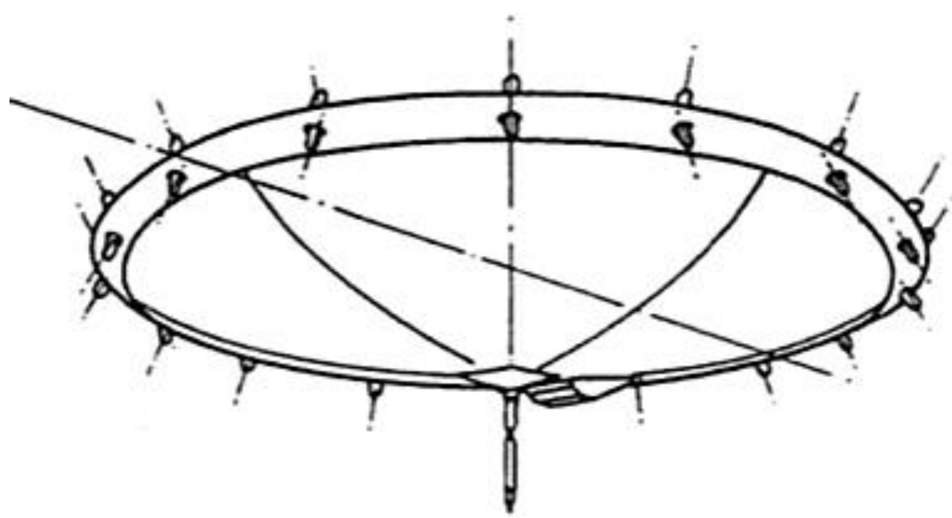
C.N.R.S. Titan - lenticular flying crane

Peter Lobner, updated 8 March 2022

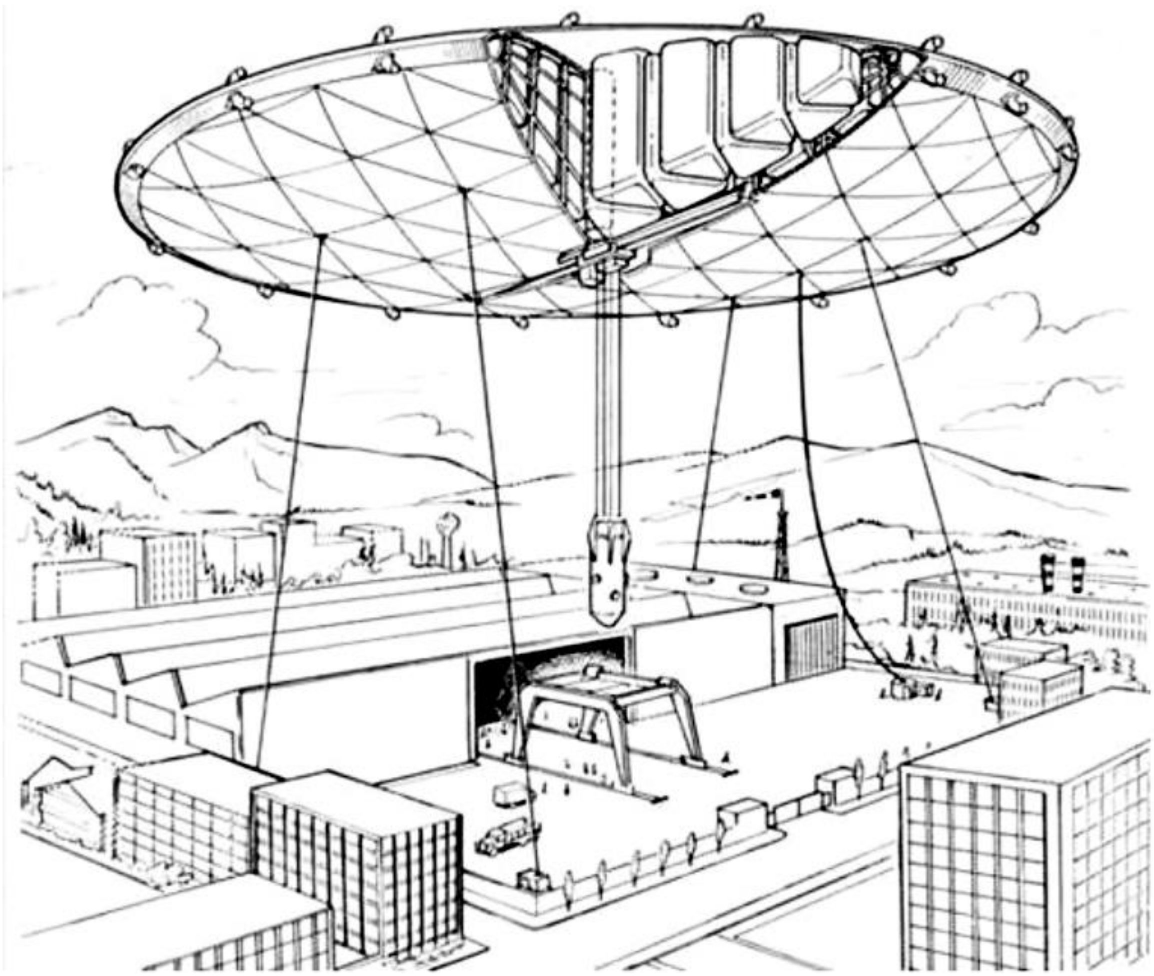
The giant Titan lenticular, heavy-lift, rigid airship design concept was the product of a 1973 – 1975 French study entitled, “Mass Transport Indivisible by Aerostatic Air Navigation Techniques,” which focused on low altitude “flying crane” airship transportation of very heavy unitary components, such as large vessels, transformers and other components for nuclear power plants.

The study was led by Pierre Balaskovic of the Space Technology Department of the C.N.R.S. (Scientific Research National Center). The Titan airship was an evolutionary development of Balaskovic’s Pégase (Pegasus) airship design concept and benefited from the prior aerodynamic studies of lenticular shapes for large airships. For Titan, the general structural design of Pégase was reinforced to handle payloads up to 500 metric tons (550 tons).



Titan general arrangement.
Source: Airship Technology, Khoury, Fig. 15.2

Titan was designed to fly at a low altitude while transporting a heavy unitary load and make an airborne load exchange while hovering and tethered at an altitude of 100 – 150 meters (328 – 492 ft) above the pickup and delivery sites. The lenticular shape made the airship insensitive to changes in wind direction while tethered and conducting a load exchange.

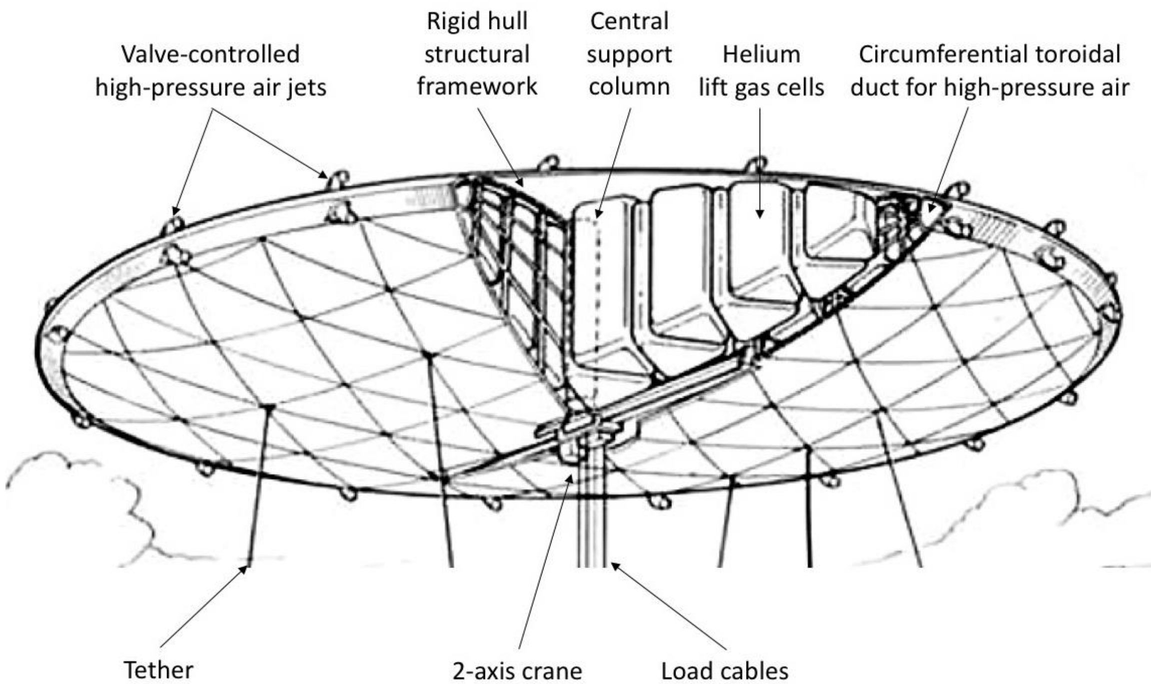


Titan tethered and picking up a reactor vessel at the factory with its 2-axis bridge crane. Source: LTA Solutions

Titan was powered by five Diesel engines with a total of 6,500 hp (4,847 kW). Edwin Mowforth described the operation of Titan's propulsion system as follows:

> "The 'live thrust' idea (from Pégase) was retained, this time using diesel-driven blowers to suck air in through a peripheral array of intakes and pressurize a circumferential toroidal duct; propulsion and control would be effected by allowing this air to escape through an appropriate selection of valve-controlled vents along the edge."

With "live thrust," the many peripheral air jets were expected to provide adequate flight control and rendered aerodynamic control surfaces unnecessary.



Titan cut-away diagram. Source: Adapted from LTA Solutions

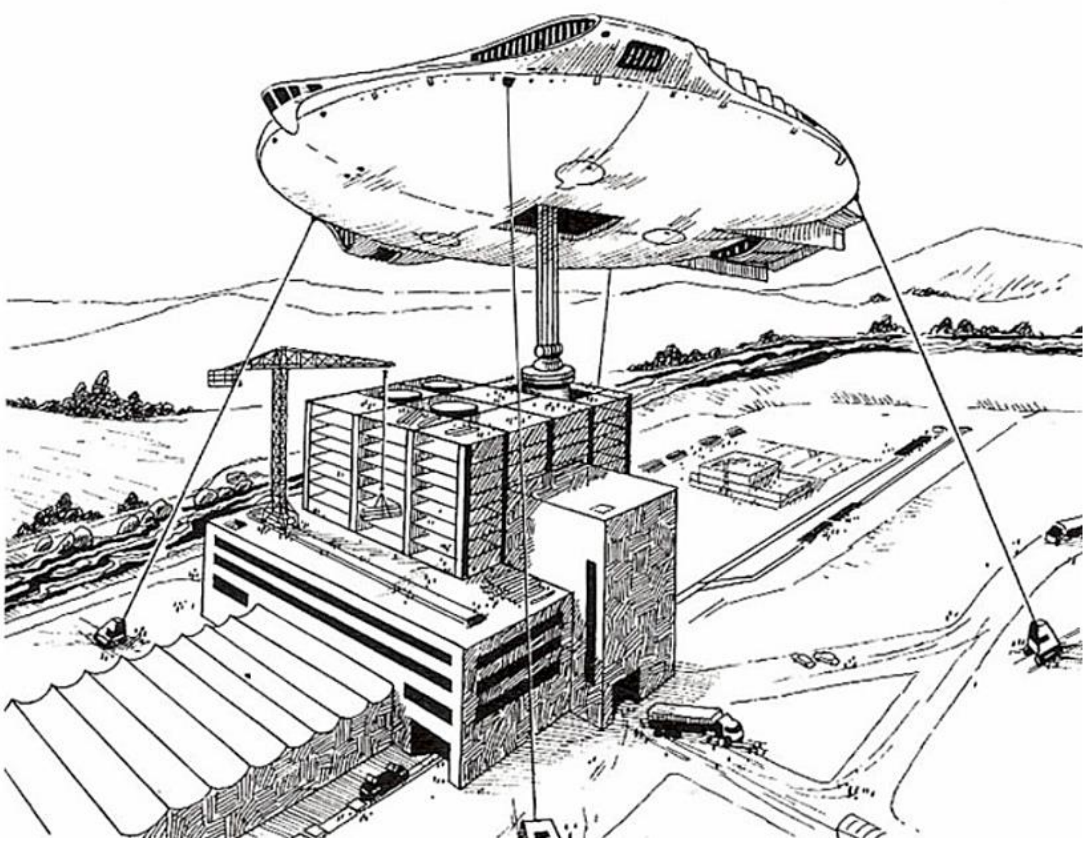
General characteristics of Titan

Parameter	Titan
Airship type	Hybrid, lenticular, rigid aircraft
Diameter	188 m (617 ft)
Height	54 m (177 ft)
Lift gas	Helium in 108 lift gas cells
Envelope volume	900,000 m^3 (31,783,200 ft^3)
Useful load	500 metric tons (550 tons)
Winch type	2-axis
Weight compensation	Water ballast
Propulsion system	5 x Diesel engines, 6,500 hp (4,847 kW) total
Speed, cruise	100 kph (62.1 mph)
Speed, maximum	120 kph (74.6 mph)
Hovering capability Altitude: Wind speed: Aerostat stabilization:	 100 to 150 m (328 – 492 ft) < 10 m/s (36 kph, 22.4 mph) x, y $\leq \pm$ 3 m (9.8 ft) z $\leq$ 0.5 m (1.6 ft)
Range	1,000 km (621 miles)
Endurance	10 hours

Source: "Les ballons du futur," Pierre Balaskovic & François Moizard (1983)

The airship was equipped with a computer-assisted piloting system and an automatic hover control system for use during load exchanges. In hover, the propulsion system is automatically controlled by measuring the tensions on the mooring cables. Precision delivery of the load is aided by the revolving bridge crane, the position of which is controlled by optical sensors (lasers installed at the installation point of the load). During the load exchange, water ballast is exchanged at the pickup and delivery sites.

Titan II was a larger version of the Titan heavy-lift airship design concept. Mowforth reports that it had a diameter of 235 meters (771 feet) and was capable of handling loads of up to 900 (990 tons) metric tons. The envelope volume was increased to 1,500,800 m^3 ($53,000,000\ ft^3$). The revised configuration of Balaskovic's Titan II design concept is shown in the following diagram.



Titan II tethered and delivering a 630 metric ton (693 ton) reactor vessel at a power plant under construction. Source: "Les ballons du futur," Pierre Balaskovic & François Moizard (1983)

Pierre Balaskovic's Titan lenticular flying crane airship design concepts were not developed into a working airship.

Atlas was a follow-on lenticular airship project led by C.N.R.S. with two primary goals: the progressive increase in the volume of the lifting gas envelope, and the development of a number of uses for the same basic airship. Like the Titan project, Atlas did not produce a working airship.

For more information

- William J. White, "Airships for the Future," p. 141, "Atlas," Sterling Publishing Co., Inc., New York, IBSN 0-8069-0090-3, 1976
- Pierre Balaskovic & François Moizard, "Les Ballons du Futur," ACE éditeur, 1983
- "Pierre Balaskovic - Balloons and Dirigibles" https://balaskovic.pagesperso-orange.fr/ballons-et-dirigeables.html
- "Le programme Titan," which is included in "Les ballons du futur," ACE éditeur, 1983, reproduced online here: http://jb.aeronef.pagesperso-orange.fr/images/titan.htm
- "Le projet: Titan," Aerall : http://aerall.org/Principaux-Projets-depuis1975.htm
- E. Mowforth, "An Introduction to the Airship," Third Edition, revised and updated, p. 115, ISBN: 0-9528578-6-3, The Airship Association, 2007
- Charles Luffman, "Lenticular Airships – An Exposition," Section 4.2, "Titan 1975," LTA Solutions, 7 May 2015 (amended): https://docplayer.net/64482432-Lta-solutions-a-lighter-than-air-aircraft-design-engineering-practice-page-1-of-16-lenticular-airships-an-exposition.html

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