

DARPA Project WALRUS

Peter Lobner, updated 16 June 2023

1. Before Project WALRUS (2001 – 2003)

The Joint Chiefs of Staff (J-4 Mobility Division) began an investigation into the military utility of hybrid airships in 2001. In June 2002, J-4 engaged Naval Air Systems Command (NAVAIR) to support this effort. In response, NAVAIR formed their Advanced Development Program Office (ADPO) – Airship Concepts, which directly supported J-4 and led the Navy’s Hybrid Ultra Large Airship (HULA) program.

2. The origin of Project WALRUS (2003 – 2005)

HULA program leadership was transferred to the Defense Advanced Research Projects Agency (DARPA) in mid-2003, where it became known as the WALRUS Global Reach Air Vehicle Program, or simply Project WALRUS. DARPA convened an industry day in March 2004 to discuss its proposed WALRUS hybrid heavy-lift airship program with interested industry teams.

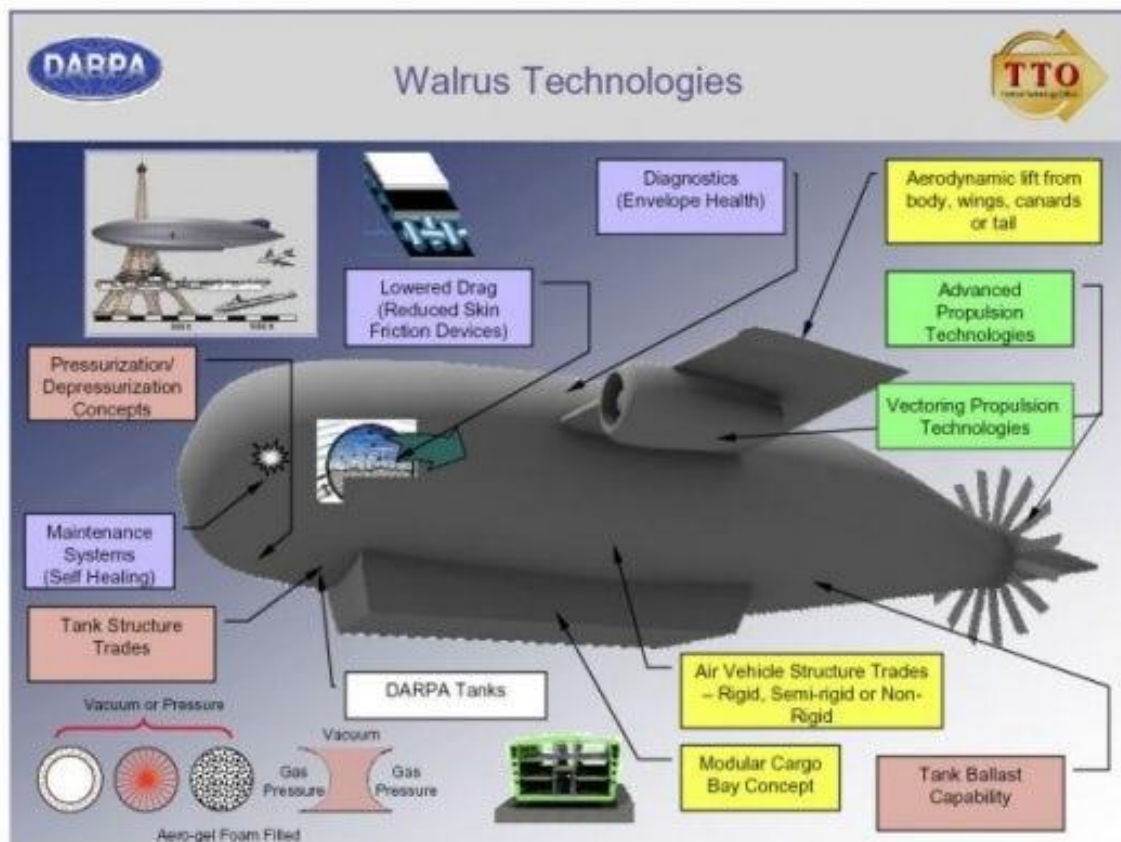
Project WALRUS sought to develop new technologies and design concepts for a strategic, heavy-lift, hybrid (semi-buoyant) cargo airship. The goal was to develop a design for an Operational Vehicle (OV) capable of carrying a 500 – 1,000 ton (454 – 907 metric ton) payload 12,000 miles (19,312 km) and delivering an Army fighting unit directly “from fort to fight.”



DARPA acknowledged that some assembly of cargo items may be required at the landing site, but that would be minimized. It was expected that a fighting unit could be fully operational within six hours after landing.

Among the advanced airship technologies of interest to DARPA were:

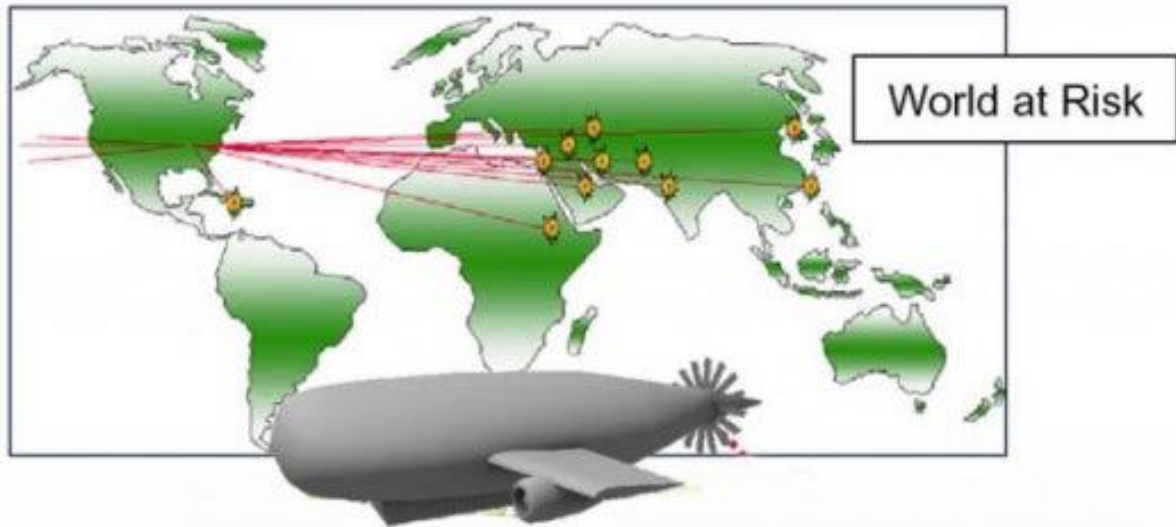
- Advanced materials for airship structures and envelopes.
- Drag reduction.
- Semi-buoyant hybrid airships that generate the necessary lift from the combined effects of aerostatic lift from helium, vectored thrust from propulsion systems, and aerodynamic lift from wings and fuselage during forward flight.
- Innovative lift and buoyancy control concepts that did not rely on off-board ballast, other than ambient air. Here the goal was to be able to discharge heavy loads at a remote landing site without having to take on compensating ballast in order to maintain control of the unloaded airship.
- Operate without significant ground infrastructure.
- Land in unimproved sites with rough ground and obstacles up to five feet tall (i.e., bushes, boulders).
- Electrostatic atmospheric ion propulsion.



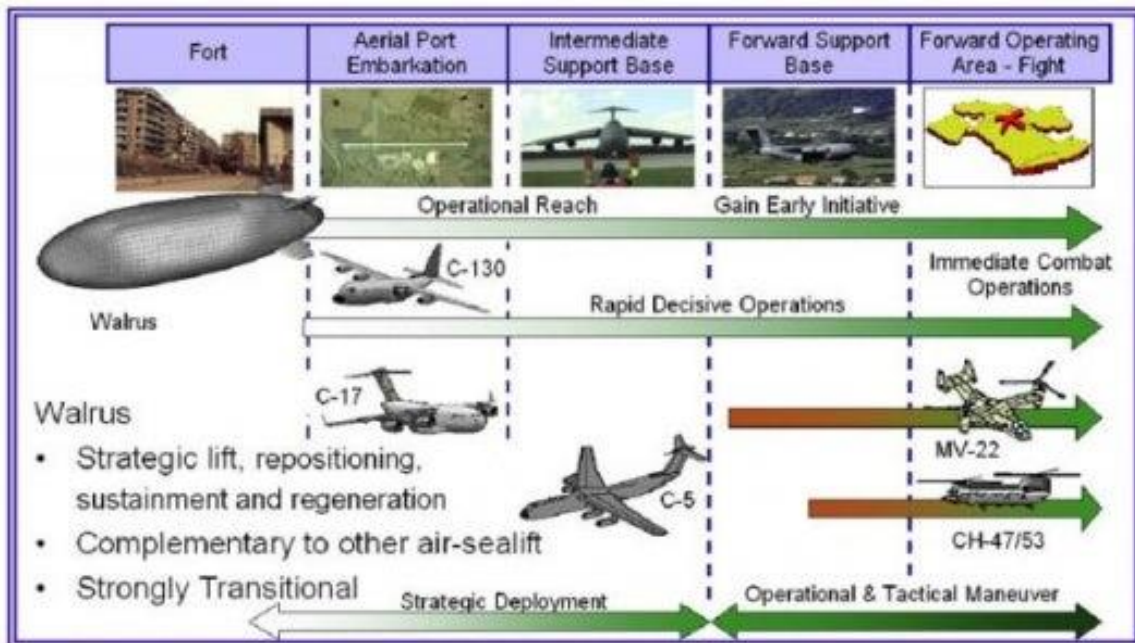
WALRUS technologies of interest. Source: DARPA

While the WALRUS OV initially was being developed for strategic airlift, it was expected to be adaptable for other missions, such as:

- Theater (shorter range) airlift
- Sea-based airlift
- Long-duration intelligence and communications missions

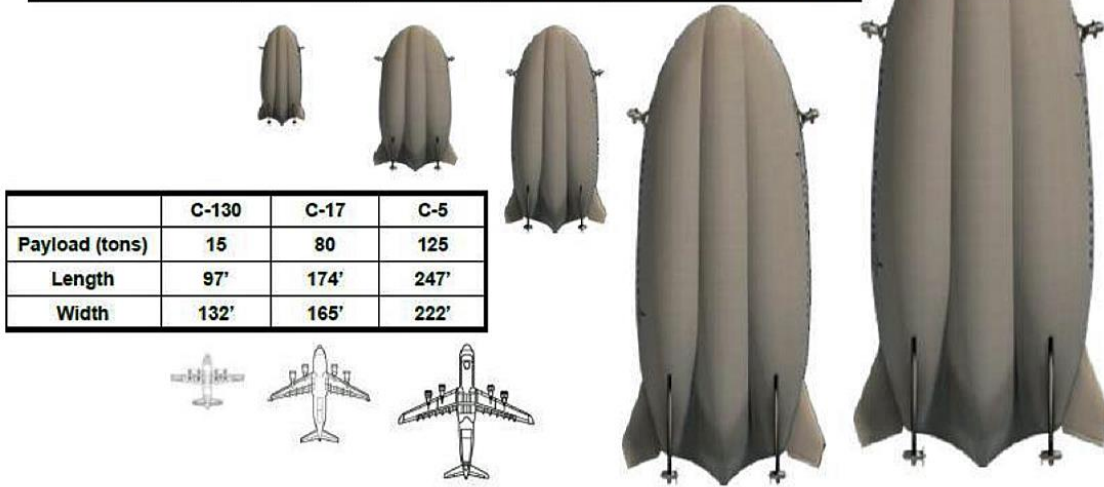


WALRUS “fort to fight” deployment capability. Source: DARPA

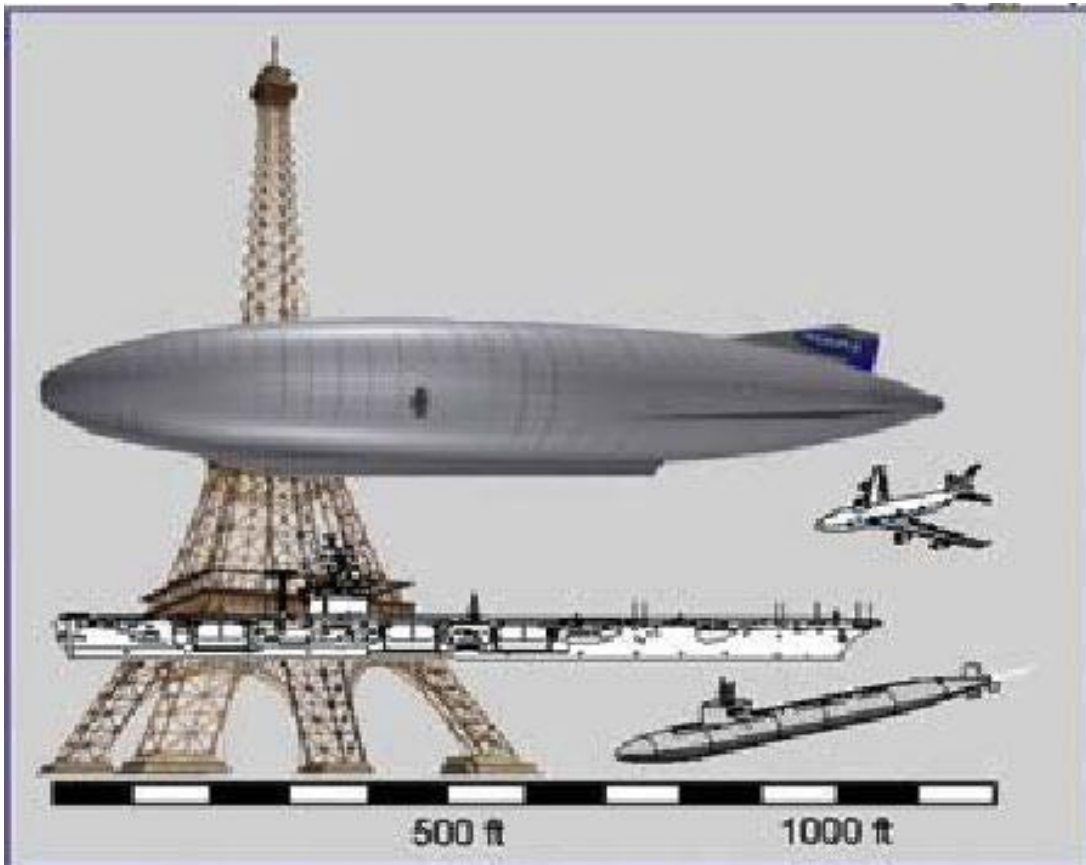


WALRUS integration with other military airlift capabilities. Source: DARPA

Hull Volume (cu ft)	185,000	1,000,000	3,000,000	35,000,000	67,000,000
Payload (tons)	2	15	50	500	1000
Length	180'	250'	370'	830'	1,000'
Width	75'	150'	185'	365'	450'



Relative scale of hybrid airships (similar to an ATG SkyCat) and USAF cargo aircraft sized for various load capacities. Source: DoD (2012)



Relative scale of a 1,000 ton hybrid airship, an aircraft carrier, a submarine, the Eiffel Tower and a Boeing 747. Source: DARPA

Here are some concepts drawings of Project WALRUS airships.



Source: <http://www.combatreform.org/>



Millennium Airship's WALRUS hybrid heavy lift airship concept.
Source: Millennium Airship, Inc. via DARPA



*Aeros WALRUS variable buoyancy heavy lift airship concept.
Source: Aeros via DARPA*



*Aeros WALRUS variable buoyancy heavy lift airship concept.
Source: Aeros*



*Lockheed Martin hybrid heavy lift airship concept.
Source: Lockheed Martin via RN3DB blog (5 Aug 2013)*

Project WALRUS would have allowed the Army to implement a "10-30-30" doctrine, in which Army units could be deployed to a distant theater within 10 days, with the goal of defeating an enemy within 30 days, and then being ready for a follow-on deployment within another 30 days. The WALRUS program was intended to support this strategy, while delivering operational and maintenance cost savings relative to using conventional aircraft.

DARPA acknowledged that WALRUS airships could only be used in areas where the Air Force already had established air superiority and in which all ground based air defenses had been suppressed. In addition, around-the-clock operation (24/7) irrespective of weather conditions could not be assured.

3. Project WALRUS Phase 1 (2005 – 2006)

In mid-2005, DARPA launched a 12-month Phase 1 study with the award of contracts to Lockheed Martin's Advanced Development Programs (the Skunk Works) in Palmdale, CA (\$2,989,799) and

Aeros Aeronautical Systems in Tarzana, CA (\$3,267,000). Other WALRUS competitors, Millennium Airship, Inc. / SkyFreighter and Advanced Technologies Group (ATG) / SkyCat, were not offered Phase 1 contracts.

Phase 1 work focused on trade studies to identify the most promising OV design options and associated technical risks. A technology development plan for risk reduction also was required. Both companies developed prototypes for their proposed designs.

Lockheed Martin P-791

The P-791 was a 120 foot (36.6 meter) long, tri-lobe, semi-buoyant, manned hybrid airship. It was designed and integrated at Lockheed Martin's Skunk Works in Palmdale, CA. The non-rigid gas envelope was manufactured by TCOM.

Initially, work on the P-791 was funded internally by Lockheed Martin to serve as a sub-scale demonstrator to validate technologies for future heavy-lift hybrid airships. At the time of the DARPA Phase 1 award in mid-2005, work on the P-791 hybrid airship already was in progress.

The first flight of the P-791 took place on 31 January 2006. *Airship* magazine reported that the P-791 flew six times. Lockheed Martin and DARPA reported that all flight test objectives were met.



Lockheed Martin P-791, 2006. Source: Lockheed Martin

Aeros Sky Dragon & Dragon Dream

Under the Phase 1 DARPA contract, Aeros successfully demonstrated the operation of their “Control of Static Heaviness” (COSH) variable buoyancy system in a ground-based test rig in 2006. Project WALRUS was terminated in mid-2006, before a flight test of the Aeros COSH system could be conducted.

Under a follow-on DARPA contract issued in October 2007 (after WALRUS termination), Aeros modified an Aeros 40D *Sky Dragon* blimp by installing two inflatable collars that were controlled by an on-board, flight-weight, prototype COSH system. On 17 July 2008, Aeros announced that a successful flight test of the modified Aeros 40D validated the operational performance of COSH. Aeros CEO Igor Pasternak explained, “We want to demonstrate we can change the static heaviness enough in a short time to be operationally acceptable.”



Modified Aeros 40D Sky Dragon demonstrated COSH. Sources: Aeros,



*Modified Aeros 40D Sky Dragon in flight.
Source: screenshot from Aeros video.*

Under subsequent contracts known as Buoyancy Assisted Lift Vehicle (BAAV) Rigid Aerostructure Technology Demonstration (2008) and Project Pelican (2011), Aeros completed the *Dragon Dream* COSH prototype airship, which was float tested and flight tested in 2013. DoD and NASA declared Project Pelican complete on 21 August 2013, seven years after the end of Project WALRUS.



Dragon Dream demonstrated COSH in 2013. Source: Aeros

4. Project WALRUS terminated (2006)

Project WALRUS was terminated in mid-2006, after completion of Phase I. DARPA reduced FY2006 funding and the agency's FY2007 budget request called for "termination of the WALRUS effort." Congress obliged by not funding the effort in FY2007.

WALRUS Phase II, which was cancelled, was conceived as a three-year program to be performed by one contractor down-selected from Phase I. Phase II was to focus on design refinement, technology development, risk reduction demonstrations of components and systems, and flight testing an Advanced Technology Demonstration (ATD) scaled airship with a payload comparable to a C-130 Hercules fixed-wing cargo airplane (about 30 tons / 27.2 metric tons).

If WALRUS Phase II had been funded, the ATD airship would have been scheduled to fly within three years, before the end of FY2009 (by the end of September 2009).

5. Project WALRUS legacy

In spite of being cancelled early, Project WALRUS was important because of its contributions to the development of large hybrid airship and variable buoyancy airship technologies and practical airship designs. Project WALRUS also generally raised industry interest in the capabilities and potential roles for large modern airships.



After the termination of WALRUS, the Navy's interest in lighter-than-air craft, including heavy lift hybrid airships, continued under the auspices of the NAVAIR Advanced Development Program Office (ADPO), Airship Concepts, which was formed in June 2002. More information is in a separate article on the Navy's HULA program.

6. For more information

- Jefferson Morris, “DARPA likely to take over heavy-lift airship project,” Aviation Week / AerospaceDaily (subscription required), 30 May 2003: <https://aviationweek.com/darpa-likely-take-over-heavy-lift-hybrid-airship-project>
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- “Contract awards for Walrus program,” FlightGlobal, 29 August 2005: <https://www.flightglobal.com/contract-awards-for-walrus-programme/62479.article>
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- “WALRUS Hunted to Extinction By Congress, DARPA?,” Defense Industry Daily, 4 April 2006: <https://www.defenseindustrydaily.com/walrus-hunted-to-extinction-by-congress-darpa-02102/>
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- Max Eddy, “DARPA’s New ‘Pelican’ Promises High-Tech Airship,” The Mary Sue, 9 May 2011: <https://www.themarysue.com/darpa-airship-pelican/>
- “Walrus/HULA Heavy-Lift Blimps Rise, Fall... Rise?” Defense Industry Daily, 18 September 2013: <https://www.defenseindustrydaily.com/walrus-heavylift-blimp-getting-off-the-ground-01103/>

Other Modern Airships articles

- *Modern Airships - Part 1:* <https://lynceans.org/all-posts/modern-airships-part-1/>
 - Aeros - *Dragon Dream*
 - ATG - *SkyCat & SkyKitten*
 - Lockheed Martin - P791
 - Navy - Hybrid Ultra Large Aircraft - HULA
- *Modern Airships - Part 2:* <https://lynceans.org/all-posts/modern-airships-part-2/>
 - Millennium Airship - *SkyFreighter*
- *Modern Airships - Part 3:* <https://lynceans.org/all-posts/modern-airships-part-3/>