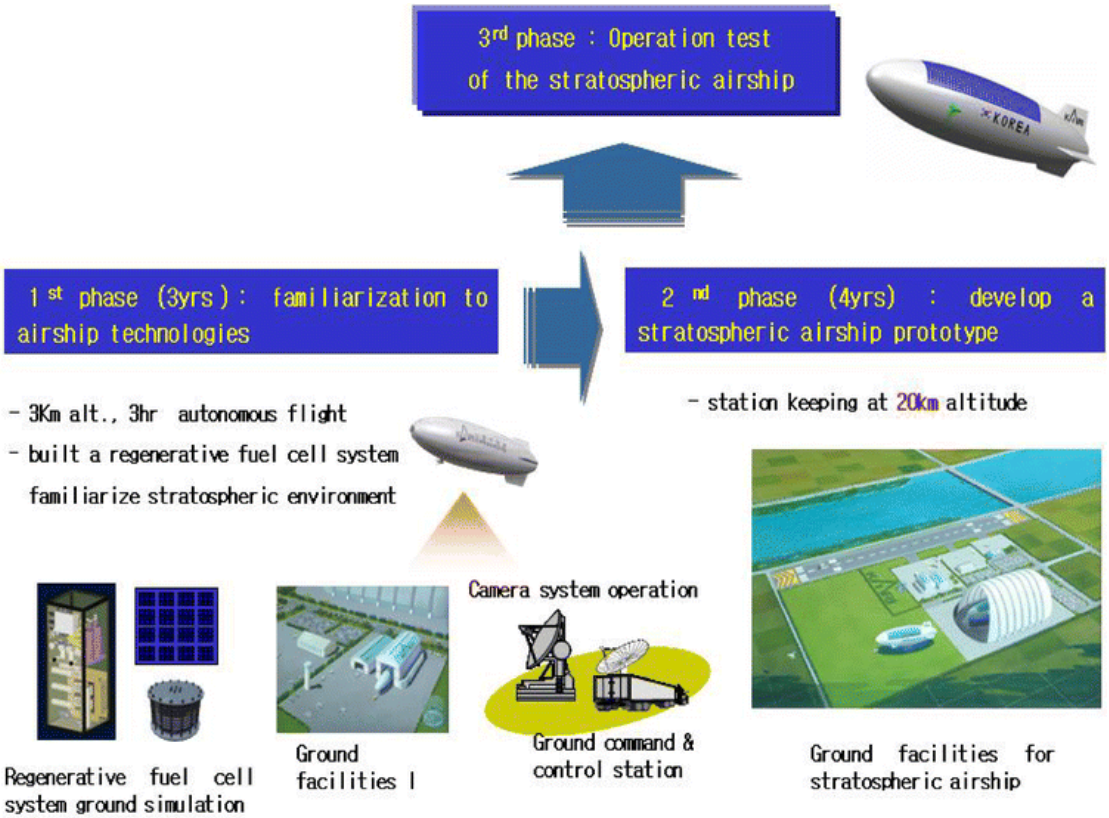
South Korea's Stratospheric Airship

Peter Lobner, updated 8 March 2022

1. Introduction

South Korea's Stratospheric Airship Program started in December 2000 with the goal of developing an airship capable of delivering communication and ground observation services for a range of users. Korea Aerospace Research Institute (KARI) was responsible for aeronautics and integration. Since February 2002, research and development aspects of communications were coordinated by the Electronics and Telecommunications Research Institute (ETRI) and analysis of communications services were performed by SK Telecom. The project received support from the South Korean Ministry of Commerce, Industry and Energy (MOCIE).

A three-phase program was designed to deliver a stratospheric airship for commercialization in 10 years.



Source: Lee, et al., 2006

The three program phases were:

- Phase 1 - Familiarization with airship technologies; develop and test fly a sub-scale demonstrator airship (3 years)
- Phase 2 - Develop a stratospheric airship prototype (4 years)
- Phase 3 - Operational test of the stratospheric airship (3 years)

Phase 1 was completed in 2004. The USE-HAAS report (2006) lists the following tasks being completed in Phase 1:

- Built an airship hangar, prototype ground command and control station, and related facilities at Goheung, in the far south of the country.
- Developed and tested electric motors to power the VIA-50.
- Designed and built the sub-scale, unmanned, non-rigid airship VIA-50 and flight tested it at Goheung, including demonstration of launch, landing and station keeping operations.
- Demonstrated safety critical control systems, including transfer of control between automatic and manual.
- Demonstrated power management of regenerative fuel cells.
- Conducted communications system tests.
- Conducted research into high strength materials and heat management.

Phase 2 started in 2004 and was planned to continue through 2008. The USE-HAAS report (2006) lists the following tasks being conducted during the first year of Phase 2:

- Envelope material development for stratospheric applications using Vectran.
- Acquisition of test data for envelope design.
- Manufacturing process refinement through scaled envelope application.
- Facilities and equipment for large envelope fabrication.
- Trade studies for airship sizing, configuration and performance.
- Thermal analysis for superheat / cool control.
- Adiabatic ascent and descent analysis.
- Ascent / descent trajectory optimization.
- Setup of environmental database for stratospheric operations.

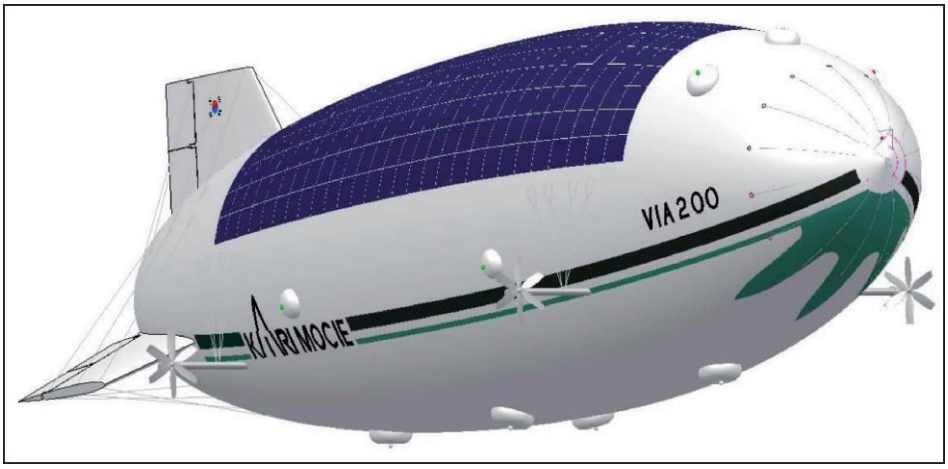
The task for optimizing ascent and descent trajectories of the stratospheric airship recognized that, relative to fixed-wing UAVs, the airship has low performance in flight speed, rate of climb and stiffness of the aerostructure. Hence, the airship could be critically affected by environmental conditions such as fast winds and wind shear (i.e., when passing through the jet stream). In addition, the stratospheric airship's trajectory must avoid violating the airspace of neighboring countries (i.e., North Korea, Japan).

Phase 2 was halted after one year, in 2005, with no future funding for the Stratospheric Airship Program.

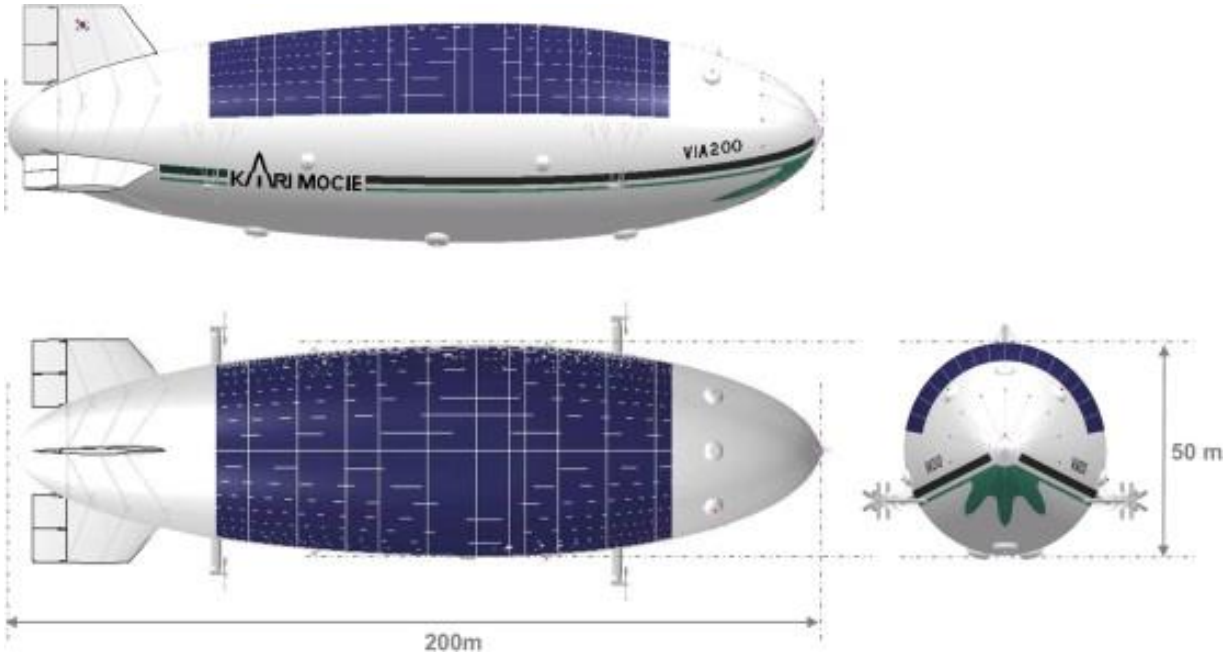
2. The full-scale airship, the VIA-200

South Korea's Stratospheric airship was designed as a large, semi-rigid, solar powered ellipsoidal airship with four flank-mounted propellers. Basic airship and mission characteristics are listed below:

- Length: 200 m (656 ft)
- Diameter: 50 m (164 ft)
- Airship mass: 22 metric tons (24.2 tons)
- Operating altitude: 20 km (12.4 miles, 65,600 ft)
- Station keeping capability: hold position in winds up to 12 m/s (26.8 mph)
- Payload (mission equipment): 1 metric ton (1,000 kg, 1.1 tons)
- Payload power consumption: 10 Kw



KARI's planned VIA-200 airship, circa 2004.
Source: d'Oliveira, et al., 2016



Three-view drawing of KARI's VIA-200 stratospheric airship. Source: Sangjong Lee, et al., 2014

Artist's rendition of KARI's VIA-200 at high altitude. Source: KARI

3. The sub-scale technology demonstrator, the VIA-50

The 50 m (164 ft) long VIA-50 was a non-rigid, unmanned, sub-scale airship intended to build familiarity with airship technologies applicable to the planned VIA-200 stratospheric airship. Development began in 2001, with manufacturing and sub-system assembly in 2002. First flight was in October 2003, at Goheung.

The VIA-50 was designed to fly long-duration missions at a maximum altitude of 5 km (3.1 miles, 16,400 ft) carrying a 100 kg (220 lb) payload and delivering 2 kW of power. The airship can be remotely piloted from the prototype ground control station (GCS). It also is capable of autonomous flight and navigation based on guidance uploaded from the GCS. A primary goal was to demonstrate station keeping within a defined boundary while on a long-duration mission.

VIA-50 inflated hull before installing gondola, propulsors & tail fins. Source: Yung-Gyo Lee, et al., 2006

VIA-50 in its hanger. Source: Yung-Gyo Lee, et al., 2006

Source: Sangjong Lee, Seong-Pil Kim & Hae-Chang Lee, 2004

VIA-50 in flight. Source: Yung-Gyo Lee, et al., 2006

4. For more information

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