Aeros - Global Rapid Redeployable (G2R) stratospheric airship

Peter Lobner, updated 10 March 2022

1. Introduction

In 2006, Aeros proposed a novel, unmanned, non-rigid, stratospheric airship design concept known as the Global Rapid Redeployable (G2R) stratospheric airship. Development of the Aeros G2R design concept was influenced by the US Army Missile Defense Agency's (MDA) 2002 objectives for a High Altitude Airship (HAA), which established the US military need for persistent surveillance airships capable of carrying large ISR (Intelligence, Surveillance, Reconnaissance) payloads on long-duration station keeping missions. In June 2006, Aeros received an Air Force one-year contract under the Small Business Innovation Research (SBIR) program to develop and validate the innovative G2R structural technology for near space platforms.

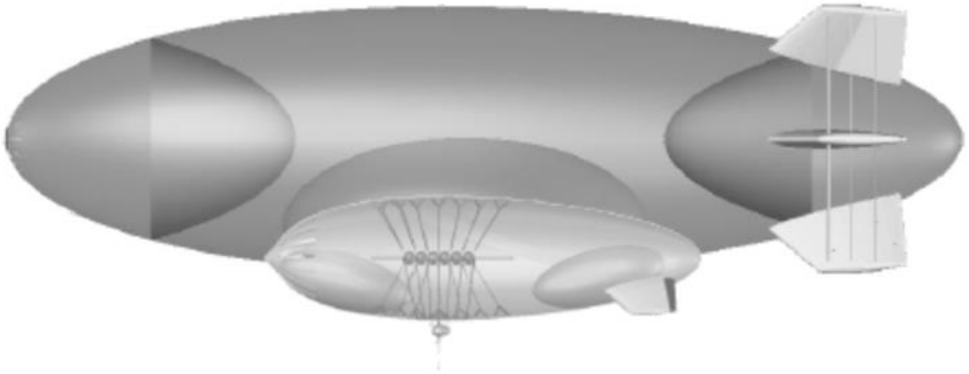
2. G2R basic design features

The G2R was a design concept for a two-component airship in which the first component was based on an existing Aeros product, the non-rigid 40D Sky Dragon blimp.

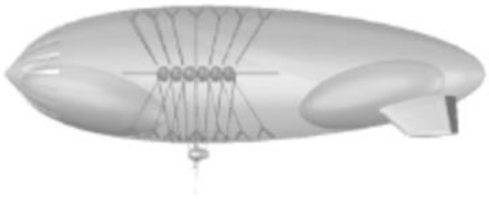
The first component of the G2R was based on an Aeros 40D Sky Dragon blimp. Source: Aeros

An Aeros 40D has a length of 152 ft (42.6 m), an envelope volume of 100,032 ft^3 (2,832 m^3), and can carry a single pilot and a payload of up to 1,000 lb (454 kg).

The second component of the G2R was a lightweight “super envelope” that was attached to the top of the Aeros 40D to provide the expansion space needed for the helium lift gas to carry the airship to its operating altitude of 65,000 ft (12.3 miles / 19.8 km), where ambient air density is only 7% of the air density at sea level. During launch and recovery at sea level, the G2R would look similar to a commercial Aeros 40D blimp. At operating altitude, the super envelope would be fully expanded and the two component airship would have grown to a length of about 335 ft (102 m). This transformation is evident in the following Aeros diagrams.

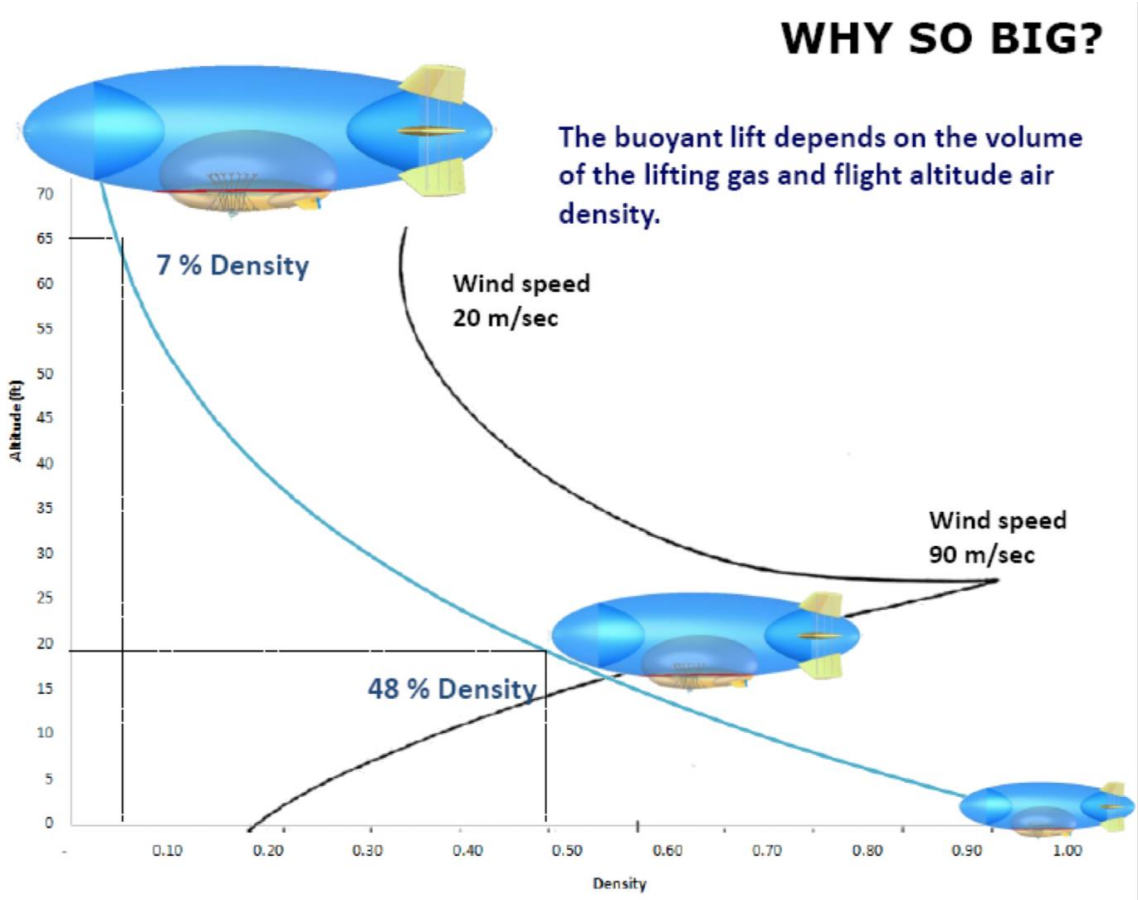


Configuration at Altitude



Configuration at Launch & Recovery

Source: Aeros



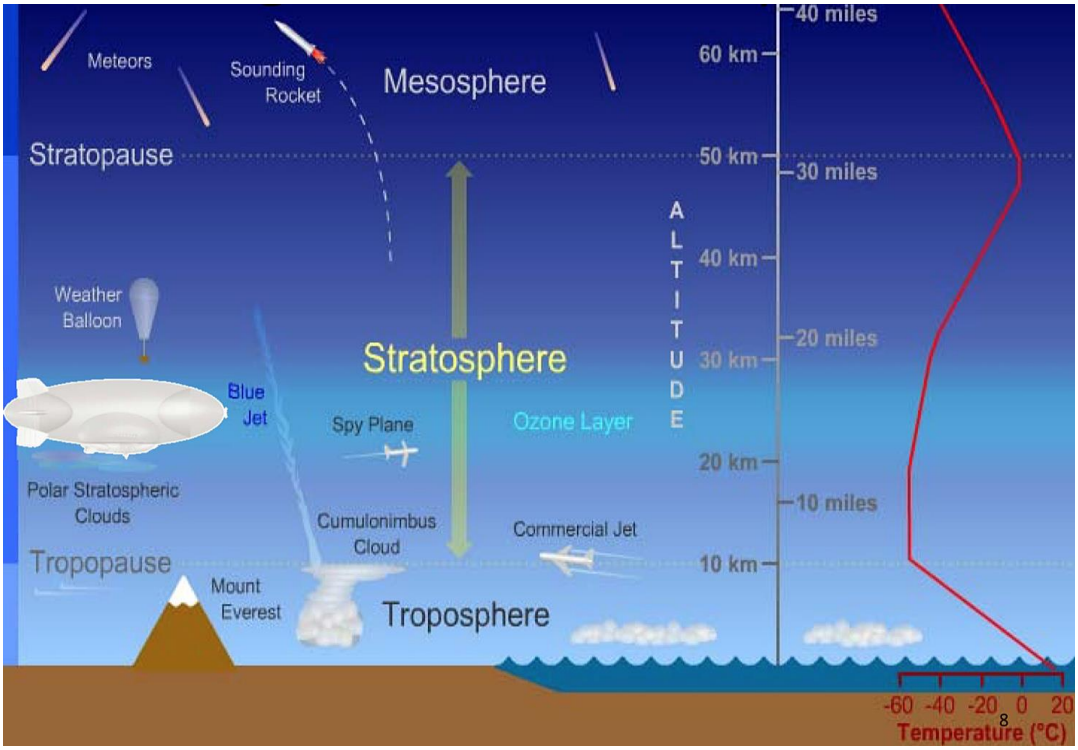
Source: Aeros

3. The stratospheric environment

While the first component of the G2R may have looked like an Aeros 40D, it would have been modified for the stratospheric environment, which is much more challenging to airship materials and systems than the relatively benign environment in the lower altitude range where commerical Aeros 40D airships operate. Environmental challenges in the stratosphere include the following:

- **Very low temperatures:** The ambient air is very cold, averaging -55° Celsius; exposed surfaces can drop to almost -80° Celsius at night due to radiative cooling to the dark sky.
- **Low air pressure and density:** This is a function of altitude, but typically is in the range of 3 – 7% of sea level conditions.

- **Less heat transfer by convection:** Convective heat transfer is reduced by low air density. Radiative heat transfer becomes more important for thermal management (gas envelope and equipment cooling).
- **High solar irradiation:** 25 to 37% higher than at sea level. This complicates thermal management of the large gas envelope, but is good for photovoltaic power generation.
- **High ultraviolet (UV) radiation:** At high altitude, there is little atmospheric screening of UV, which can deteriorate the gas envelope and other materials.
- **High ozone concentration:** The airship is operating in the "ozone layer", formed by 180-240 nm (nanometer) ultraviolet interactions with oxygen. Ozone can deteriorate the gas envelope and other materials.
- **Possibie electrical arcing:** This is more likely in the low density atmosphere, potentially damaging electrical equipment.
- **Possible lightning activity:** From cloud tops, including blue jets.

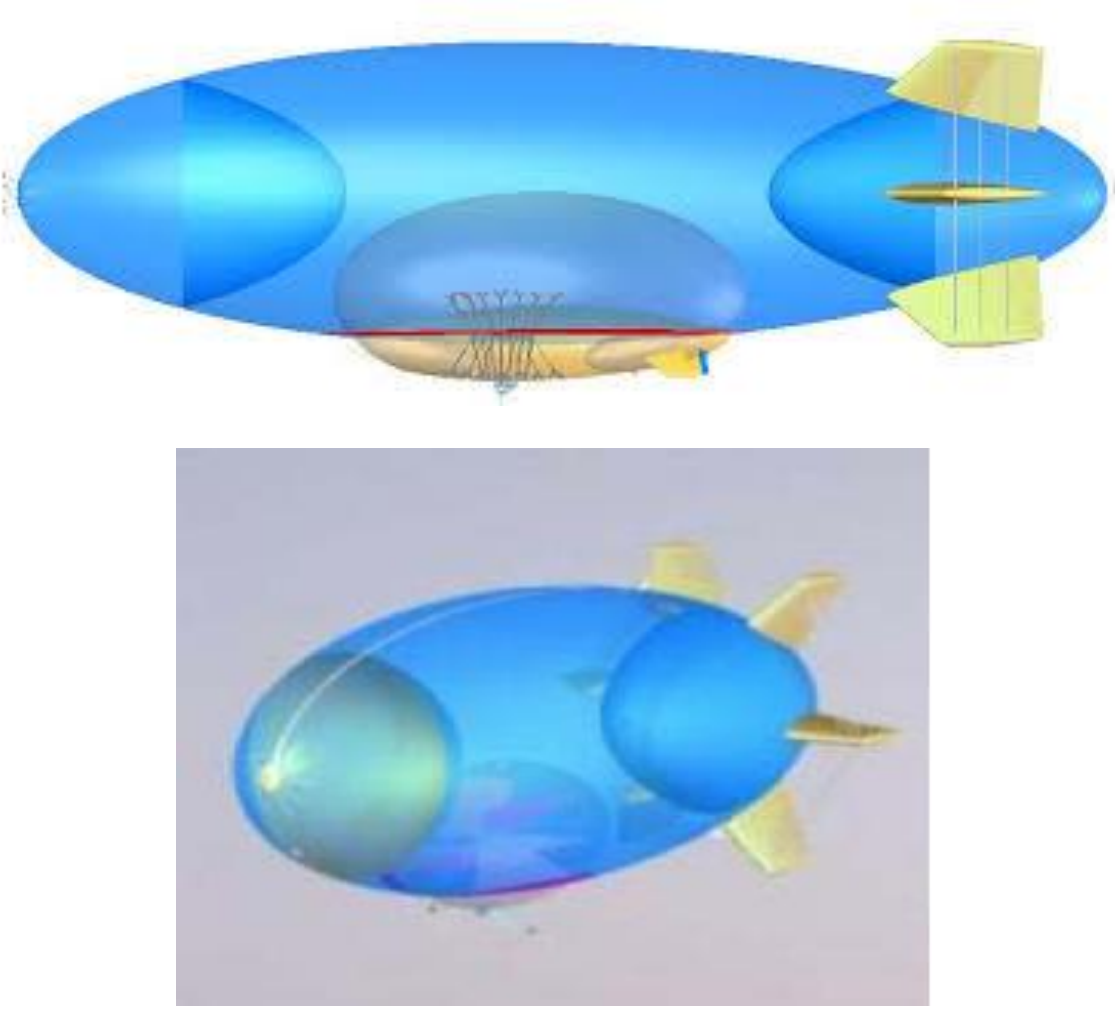


The G2R stratospheric environment. Source: Aeros

4. G2R operational capabilities

The G2R was designed for worldwide rapid deployment with short turn around times (4 to 6 hours) to re-launch. It was designed to operate in-theater with limited ground crew / logistics support and no hangar. Operational features included:

- Endurance: 21 days on station at high altitude
- Power source: Hybrid solar photovoltaic with fuel cells / batteries for 24/7 power, except at extreme latitudes
- Electric motor driven propellers optimized for operation in low density air and low speed
- Speed: 30 knots cruise, 47 knots maximum
- Payload: 1,000 kg (2,205 lb)



Fully inflated G2R profile & bow quarter views. Source: Aeros

5. For more information

- "Global Rapid Redeployable Stratospheric Airship (G2R)," SBIR-STTR, 20 June 2006: https://www.sbir.gov/sbirsearch/detail/351725
- Fred Edworthy, "Worldwide Aeros Corp. Montebello, California," presentation at Airships: A New Horizon for Science, 30 April to 3 May 2013: https://kiss.caltech.edu/workshops/airships/presentations/edworthy.pdf

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