MISSION OVERVIEW

SLC-37
CCAFS, FL

ULA®
United Launch Alliance

DELTA

The ULA team is proud to be the launch provider for the U.S. Air Force (USAF) Global Positioning System (GPS) Directorate by delivering replenishment satellites aboard Atlas V and Delta IV launch vehicles. GPS satellites serve and protect our warfighters by providing navigational assistance for U.S. military operations on land, at sea, and in the air. Civilian users around the world also use and depend on GPS for highly accurate time, location, and velocity information.

GPS IIF-3 is one of the next generation GPS satellites, incorporating various improvements to provide greater accuracy, increased signals, and enhanced performance for users.

The ULA team is focused on attaining Perfect Product Delivery for the GPS IIF-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).

We sincerely thank the entire team, which consists of the USAF, The Aerospace Corporation, ULA, and major suppliers of ULA, for their continued hard work, and commitment to mission success and perfect product delivery.

Go Delta, Go GPS!

Jim Sponnick
Vice President, Mission Operations

GPS IIF-3 SATELLITE | Overview

The Navstar GPS is a constellation of satellites that provides navigation data to military and civilian users worldwide. The system is operated and controlled by the 50th Space Wing, located at Schriever Air Force Base, CO.

GPS utilizes 24 satellites, in six different planes, with a minimum of four satellites per plane, positioned in orbit approximately 11,000 miles above the Earth's surface. The satellites continuously transmit digital radio signals pertaining to the exact time (using atomic clocks) and exact location of the satellites. The GPS IIF series have a design life of 12 years. With the proper equipment, users can receive these signals to calculate time, location, and velocity. The signals are so accurate that time can be measured to within a millionth of a second, velocity within a fraction of a mile per hour, and location to within feet. Receivers have been developed for use in aircraft, ships, land vehicles, and to hand carry.

As a result of increased civil and commercial use as well as experience in military operations, the USAF has added the following capabilities and technologies to the GPS IIF series to sustain the space and control segments while improving mission performance:

- Two times greater predicted signal accuracy than heritage satellites.
- New L5 signals for more robust civil and commercial aviation.
- An on-orbit, reprogrammable processor, receiving software uploads for improved system operation.
- Military signal "M-code" and variable power for better resistance to jamming hostile environments, meeting the needs of emerging doctrines of navigation warfare.

DELTA IV MEDIUM+ (4,2) LAUNCH VEHICLE | Overview

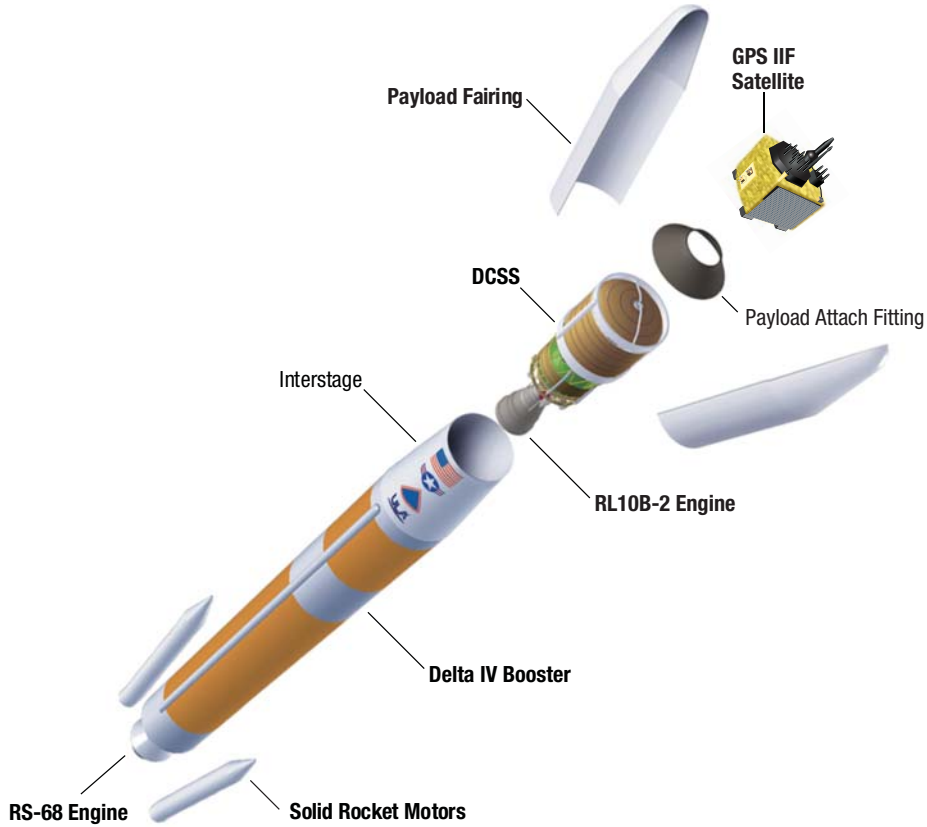
The Delta IV Medium+ (4,2) consists of a single Delta IV common booster core (CBC), the Delta cryogenic second stage (DCSS), and two solid rocket motors (SRM). The CBC and the DCSS are connected by a composite cylindrical interstage adapter (ISA). The SRMs are connected to the booster by two ball-and-socket joints and structural thrusters.

The SRMs, with a 60 in diameter and 53 ft length, are constructed of a graphite-epoxy composite. The SRMs burn for approximately 94 seconds and are jettisoned approximately 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 stage 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 satellite are provided via the payload attach fitting (PAF). The GPS missions use a 4-m diameter payload fairing (PLF). The PLF is a composite bisector (two-piece shell) fairing. The vehicle's height, with the 38.5-ft tall PLF, is approximately 206 ft.

DELTA IV MEDIUM+ (4,2) LAUNCH VEHICLE | Expanded View



Delta IV GPS IIF-3

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 GPS IIF-3 | Mission Overview

The GPS IIF-3 mission will launch from Space Launch Complex 37 (SLC-37) at Cape Canaveral Air Force Station (CCAFS), FL on a Delta IV Medium+ (4,2) vehicle.

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

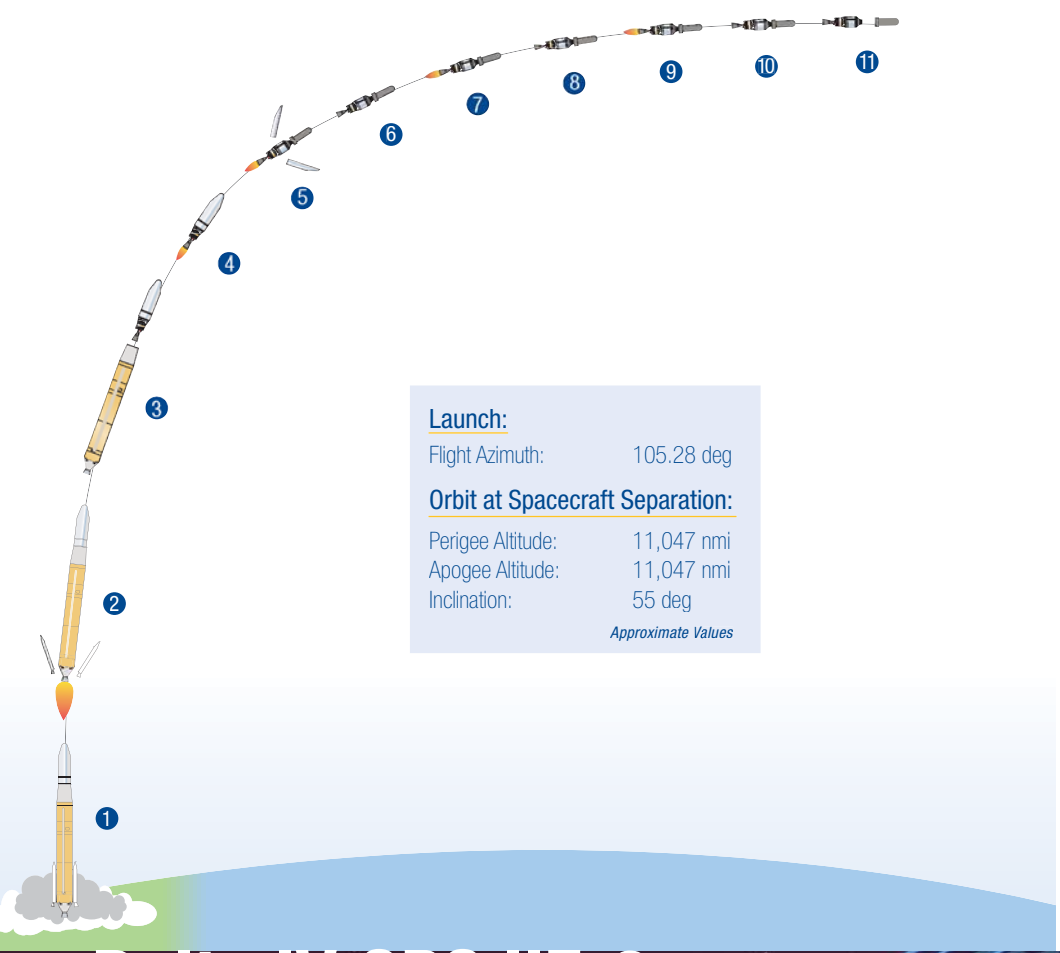
The three-burn mission will fly an easterly trajectory from SLC-37 with an approximately 105-degree flight azimuth. The separation event will release the GPS IIF-3 satellite into a geosynchronous orbit with 11,047-nautical mile (nmi) perigee and apogee altitudes and a 55-degree inclination.

Launch begins with RS-68 engine ignition approximately 5 seconds prior to liftoff (T-5.0 seconds). SRM ignition takes place at T-0.01 second after telemetry indication of healthy RS-68 startup. Liftoff occurs at T+0.0 seconds. Shortly after the vehicle clears the pad, it performs its pitch/yaw/roll program. Maximum dynamic pressure occurs approximately 60 seconds into flight.

The SRMs burn out at approximately T+94 seconds, and are jettisoned at T+100 seconds. Ignition of the second stage or DCSS main engine occurs 15 seconds after first stage separation. Payload fairing jettison takes place at approximately 276 seconds into the flight.

At approximately 12 minutes into the mission, the first second stage engine cutoff (SECO-1) occurs and DCSS has achieved its parking orbit. Following a 9-minute coast phase, DCSS reorients itself for restart. Restart ignition takes place approximately 21 minutes into the mission and lasts about 3 minutes. Following a nearly 3-hour coast phase, the second stage engine is restarted for a third burn lasting approximately 2 minutes. After SECO-3, the DCSS re-orients its attitude for the separation event. The GPS IIF-3 spacecraft separates 3 hours 33 minutes after liftoff.

FLIGHT PROFILE | Liftoff to Spacecraft Separation



Launch:

Flight Azimuth: 105.28 deg

Orbit at Spacecraft Separation:

Perigee Altitude: 11,047 nmi
Apogee Altitude: 11,047 nmi
Inclination: 55 deg

Approximate Values

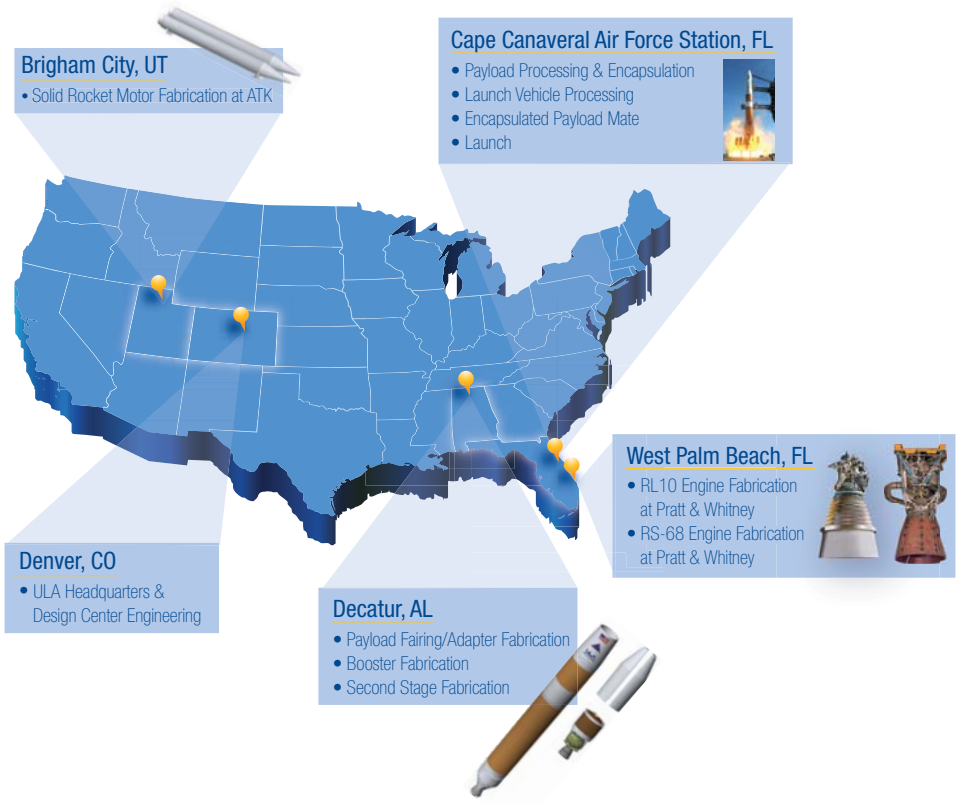
SEQUENCE OF EVENTS | Liftoff to Spacecraft Separation

	Event	Time (seconds)	Time (hr:min:sec)
1	RS-68 Engine Ignition	-5.0	-00:00:05.0
	SRM Ignition	-0.1	-00:00:00.1
	Liftoff (Thrust to Weight > 1)	0.0	00:00:00.0
	Begin Pitch/Yaw Maneuver	8.0	00:00:08.0
	Mach 1.05	46.9	00:00:46.9
	Maximum Dynamic Pressure	60.2	00:00:60.2
2	SRM Burnout	94.1	00:01:34.1
	SRM Jettison	100.0	00:01:40.0
3	MECO	245.6	00:04:05.6
	First-Stage Separation	251.6	00:04:11.6
4	Second-Stage Ignition	266.1	00:04:26.1
5	Payload Fairing Jettison	276.5	00:04:36.5
6	First Cutoff—Second Stage (SECO-1)	731.5	00:12:11.5
7	First Restart—Second Stage*	1,277.4	00:21:17.4
8	Second Cutoff—Second Stage (SECO-2)*	1,474.4	00:24:34.4
9	Second Restart—Second Stage*	12,044.6	03:20:44.6
10	Third Cutoff—Second Stage (SECO-3)*	12,142.5	03:22:22.5
11	Spacecraft Separation (SC)*	12,783.0	03:33:03.0

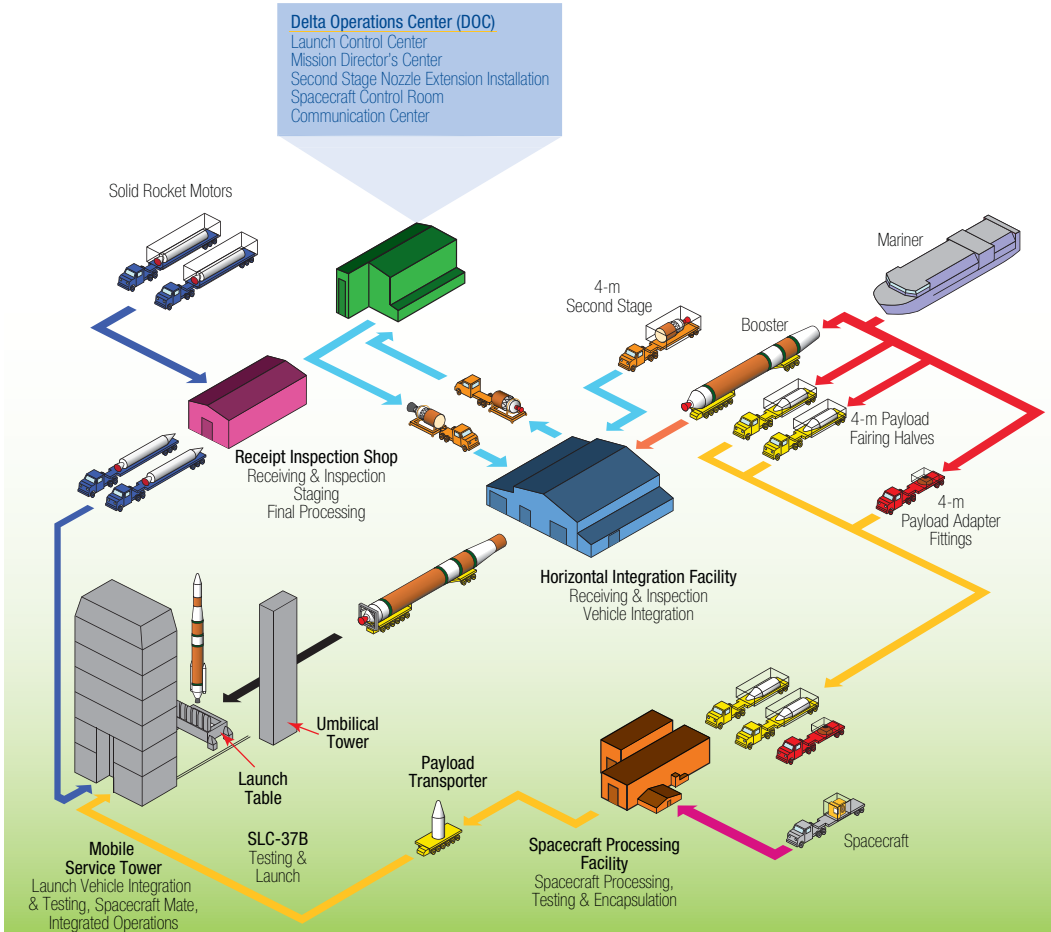
**Times apply to DscN mission only*

Delta IV GPS IIF-3

DELTA IV PRODUCTION & LAUNCH | Overview

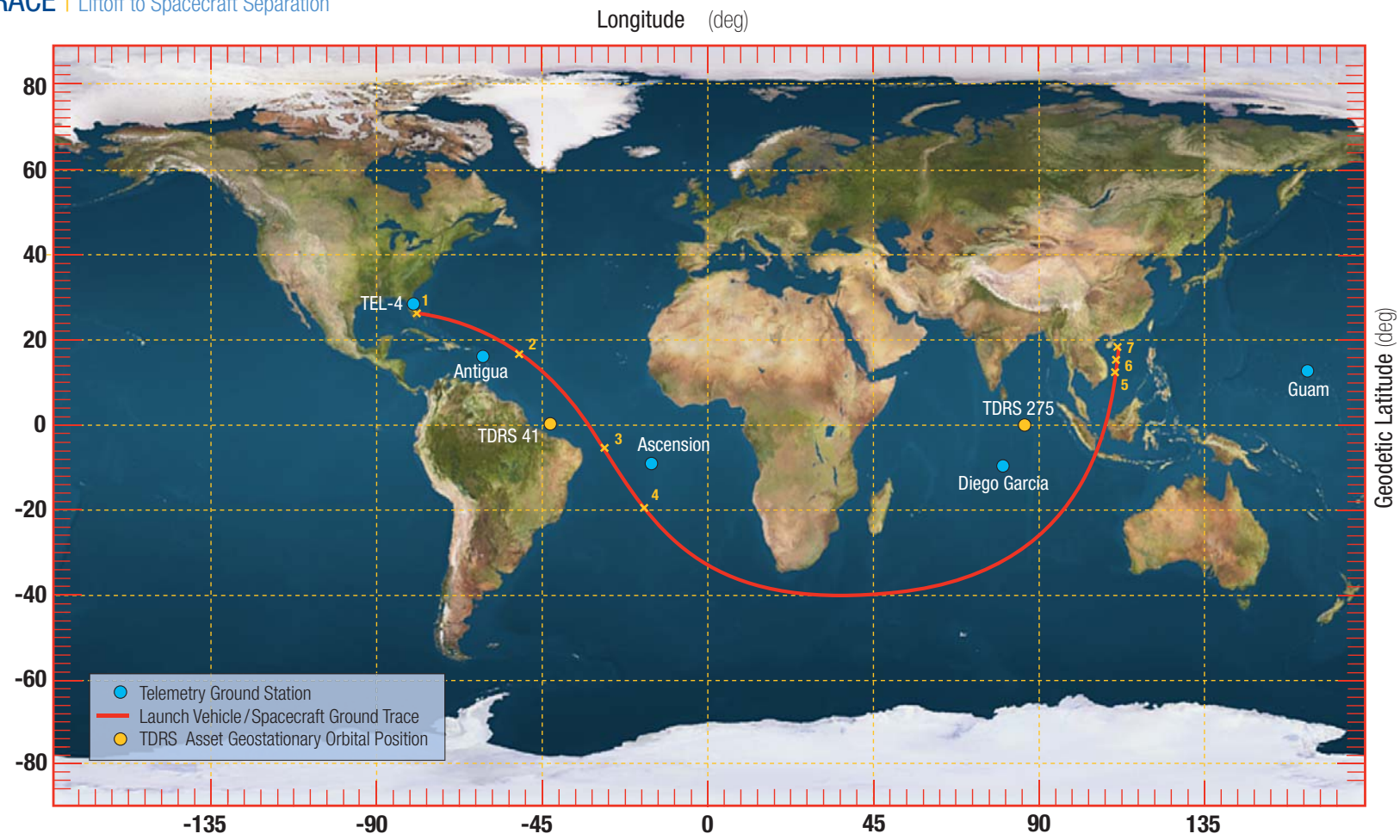


DELTA IV PROCESSING | Cape Canaveral



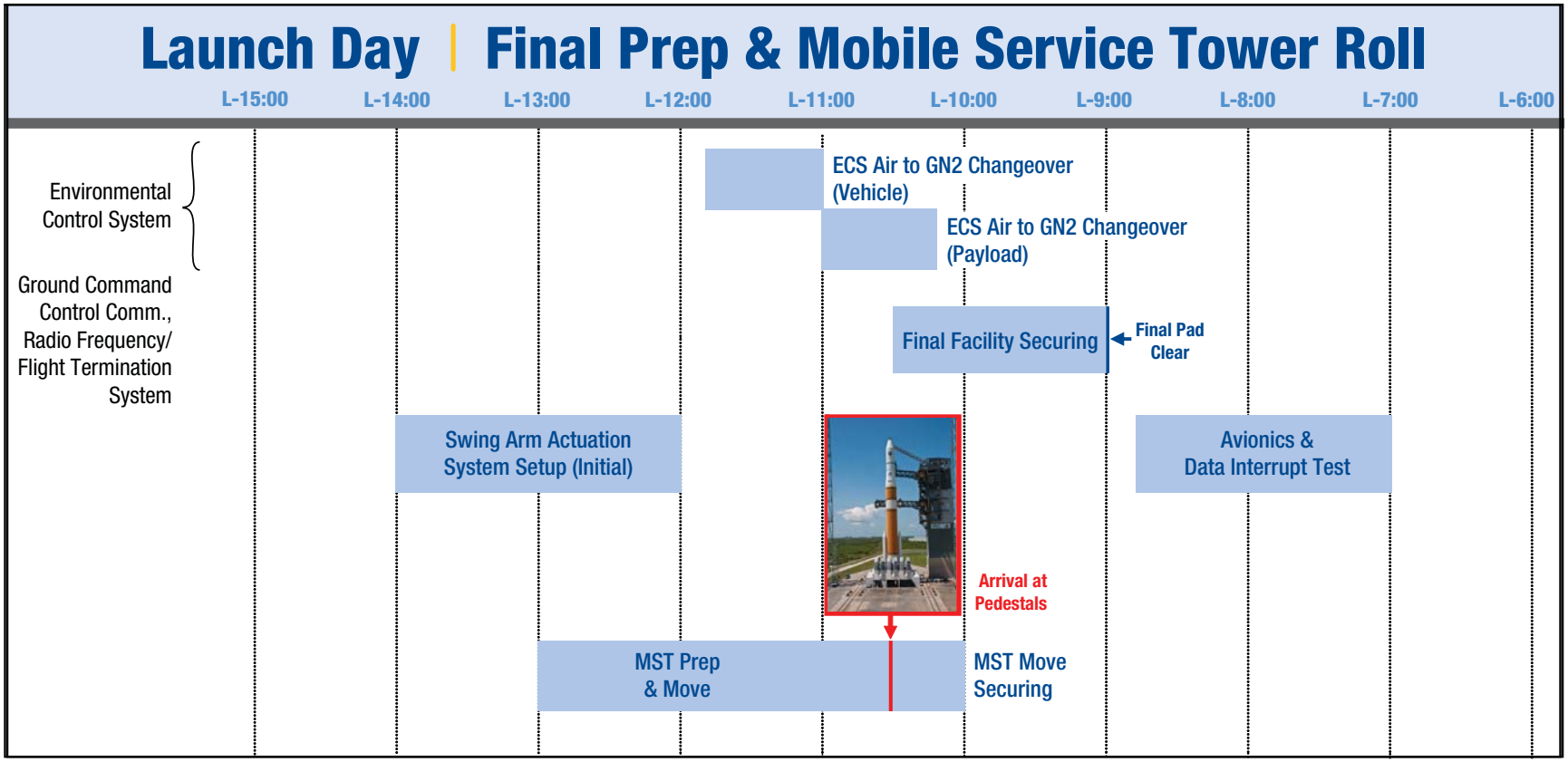
Delta IV GPS IIF-3

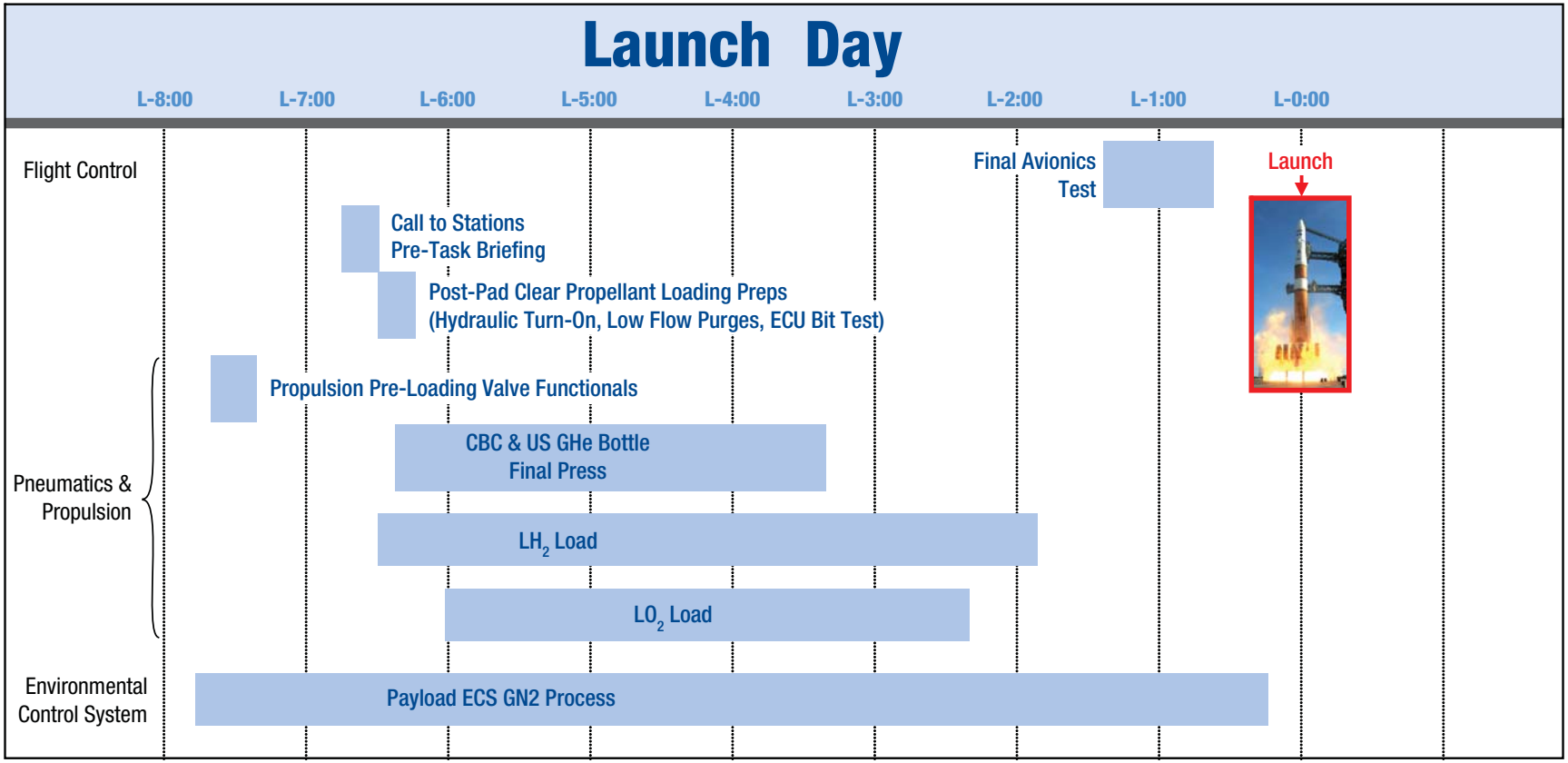
GROUND TRACE | Liftoff to Spacecraft Separation



1 = MECO (0:04:05.6) | **2 =** SECO-1 (0:12:11.5) | **3 =** 1st Restart—2nd Stage (0:21:17.4) | **4 =** SECO-2 (0:24:34.4)
5 = 2nd Restart—2nd Stage (3:20:44.6) | **6 =** SECO-3 (3:22:22.5) | **7 =** S/C Sep (3:33:03.0)

Delta IV GPS IIF-3


Launch Day | Final Prep & Mobile Service Tower Roll
L-15:00
L-14:00
L-13:00
L-12:00
L-11:00
L-10:00
L-9:00
L-8:00
L-7:00
L-6:00
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
Pneumatics & Propulsion
CBC & US GHe Bottle Final Press
LH2 Load
LO2 Load
Environmental Control System
Payload ECS GN2 Process

GPS IIF-3

Delta IV

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