

Vaeth & Stehling - Helium Horses

Peter Lobner, 8 March 2022

1. Introduction

In the early 1970s, Gordon Vaeth, Director, Office of Systems Engineering at the National Oceanic and Atmospheric Administration (NOAA), and Kurt Stehling, an aerospace consultant to NOAA, developed a vision of the potential roles of large rigid airships as configurable, multi-mission platforms that could meet the needs of a variety of users while doing so with lower environmental impacts than conventional modes of transportation. Vaeth referred to these giant airships as “helium horses.” Potential applications included heavy-lift cargo carrier, humanitarian aid delivery vehicle, scientific platform, military / Coast Guard patrol vehicle and flying cruise ship.



Kurt Stehling & Gordon Vaeth showing a graphic of one of their large rigid airship “helium horse” designs.

Source: adapted from Naval Aviation News (May 1974)

Vaeth recommended a “proof-of-concept” flight program involving a small to moderate size experimental testbed airship with a useful lift of about 30 tons (27.2 metric tons) to be operated by the National Aeronautics and Space Administration (NASA). He estimated that such an airship could be flying in 3 years for an approximate total cost of \$30 million.

2. General characteristics of a helium horse

Vaeth and Stehling’s helium horse concept has been described in 1974 Congressional testimony and several magazine articles from 1974 to 1976. Following is a composite list of helium horse characteristics compiled from these sources.

- Very large:
 - Can be sized to carry payloads of up to 1,000,000 pounds (500 tons / 454 metric tons) with almost no limitation on payload dimensions, for example:
 - Fully-assembled structures
 - Large, pre-assembled nuclear plant components
 - Basic parameters: 1,000 ft (304.8 m) long, 300 ft (91.4 m) in diameter, gas volume 25,000,000 ft³ (707,921 m³), gross lift of 700 tons (635 metric tons) and useful lift of 400 – 500 tons (363 – 454 metric tons)
 - A 100,000,000 ft³ (2,832,000 m³) airship would be about 1,800 ft (548.6 m) long
- Rigid hull:
 - High-strength alloy and fiber-reinforced composite material
 - Minimum of internal girderwork
- Pre-stressed metallic or plastic skin:
 - Possibly serving as both the lifting gas container and structure
- Helium lifting gas
- Variable buoyancy control:
 - The goal was to eliminate the need for ballast and venting lifting gas
 - One concept identified by Vaeth involved vaporizing and liquifying helium

- Vertical takeoff and landing (VTOL) and hover:
 - Capable of operating from open sites with no conventional airport facilities
 - Requires only a clear landing site at least twice the length of the airship to allow the airship to weather vane around a mast to point into the wind
- “Arrivals” and “departures” could be possible without landing:
 - Vaeth felt that the airship should be kept off the ground as much as possible to minimize ground handling problems.
 - Passengers and cargo could be transferred with a helicopter or a “hook-on” airplane.
 - Airborne load exchanges of cargo could be executed with winches while the airship hovers overhead, maintaining position with thrust vector control and buoyancy management.
- Can be propelled by a Rankine-cycle (steam) engine operating as a closed-cycle system:
 - Liquid fuel, steam turbine driving large, counter-rotating tail-mounted propellers.
 - The skin of the airship could serve as a radiator for the Rankine-cycle propulsion system
- Could be nuclear powered
- Can be made exceptionally quiet
- Cruise speed of 100 – 150 mph (161 – 241 kph)
- Range of 10,000 miles (16,093 km), at a maximum of 2,400 – 3,600 miles (3,862 – 5,794 km) per day
 - Extendable with inflight refueling from ships at sea if needed.
- Can operate over a wide altitude range:
 - A flying cruise ship would operate primarily at a low altitude of about 1,000 ft (305 m)
 - Other applications could operate at much higher altitudes. For example, WW I Zeppelins could reach an altitude of 25,000 ft (7,620 m)

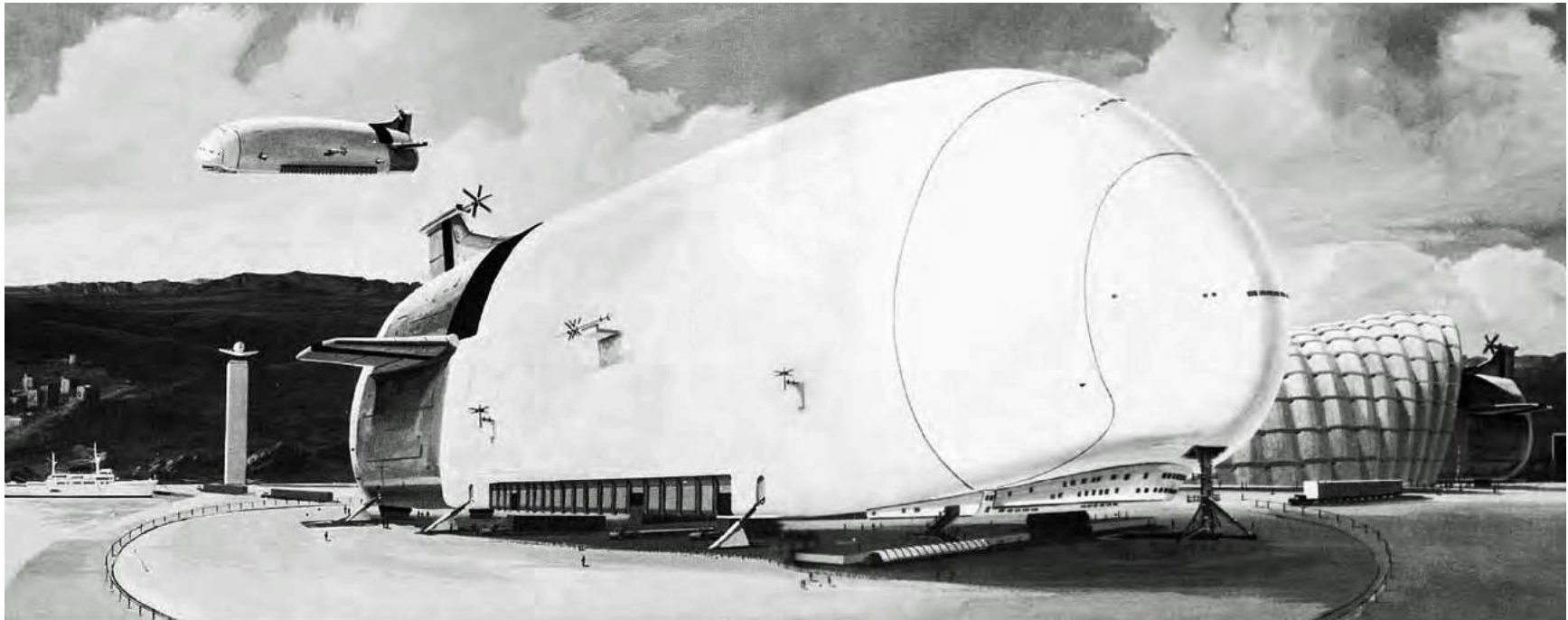
3. Heavy-lift airship

Vaeth and Stehling developed conceptual designs for a heavy lift helium horse that could be configured for a range of missions in addition to its basic heavy cargo transport function. For example:

- **Sea Control Ship:** A large airship could serve as an airborne version of a Sea Control Ship, intended to augment the capabilities of the US Navy's surface ships performing that function. This particular application would be revisited in the late-1980s in the US Navy's Sentinel 5000 airship program.
- **Humanitarian aid delivery:** Taking advantage of its large cargo carrying capacity, long range and relatively high speed, a heavy-lift airship could be permanently configured for rapid deployment and delivery of humanitarian aid wherever it is needed in the world. The ability to deliver passengers and cargo without landing would be of particular value in areas where the local infrastructure has been damaged.
- **Luxury cruise ship:** Vaeth felt that the airship should not be seen as a competitor to the airplane for routine passenger travel. Rather the airship's passenger-carrying role should focus on luxury travel. In a flying cruise ship configuration, the airship could carry 200 to 500 passengers.



*View from the passenger lounge on a large airship.
Source: Naval Aviation News (May 1974)*



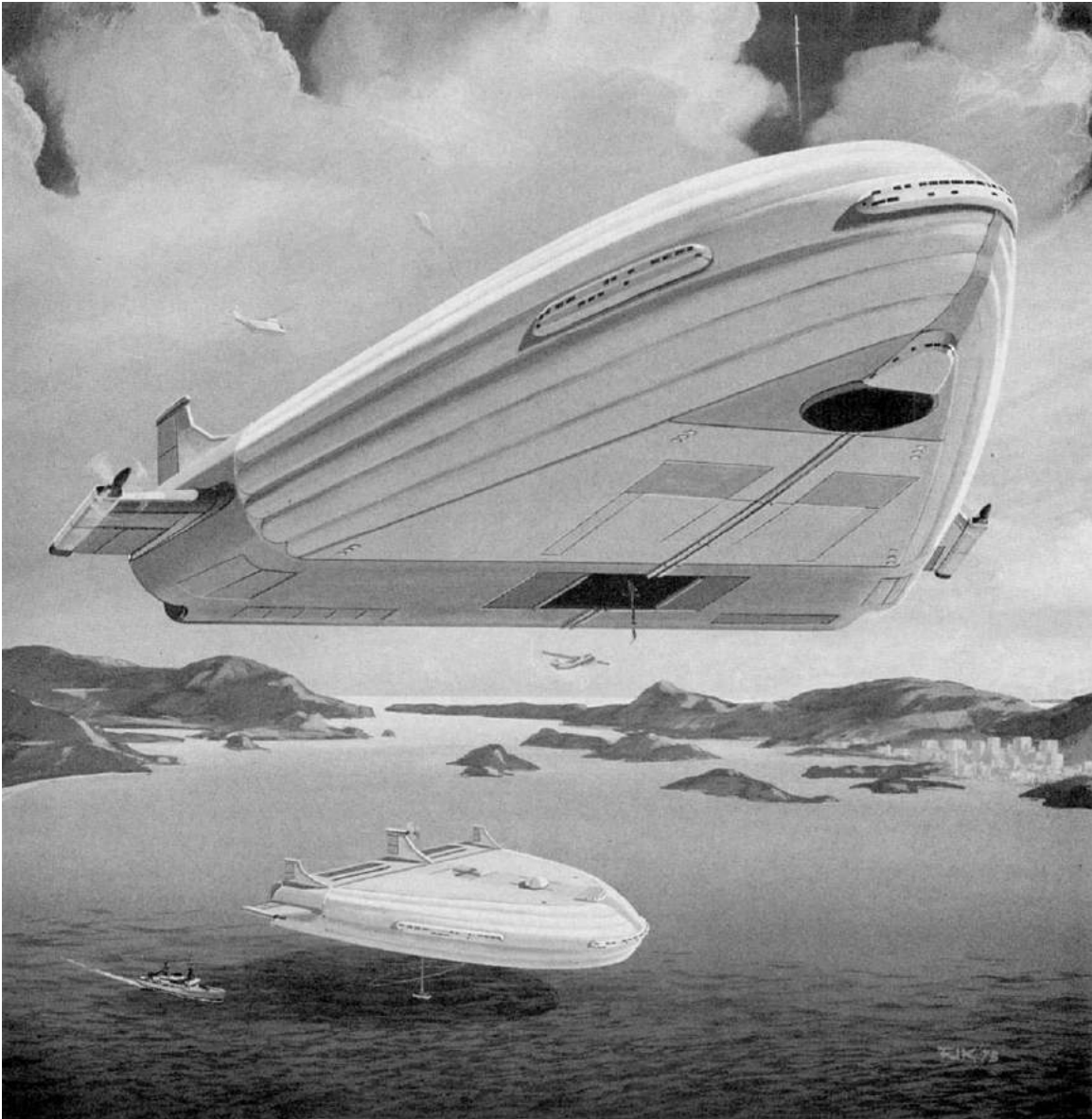
A 50-million ft³ (1.4-million m³) heavy lift cargo airship moored on a turntable. Note the airship in the inflatable hangar in the background (right) and another airship in flight. Source: adapted from Naval Aviation News (May 1974)



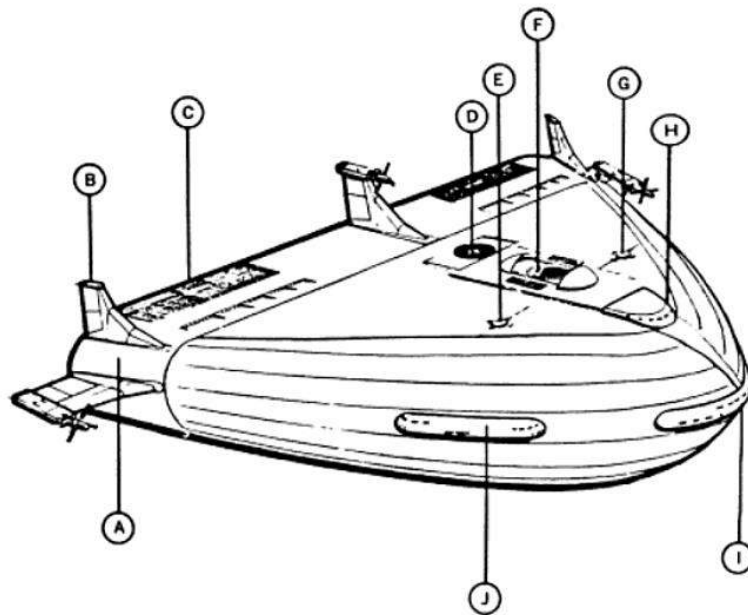
*Heavy-lift airship delivering humanitarian supplies while hovering above the delivery site, without benefit of a local airport or prepared facilities.
Source: adapted from Naval Aviation News (May 1974)*

4. Large delta airship

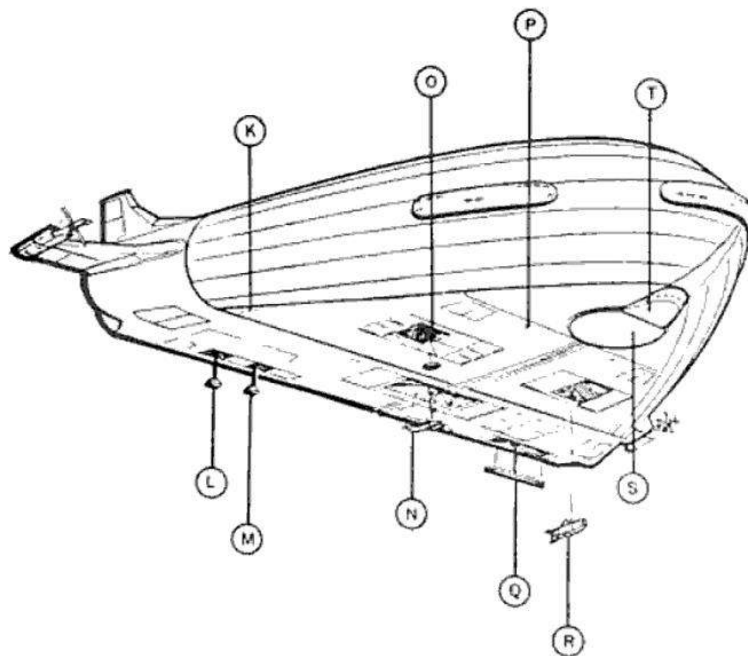
Vaeth and Stehling described a large, delta-shaped airship that could be equipped as a research platform, with a variety of airborne sensors and the ability to launch research sounding balloons and rockets, place and recover instrumented buoys, and deploy and recover a helicopter and a small submersible. The airship also could be equipped with systems to remediate oil spills.



Two heavy-lift airships configured as multi-purpose environmental monitoring / research and cleanup platforms. The lower airship is engaged in cleaning up an oil spill. Source: The AOPA Pilot (1974)



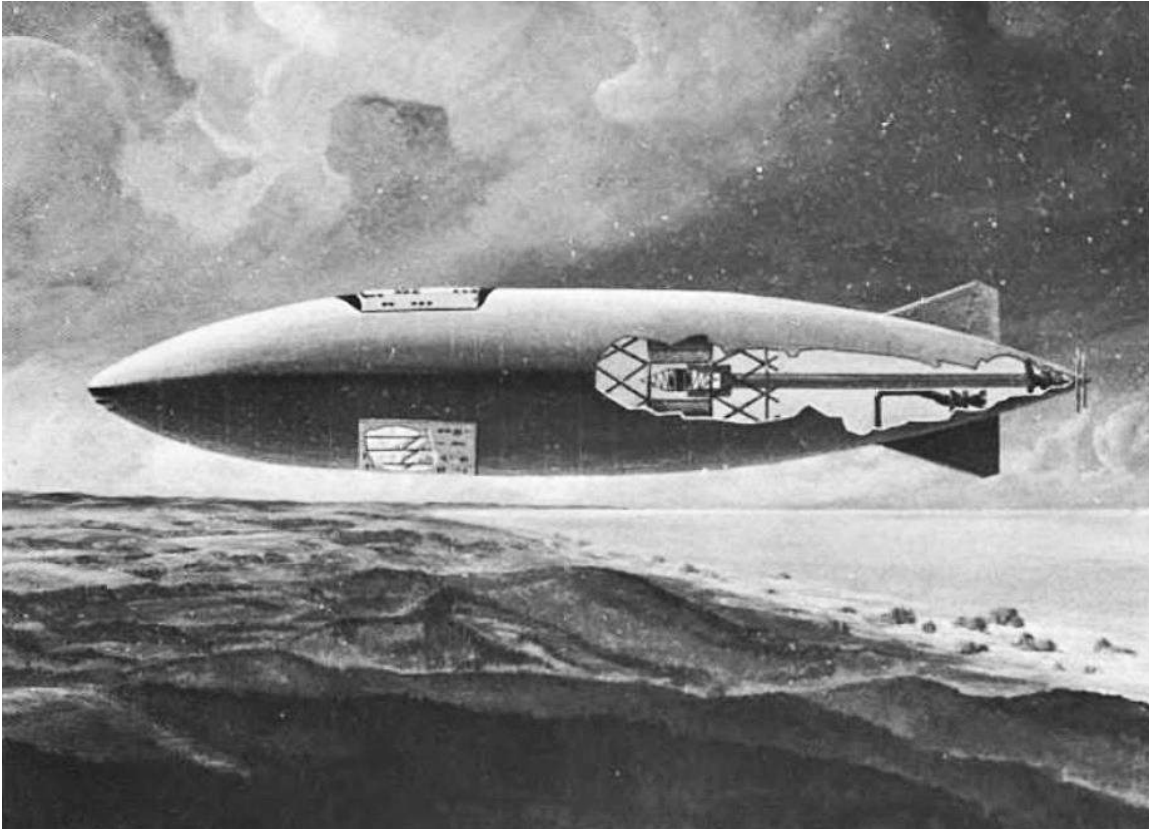
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|---|---------------------------|---|---------------------------------|---|-----------------------|
| A | Rankine cycle engine | H | Meteorological laboratory | O | Environmental buoy |
| B | Radar in fin | I | Bridge & data management center | P | Laser illuminator |
| C | Solar cell array | J | Living spaces | Q | Marine sampling scoop |
| D | Rocket launcher | K | Search lights | R | Submersible |
| E | Helicopter pad | L | Chemical dispensing nozzle | S | Microwave altimeter |
| F | Astrophysical observatory | M | Pollution cleanup pump | T | Marine Laboratory |
| G | Balloon launcher | N | Hook-on airplane | | |



Source: adapted from Stehling & Vaeth, Naval Aviation News (1974)

5. Nuclear powered Helium Horse

Nuclear power was an airship propulsion option considered by Vaeth and Stehling, but only at a very high level.



*A nuclear-powered 12,500,000 ft³ (354,000 m³) passenger airship design concept developed by Boston University scientists.
Source: Gordon Vaeth, Congressional Testimony (16 July 1974)*

In the above concept drawing, the airship bridge is located at the nose and working and living spaces are almost amidships, but well forward of the nuclear propulsion plant.

6. In retrospect

Gordon Vaeth and Kurt Stehling were airship visionaries who were well ahead of their time. Now, almost 50 years later, part of their vision may be realized in the large rigid airships being built, and the even larger airships being planned, by the firm LTA Research and Exploration.

7. For more information

- William Garvey, “Will the Sky Giants Return?” The AOPA Pilot, March 1974: <https://aeroresourcesinc.com/uploads/197403-1974%20Will%20The%20Dirigible%20Return.pdf>
- Kurt R. Stehling & J. Gordon Vaeth, “A Compelling Case for the Helium Horse,” Naval Aviation News, pp. 10 to 25, May 1974 (p. 22 is missing in the following link):
<https://www.history.navy.mil/content/dam/nhhc/research/historie/s/naval-aviation/Naval%20Aviation%20News/1970/pdf/may74.pdf>
- “Advanced Aeronautical Concepts: Hearings Before the Committee on Aeronautical and Space Sciences,” United States Congress, Ninety-Third Congress, “Statement by J. Gordon Vaeth, Director, Systems Engineering, National Environmental Satellite Service, National Oceanic and Atmospheric Administration”, pp. 86 to 96, 18 July 1974:
https://books.google.com/books?id=FFAQAAAAIAAJ&pg=PA93&lpg=PA93&dq=helium+horse,+Vaeth&source=bl&ots=YYJg0wWflc&sig=ACfU3U1FWRKsttBQP0KmhH2f5_-IYtyEqQ&hl=en&sa=X&ved=2ahUKEwi65ru9jqH2AhXNIEQIHe ghCUQQ6AF6BAgKEAM#v=onepage&q=helium%20horse%2C%20Vaeth&f=false
- William F. Shea, “Lighter Than Air: A Look at the Past, a Look at the Possibilities,” Division of Aeronautics, California Department of Transportation, 1976:
<https://ntrs.nasa.gov/api/citations/19760007953/downloads/19760007953.pdf>
- William J. White, “Airships for the Future,” p. 144, Sterling Publishing Co., Inc., New York, ISBN 0-8069-0090-3, 1976

Other Modern Airships articles

- *Modern Airships - Part 1*: <https://lynceans.org/all-posts/modern-airships-part-1/>
 - Airship Advertising / Laws Corp. – rigid airship
 - Airfloat Transport Ltd. – HL airship
 - Cargo Airship Ltd. – shipping container carrier
 - LTA Research and Exploration – rigid airships
 - Wendel R Wendel – STAR*FLITE rigid airship

- US Navy YEZ-2A / Sentinel 5000
- *Modern Airships - Part 2*: <https://lynceans.org/all-posts/modern-airships-part-2/>
- *Modern Airships - Part 3*: <https://lynceans.org/all-posts/modern-airships-part-3/>