MISSION OVERVIEW | SLC-37 CCAFS, FL

ULA
United Launch Alliance

DELTA

United Launch Alliance (ULA) is proud to be a part of the WGS-6 mission with the U.S. Air Force Space Command's Space and Missile Systems Center (AFSPC/SMC). The WGS-6 mission marks the 23rd Delta IV launch and the fourth launch of the Delta IV Medium+ (5,4) launch vehicle configuration.

This WGS mission is the sixth installment of the Wideband Global SATCOM (WGS) system. The WGS satellites are an important element of a new high-capacity satellite communications system providing enhanced communications capabilities to our troops in the field for the next decade and beyond. WGS enables more robust and flexible execution of Command and Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), as well as battle management and combat support information functions. The WGS constellation augments the existing service available through the UHF Follow-on satellite by providing enhanced information broadcast capabilities.

The ULA team is focused on attaining Perfect Product Delivery for the WGS-6 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 ULA team for its dedication in bringing WGS-6 to launch, and to the AFSPC/SMC for selecting Delta for this important mission.

Go Delta, Go WGS!

Jim Sponnick
Vice President, Atlas and Delta Programs

WGS-6 SATELLITE | Overview

WGS supports communications links in the 500 MHz range of the X-band and 1 GHz range of the Ka-band spectra. WGS can filter and route up to 4.875 GHz of instantaneous bandwidth. WGS-6, the third Block II satellite, includes a high-bandwidth radio frequency (RF) bypass capability in addition to the previous capabilities provided by the Block I satellites. Depending on the mix of ground terminals, data rates, and modulation schemes employed, a WGS satellite can support data transmission rates between 2.4 and 3.6 Gbps.

WGS has 19 independent coverage areas that can be positioned throughout its field of view. This includes eight steerable/shapeable X-band beams formed by separate transmit/receive phased arrays; 10 Ka-band beams served by independently steerable diplexed antennas (three with selectable RF polarization); and transmit/receive X-band Earth-coverage beams. WGS can tailor coverage areas and connect X-band and Ka-band users anywhere within its field of view.

Four Army Wideband Satellite Operations Centers (WSOC) provide command and control of WGS. Each Global SATCOM Configuration and Control Element (GSCCE) has the capability to control up to three satellites at a time, using X-band or Ka-band telemetry and command links. Spacecraft platform control is accomplished by the 3rd Space Operations Squadron at Schriever Air Force Base in Colorado Springs, CO, using WGS mission-unique software and databases.

Support technologies for WGS include the xenon-ion propulsion system (XIPS), which is 10 times more efficient than conventional bipropellant systems, highly efficient triple-junction gallium arsenide solar cells, and deployable radiators with flexible heat pipes. Four 25-cm XIPS thrusters remove orbit eccentricity during transfer orbit operations. The thrusters are also used to perform orbit maintenance and any required station-change maneuvers during the mission's life. The triple-junction gallium arsenide solar cells provide on-orbit electrical power for the spacecraft. The deployable radiators' flexible heat pipes provide increased radiator area, resulting in a cooler, more stable thermal environment for the satellite.

Image Courtesy of Boeing

DELTA IV MEDIUM+ (5,4) LAUNCH VEHICLE | Overview

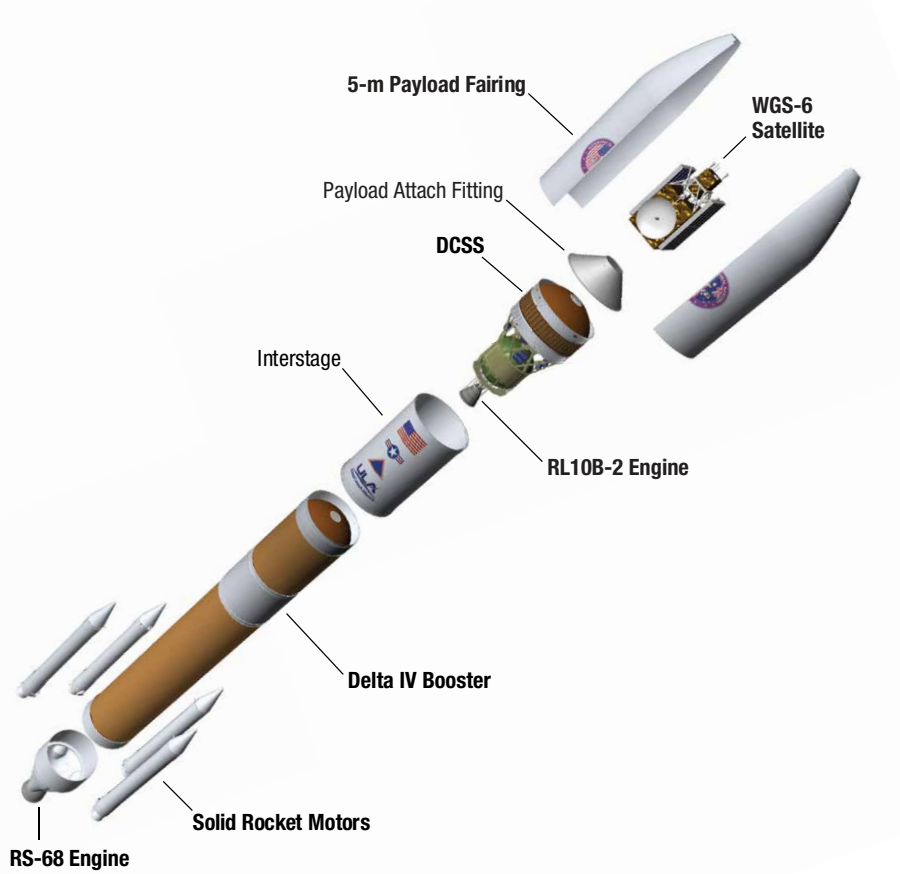
The Delta IV Medium+ (5,4) consists of a single Delta IV common booster core (CBC), the Delta cryogenic second stage (DCSS), four solid rocket motors (SRM) and a 5-m diameter payload fairing. The CBC and the DCSS are connected by a composite cylindrical interstage adapter (ISA). The SRMs are connected to the booster by two ball-and-socket joints and four structural thrusters.

The SRMs are approximately 5 ft in diameter and 53 ft long, and are constructed of a graphite-epoxy composite. Their throttle profile is designed into their propellant grain. Two of the SRMs have thrust vector control (TVC) capabilities, and two have fixed nozzles. The SRMs burn for approximately 92 seconds and are jettisoned at roughly 100 seconds into the flight.

The Delta IV booster tanks are structurally rigid, and constructed of isogrid aluminum barrels, spun-formed aluminum domes, machined aluminum tank skirts, and a composite centerbody. Delta IV booster propulsion is provided by the RS-68 engine system. The RS-68 burns cryogenic liquid hydrogen and liquid oxygen, and delivers 663,000 lb of thrust at sea level. The booster's cryogenic tanks are insulated with a combination of spray-on and bond-on insulation, and helium-purged insulation blankets. The Delta IV booster is controlled by the DCSS avionics system, which provides guidance, flight control, and vehicle sequencing functions during CBC and DCSS phases of flight. The boost phase of flight ends 6 seconds after main engine cutoff (MECO), when the separation charge in the interstage adapter is fired and 16 pneumatic actuators push the spent Delta IV CBC stage and the DCSS apart.

The DCSS propellant tanks are structurally rigid and constructed of isogrid aluminum ring forgings, spun-formed aluminum domes, machined aluminum tank skirts and a composite intertank truss. The DCSS is also a cryogenic liquid hydrogen/liquid oxygen-fueled vehicle. It uses a single RL10B-2 engine that produces 24,750 lb of thrust. Like the CBC, the DCSS cryogenic tanks are insulated with a combination of spray-on and bond-on insulation, and helium-purged insulation blankets. An equipment shelf attached to the aft dome of the DCSS liquid oxygen tank provides the structural mountings for vehicle electronics. The structural and electronic interfaces with the spacecraft (SC) are provided by the payload attach fitting (PAF). The WGS-6 mission uses a 5-m diameter payload fairing (PLF). The PLF is a composite bisector (two-piece shell) fairing. The vehicle's height, with the 47-ft tall PLF, is approximately 217 ft.

DELTA IV MEDIUM+ (5,4) LAUNCH VEHICLE | Expanded View



Delta IV WGS-6

SPACE LAUNCH COMPLEX 37 (SLC-37) | Overview

1 Mobile Service Tower (MST)
2 Launch Vehicle
3 Launch Table
4 Fixed Umbilical Tower (FUT)
5 Lightning Protection Towers
6 LH_2 Storage Tank
7 LO_2 Storage Tank

DELTA IV WGS-6 | Mission Overview

The WGS-6 mission will be flown on an easterly trajectory from Space Launch Complex 37 at Cape Canaveral Air Force Station (CCAFS), FL. The Delta IV will release the WGS-6 satellite into a supersynchronous transfer orbit.

The mission begins with RS-68 engine ignition approximately 5.5 seconds prior to liftoff (T-5.5 seconds). Liftoff occurs at T+0.0 seconds. SRM ignition takes place at T-0.02 seconds after telemetry indication of healthy RS-68 startup.

Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll program. Maximum dynamic pressure occurs approximately 50 seconds into flight.

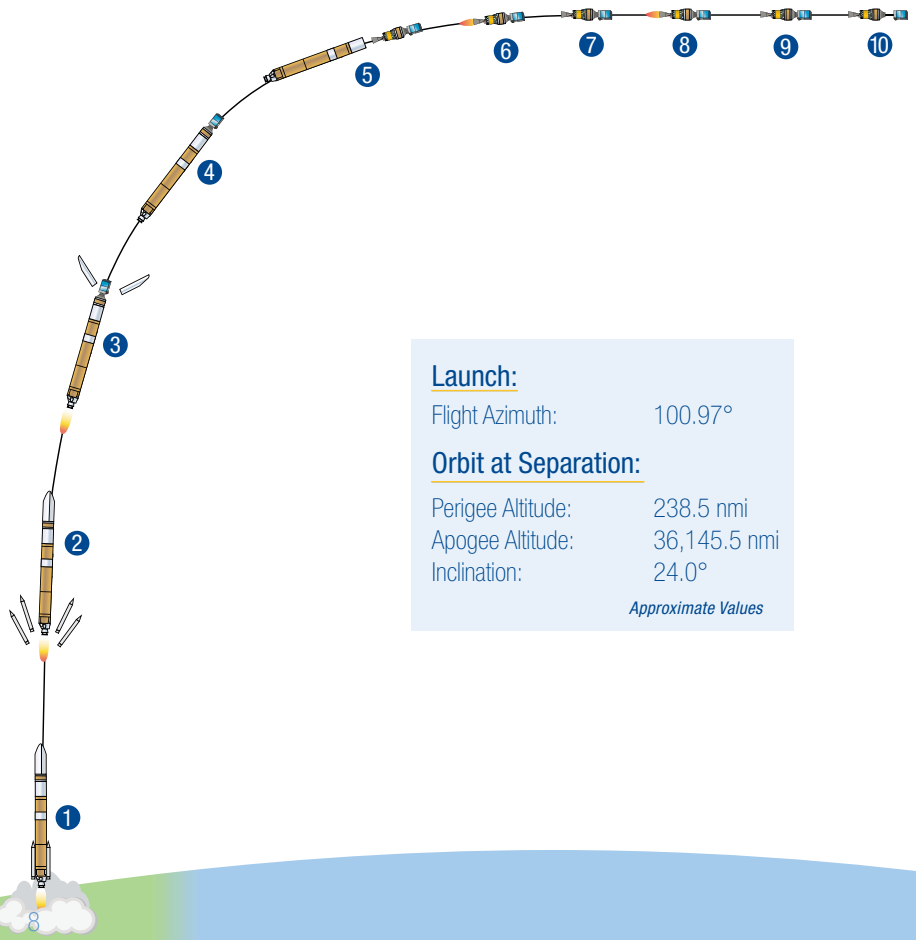
The SRMs burn out at approximately T+92 seconds, and are jettisoned in pairs at T+100 and 102 seconds. Payload fairing jettison takes place at approximately 207 seconds; about 40 seconds prior to main engine cutoff (MECO).

DCSS separation is approximately 6 seconds after MECO. DCSS main engine start occurs 13 seconds after the separation event. At approximately 20 minutes into the mission, the first second stage engine cutoff (SECO-1) occurs and DCSS has achieved its parking orbit.

During an 8-minute coast phase, DCSS reorients itself for restart. Restart ignition takes place approximately 28 minutes into the mission and lasts about 3 minutes. Following SECO-2, DCSS re-orients its attitude for the separation event. The WGS-6 satellite separates approximately 41 minutes after launch.

Delta IV WGS-6

FLIGHT PROFILE | Liftoff to Separation



Launch:

Flight Azimuth: 100.97°

Orbit at Separation:

Perigee Altitude: 238.5 nmi
Apogee Altitude: 36,145.5 nmi
Inclination: 24.0°

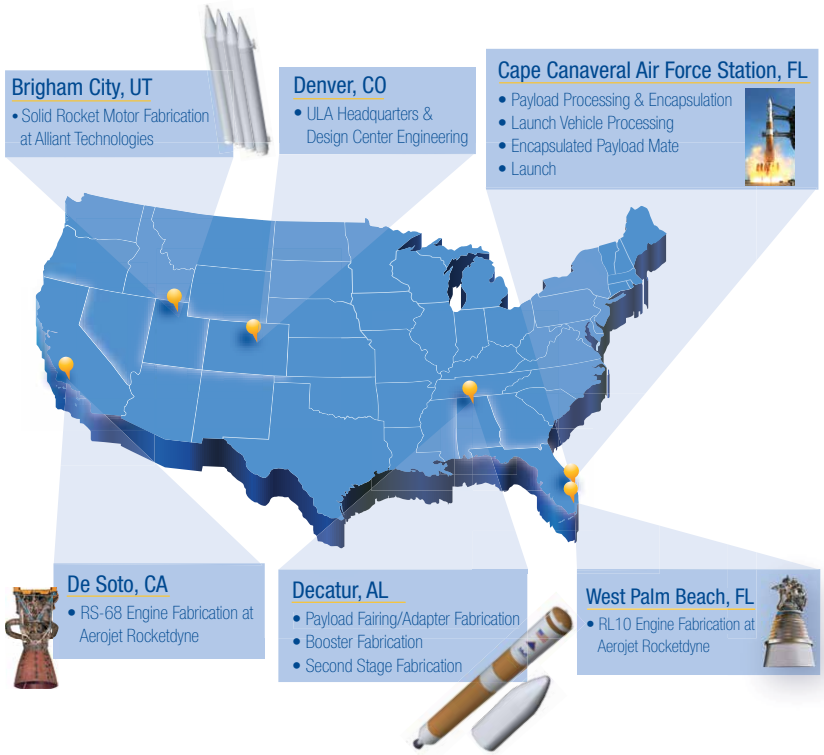
Approximate Values

SEQUENCE OF EVENTS | Liftoff to Separation

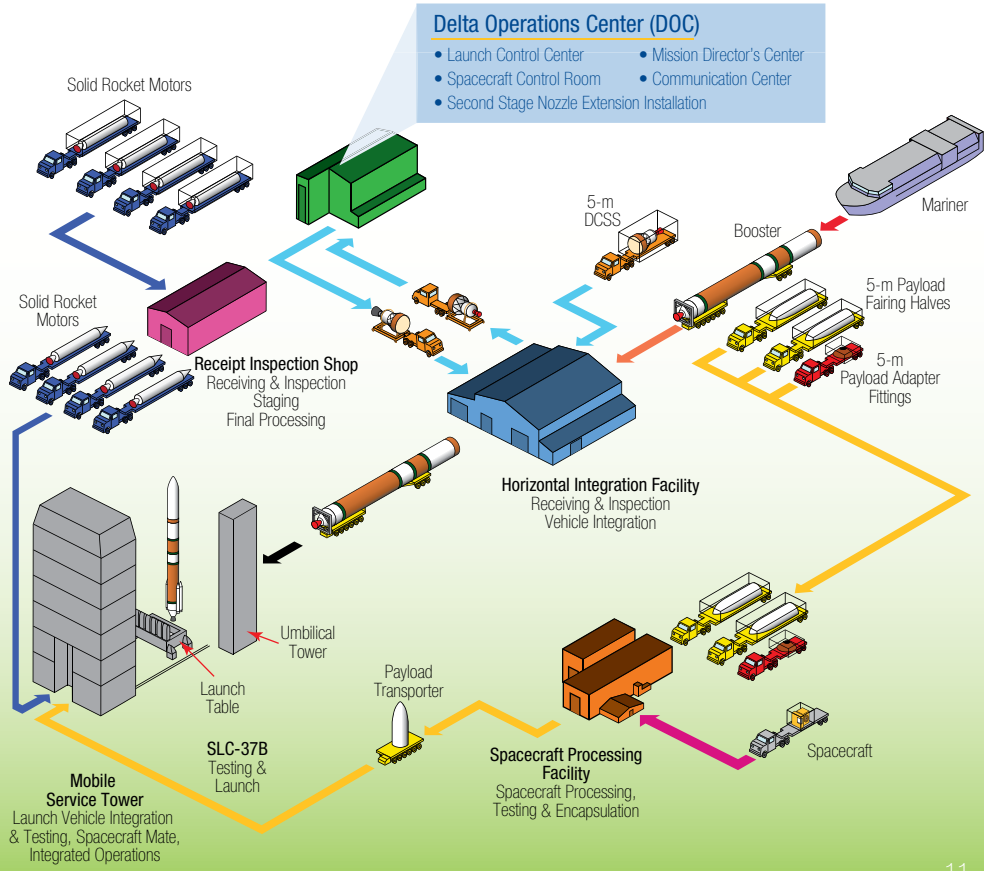
	Event	Time (seconds)	Time (hr:min:sec)
1	RS-68 Engine Ignition	-5.5	-0:00:05.5
	Liftoff (Thrust to Weight > 1)	0.0	0:00:00.0
	Begin Pitch/Yaw/Roll Maneuver	7.0	0:00:07.0
	Maximum Dynamic Pressure	50.0	0:00:50.0
2	SRM Burnout—Fixed Nozzle	91.2	0:01:31.2
	SRM Burnout—TVC Nozzle	92.4	0:01:32.4
	SRM Jettison—Fixed Nozzle	100.0	0:01:40.0
	SRM Jettison—TVC Nozzle	102.4	0:01:42.4
3	Payload Fairing Jettison	207.5	0:03:27.5
4	MECO	247.8	0:04:07.8
5	First-Stage Separation	255.0	0:04:15.0
6	Second-Stage Ignition	268.0	0:04:28.0
7	SECO-1	1,232.3	0:20:32.3
8	First Restart—Second Stage	1,702.5	0:28:22.5
9	SECO-2	1,890.8	0:31:30.8
10	WGS-6 Separation	2,437.5	0:40:37.5

Delta IV WGS-6

DELTA IV PRODUCTION & LAUNCH | Overview

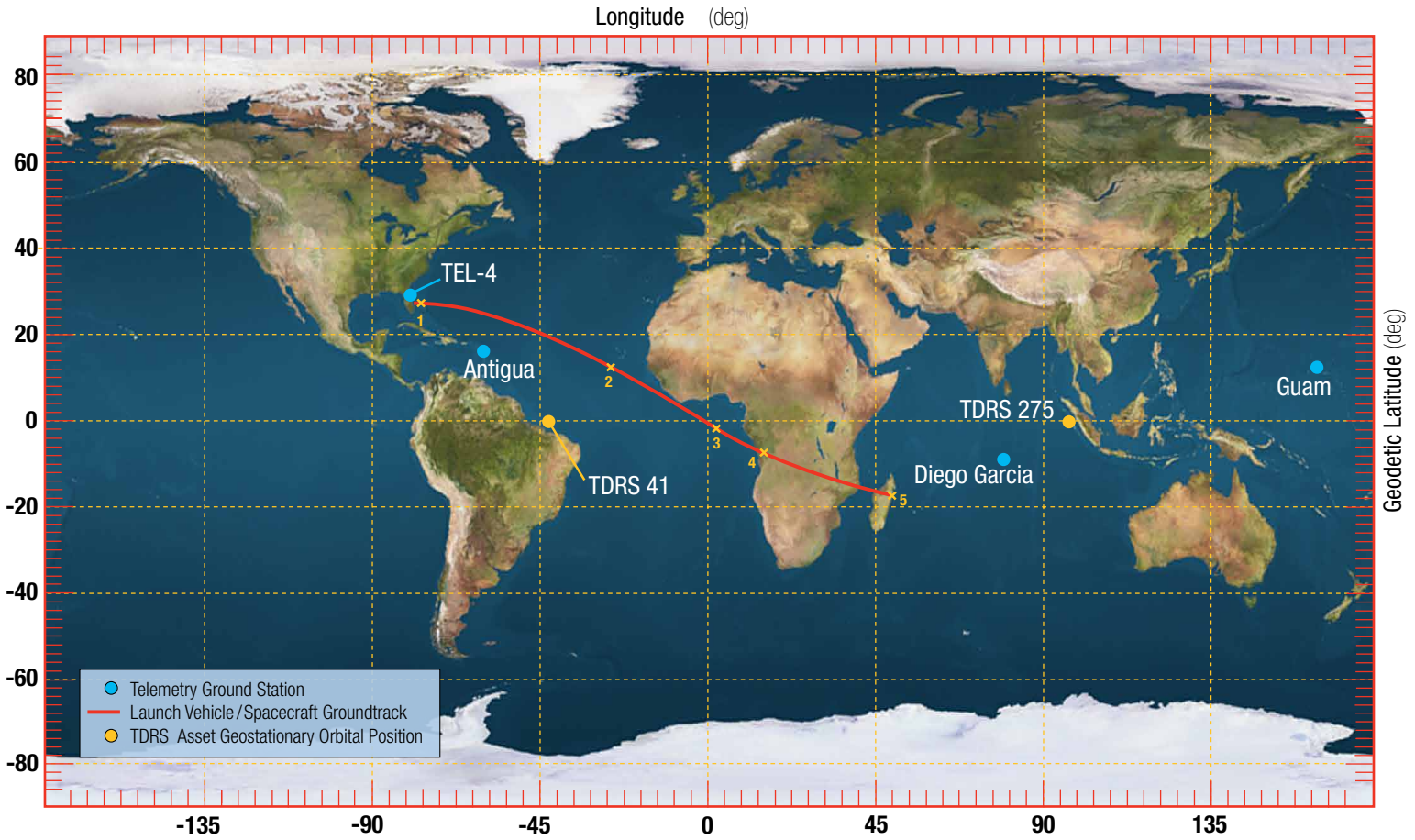


DELTA IV PROCESSING | Cape Canaveral



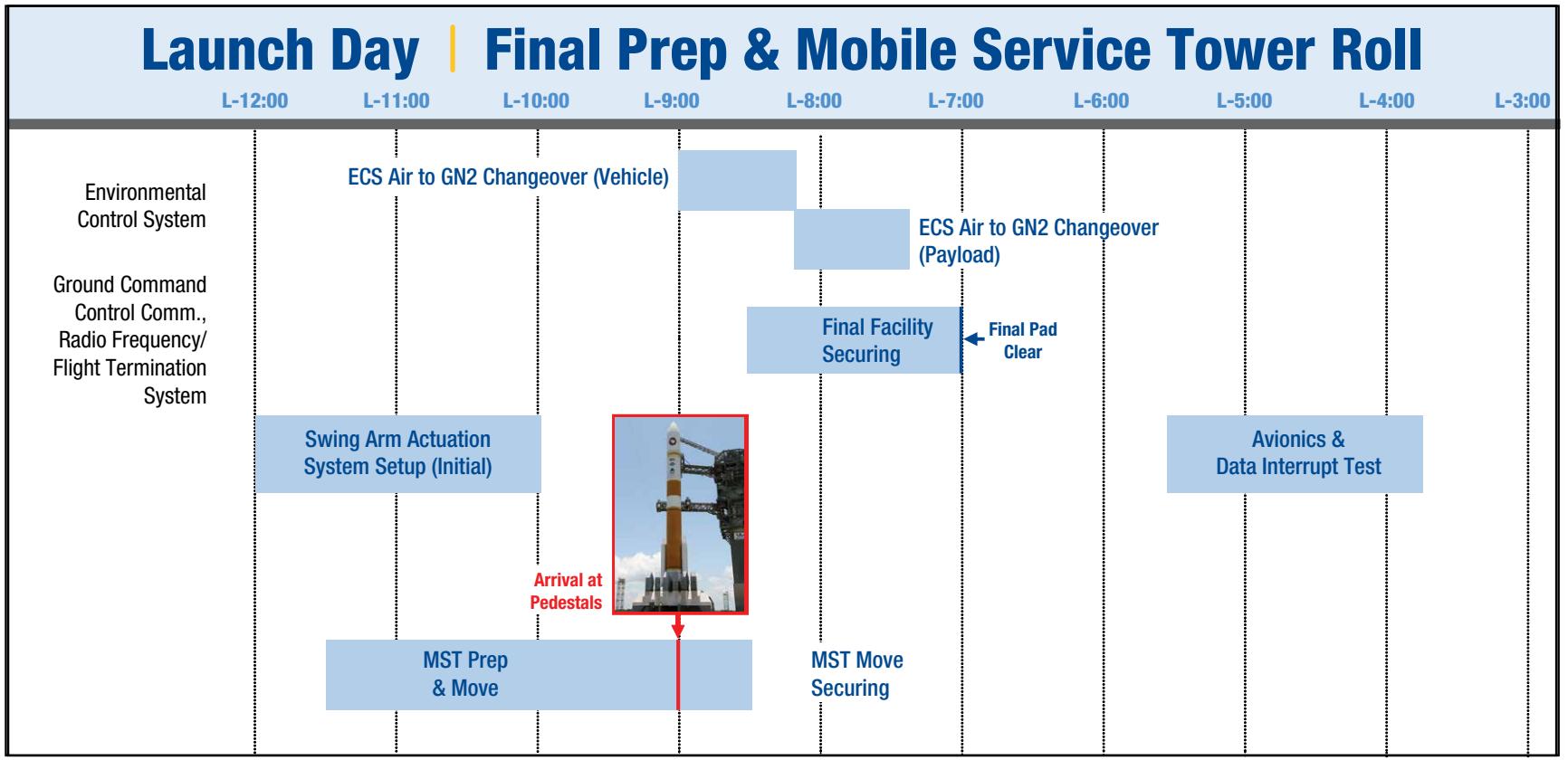
Delta IV WGS-6

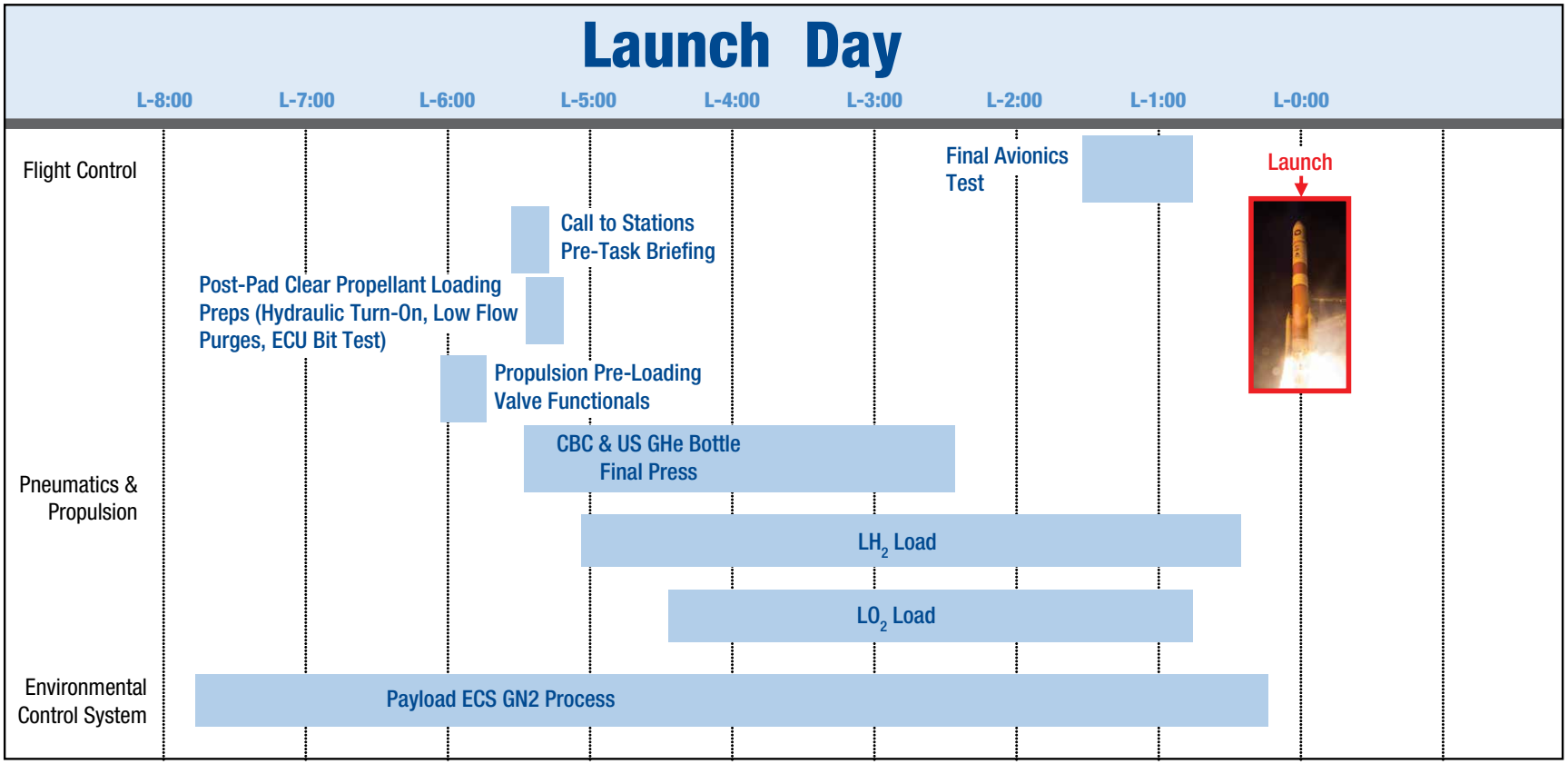
GROUND TRACE | Liftoff to Separation



1 = MECO (0:04:07.8) | **2 =** SECO-1 (0:20:32.3) | **3 =** 1st Restart— 2nd Stage (0:28:22.5) | **4 =** SECO-2 (0:31:30.8) | **5 =** WGS-6 Separation (0:40:37.5)

Delta IV WGS-6


Launch Day | Final Prep & Mobile Service Tower Roll
L-12:00
L-11:00
L-10:00
L-9:00
L-8:00
L-7:00
L-6:00
L-5:00
L-4:00
L-3:00
Environmental Control System
Ground Command Control Comm., Radio Frequency/ Flight Termination System
ECS Air to GN2 Changeover (Vehicle)
ECS Air to GN2 Changeover (Payload)
Final Facility Securing
Final Pad Clear
Swing Arm Actuation System Setup (Initial)
Avionics & Data Interrupt Test
Arrival at Pedestals
MST Prep & Move
MST Move Securing


Launch Day
L-8:00
L-7:00
L-6:00
L-5:00
L-4:00
L-3:00
L-2:00
L-1:00
L-0:00
Flight Control
Final Avionics Test
Launch
Call to Stations Pre-Task Briefing
Post-Pad Clear Propellant Loading Preps (Hydraulic Turn-On, Low Flow Purges, ECU Bit Test)
Propulsion Pre-Loading Valve Functionals
CBC & US GHe Bottle Final Press
Pneumatics & Propulsion
LH2 Load
LO2 Load
Environmental Control System
Payload ECS GN2 Process

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