Aeros Aeroscraft *Dragon Dream*

Peter Lobner, Updated 3 April 2021

1. Introduction

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.

In 2005, Aeros was one of two contractors selected by the Defense Advanced Research Projects Agency (DARPA) to conduct Phase I of Project WALRUS and develop a prototype of their variable buoyancy airship that implemented a process called “Control of Static Heaviness” (COSH). The prototype, named *Dragon Dream*, was completed under Project Pelican and successfully flew in 2013.

Aeros developed a family of advanced COSH airship designs, known as Aeroscraft, that are scaleable and configurable for a range of commercial, civil, military and private applications. Aeros LTA products also include the non-rigid Aeros 40E *Sky Dragon* airship and advanced tethered aerostatic systems. The Aeros website is here: [http://aeroscraft.com](http://aeroscraft.com)

2. Aeros patents

During the development of *Dragon Dream*, Aeros developed an impressive patent portfolio to address their key technologies for rigid airship aerostructures, an air bearing landing system, and most importantly, the COSH flight system for a constant volume, variable buoyancy air vehicle. Following is an overview of these patents.

**Patent US D663255S1 - Rigid body airship**

This patent, which was granted on 10 July 2012, applies to the “ornamental design” of a rigid airships, which is defined in a series of
figures. This design is implemented in *Dragon Dream* and subsequent Aeros Aeroscraft designs. You’ll find this patent here: https://patentimages.storage.googleapis.com/20/f2/57/977fdf5951a75b/USD663255.pdf

Generic 3-view drawing of an Aeros Aeroscraft airship.  
*Source: Patent US D663255S1*

**Patent US 9266597B1 - Aerostructure for rigid body airship**

This patent, which was granted on 23 February 2016, describes the design of a rigid airship hull of the type implemented in Aeros Aeroscraft airships. The patent states:

“An airship hull is provided that is sufficiently light and cost effective so as to make lifting body type airships practical vehicles for carrying people and cargo. The present invention hull design includes three main structural features, i.e., a rigid internal main frame which carries all primary moment and shear loads induced in the vehicle, the vehicle’s skin which forms a semi-rigid barrier membrane for the lighter-than-air lifting gas, and a rigid aeroshell frame interposed between the main frame and the skin. The aeroshell frame and skin, in combination, are referred to as the aeroshell. The aeroshell carries the aerodynamic pressure loads induced on the airship”

“A lift producing hull is highly advantageous because it allows an airship to take off in a statically negative condition, i.e., in a condition where the hull and payload weight exceed the maximum buoyancy supplied by the lifting gas.”

The rigid main frame is the lightweight, high strength truss structure shown in patent Figure 2.

![FIG.2](image)

The rigid aeroshell frame shown in patent Figure 3 defines the external shape of the airship. It is installed around, and is attached to the main frame.

![FIG.3](image)
The skin fabric shown in patent Figure 4 is a membrane that is stretched over the aeroshell frame.

The complete rigid aeroshell (hull), comprised of the main frame, the aeroshell frame and the skin, is shown in patent Figure 1.
The Dragon Dream’s fully assembled, lightweight main frame, which supports the airship’s COSH equipment, its cockpit, cargo, and cargo containment structures. Carbon fiber/epoxy tubes in a range of sizes are combined with aluminum tubing (future airships will incorporate all-carbon tubing). Tubes are connected with aluminum joints, and adhesive bondlines to prevent galvanic corrosion. Source: Aeros
Patent US 8864068B1 – Multi-chamber landing system for an air vehicle

This patent, granted on 21 October 2014, relates to lightweight, multi-chamber, air bearing landing system (ABLS) that is able to absorb and redistribute energy during vertical takeoff and landing for an airship. The ABLS also provides suction to increase the vehicle's stability while on the ground. The system also can adjust the attitude of an airship on the ground to enable the airship to clear obstacles while taxiing on uneven ground and to facilitate loading and unloading.

You can read this patent here: https://patentimages.storage.googleapis.com/d9/9c/f7/2dc42aa4dcef6c/US8864068.pdf

ABLS module configuration. Source: Patent US 8864068B1

Four ABLS modules installed under Dragon Dream’s aeroshell. Source: Aeros
This patent, which was granted on 28 April 2015, describes Aeros’ variable buoyancy technology known as “Control of Static Heaviness” (COSH).

“The invention relates generally to the flight system for a constant volume, variable buoyancy air vehicle able to achieve vertical takeoff and landing utilizing lighter-than-air static lift principals and achieving forward flight by utilizing heavier-than-air dynamic lift principals. More particularly, this invention relates to a flight system combining an aerodynamically efficient hull filled with lifting gas and incorporating a system for controlling the pressure of a lifting gas in a constant volume envelope and the ability to adjust buoyancy by actively compressing or decompressing the lifting gas, with the resulting pressure differential being borne essentially by an internal pressure tank.”

“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.”

COSH is the variable buoyancy system implemented into the Dragon Dream prototype airship and in subsequent Aeros Aeroscraft airship designs. You can read the patent here:


3. 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).
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 US 9016622B1.
Simple mechanical process for transferring helium back and forth between the main envelope and the pressurized storage tanks. Source: Patent US 9016622B1

Operation of the variable buoyancy system in different flight modes: takeoff, landing & off-loading cargo. Source: Patent US 9016622B1

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
4. 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. Project WALRUS was terminated in mid-2006, after completion of Phase I.

Under a follow-on DARPA contract issued in October 2007, Aeros modified an Aeros 40D Sky Dragon non-rigid airship by installing two inflatable collars that were controlled by an on-board, flight-weight, prototype COSH system. Aeros announced 17 July 2008 that a successful flight test of the modified Aeros 40D validated the operation of COSH. Aeros CEO Igor Pasternak explained, “We want to demonstrate we can change the static heaviness enough in a short time to be operationally acceptable.”

The variable buoyancy Aeros 40D with two inflatable collars that were controlled by the on-board, flight-weight, prototype COSH system. 
Source: Aeros
5. Proof-of-concept of the lightweight rigid aerostructures

In September 2008, Aeros was awarded a DARPA contract for a Buoyancy Assisted Lift Vehicle (BAAV) Rigid Aerostructure Technology Demonstration. Under this contract, Aeros conducted scale demonstrations to validate that a full-scale airship with a rigid aerostructure can be both light and strong enough to accommodate high-speed dynamic air loads without failure. Aeros announced successful completion of the BAAV program on 10 September 2009.

6. 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 for added stability on the ground;
- Vectored thrust engines propel the vehicle in forward flight and while taxiing on the ground and improve low-speed control.
- The Low-speed control (LSC) system manages the engines and maintains position and orientation during vertical takeoff and landing (VTOL) and hover in low wind conditions.
7. Testing the *Dragon Dream* prototype

*Dragon Dream* was first “float tested” on 3 January 2013 inside a World War II-era former blimp hangar at a former Marine Corps Air Station in Tustin, CA, which was under license to the Navy. 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* bow view on first “static float test” in January 2013 (above); stern view showing the fixed aft propulsor and diverter flaps (below). Source, both photos: Aeros
The airship was rolled out of its hangar on 4 July 2013. Outdoor taxi tests on the air bearing landing system, COSH tests, and low speed control (LSC) system tests were conducted. DoD and NASA acknowledged that work under Project Pelican was completed within budget on 21 August 2013.
Veteran airship pilot Alfred ‘Corky’ Belanger (L), Aeroscraft Test Pilot in Command, and Test Pilot General Raymond Johns (ret.), check systems in advance of flight test. Source: Aeros

Taxi test on the ABLS, July 2013. Source: Aeros
On 5 September, Aeros announced that the 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. You can watch a short (1:31 minute) Aeros video of that flight here: https://www.youtube.com/watch?v=WjQ8PL1Y6SU
The *Dragon Dream* airship was damaged on 7 October 2013 when a 20-by-20 foot section of the roof of its World War II-era hangar collapsed and fell onto the airship. Aeros determined that the airship was not repairable.

*Part of the central roof of the North Tustin blimp hangar collapsed.*
*Source: Associated Press via daily Mail*

*Damage to the rear part of the Dragon Dream.*
*Source: Allan Ripp via The LTA Society*
The undamaged front part of Dragon Dream deflating after the roof collapse. Source: ZUMAPRESS via Daily Mail


Aeros disassembled the damaged airship and salvaged what it could. In 2015, Aeros filed a lawsuit (Case No. CV15-1712-PJW) in the US District Court for the Central District of California against the Navy related to the loss of Dragon Dream and its impact on future Aeros business. The lawsuit was settled on 20 November 2017 with a ruling in favor of Aeros with a determination that they were entitled to damages in the amount of $6,882,918.

See my separate article on the Aeros Aeroscraft family of airships that incorporate key technologies demonstrated by Dragon Dream.
8. For more information


