true vertical takeoff and landing at maximum payload, to hover over unprepared surfaces, and to offload over-sized cargo directly at the point of need." Operational Aeroscraft airships will be designed with an internal cargo bay and a cargo suspension deployment system that permits terrestrial or marine (shipboard) delivery of cargo from a hovering Aeroscraft, without the need for local infrastructure or external ballast. The COSH variable buoyancy system and the low speed control (LSC) system are designed to precisely manage airship buoyancy and position throughout the in-flight load exchange operation.



Discharging cargo from a hovering Aeroscraft airship.
Source: Aeros



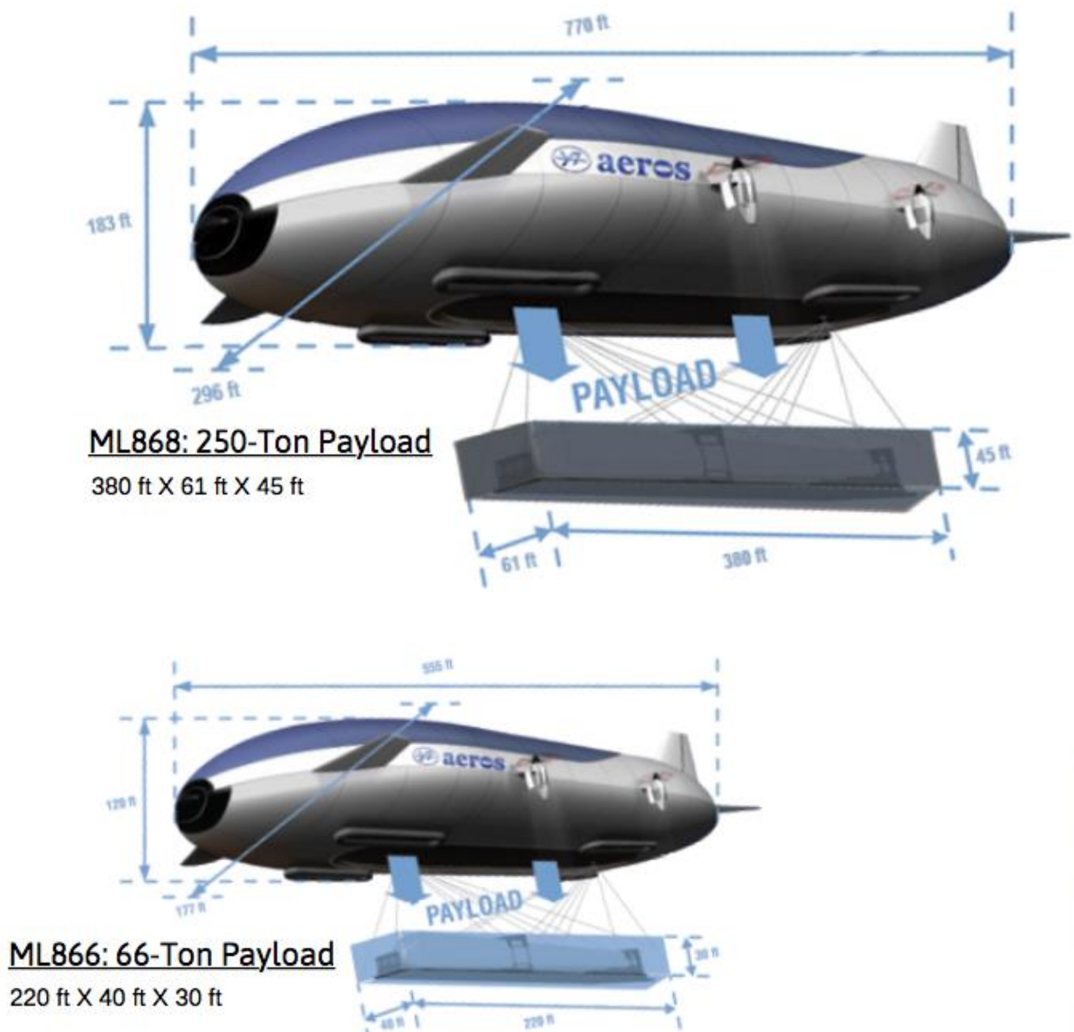
Concept drawing, ML866 / Aeroscraft Gen 2 hovering and making an in-flight load exchange in the Arctic. Source: Aeros

In 2014, Aeros reported it has completed the design and implemented a 'design freeze' for the ML866. In September 2015, Aeroscraft CEO Igor Pasternak announced, “We are excited to reveal production is underway on the 555 ft (169 m) long ML866, and (we are) committed to achieving FAA operational certification for the first deployable Aeroscraft in approximately five years.”

On 8 August 2018, Aeroscraft announced that “they have completed the preliminary design phase for their Aeroscraft Gen 2 Cargo Airship”……”Aeroscraft Gen 2 will have enhanced buoyancy control, flight surfaces and modular cargo systems. The aircraft will feature zero emission operations, representing the only truly green technology capable of moving cargo over long distances. Aeros is now proceeding with the build and test phase on all major systems and subsystems for Aeroscraft Gen 2.” The Aeroscraft Gen 2 is being designed with great range (3,100 nautical miles; 5,741 km), a cruise speed of 100 – 120 knots, and an altitude ceiling of 12,000 feet (3,658 m).

Beyond the ML866

The basic Aeroscraft design can be scaled up to handle much heavier cargo. The approximate scaling of an Aeroscraft airship as a function of cargo weight is shown in the following graphic.



Aeroscraft airship scaling to handle larger cargo loads.
Source: Aeroscraft