

ATLAS V



AEHF-3

Advanced Extremely High Frequency-3

MISSION OVERVIEW | SLC-41
CCAFS, FL





United Launch Alliance (ULA) is proud to be a part of the third Advanced Extremely High Frequency (AEHF-3) mission with the U.S. Air Force Space Command's Space and Missile Systems Center (AFSPC/SMC). The AEHF constellation is the next generation of global, high-security, survivable communications satellites used by all branches of the United States military.

AEHF satellites are the follow-on to the Department of Defense's current five-satellite Milstar communications constellation. When fully operational, the Advanced EHF constellation will consist of four crosslinked satellites providing 10 times the throughput of the Milstar system with a substantial increase in coverage to users.

The Military Satellite Communications Systems Directorate (SMC/MC) is the lead agency responsible for managing the AEHF contract and ensures that the secure communications capabilities of this system are made available to military personnel around the globe.

The ULA team is focused on attaining Perfect Product Delivery for the AEHF-3 mission, which includes a relentless focus on mission success (the perfect product) and also excellence and continuous improvement in meeting all of the needs of our customers (the perfect delivery).

My thanks to the entire team for its dedication in bringing AEHF-3 to launch and to the Air Force for trusting ULA to deliver this critical national security capability to orbit.

Go Atlas, Go Centaur, Go AEHF!

A handwritten signature in black ink, appearing to read 'J. Sponnick'.

Jim Sponnick

Vice President, Atlas and Delta Programs

AEHF-3 SATELLITE | Overview

The AEHF system is a joint service satellite communications system providing survivable, global, secure, protected, jam-resistant communications for high-priority military ground, sea and air assets. Advanced EHF allows the National Security Council and Unified Combatant Commanders to control tactical and strategic forces at all levels of conflict through general nuclear war and supports the attainment of information superiority.

The AEHF system augments and improves on the capabilities of Milstar and expands the SMC/MC architecture. It provides connectivity across the spectrum of mission areas, including land, air and naval warfare; special operations; strategic nuclear operations; strategic defense; theater missile defense; and space operations and intelligence.

The AEHF system is composed of three segments: space (the satellites), ground (mission control and associated communications links), and terminals (the users). The segments provide communications in a specified set of data rates from 75 bps to approximately 8 Mbps. The space segment consists of a cross-linked constellation of four satellites in geosynchronous earth orbit. The mission control segment controls satellites on orbit, monitors satellite health, and provides communications system planning and monitoring. This segment is highly survivable, with both fixed and mobile control stations. System uplinks and crosslinks operate in the extremely high frequency (EHF) range and downlinks in the super high frequency (SHF) range. The terminal segment includes fixed and ground mobile terminals, ship and submarine terminals and airborne terminals used by all of the services and international partners: Canada, the Netherlands, and the United Kingdom.

Weighing in at approximately 13,600-lb fully fueled, the satellite is based on the Lockheed Martin A2100 commercial satellite that includes hall current thruster electric propulsion, which is 10 times more efficient than conventional bipropellant systems. The thrusters remove orbit eccentricity during transfer orbit operations, orbit maintenance and satellite repositioning. The payload features onboard signal processing and crossbanded EHF/SHF communications. Increased coverage is provided by antennas consisting of two SHF downlink phased arrays, two crosslinks, two uplink/downlink theater anti-jam nulling antennas, one uplink EHF phased array, six uplink/downlink gimbaled dish antenna, one each uplink/downlink earth coverage horns.



Image Courtesy of Lockheed Martin Corporation

ATLAS V 531 LAUNCH VEHICLE | Overview

The Atlas V 531 consists of a single Atlas V booster stage, the Centaur upper stage, three solid rocket boosters (SRBs), and a 5-m payload fairing (PLF).

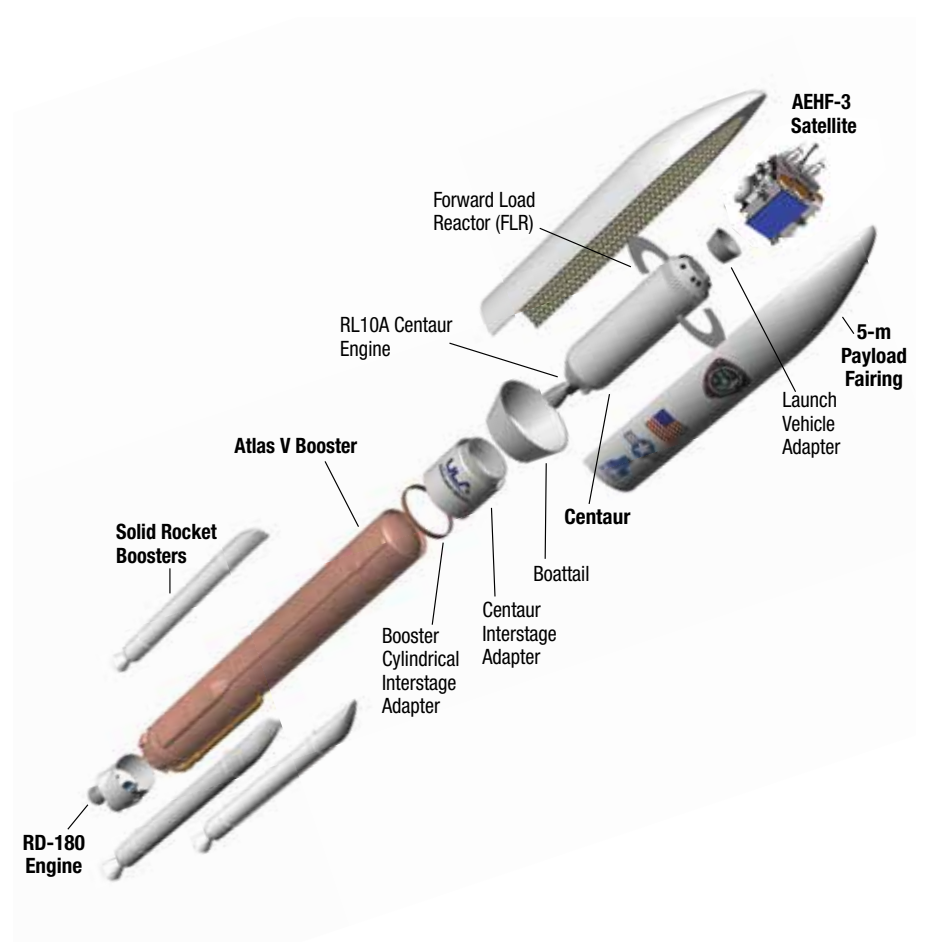
The Atlas V booster is 12.5 ft in diameter and 106.5 ft in length. The booster's tanks are structurally rigid and constructed of isogrid aluminum barrels, spun-formed aluminum domes, and intertank skirts. Atlas booster propulsion is provided by the RD-180 engine system (a single engine with two thrust chambers). The RD-180 burns RP-1 (Rocket Propellant-1 or highly purified kerosene) and liquid oxygen, and it delivers 860,200 lb of thrust at sea level. The Atlas V booster is controlled by the Centaur avionics system, which provides guidance, flight control, and vehicle sequencing functions during the booster and Centaur phases of flight.

The SRBs are approximately 61 in. in diameter, 67 ft in length, and constructed of a graphite-epoxy composite with the throttle profile designed into the propellant grain. The SRBs are jettisoned by structural thrusters following a 92-second burn.

The Centaur upper stage is 10 ft in diameter and 41.5 ft in length. Its propellant tanks are constructed of pressure-stabilized, corrosion resistant stainless steel. Centaur is a liquid hydrogen/liquid oxygen- (cryogenic-) fueled vehicle. It uses a single RL10A-4-2 engine producing 22,300 lb of thrust. The cryogenic tanks are insulated with a combination of helium-purged insulation blankets, radiation shields, and spray-on foam insulation (SOFI). The Centaur forward adapter (CFA) provides the structural mountings for the fault-tolerant avionics system and the structural and electrical interfaces with the spacecraft.

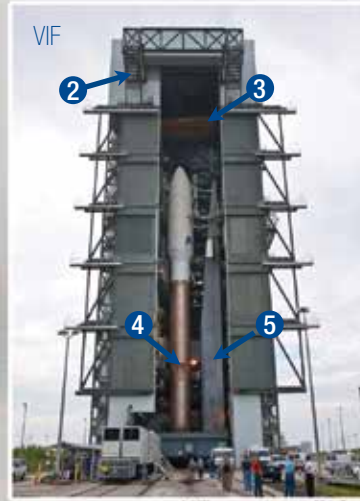
The AEHF-3 satellite is encapsulated in the Atlas V 5-m diameter short PLF. The 5-m PLF is a sandwich composite structure made with a vented aluminum-honeycomb core and graphite-epoxy face sheets. The bisector (two-piece shell) PLF encapsulates both the Centaur and the spacecraft, which separates using a debris-free pyrotechnic actuating system. Payload clearance and vehicle structural stability are enhanced by the all-aluminum forward load reactor (FLR), which centers the PLF around the Centaur upper stage and shares payload shear loading. The vehicle's height with the 5-m short PLF is approximately 197 ft.

ATLAS V 531 LAUNCH VEHICLE | Expanded View



SPACE LAUNCH COMPLEX 41 (SLC-41) | Overview

- 1 Vertical Integration Facility (VIF)
(See inset)
- 2 Bridge Crane Hammerhead
- 3 Bridge Crane
- 4 Launch Vehicle
- 5 Mobile Launch Platform (MLP)
- 6 Centaur LO₂ Storage
- 7 High Pressure Gas Storage
- 8 Booster LO₂ Storage
- 9 Pad Equipment Building (PEB)
- 10 Pad ECS Shelter



ATLAS V AEHF-3 | Mission Overview

The third AEHF mission will be flown on an easterly trajectory from Space Launch Complex 41 (SLC-41) at Cape Canaveral Air Force Station (CCAFS), Florida. The satellite will be released into a supersynchronous transfer orbit. Following separation, the satellite will tailor its orbit using an on-board propulsion system and begin its mission.

Mission telemetry data will be gathered by TEL-4 (Merritt Island), Antigua, Diego Garcia, and Guam Tracking Stations. The orbiting Tracking and Data Relay Satellite (TDRS) constellation will also participate in gathering telemetry during the AEHF-3 mission.

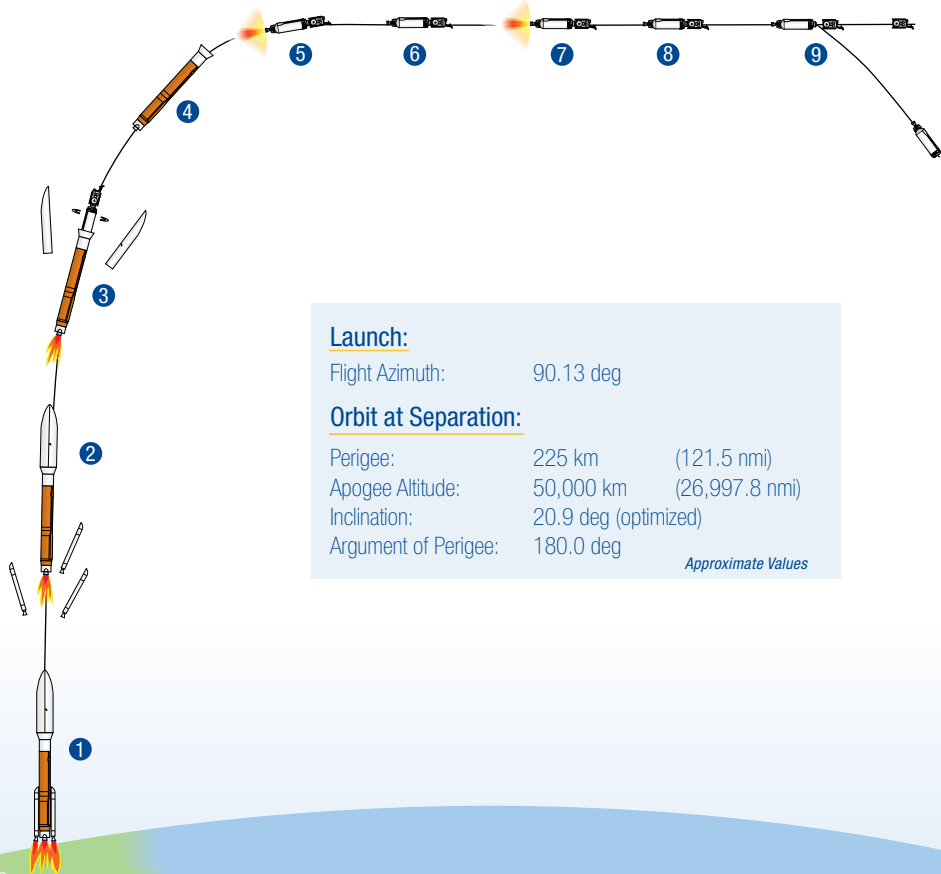
The mission begins with RD-180 engine ignition approximately 2.7 seconds before liftoff (T-2.7 seconds). SRB ignition takes place at T+0.8 seconds after telemetry indication of healthy RD-180 startup. Liftoff occurs at T+1.1 seconds. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll maneuver. Maximum dynamic pressure peaks during the flight at approximately 46.7 seconds. The SRBs burn out at approximately 92 seconds. The first two SRBs are jettisoned 115 seconds into the flight; the third is jettisoned at approximately 116 seconds. The PLF and FLR jettison events take place at 209 and 214 seconds, respectively, during the boost phase of flight. Booster engine cutoff (BECO) occurs at approximately 257 seconds.

Centaur separation occurs 6 seconds after BECO with Centaur main engine start (MES-1) occurring 16 seconds later. Just after 14 minutes into the mission, the first Centaur main engine cutoff (MECO-1) occurs.

At 22 minutes into the mission, Centaur reorients itself for its second main engine start (MES-2). The second Centaur engine burn lasts approximately 5 minutes, followed by the second Centaur main engine cutoff (MECO-2). After MECO-2, Centaur reorients its attitude for spacecraft separation and begins a passive thermal control roll (PTC). AEHF-3 separates about 51 minutes after liftoff.

Atlas V AEHF-3

FLIGHT PROFILE | Liftoff to Separation



Launch:

Flight Azimuth: 90.13 deg

Orbit at Separation:

Perigee: 225 km (121.5 nmi)
 Apogee Altitude: 50,000 km (26,997.8 nmi)
 Inclination: 20.9 deg (optimized)
 Argument of Perigee: 180.0 deg

Approximate Values

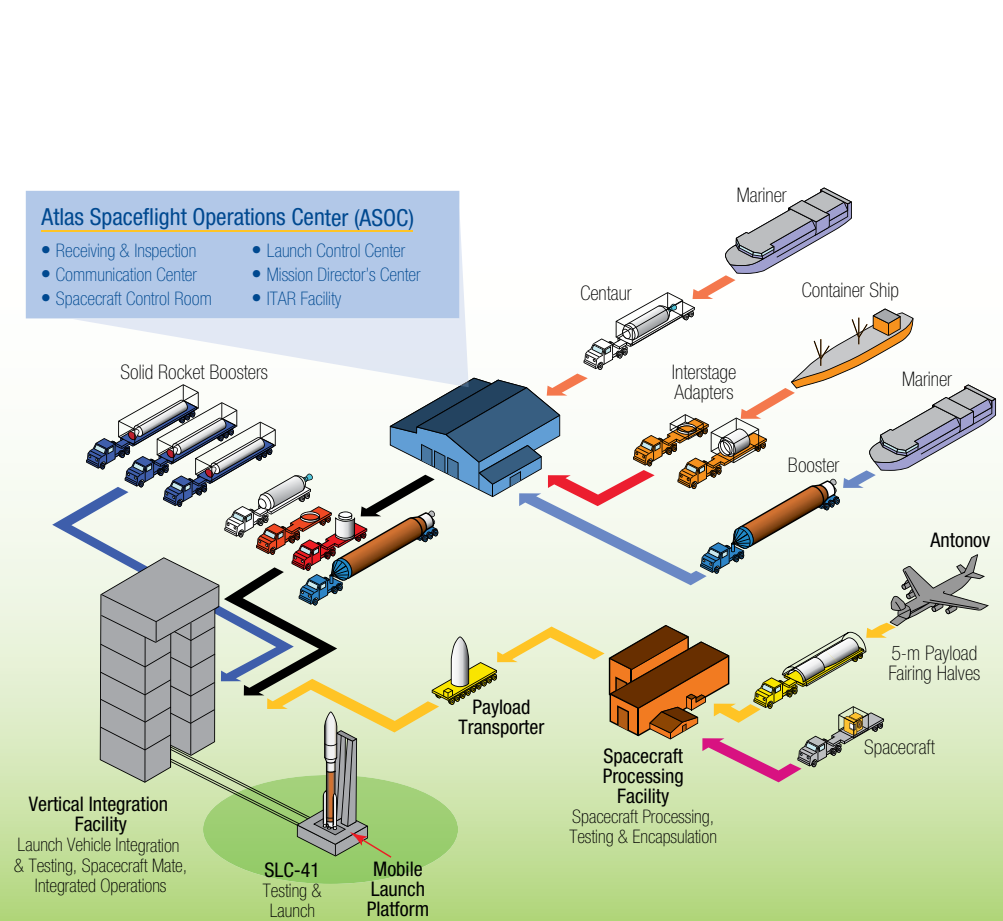
SEQUENCE OF EVENTS | Liftoff to Separation

	Event	Time (seconds)	Time (hr:min:sec)
1	RD-180 Engine Ignition	-2.7	-00:00:02.7
	Liftoff (Thrust to Weight >1)	1.1	00:00:01.1
	Begin Pitch/Yaw/Roll Maneuver	5.4	00:00:05.4
	Mach 1	38.2	00:00:38.2
	Maximum Dynamic Pressure	46.7	00:00:46.7
2	SRB 1 & 2 Jettison	114.5	00:01:54.5
	SRB 3 Jettison	116.0	00:01:56.0
3	Payload Fairing Jettison	209.1	00:03:29.1
	Forward Load Reactor Jettison	214.1	00:03:34.1
4	Atlas Booster Engine Cutoff (BECO)	257.3	00:04:17.3
	Atlas Booster/Centaur Separation	263.3	00:04:23.3
5	Centaur First Main Engine Start (MES-1)	273.2	00:04:33.2
6	Centaur First Main Engine Cutoff (MECO-1)	840.6	00:14:00.6
7	Centaur Second Main Engine Start (MES-2)	1,317.6	00:21:57.6
8	Centaur Second Main Engine Cutoff (MECO-2)	1,655.3	00:27:35.3
9	AEHF-3 Separation	3,058.3	00:50:58.3

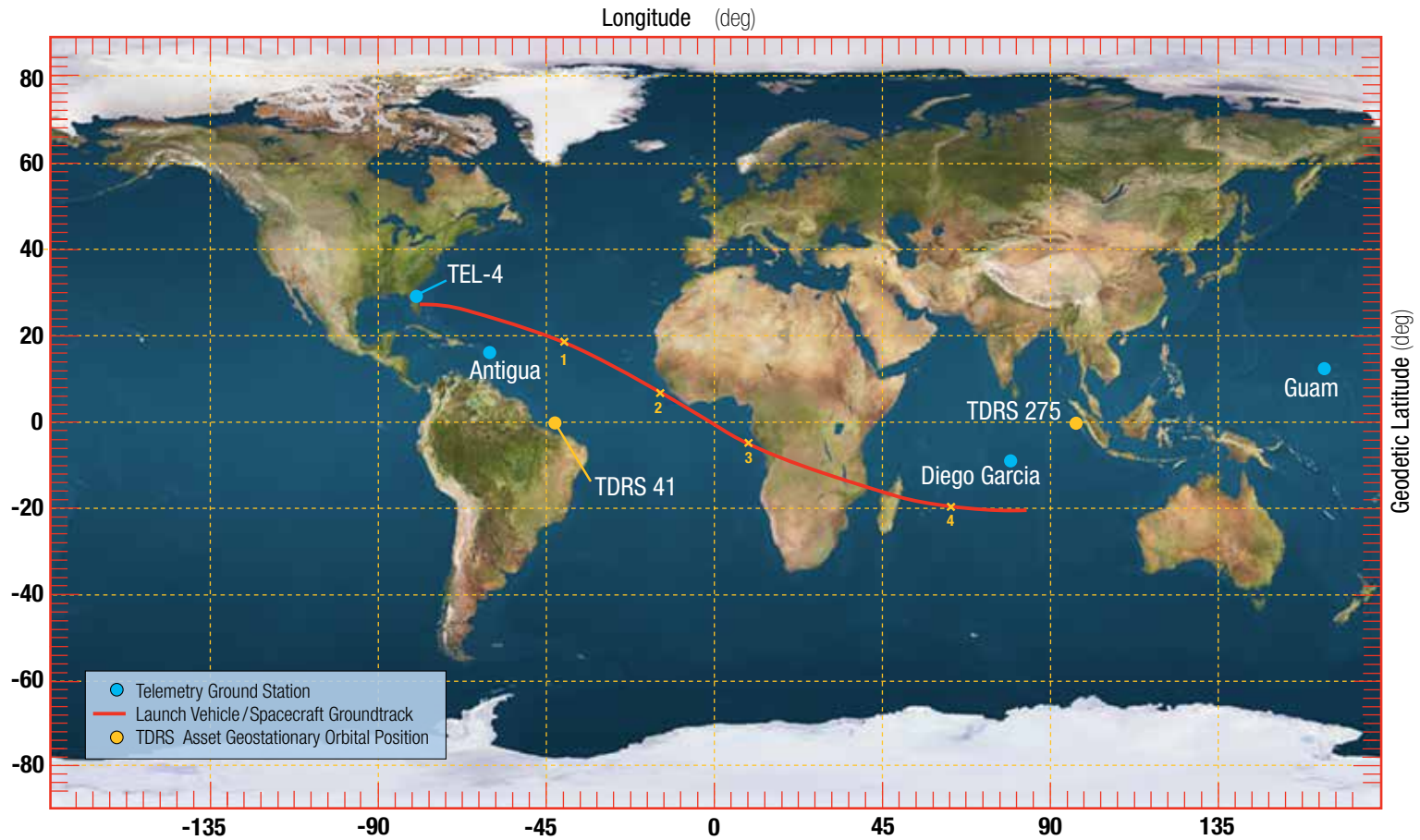
ATLAS V PRODUCTION & LAUNCH | Overview



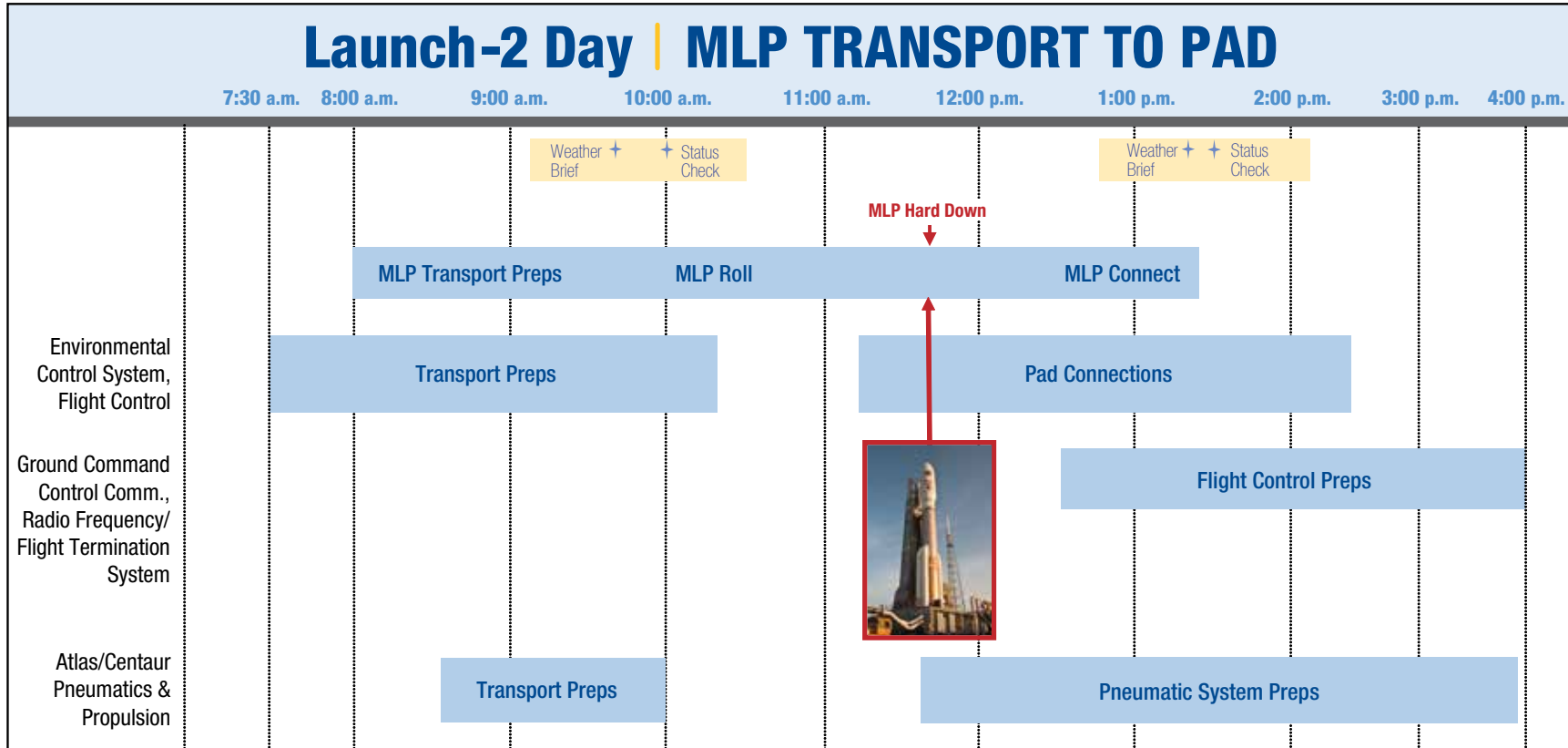
ATLAS V PROCESSING | Cape Canaveral



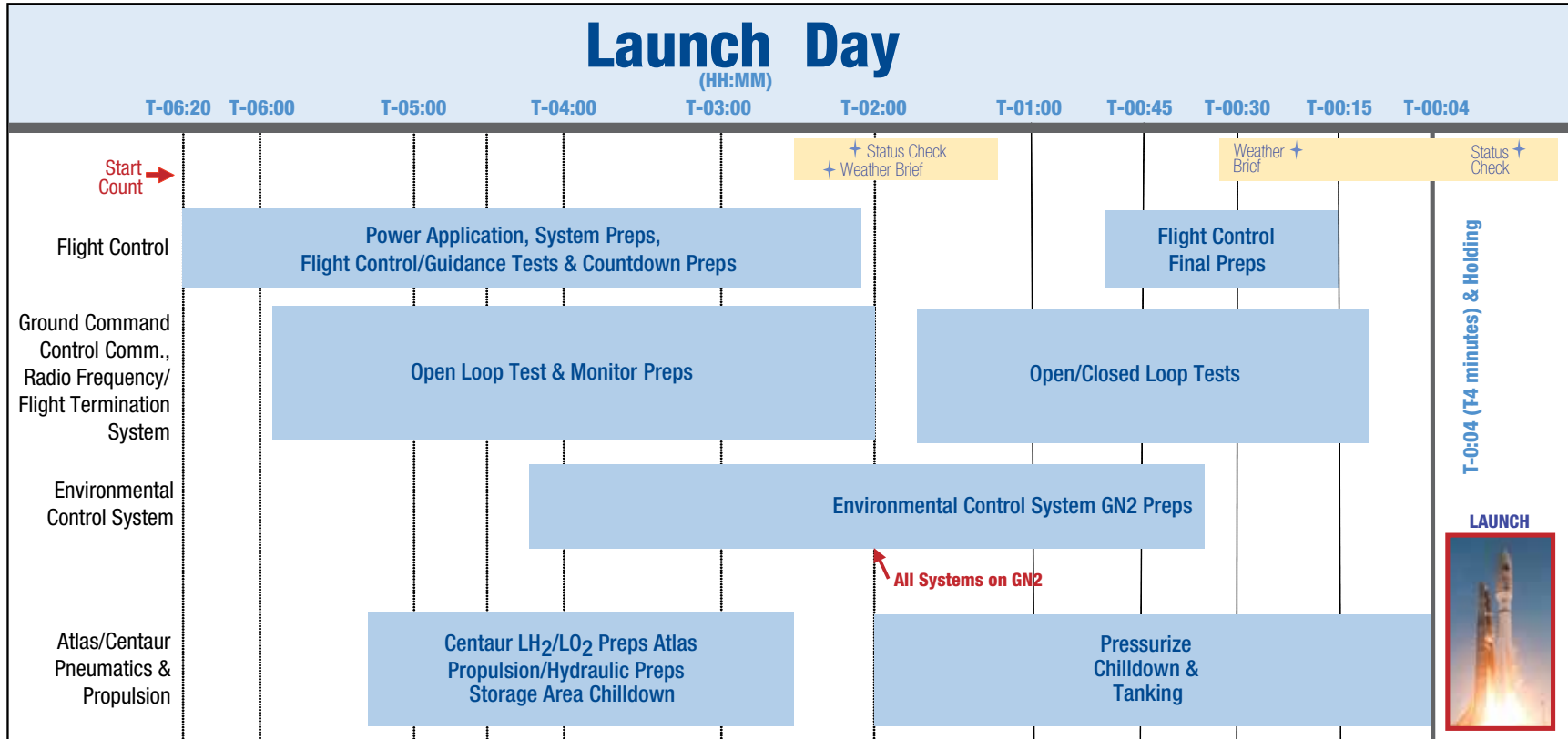
GROUND TRACE | Liftoff to Separation



1 = MECO-1 (0:14:00.6) | 2 = MES-2 (0:21:57.6) | 3 = MECO-2 (0:27:35.3) | 4 = AEHF-3 Separation (0:50:58.3)



COUNTDOWN TIMELINE | Launch Day



ATLAS V



AEHF-3

Advanced Extremely High Frequency-3

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