Buoyant Aircraft Systems International (BASI) rigid airships

Peter Lobner, 29 July 2019

Background

BASI, founded in 2011 by Dr. Barry Prentice in Winnipeg, Manitoba, is developing designs for large, rigid cargo airships intended for year-round operation in the harsh environment of the Canadian Arctic.

The first prototype airship, built jointly by BASI and ISO Polar Airships, was the 25-meter (82 foot), single-pilot MB80 named “Giizhigo-Misameg”, which means "Sky Whale" in the Oji-Cree language. It was unveiled in December 2011. BASI had a research hangar and operated three prototype airships at the Winnipeg / St. Andrews airport. That hanger and the airships were destroyed in a windstorm in July 2016.

BASI has developed designs for two large rigid airships intended for civilian service in the Arctic: the 10-ton MB 310 and a larger 30-ton MB 560 airship.

1:100 scale model of the BASI airship. Source: BASI

In February 2018, BASI and Airships do Brazil signed a Memorandum of Understanding (MoU) under which the two companies will work together to develop a cargo airship industry in Canada and Brazil. Their near-term goal is to produce zeppelin-style rigid airships for their respective domestic markets, where vast areas of each country (about 70% of each country) do not have reliable access to road transportation or other modes of transportation. Dr. Prentice is reported to have commented, “Our problem is impenetrable areas that are cold and Arctic. (Brazil) has impenetrable areas that are hot and humid."

You’ll find the BASI website here: https://www.buoyantaircraft.ca

Business case of Canadian Arctic airships

The business case for an Arctic cargo airship is supported by BASI’s observation that, “The economic boundary of an airship increases with size. A transport airship of less than 50 tonne (50,000 kg; 110,200 lb) lift size has a market radius of about 400 kilometers (249 miles). Canada has scores of communities without road access that live within this distance of a road. Goods can be transshipped at the road ends and delivered more economically to resource camps and remote communities.” The business model for BASI airships is based on operating from one or more fixed end-of-the road “marshalling” sites and serving specific remote destinations that have established the needed ground facilities for these airships.

BASI also notes that, “Traditional ice roads are experiencing ever-shorter seasons of use. The construction of all-weather roads is extremely expensive. The terrain is rough, the permafrost unstable and numerous watercourses must be bridged.” In Arctic regions, the average cost of building gravel roads is about $3 million per kilometer. The annual cost for establishing and maintaining a seasonal ice road also is very high.

Dr. Prentice has suggested that commercial airships regularly operating in the Arctic also could be a cost-effective solution to Canada’s need for an emergency response capability in the region. He says, “Regular use of airships on scheduled services to mines and remote villages could be interrupted to carry emergence supplies from prepositioned locations to the site of a ship wreck or oil spill. In such arrangements, governments normally pay an annual stand-by to the aircraft operators that is much less than the cost of owning and operating equipment.”

General features of BASI airships

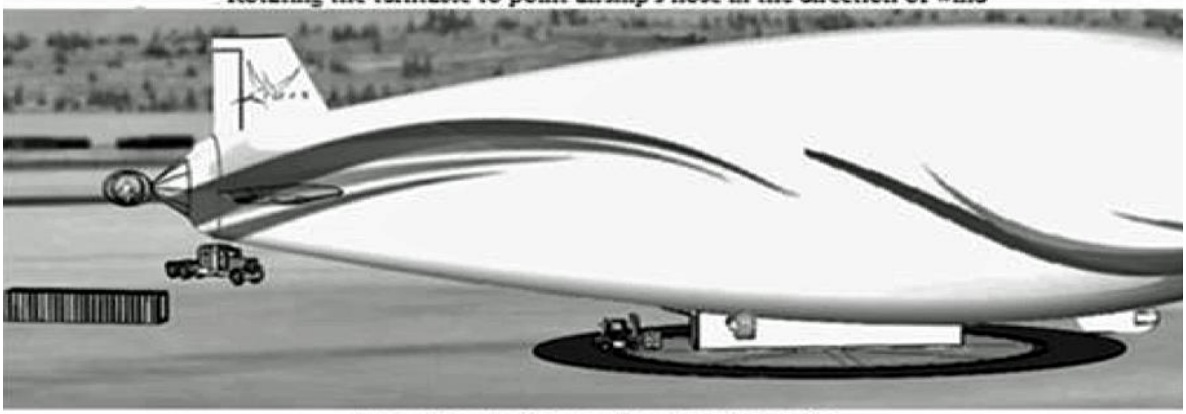
BASI airships are modern zeppelin-style, rigid airship with the following features:

- Rigid tubular airframe.
- All-metal hull.
- Large enclosed cargo bay under the gas envelope.
- Designed for operation in extreme environmental conditions (from Arctic conditions to tropical conditions).
- A hybrid-electric power system supplies electric motor driven vectorable thrusters for propulsion and maneuvering.
- Capable of vertical takeoff and landing (VTOL) operations and hovering.
- Designed to operate only from fixed bases and to land on a rotating turntable that can keep the airship pointed into the wind.
- The fixed-base operating concept enables some systems to be located on the ground rather than on the airship. For example:
    - Access to ground-power reduces the need for on-board electrical power during mooring and cargo load exchanges
    - Ground-handling equipment can be staged at the base, reducing the need for onboard cargo handling
    - A simple water-based ballasting system can be used, with water ballast available on the ground at each location to offset airship weight changes during load exchanges
- BASI airship are not intended to deliver cargo to sites without the required fixed-base landing system.
- BASI airships are not intended to deliver large suspended loads.
- The lifting gas cells are designed to hold either hydrogen or helium and are protected with a proprietary system of fire-resistant materials and a firewall.
    - Canadian, U.S. and European aviation regulations currently prohibit the use of flammable lifting gas.

The mooring and load exchange process for a BASI airship is shown in the following sequence of drawings that start with the airship being winched down to a landing pad with a rotating turntable. This system is known as a Terminal Support System Buoyant Aircraft Rotating Terminal, (BART), which includes a loading dock for trucks, ballast water, fuel and forklift trucks. BART is intended to limit ground handling time to one hour or less with a small ground crew. BASI estimates that a BART turntable installation costs about $2 million.

Mooring the airship MB 310 using winches

Rotating the turntable to point airship's nose in the direction of wind



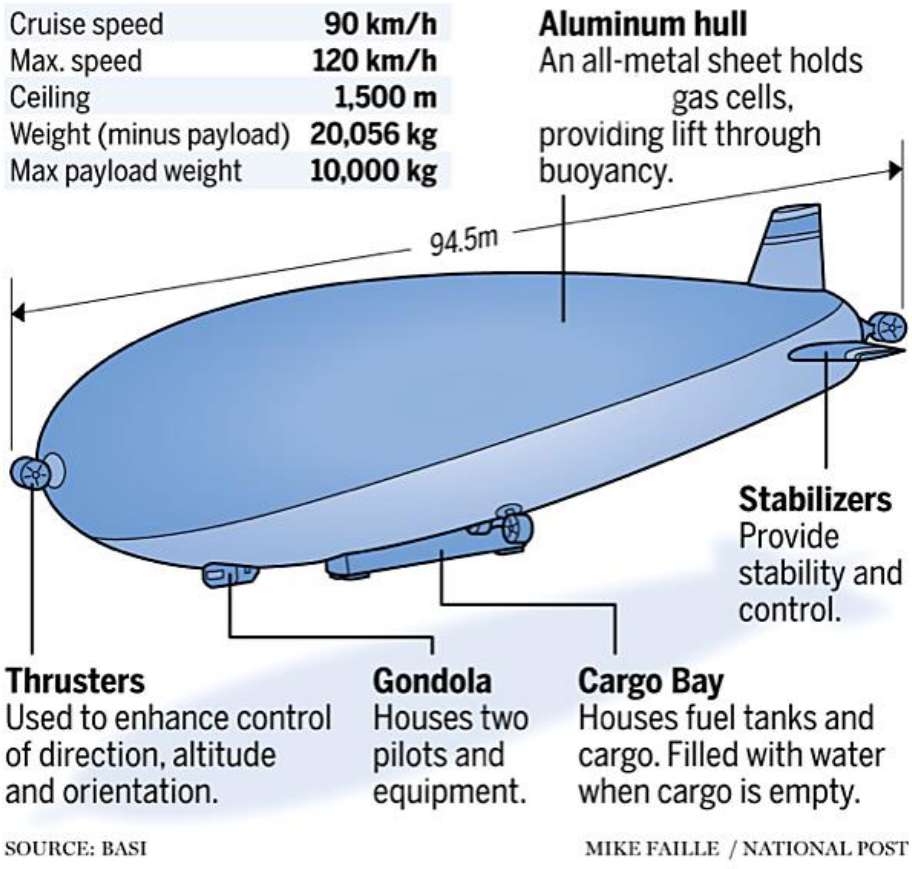
Unloading the Cargo using a forklift trailer

Source: Dr. Barry E. Prentice, "Airships: An idea whose time has come", University of Manitoba, 2016

BASI's two large, rigid airships, the 10-ton MB 310 and a larger 30-ton MB 560, are described in the following sections. Under their business arrangement with Airships do Brazil, the first joint airship, to be named the ADB 3-15, will be designed to carry a cargo of 15 metric tons (16.5 short tons). This joint airship is not addressed here.

The BASI 10-ton MB 310 airship

The 10-ton MB 310 airship design preceded BASI's current 30-ton MB 560 airship design. Many design features of the original MB 310 are similar to the MB 560 airship, which has been the recent focus of BASI's design efforts because the 30-ton cargo capacity is a better match to the operational needs of customers in the North. The current design of BASI's 10-ton airship has adopted the same constant diameter envelope shape as the MB 560, which will simplify manufacturing and airship control.



BASI 10-ton MB 310 airship concept general arrangement.
Source: Adapted from BASI / National Post

Rendering of the MB 310 airship on a BART at a remote Arctic site. Source: BASI.

Rear quarter view of an MB 310 airship showing the gondola and cargo bay along the bottom of the gas envelope. Source: BASI.

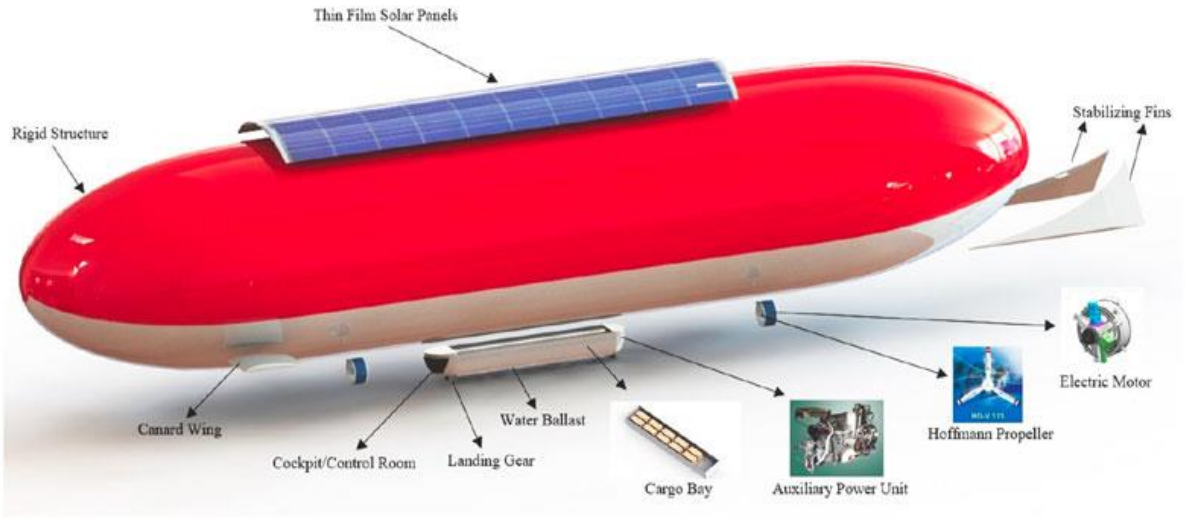
The BASI 30-ton MB 560 airship

Rendering of the BASI 30-ton MB 560 airship on a BART at a remote Arctic site. Source: BASI.

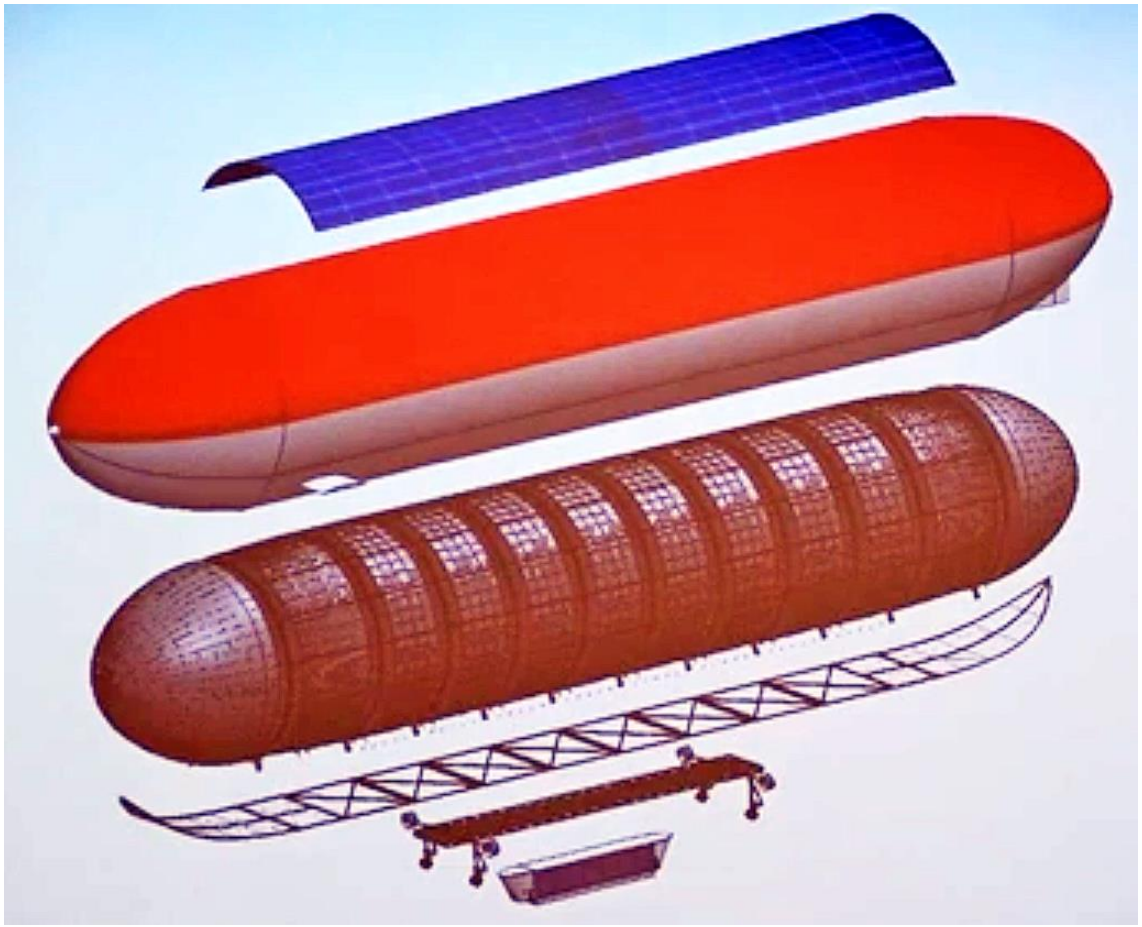
Basic technical parameters of the 30-ton airship are summarized below.

- Crew: pilot & co-pilot or unmanned
- Dimensions: L 560 ft, W 100 ft, H 90 ft (171 x 30 x 27 m)
- Gas envelope volume: 2.2 million cubic feet (62,297 cubic meters)
- Freight capacity: 30 short tons (60,000 lb, 27,216 kg)
- Electric power source: initially 2 x Pratt & Whitney PT-6 auxiliary power units
- Propulsion: 4 x 390 kW electrically-powered vectorable thrusters mounted under the gas envelope (range is 180 degrees, from full up to full down)
- Speed: 80 knots cruise; 100 knots maximum
- Range: typical 800 miles (1,287 km); max. 1,200 miles (1,931 km)
- Endurance: 10 hours
- Flying altitude: maximum 5,000 ft (1,524 meters)

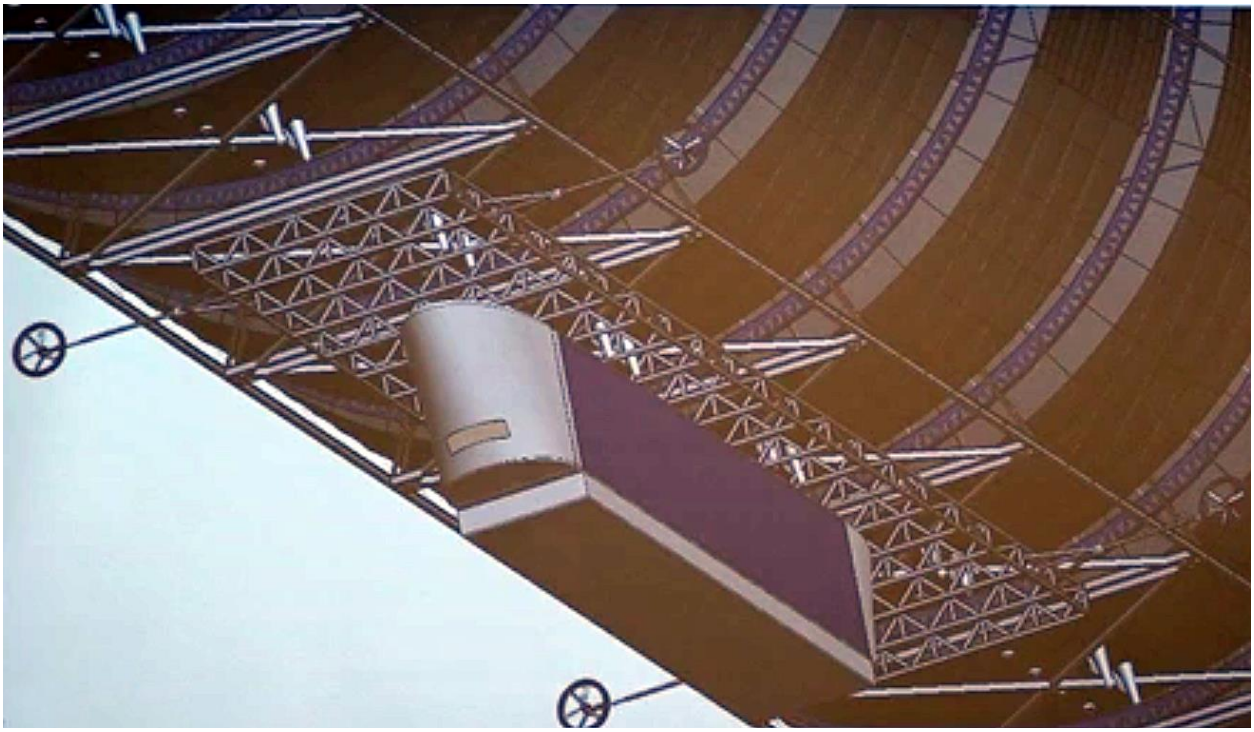
A hybrid-electric prolusion system is used to power the airship. Initially, gas turbine generators (Pratt & Whitney PT-6 aircraft auxiliary power units) will be employed, but the plan is to eventually shift to hydrogen fuel and thin-film solar panels in order to eliminate carbon emissions.



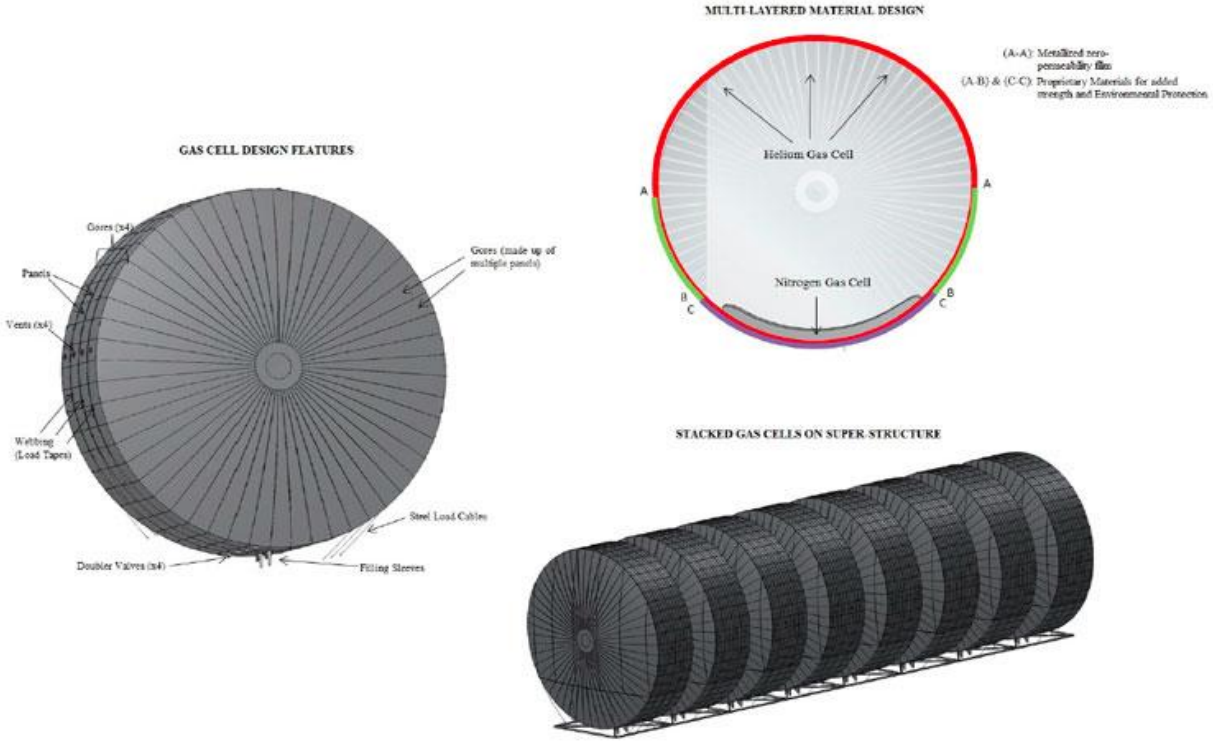
Basic design features of the BASI 30-ton MB 560 cargo airship.
Source: BASI



Exploded view of the BASI 30-ton MB 560 cargo airship.
Source: BASI

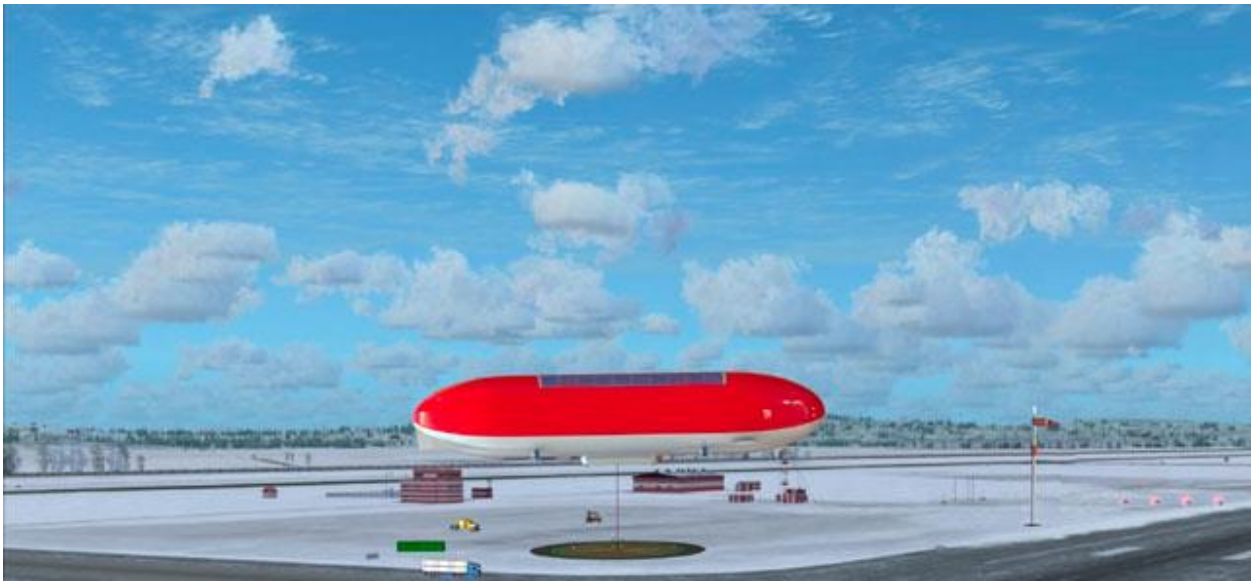


Arrangement of the gondola, including the cargo bay, and the load-bearing structure under the lifting gas cells. Source: BASI



Low-permeability lifting gas cells, designed for helium or hydrogen. Source: BASI

Rendering of a BASI 30-ton MB 560 cargo airship in flight. The enclosed cargo bay is located under the center section of the gas envelope. Source: BASI



Rendering of a BASI 30-ton MB 560 cargo airship being winched down to the landing pad on a Terminal Support System Buoyant Aircraft Rotating Terminal (BART). Source: BASI