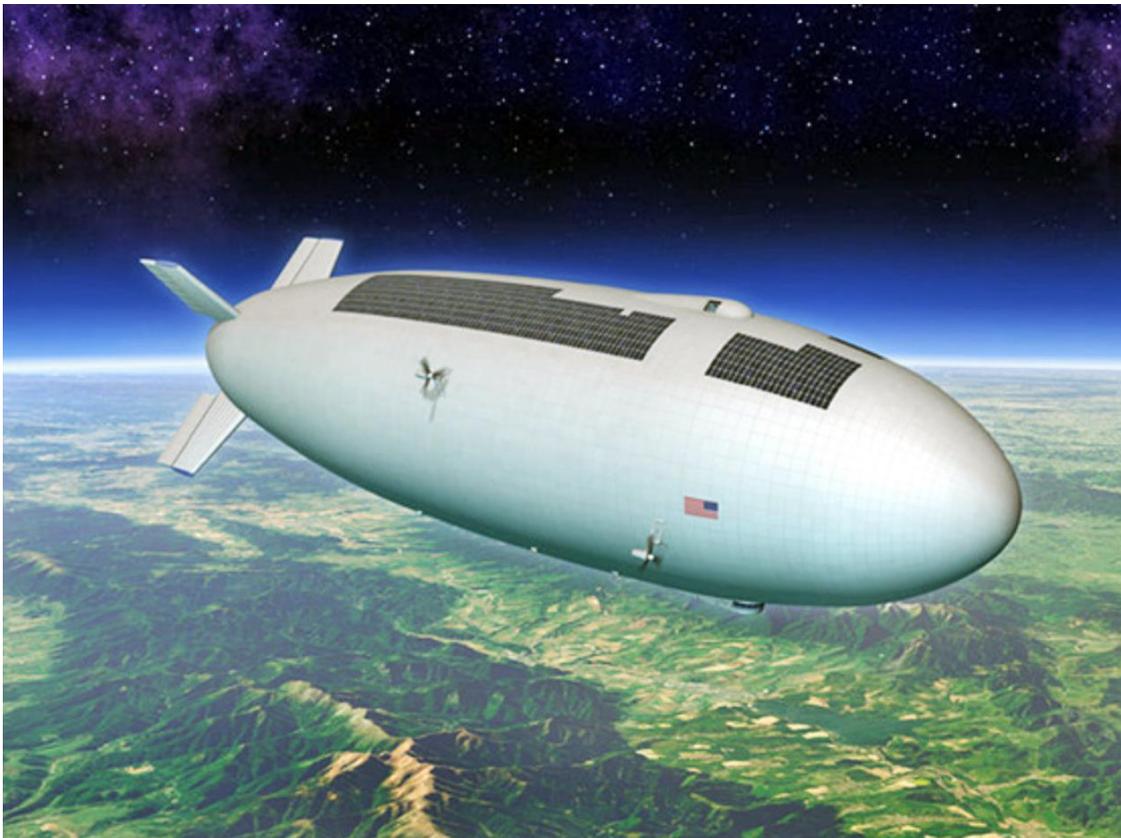


## NASA 20-20-20 challenge

Peter Lobner, 3 April 2021

### 1. Introduction

Over the past several decades, there have been many conceptual designs of large stratospheric airships intended to carry multiple-ton payloads on long duration missions at altitudes between 60,000 and 75,000 ft (18.3 and 22.8 km), but none have been built and flown. In 2013, the National Aeronautics and Space Administration (NASA) announced their preliminary plans for a “20-20-20” Centennial Challenge competition to develop high-altitude airships, lighter-than-air maneuverable vehicles, as platforms for astronomical and Earth observatories.



*Concept for an airship observatory, including a world-class telescope on the top of the airship and a suite of Earth and atmospheric instruments mounted on the bottom. Source: Mike Hughes (Eagre Interactive) / Keck Institute for Space Studies, circa 2013.*

## 2. Benefits of a high-altitude astronomical observatory

At the target altitude of 20 km (65,617 ft), an airship is above 95% of the atmosphere, but still has enough of an atmosphere for a propulsion system to maintain a desired position in the usually light stratospheric winds. In stratospheric atmospheric conditions, the airship-borne telescope will be able to “see” much better than the best ground based observatories, with far less impact from atmospheric absorption and turbulence, terrestrial light sources and weather in the troposphere. At an altitude of 20 km, astronomers expect much better telescope performance, particularly in the ultraviolet and the sub-millimeter and millimeter ranges.

The airship’s telescope will still encounter some jitter from stratospheric winds and airship machinery. With suitable vibration damping, the airship’s telescope could be close to a “diffraction-limited” system, operating with a resolution near the instruments theoretical optical limits. In this case, the telescope’s resolution is only limited only by the size of the optical system and not by the effects of the atmosphere. A lightweight 4-meter class telescope could be possible on a large stratospheric airship.

## 3. The 20-20-20 (almost) Airship Challenge

NASA’s preliminary plans for the 20-20-20 Airship Challenge are described in the 2014 Jet Propulsion Laboratory (JPL) / Keck Institute presentation at the following link:

[https://www.kiss.caltech.edu/papers/airships/papers/Airships\\_rhodes\\_HQ\\_Sept\\_2014-v2.pdf](https://www.kiss.caltech.edu/papers/airships/papers/Airships_rhodes_HQ_Sept_2014-v2.pdf)



Source:  
NASA

The first step was NASA’s formal Request for Information (RFI) issued in November 2014 to solicit interest in the competition. Responses were due on 1 December 2014. One of the criteria NASA said they would use in deciding whether to proceed with the Challenge was interest among the community.

NASA’s 20-20-20 Airship Challenge was designed a two-tiered challenge that provided opportunities to evaluate a wide range of innovative methods to launch an airship into the stratosphere, maintain altitude, and maintain assigned position for a specified period of time. The specific Tier 1 and Tier 2 goals were:

<b>Key Challenge Requirement</b>	<b>Tier 1</b>	<b>Tier 2</b>
Minimum altitude (km)	20	20
Mission duration (hours)	20	200
Payload mass (kg / lb)	20 / 44	200 / 440
Station keeping diameter (km / miles)	20 / 12.4	20 / 12.4
Path traversing (navigate between two designated points)	No	Yes
Airship scalability review for longer duration flights with larger payloads	Yes	Yes

In 2014, this was a very difficult challenge. At that time, no powered airship had been able to sustain an altitude of 20 km (65,617 ft) for more than eight hours.

This Challenge sought to engage the aerospace industry, educational institutions, and amateurs to provide solutions. The Challenge intended to award seed money to the first 10 Teams to present and pass an Airship Scalability Review (~\$20K per team). There was an anticipated \$2 million to \$3 million prize purse associated with this Challenge.

NASA issued a second RFI for the “Centennial Challenges Program 20-20-20 - Airship Challenge Competition” on 22 March 2016, seeking feedback on the proposed competition requirements and rules, and soliciting interest in potentially competing in this challenge. In the RFI, NASA clarified that the airship station keeping was required in stratospheric winds of less than 15 meters / sec (33.5 mph). Responses were due by 6 May 2016.

In the end, NASA's 20-20-20 Airship Challenge didn't proceed beyond the second RFI. Five years later, in 2021, there still are no stratospheric airships capable of meeting even the Tier 1 goals.

#### 4. For more information

- NASA's Centennial Challenges Program:  
[www.centennialchallenges.nasa.gov](http://www.centennialchallenges.nasa.gov)
- "Airships: A New Horizon for Science," The Keck Institute for Space Studies, 1 February 2014:  
<https://arxiv.org/pdf/1402.6706.pdf>
- J. Rhodes, et al., "The 20-20-20 Airships NASA Centennial Challenge," Caltech / JPL / Keck Institute for Space Studies, 2014:  
[https://www.kiss.caltech.edu/papers/airships/papers/Airships\\_rhodes\\_HQ\\_Sept\\_2014-v2.pdf](https://www.kiss.caltech.edu/papers/airships/papers/Airships_rhodes_HQ_Sept_2014-v2.pdf)
- Bruce Dorminey, "Astronomy From High Altitude Airships," Forbes, 14 July 2014:  
<https://www.forbes.com/sites/brucedorminey/2014/07/29/astronomy-from-high-altitude-airships/?sh=27d9d08219c3>
- "20-20-20 Airships NASA Centennial Challenge RFI," 2014:  
<https://cor.gsfc.nasa.gov/news/challenge.php>
- Alina Kiessling, "NASA's 20-20-20 Airship Program Requests Your Input," American Astronomical Society, 18 November 2014: <https://aas.org/posts/news/2014/11/nasas-20-20-20-airship-program-requests-your-input>
- E. Landau & P. Dyches, "NASA seeks comments on possible airship challenge," PhtsOrg, 26 November 2014:  
<https://phys.org/news/2014-11-nasa-comments-airship.html>
- National Aeronautics and Space Administration (NASA) Centennial Challenges Program 20-20-20 - Airship Challenge Competition Requirements, Rules & Technical Document, Request for Information (RFI), Solicitation Number: NNM16ZZP002L, 22 March 2016:  
<http://www.blimpinfo.com/wp-content/uploads/2016/03/NASA-Centennial-Challenge-20-20-20-Airship.pdf>