SkyHook International & Boeing JLH-40 / HLV helistat

Peter Lobner, Updated 24 August 2021

1. Introduction

SkyHook International Inc. was a privately held firm founded by Peter Jess in Calgary, Alberta, Canada. Their primary business was in providing logistics support in remote Arctic regions. SkyHook International conceived and patented the helistat design that became the SkyHook JHL-40 heavy lift vehicle (HLV), which was later known simply as the Skyhook HLV. Cargo was carried as an external sling load.

A helistat is an airship / helicopter hybrid in which the airship part of the hybrid aircraft carries most or all of the empty weight of the aircraft itself and helicopter rotors deployed in some fashion around the airship work in concert to lift and propel the fully loaded aircraft without the need for an exchange of ballast during load transactions (pickups or deliveries).

2. The business case for the SkyHook JLH-40 / HLV

The target market for the SkyHook JHL-40 / HLV included oil, gas and mine operators, timber operators, construction contractors, governments and the military, particularly those working in remote Arctic regions. Designed specifically for this challenging environment, Boeing and Skyhook International claimed their aircraft could safely transport more than 40 metric tons, over 200 miles, at -30°C, in zero visibility and 25 knot winds. The Skyhook JHL-40 / HLV was designed to carry more than twice the payload of any existing helicopter at half the helicopter price per ton.

The business case for a SkyHook JHL-40 / HLV operating in the high-North was strengthened by the avoided cost and environmental benefits of not building roads or rails for ground transportation into sensitive Arctic regions.

SkyHook International projected a near-term market for 50 to 60 SkyHook JHL-40 / HLV helistats.

3. Skyhook International Improved Hybrid Lift Air Vehicle patent

The primary patent addressing the design of the SkyHook JHL-40 / HLV is WIPO International Publication Number WO 2009/152604 A1; “Improved Hybrid Lift Air Vehicle,” which was filed on 21 May 2009 and was published 23 December 2009. The inventors were Peter Jess and Ken Laubsch, and the applicant was SkyHook HLV International Inc., Alberta, Canada. You can read this patent here: https://patentimages.storage.googleapis.com/48/ac/66/c0375cae5e7db2/WO2009152604A1.pdf

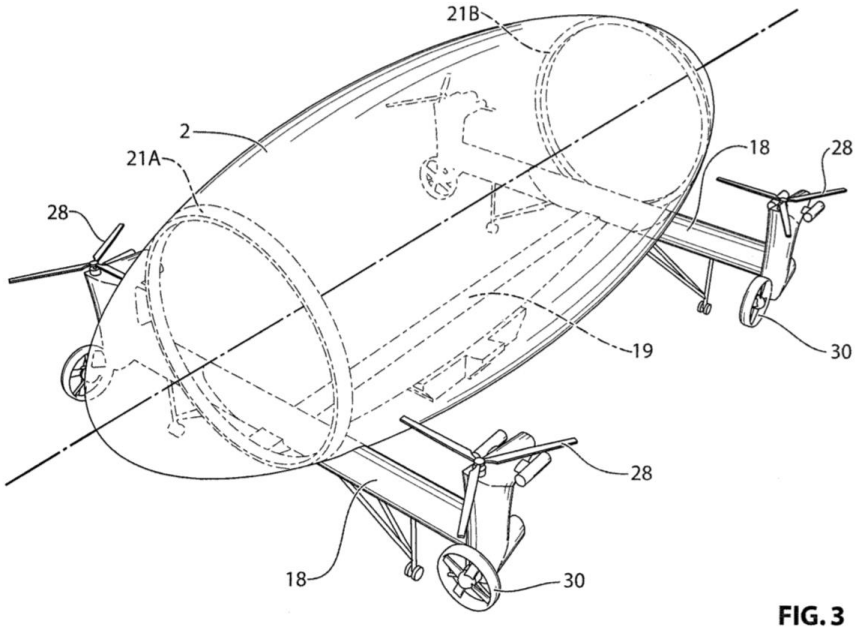


FIG. 3

The hybrid lift air vehicle described in the patent and shown in patent Figure 3, above, is very close to the original design of the SkyHook JHL-40 / HLV. The semi-rigid air vehicle is comprised of a lifting gas envelope (2) that generates enough aerostatic lift to compensate for the empty weight of the aircraft, variable thrust helicopter rotors (28) that provide the vertical thrust needed to lift the attached payload, variable thrust lateral thrusters (30) that provide thrust for propulsion and maneuvering, and rigid frames (18) that connect the engines with the keel (19), which carries the connected load (12). The keel hoops (21A, 21B) attached to the keel provide structural integrity for the gas envelope and transfer loads from the keel into the envelope. More keel hoops could be added to improve load distribution into the envelope.

As described in the patent, "…two diagonally opposite lateral thrusters (30) are independently controllable and oriented to provide forward and reverse directed thrust, and the other two diagonally opposite lateral thrusters (30) are independently controllable and oriented to provide sideways thrust so that the air vehicle can be readily maneuvered as needed." The different orientations of the lateral thrusters is evident in patent figure 1, below.

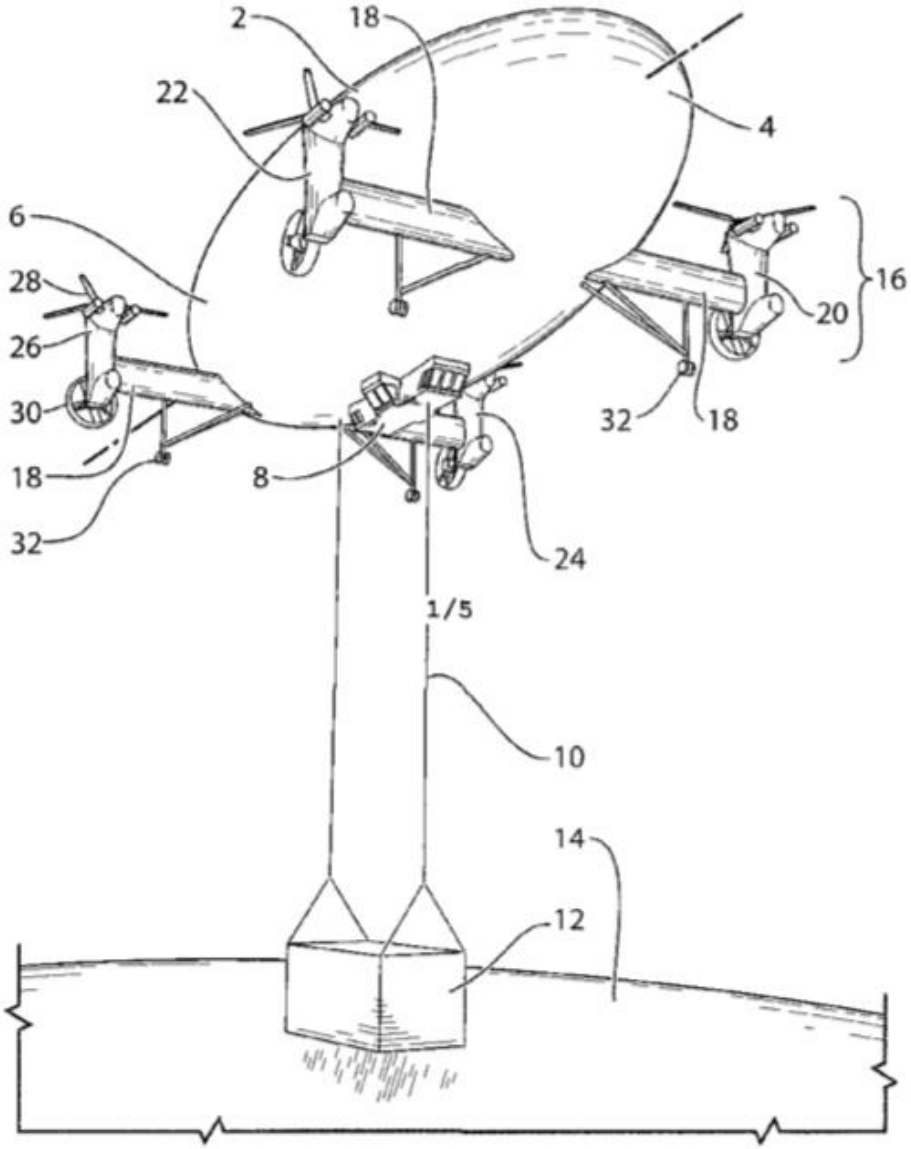


FIG. 1

The crew is accommodated in the gondola (8) located under the gas envelope (2), along with the controls for maneuvering and operating the air vehicle, and controls for lifting and lowering loads.

4. The original SkyHook JHL-40 design and schedule (2008)

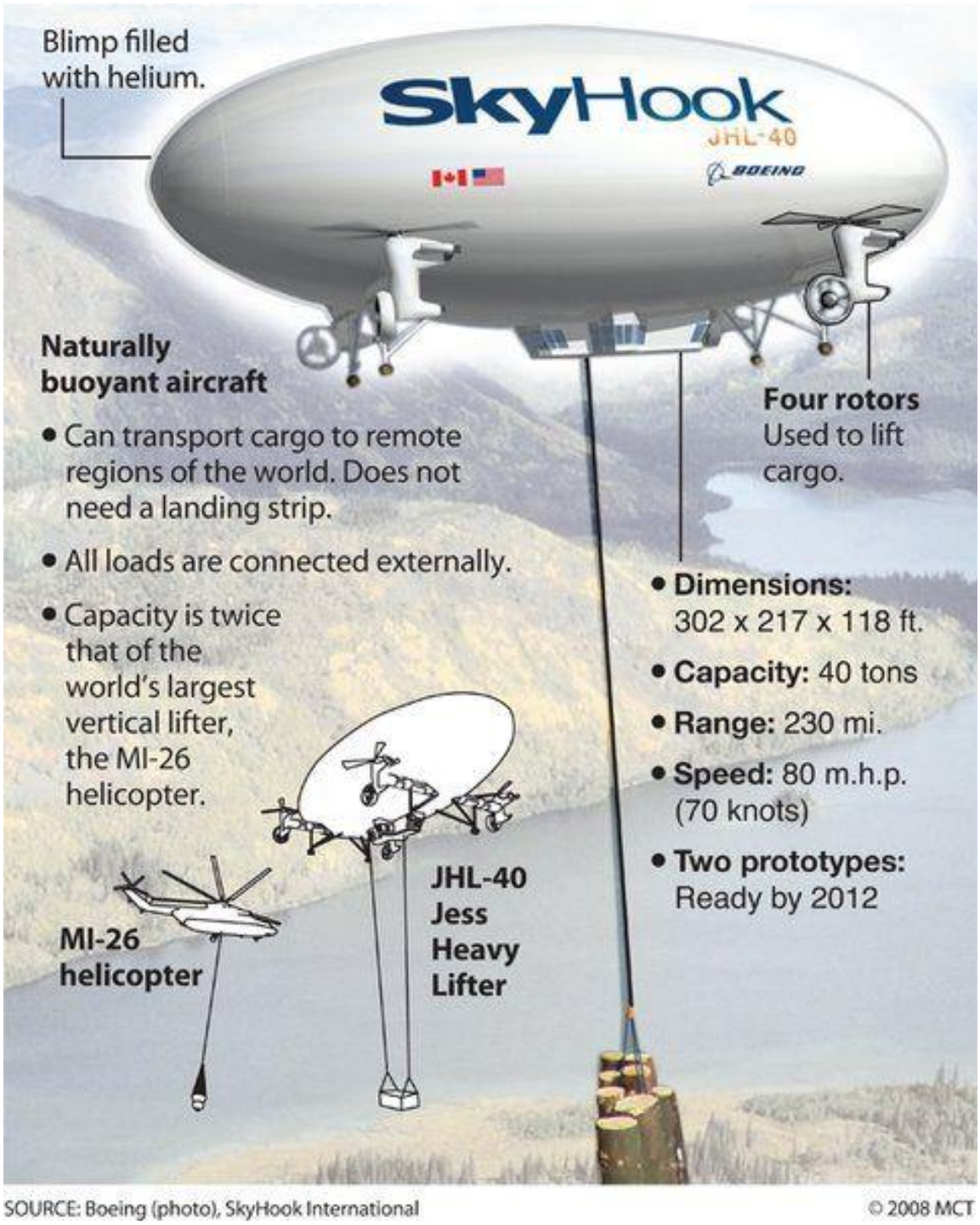
The SkyHook JLH-40 (JHL = “Jess Heavy Lifter” and 40 = 40 metric ton / 88,000 lb payload) is the commercial incarnation of the patented heavy lift helistat described in WIPO International Publication Number WO 2009/152604 Al.

SkyHook International approached Boeing Advanced Rotorcraft Systems with a proposal for the two firms to develop and build the JHL-40. Boeing completed their own feasibility study for SkyHook in 2007, and in July 2008, Pat Donnelly, director of Advanced Rotorcraft Systems, announced that Boeing would team with SkyHook International to build the SkyHook JHL-40.

Under their business agreement, privately owned SkyHook International would fund Boeing's engineering and development work and would own, operate, maintain and service all airships produced. Initially, Boeing was to build two prototypes by 2012 at its factory in Ridley Park, PA. When the airship was certified and entered production, Skyhook International planned to establish an operating entity offering heavy lift services to the oil and gas, forestry, mining and construction industries.

Development work actually began in March 2008 and originally was scheduled to take 59 months (thru Feb. 2013), with a commitment to build the first JHL-40 being made at around the 45-month mark (by Dec. 2011). The JHL-40 was to be certified by Transport Canada and the U.S. Federal Aviation Administration.

The SkyHook helium-filled gas envelope was sized to generate the aerostatic lift needed to make the fully-fueled airframe neutrally buoyant. The four fixed rotors were based on Boeing’s CH-47 Chinook helicopter rotor system design and would generate the vertical dynamic lift needed to lift the 40 metric ton payload. The turbo-shaft engine for each rotor may be different than the Honeywell T55 used in the Chinook helicopter. The rotors only lift the payload. In an emergency, the payload can be jettisoned, quickly restoring lighter-than-air (LTA) flight characteristics. The lateral thrusters provide cruise propulsion and precise lateral positioning during a load exchange.



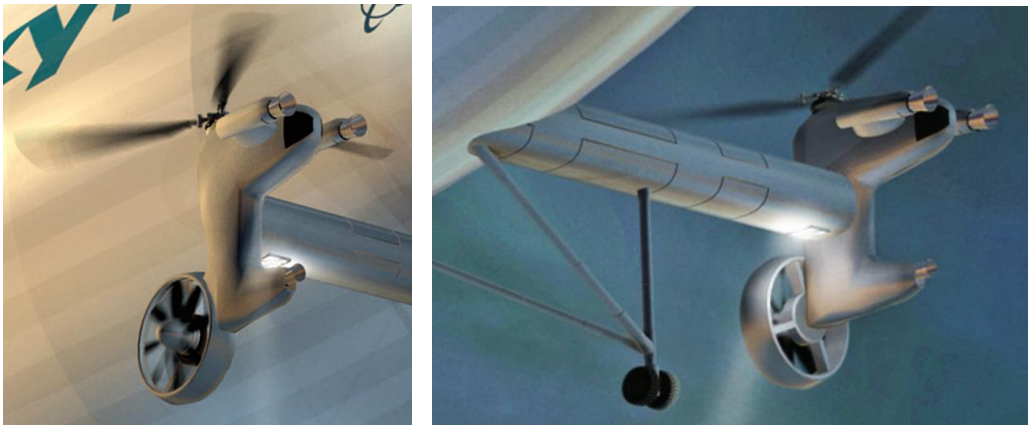
The SkyHook JHL-40 airframe was 302 feet (92 m) long, slightly shorter than the 1980s-vintage Piasecki PA-97-34J. The SkyHook originally was designed to carry an external sling load of 40 metric tons (88,000 lb) at a speed of 70 knots over a range of 230 miles

(370 km) without refueling. Without cargo, the SkyHook was expected to have a ferry range of 800 miles (1,287 km). It was designed to operate in Arctic conditions, at -30° C, in zero visibility and 25 knot winds.

Load exchange was accomplished with the SkyHook hovering precisely over its destination with the coordinated rotor system managing the increase in lift needed during load pickup and the decrease in lift needed during load delivery. No exchange of ballast was needed during a load exchange. The lateral thrusters maintained the airship's precise geo-positioning during load handling.

Rendering of the SkyHook JHL-40 making a load exchange.
Source: Boeing / SkyHook International, circa 2008

Renderings of the SkyHook JHL-40 in flight.
Source, both graphics: Boeing / SkyHook International, circa 2008

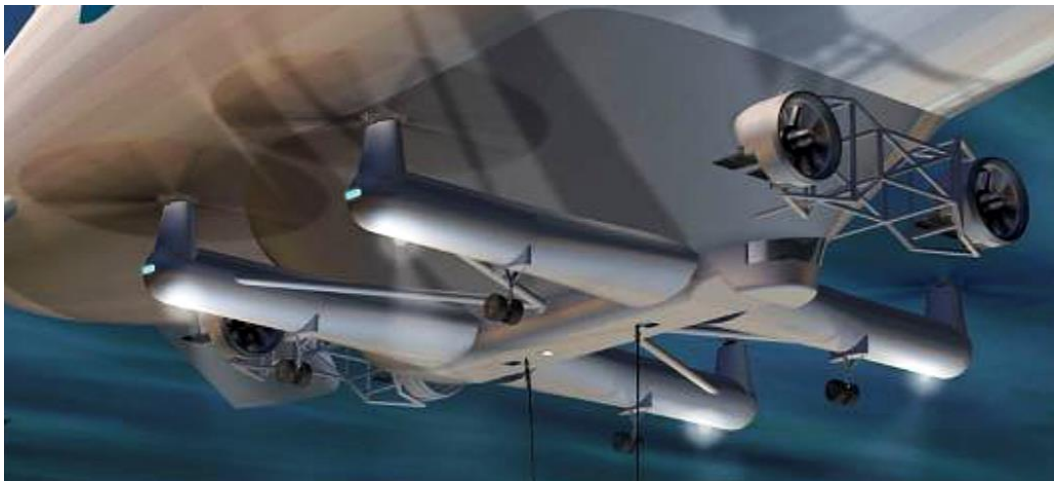


Original SkyHook JHL-40 rotor and lateral thruster arrangement. Source: Boeing / Skyhook International, circa 2008.

5. Updated SkyHook HLV configurations 3E & 3F (2009)

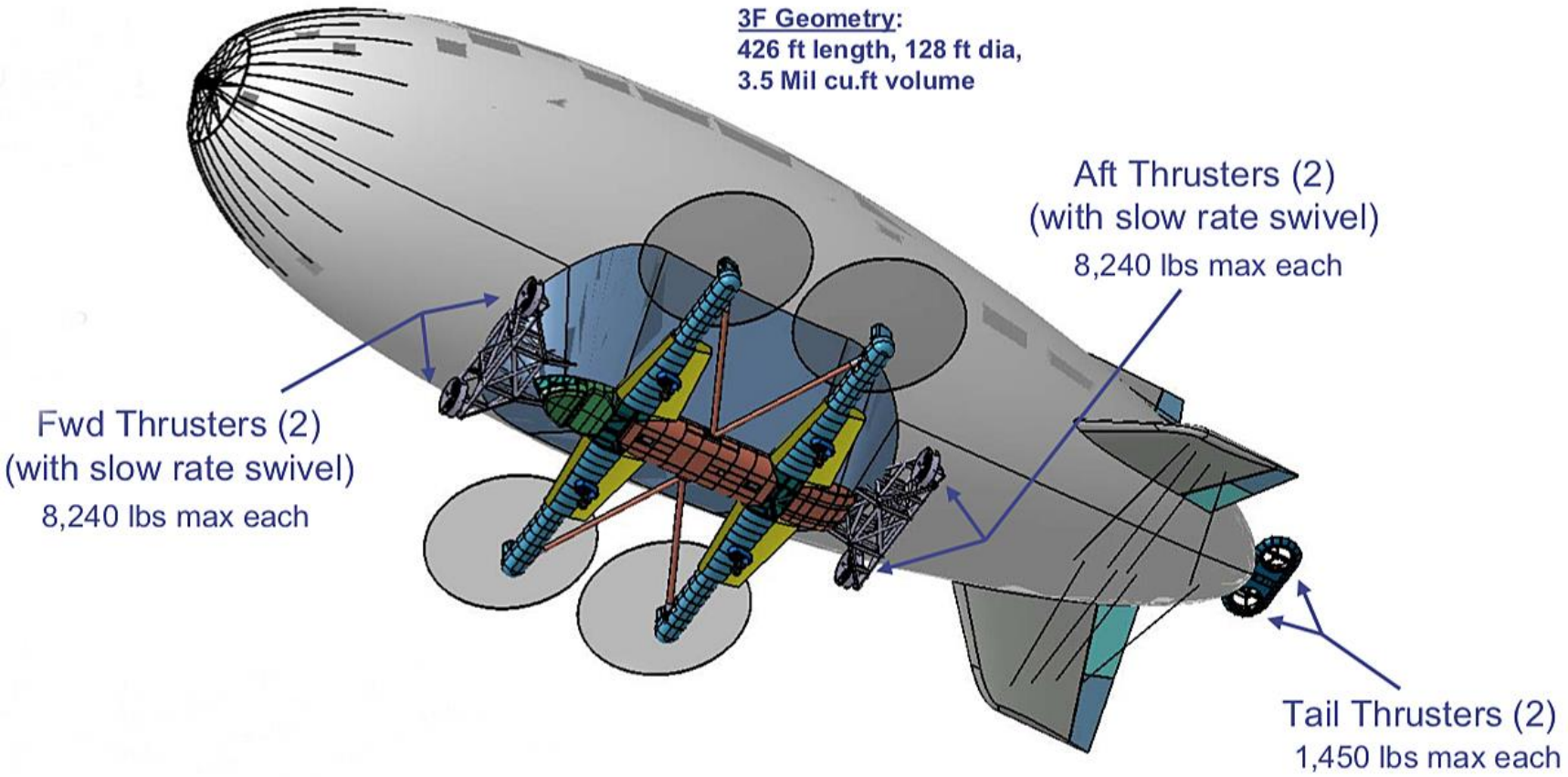
By March 2009, at Critical System Selection (CSS) midpoint, the design had evolved to the "3E Geometry" and by October 2009, the "3F Geometry" was being presented to customers. Major changes from the original 2008 design were:

- Three-piece tail surfaces were added to envelope
- Improved interface between the envelope and rigid structure
- Moved main rotors closer to the center of gravity
- Reconfigured the lateral thrusters
- Commercial off-the-shelf propulsion system
- Four-piece ballonet

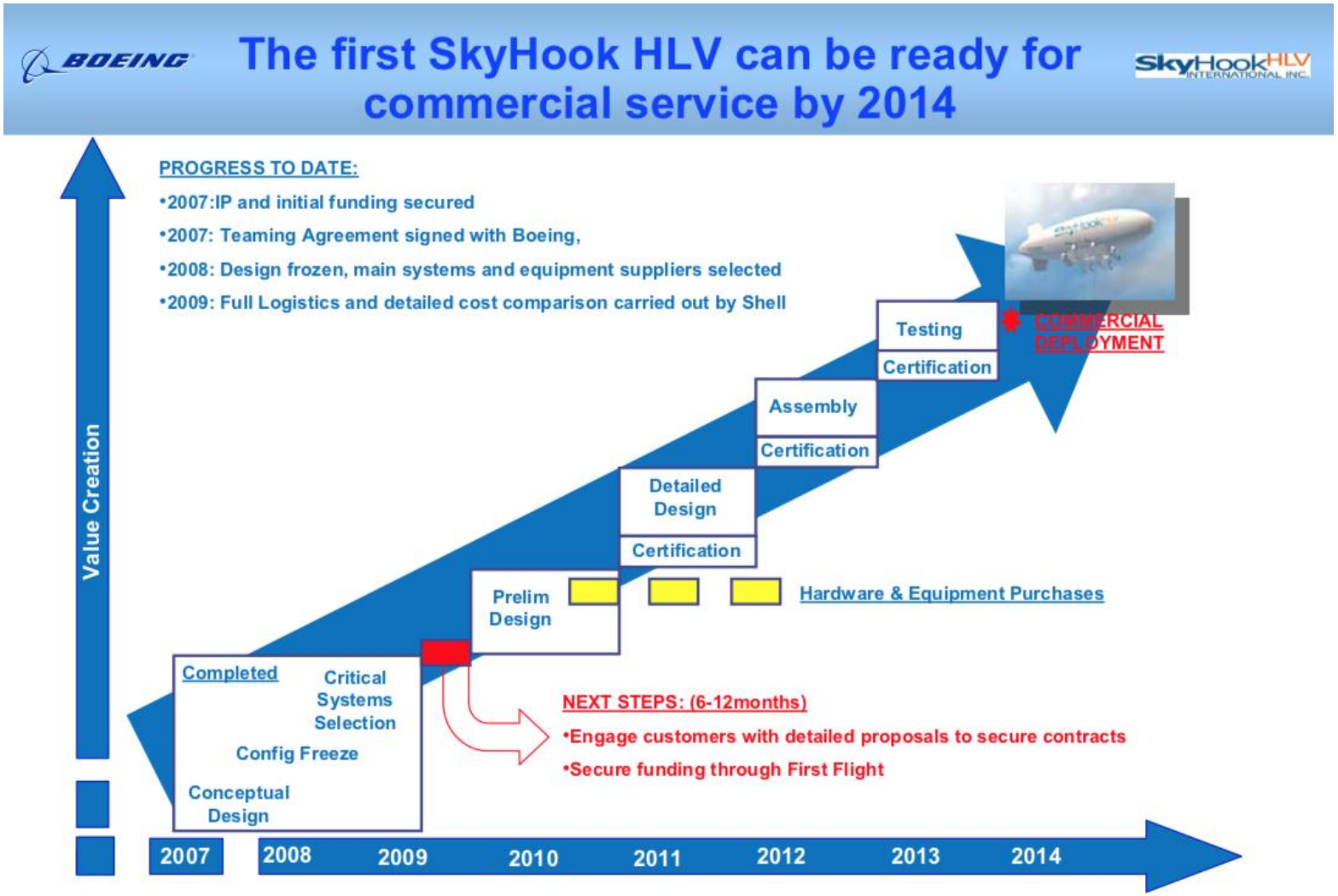


Skyhook HLV rotor and lateral thruster arrangement in 3E configuration, mid-2009. Source: Boeing / Skyhook International

Comparison of the SkyHook JHL-40 2008 original configuration (left) and the Skyhook HLV mid-2009 3E configuration (right). Source: Boeing / Skyhook International



General arrangement of the SkyHook HLV 3F configuration, circa Oct 2009
Source: Boeing / Skyhook International



Source: Boeing / Skyhook International, circa October 2009

The program schedule, as reported in October 2009, showed that the first aircraft was expected to fly in 2013, with commercial service entry in 2014. However, the development program was stopped about a year later, in about mid-2010, before the detailed design phase was completed. Since the demise of the SkyHook program, there has not been another heavy-lift helistat program.

Source: Boeing / Skyhook International, circa mid-2009.

6. For more information

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- Kenneth L. Laubsch, “The SkyHook HLV Aircraft - A Heavy Lift, Short Haul Vertical Transportation System,” The Boeing Company, October 2009: https://isopolar.com/wp-content/uploads/2013/03/Kenneth-Laubsch-presentation-The-SkyHook-HLV-A-Heavy-Lift-Short-Haul-Vertical-Transportation-System.pdf

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