# Raytheon - Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) / 590K aerostat system

Peter Lobner, 16 June 2023

## 1. Introduction

The Department of Defense (DoD) established the Aerostat Joint Project Office in January 1996, with headquarters in Huntsville, AL. In this joint-services organization, the Army provided the program manager and the Navy and Air Force provided deputy program managers. This organization was responsible for developing a 1990s design concept into a competitive bid specification for the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS).



A JLENS 74-meter aerostat at its Mobile Mooring Station (MMS) during testing at White Sands Missile Range, NM. Source: Photo by John Hamilton, WSMR PAO (22 Feb. 2012)

JLENS was a large aerostat-based radar system designed to complement fixed-wing aircraft and land-based radar systems in the following roles:

 JLENS primary role was to operate as a key component of the Army and Joint Integrated Air and Missile Defense System.
 With its persistent 360° field of view from high altitude, JLENS was uniquely positioned to provide unmanned aerial vehicle (UAV) and cruise missile threat warning, target identification, and precision targeting information for air defense weapons systems. In so doing, JLENS increased the capabilities of these existing air defense weapons systems by allowing them to engage targets normally below, outside or beyond their fields of view

• JLENS had secondary roles to detect and track surface moving targets and to detect, track, and provide launch point estimates for tactical ballistic missiles and large caliber rockets.

JLENS offered the possibility of accomplishing these roles at much lower operating costs than fixed-wing aircraft alternatives.



JLENS infographic highlighting the expected performance capabilities and economics of the system. Source: Raytheon

## 2. The JLENS "Orbit"

The basic deployable JLENS unit was known as an "Orbit," which was comprised of two TCOM 74M<sup>™</sup> (74-meter / 242.8 ft) tethered aerostats and associated systems and equipment located on the ground. One JLENS aerostat carried a wide area surveillance radar (SuR), an Identification-Friend-or-Foe (IFF) system and a communications payload. The other JLENS aerostat carried a precision fire control radar (FCR), IFF, and a common communications payload for passing targeting data to air defense systems. Each aerostat in a JLENS Orbit was supported by the following elements on the ground:

- An 81,627 kg (180,000 lb) Mobile Mooring Station (MMS), including winch and tether
- Communication and Processing Group (CPG)
- A Single JLENS Orbit Communications Payload CEC / 1 ink-16 Surveillance Radar Fire Control Radar Tether Tether Mobile Mooring Station Mobile Mooring Station Processing Station Processing Station **JNCLASSIFIED**
- Associated ground support equipment (GSE)

Elements of one JLENS Orbit. Source: US Army.

All elements of a JLENS Orbit were relocatable and could be transported by aircraft (C-5, C-17), railway, ship, or roadway. About five days were required to go from transport configuration to full deployment, or vice versa.

At an operating altitude of 3,048 m (10,000 ft), the JLENS VHF surveillance radar had a maximum range of 550 km (340 miles) against low-flying aerial targets, and could detect surface moving targets within 225 km (140 miles).



The other JLENS aerostat carried an Xband fire-control radar and was responsible for feeding precision targeting data to air defense systems, including:

- Army's MIM-104 Patriot surface-to-air missile system
- Navy's Aegis shipboard SM-6 surface-to-air missile system
- Air Force interceptor aircraft armed with AIM-120 AMRAAM airto-air missiles
- NASAMS [Norwegian (or National) Advanced Surface-to-Air Missile System], which also uses the AMRAAM



Coverage provided by JLENS SuR and FCR radars. Source: US Army

### 3. The original JLENS development plan

Originally, JLENS was conceived as a nationwide system with 16 Orbits (2 prototype Orbits and 14 production Orbits), which would be installed in coastal locations. In 2010, the top-level project schedule indicated Initial Operating Capability (IOC) and start of full-rate production in 2014.



Source: JLENS Selected Acquisition Report (SAR), 31 Dec 2010

TCOM manufactured four prototype JLENS aerostats for the two prototype Orbits. The initial deployment involved one JLENS Orbit deployed for a planned threeyear operational test and evaluation at the Army's Aberdeen Proving Grounds in Maryland.

The accompanying table shows the planned procurement schedule for the 14 production Orbits, as reported in an Army 2010 Selected Acquisition Report (SAR).

Fiscal Year	Quantity	End Item Recurring Flyaway TY \$M
2013	1	334.1
2014	1	342.0
2015	1	323.0
2016	1	324.0
2017	1	320.3
2018	1	321.5
2019	2	611.3
2020	2	615.3
2021	2	621.6
2022	2	628.6
2023		
2024		
Subtotal	14	4441.7



A moored JLENS TCOM 74M aerostat (foreground) and a slightly smaller TCOM 71M aerostat (background) at the TCOM manufacturing facility at the former blimp base in Weeksville, NC. Source: Flickr image via Bill Dickinson

#### 4. JLENS program timeline (abstracted from several sources)

- January 1998: H&R Co., a joint venture between Hughes Aircraft and Raytheon, competed against two other bidders and won the initial JLENS contract. As the program matured, the program lead became Raytheon Integrated Defense Systems, Andover, MA.
- October 2005: Raytheon's JLENS successfully completed a system functional review, marking the end of the "technology development / acquisition phase" and the start of the "system development and demonstration phase."
- March 2008: Raytheon's JLENS successfully completed Orbit preliminary design review (PDR).
- 14 April 2010: Successful first flight of a JLENS aerostat. It reached 305 m (1,000 feet) AGL at the Army's Utah Test and Training Range (UTTR) Echo Site (at Dugway Proving Ground), about 129 km (80 miles) west of Salt Lake City, UT.
- **14 July 2010:** A JLENS aerostat deployed at UTTR reached an altitude of 10,600 feet (3,231 m) Above Mean Sea Level (AMSL), carrying a mock payload of about 2,268 kg (5,000 pounds).
- **30 September 2010:** JLENS aerostat #3 was involved in an accident at the TCOM manufacturing facility in in Weeksville, NC (a former Navy blimp base), when a Skyship 600 airship broke free from its nearby

mooring mast during severe weather and collided with the JLENS aerostat. Aerostat #3 and its components were a total loss while the mobile mooring station sustained moderate but repairable damage. Impact to the JLENS program were late delivery of JLENS aerostats #3 and #4 and a delay in the test and training schedule. The Army requested an additional \$168 million in the program's next year budget for a replacement JLENS aerostat.

- July 2011: Raytheon announced a successful JLENS aerostat endurance test at the UTTR. A subsequent press release reported a 14-day test, about one-half of the expected 30-day typical JLENS mission.
- Nov Dec 2011: JLENS successfully completes its first set of tracking tests at the UTTR, tracking simulated low-flying cruise missiles, plus live UAVs, fighter aircraft, and moving surface targets on ground and water. It also demonstrated its ability to communicate Link-16 targeting data, and interface with IFF combat identification systems.
- **Early 2012:** The Army restructured JLENS consistent with significant budget cutbacks affecting the program.
- March 2012: All 14 production JLENS Orbits were cancelled, leaving just two prototype Orbits.
- Sep 2012 Aug 2013: Integrated functional testing at UTTR and White Sands Missile Range (WSMR), NM
  - **Patriot surface-to-air missile test (Apr 2012):** During an exercise at the UTTR, JLENS provided integrated fire control targeting information to a Patriot battery, which engaged and destroyed a fixed-wing target drone aircraft.
  - Small boat test (Sep 2012): At UTTR, JLENS simultaneously detected and tracked multiple speedboats on the Great Salt Lake, which simulated a real-world swarming scenario with a series of tactical maneuvers at low and high speeds. This test demonstrated JLENS usefulness in protecting key ports.
  - SM-6 surface-to-air missile test (Sep 2012): In tests at WSMR, JLENS fire-control radar acquired and tracked a target that mimicked an anti-ship cruise missile, then the Cooperative Engagement Capability (CEC) was used to pass the data on to the firing ship. The missile used JLENS targeting data to move into range of its own radar, found the target, and destroyed it.

- **Tactical ballistic missile test (Dec 2012):** At WSMR, a JLENS tracked four threats similar to tactical ballistic missiles, and it met its primary and secondary goals, including launch point estimation, ballistic tracking and discrimination
- Electro-optical (EO) turret test (Jan 2013): This Raytheon-funded test demonstrated the capabilities of its multi-spectral targeting system-B (MTS-B) day/night surveillance and targeting turret (not part of the baseline JLENS configuration), which, despite heavy smoke from recent forest fires, visually tracked targets, and watched Raytheon employees simulate planting a roadside land mine. JLENS simultaneously tracked surface targets with its integrated radar system, demonstrating the potential for integrating JLENS radar and EO/IR payloads in the future.
- AMRAMM air-to-air missile test (Jul 2013): A successful interception of a target drone by an AIM-120C-7 AMRAAM air-to-air missile, fired from an F-15E Strike Eagle fighter was executed based on a Link-16 cue from JLENS. This intercept was the first test of JLENS against a low-flying cruise missile target.
- Joint Air Force & Army test (Aug 2013): JLENS provided integrated fire control targeting information to Air Force fighters and operational Army Patriot air defense missile systems during multiple live missile flight tests in a controlled test environment.
- October 2014: Lab tests demonstrated that JLENS data could be converted into a format for use by the North American Air Defense Command's (NORAD's) command and control system.
- **December 2014**: The first JLENS prototype aerostat system was introduced to the public at Aberdeen Proving Ground, MD. At this time, the program had cost about \$2.8 billion, with an additional \$43.3 allocated for the first year of the operational test and evaluation program.
- August 2015: The second JLENS prototype aerostat was launched at Aberdeen Proving Ground, establishing the first prototype JLENS "Orbit."
- Mid-2015 Mid-2017: The two JLENS units at Aberdeen, installed about 3.2 km (2 miles) apart, were part of a planned three-year test & evaluation



program to assess JLENS operational capabilities and reliability, and its integration with NORAD's command and control system. Based on a successful outcome from this evaluation program, the Army expected to achieve an Initial Operational Capability (IOC) and initiate low-rate production in 2017 (about three years later than the target dates published in 2010, which called for an IOC in 2014). The program's second Orbit was kept in strategic reserve for potential future deployment.

• **29 October 2015:** One JLENS aerostat broke free from its mooring at Aberdeen Proving Ground and drifting 257 km (160 miles) north over central Pennsylvania, dragging about 6,600 ft (2,012 m) of its tether cable, which damaged power lines and cut power to 20,000. When the aerostat descended to a low enough altitude, it was shot down by state troopers. An investigation into the incident reported that a number of errors were responsible, including design issues (a faulty air pressure sensor allowed the aerostat's tail fins to partially deflate in high winds), as well as human and procedural error.



JLENS aerostat with deflated tail fins broke free from its mooring at Aberdeen Proving Ground & drifted to and crashed in Moreland Township, PA. Source: Screenshots from ABC News video (29 Oct 2015)

- **December 2015:** Congress slashed the JLENS budget in spite of support from the defense appropriations subcommittees in the House and Senate and many retired military leaders.
- March 2016: After limited testing resumed in February, the tests demonstrated that the JLENS had ongoing radar system performance and reliability issue.
- **April 2016:** The House Armed Services Committee issued a massive cut to the JLENS program. The Senate Appropriations Committee turned down the DoD's request to realign funding to fix deficiencies and resume trials.
- Later in 2016: The JLENS prototype aerostats were deflated and put in storage.
- **2017:** The JLENS program was defunded and shut down.

### 5. The JLENS aerostat

For the JLENS mission, TCOM's standard 71M<sup>™</sup> aerostat was enlarged to account for the payload weight, operating altitude and operating temperature range required for the JLENS mission. The resulting aerostat was designated the TCOM 74M<sup>™</sup>.

<b>General characteristics</b>	of the R	Raytheon Jl	LENS aerostats
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Parameter	JLENS
Length	74 m (242.8 ft)
Diameter, max	About 24.4 m (80 ft)
Volume	17,000 m <sup>3</sup> (590,000 ft <sup>3</sup> )
Envelope manufacturer	TCOM, model 74M <sup>™</sup>
Tether	Fiber optic, powered tether
Weight, payload	1,588 kg (3,500 lb)
Altitude, max. operating	3,048 m (10,000 ft)
Mission duration	30 days
Number built	4



JLENS moored at its Mobile Mooring Station. Source: US Air Force via Flight Global (2016)



JLENS aloft at WSMR; Mobile Mooring Station at lower left. Source: Photo by John Hamilton, WSMR PAO (24 Fen 2012)



JLENS directly overhead. Source: Flight Global (2016)



JLENS at its Mobile Mooring Station. Source: militaryaerospace.com (24 June 2014)



JLENS at its Mobile Mooring Station. Source: Flight Global (Oct 2015)



JLENS at its Mobile Mooring Station. Source: militaryaerospace.com (24 June 2014)



JLENS moored, view aft toward radar windscreen. Source: militaryaerospace.com (24 June 2014)



JLENS moored, view from the port tail fin, looking forward. Note the retracted radar windscreen. Source: DoD, via WGAL (2015)

### 6. For more information

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- "JLENS," Wikipedia: <u>https://en.wikipedia.org/wiki/JLENS</u>
- "National Cruise Missile Defense: Issues and Alternatives," Congressional Budget Office, February 2021: <u>https://www.cbo.gov/publication/56990</u>

# <u>Videos</u>

- "JLENS Operations at White Sands Missile Range 2012," (36.11 min), posted by WSMRBD, 16 October 2013: <u>https://www.youtube.com/watch?v=Xxe2e2lQwfo</u>
- "Joint Land Attack Cruise Missile Defense Elevated Sensor (JLENS)," (6.31 min), posted by AIRBOYD, 25 April 2014: <u>https://www.youtube.com/watch?v=bhSGbl5SkWw</u>
- "U.S. Army plans to use blimps JLENS system to protect Washington D.C. against cruise missiles," (2:52 min), posted by armyreco, 19 December 2014: <u>https://www.youtube.com/watch?v=YnHOU6MMS30</u>
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### Other Modern Airships articles

- Modern Airships Part 1: <u>https://lynceans.org/all-posts/modern-airships-part-1/</u>
  TCOM tethered aerostats
- Modern Airships Part 2: <u>https://lynceans.org/all-posts/modern-airships-part-2/</u>
  - Israel High Availability Aerostat System (HAAS) Tal Shamaim (Sky Dew)
- Modern Airships Part 3: <u>https://lynceans.org/all-posts/modern-airships-part-3/</u>