GPS IIR-18 (M)

U.S. Air Force

Delta Launch Vehicle Programs

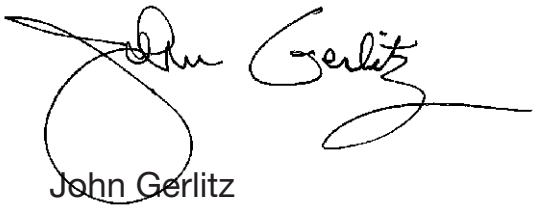
ULA™
United Launch Alliance

GPS IIR-18 (M)

The Delta team is proud to be the launch provider for the Air Force Global Positioning System (GPS) program by delivering replenishment satellites to orbit aboard the Delta II rocket. GPS satellites serve and protect our war fighters 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 directional assistance.

GPS IIR-18 (M) is the fifth of the modernized GPS satellites, incorporating various improvements to provide greater accuracy, increased resistance to interference and enhanced performance for users. It will be launched aboard a Delta II 7925-9.5 vehicle in December 2007 from Space Launch Complex 17A at Cape Canaveral Air Force Station, FL.

We wish to thank our Delta II team, which consists of the U. S. Air Force, The Aerospace Corporation, ULA, and major suppliers of ULA, for their continued hard work and commitment to mission success. We look forward to continuing our support for the Air Force aboard Delta II launch vehicles.



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Launch & Range Systems Wing

GPS Mission

The Navstar Global Positioning System (GPS) is a constellation of orbiting satellites that provides navigation data to military and civilian users all over the world. The system is operated and controlled by the 50th Space Wing, located at Schriever Air Force Base, Colo.

GPS satellites orbit the Earth every 12 hr, emitting continuous navigation signals. With the proper equipment, users can receive these signals to calculate time, location, and velocity. The signals are so accurate that time can be figured to within a millionth of a second, velocity within a fraction of a mile per hour, and location to within 100 ft. Receivers have been developed for use in aircraft, ships, and land vehicles, as well as for hand-carrying.

GPS provides 24-hr navigation services including:

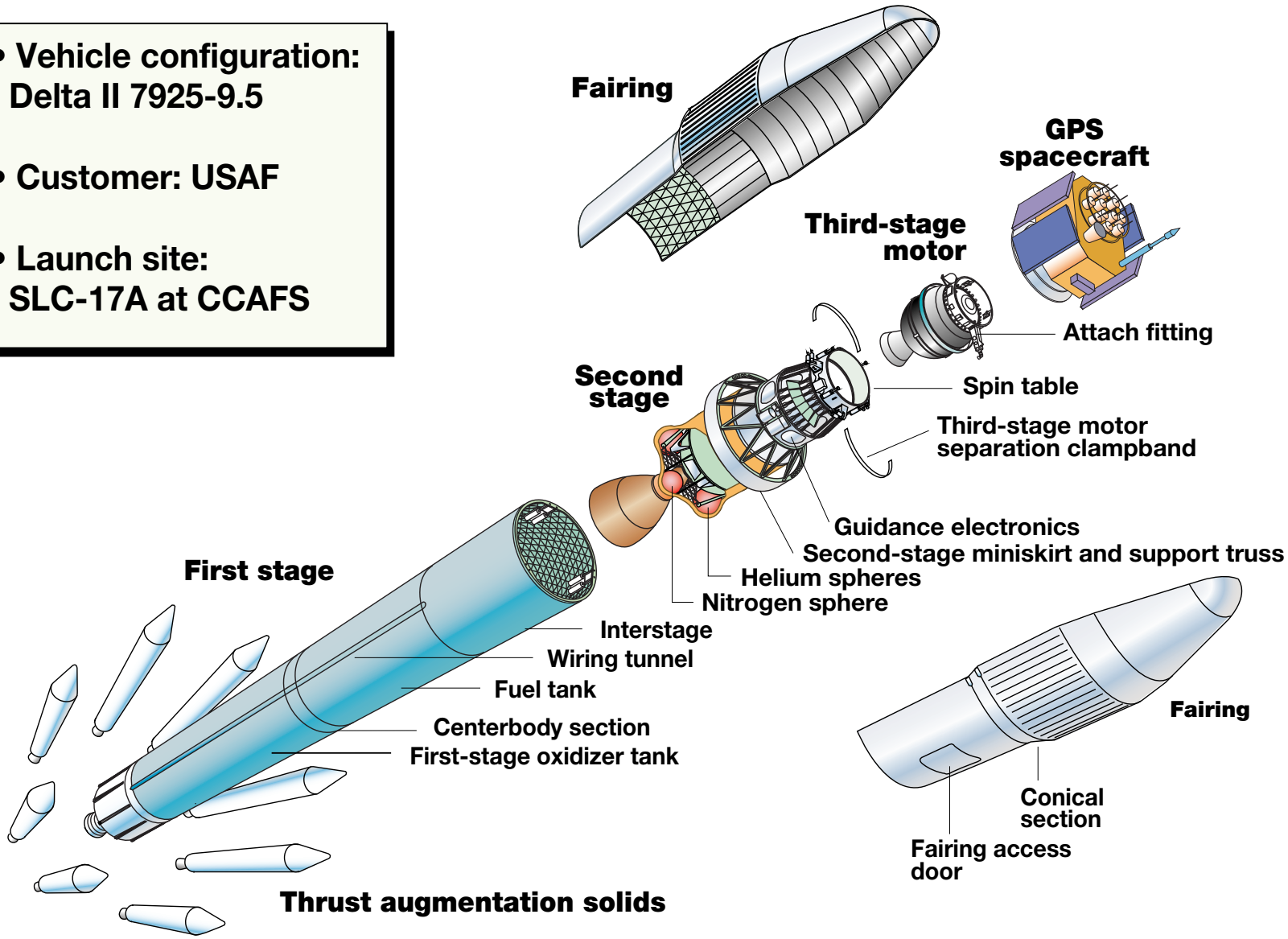
- Extremely accurate, three-dimensional location information (latitude, longitude, and altitude), velocity, and precise time
- A worldwide common grid that is easily converted to any local grid
- Passive all-weather operations
- Continuous real-time information
- Support to an unlimited number of users and areas
- Support to civilian users at a slightly less accurate level

The GPS constellation is designed and operated as a 24-satellite system, consisting of six planes, with a minimum of four satellites per plane.

The GPS satellites are placed into nearly 11,000-mile circular orbits. While circling the Earth, the systems transmit signals on three different L-band frequencies. Their design life is 10 years.

Delta II 7925-9.5 Launch Vehicle

- Vehicle configuration: Delta II 7925-9.5
- Customer: USAF
- Launch site: SLC-17A at CCAFS



GPS IIR (M) Spacecraft
Mission Requirements

• Transfer orbit criteria (defined at space vehicle separation)	
– Apogee altitude	10,998.00 nmi (integrated)
– Perigee altitude	104.00 nmi
– Inclination	40.00 deg
– Geodetic latitude (at first apogee)	-10.05 deg N
– Ascending node	
• Payload weight	4,540.0 lb (2,059.3 kg)
• Transfer orbit injection mode	Ascending node
• Launch pad	SLC-17A

GPS IIR (M) Spacecraft
Mission Requirements *(continued)*

• Spin rate	55 rpm
• Second-stage probability of command shutdown (PCS)	≥ 99.7%
• Free molecular heating rate at fairing separation	≤ 0.1 Btu/ft^2-sec (1,135 W/m^2)

GPS IIR (M) Flight Mode Description

- Delta II 7925-9.5 vehicle configuration
- Launch from CCAFS SLC-17A down flight azimuth of 110 deg
- 6/3 GEM solid motor firing sequence
- Common boost trajectory utilized for both descending and ascending node injections
- Boost trajectory designed to meet controllability, structural and environmental constraints while maximizing vehicle performance
- Dogleg maneuver used to increase parking orbit inclination
  - Maneuver split between booster and second-stage flight to meet Range Safety constraints
- Main Engine Cutoff (MECO) occurs at first-stage propellant depletion; approximately 263 sec after liftoff
- Second stage separates 8 sec after MECO; Stage II ignited 5.5 sec later
- Payload fairing jettisoned when free molecular heating rate is
  < 0.1 Btu/ft^2-sec (1,135 W/m^2)
- Second-stage first burn places vehicle in parking orbit at SECO-1
  - Ascending node: 94 x 111 nmi orbit at 37.50 deg inclination

GPS IIR (M) Flight Mode Description
(continued)

- Following SECO-1, vehicle is reoriented to second-stage restart and third-stage burn attitude
- At end of reorientation maneuver, vehicle is rolled at 1 deg/sec for thermal conditioning
- Following coast period of 51.7 min, second-stage restart occurs at approximately 62.5 min after liftoff over the Guam T/M tracking station
  - Restart burn duration of approximately 42.5 sec
  - At SECO-2, vehicle in 103 x 670 nmi orbit at 37.95 deg inclination

GPS IIR (M) Flight Mode Description
(continued)

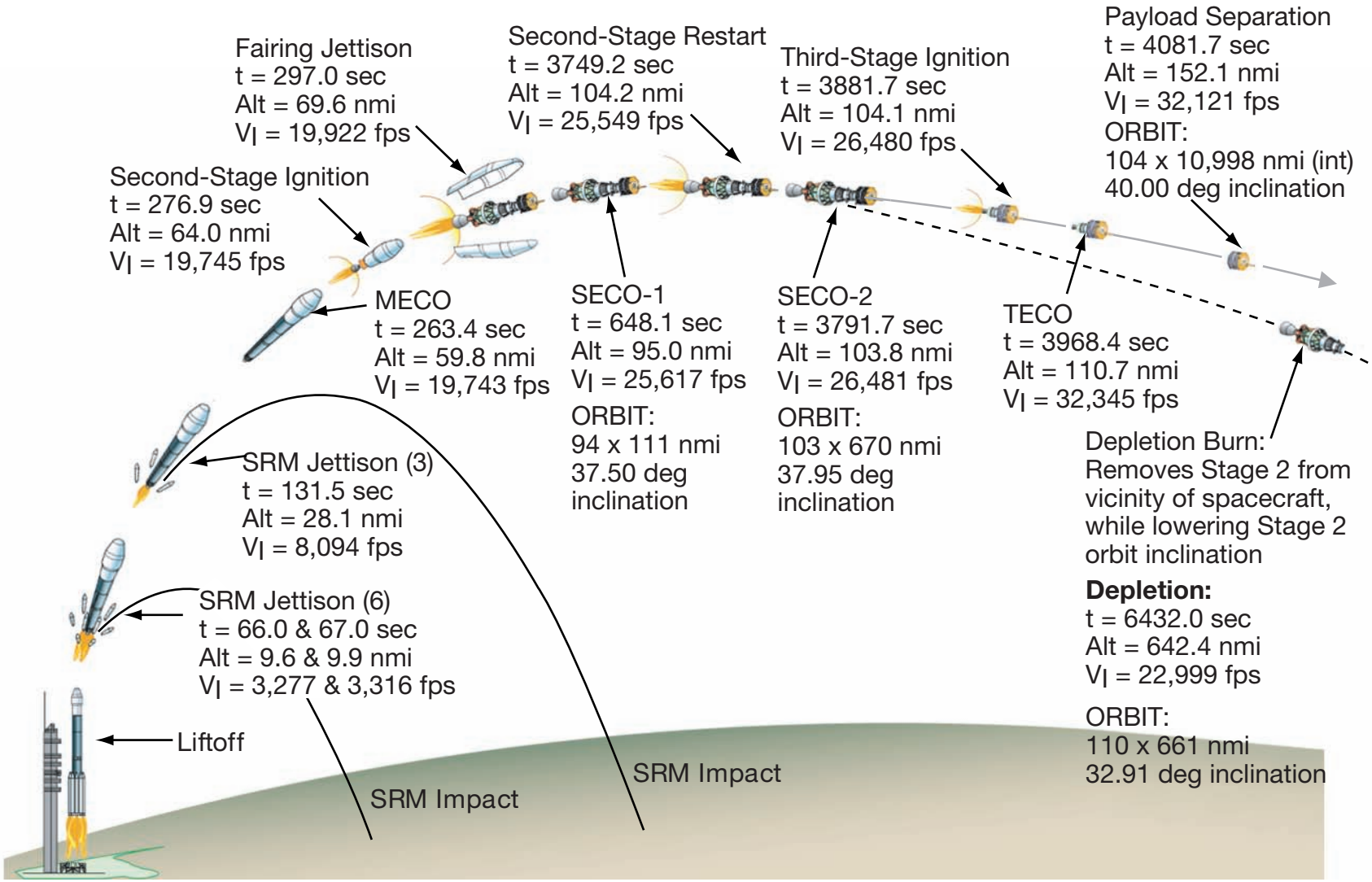
- Spin-up and separation of third stage follows restart burn cutoff

- Third-stage burn and nutation control system (NCS) blowdown places space vehicle into the desired transfer orbit

- Space vehicle separation occurs approximately 68 min after liftoff; third-stage yo deployed 2 sec after separation to tumble stage and preclude recontact with the spacecraft

- Guam tracking station provides telemetry coverage of second-stage restart through spacecraft separation

GPS IIR (M) Ascending Node Flight Profile



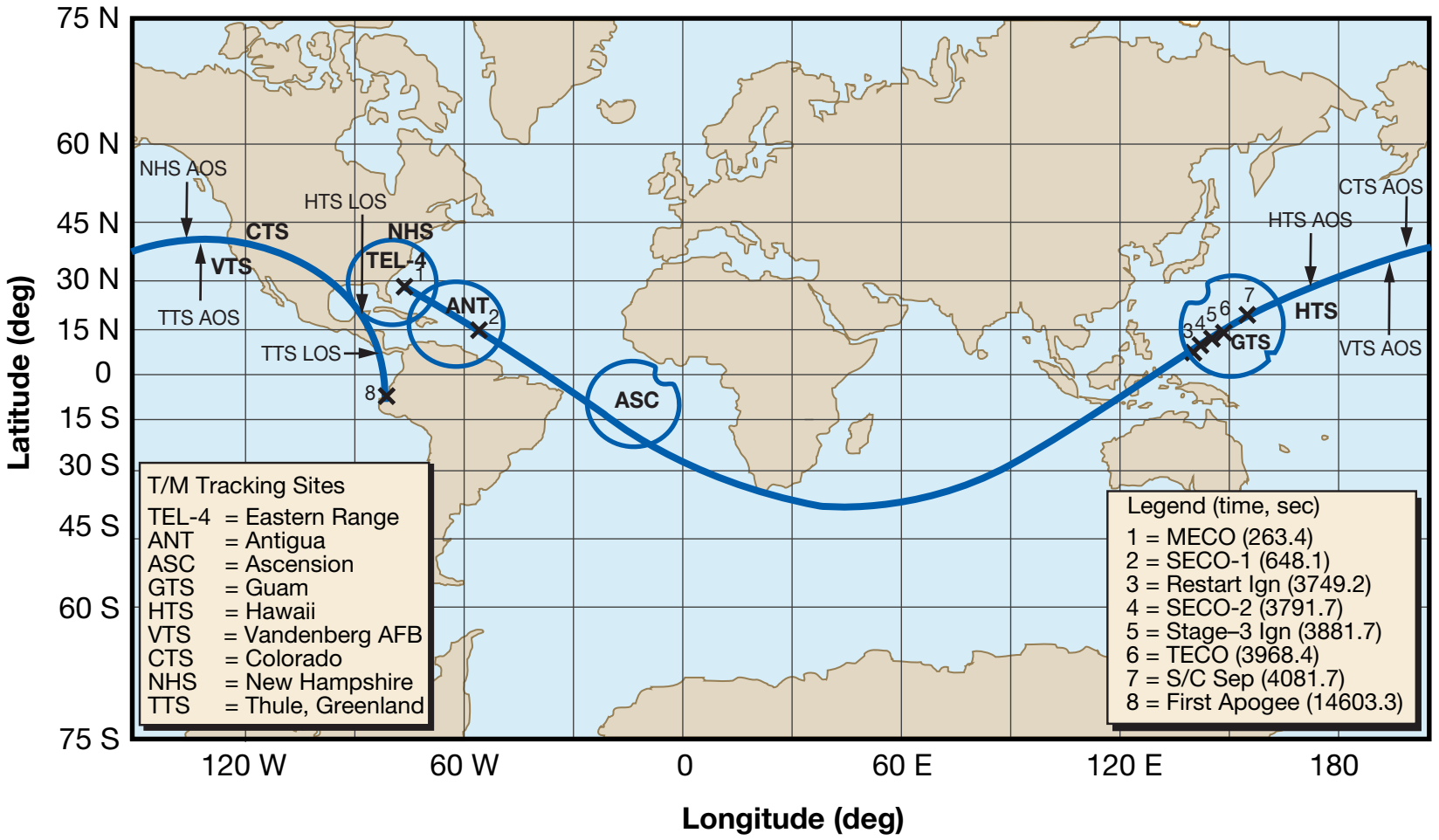
GPS IIR (M) Mission Sequence of Events

Event	Time (min:sec)
Liftoff	00:00.0
Mach 1	00:32.6
Maximum dynamic pressure	00:49.8
Six solid motors burnout	01:03.1
Three solid motors ignition	01:05.5
Jettison three solid motors	01:06.0
Jettison three solid motors	01:07.0
Three solid motors burnout	02:08.8
Jettison three solid motors	02:11.5
Begin dogleg maneuver – Stage I	02:20.0
End dogleg maneuver – Stage I	02:40.0
MECO	04:23.4
Stage I-II separation	04:31.4
Stage II ignition	04:36.9
Begin dogleg maneuver – Stage II	04:43.0
End dogleg maneuver – Stage II	04:53.0

GPS IIR (M) Mission Sequence of Events
(continued)

Event	Time (hr:min:sec)
Jettison fairing	00:04:57.0
First cutoff – second stage (SECO-1)	00:10:48.1
Begin reorientation maneuver	00:12:30.0
End reorientation maneuver	00:17:10.0
Begin coast roll maneuver	00:17:20.0
End coast roll maneuver	00:56:25.0
Restart second stage	01:02:29.2
Second cutoff – second stage (SECO-2)	01:03:11.7
Fire spin rockets	01:04:01.7
Stage II-III separation	01:04:04.7
Stage III ignition/NCS enable	01:04:41.7
Stage III burnout (TECO)	01:06:08.4
Begin NCS blowdown	01:06:51.7
End NCS blowdown	01:07:44.0
Spacecraft separation	01:08:01.7
Stage III yo deploy	01:08:03.7
First apogee of transfer orbit	04:03:23.3

GPS IIR (M) Ascending Node Orbit Trace



Depletion Burn Flight Mode Description

- Second stage depletion burn follows primary mission to safe the stage and lower inclination to minimize casualty probability

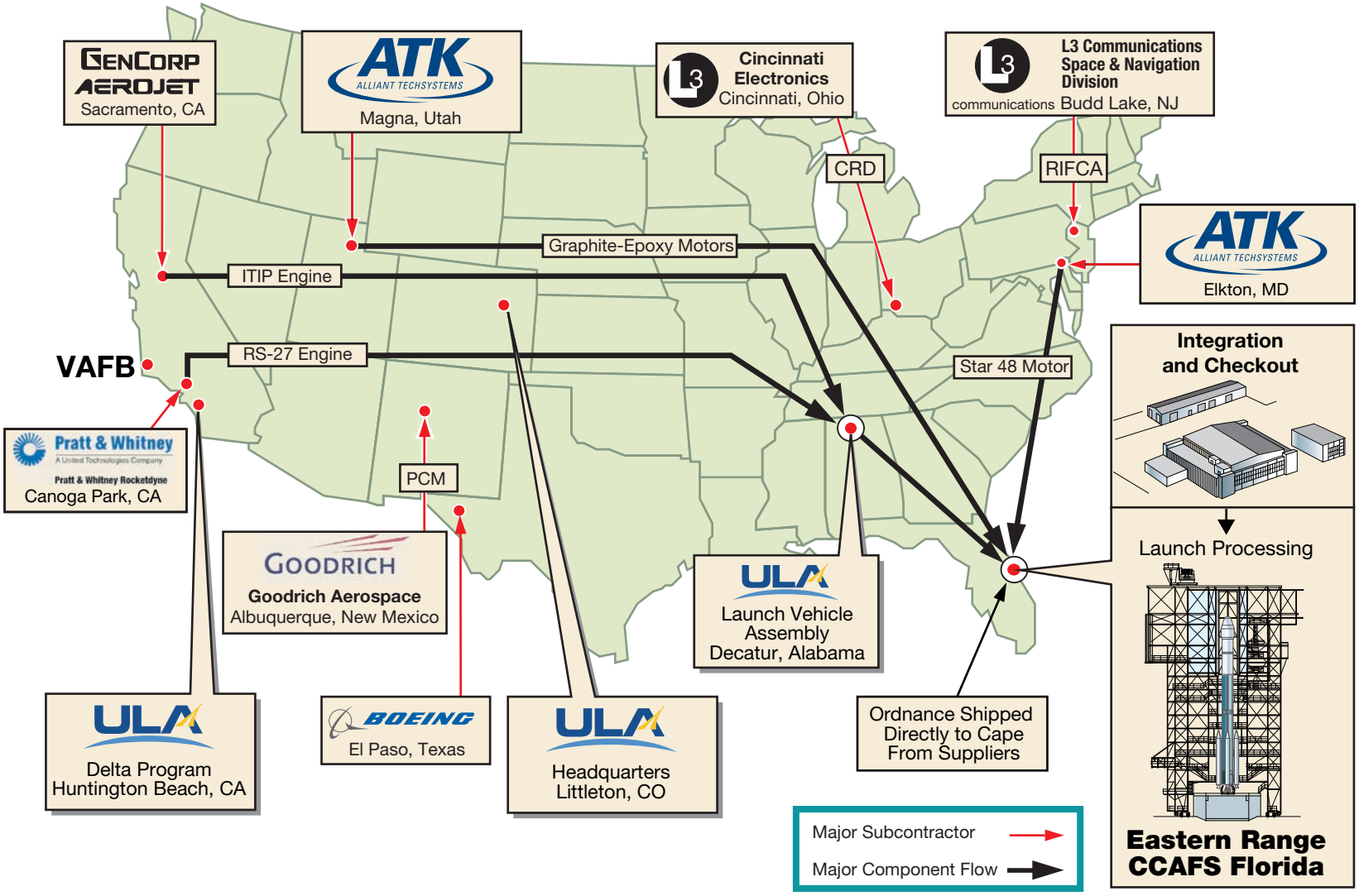
- After Stage II-III separation, vehicle is reoriented to second stage depletion burn attitude

- Depletion burn ignition for ascending node trajectory occurs at 1 hr, 46 min, 40 sec over Eastern Range Tel-4 and Antigua tracking stations

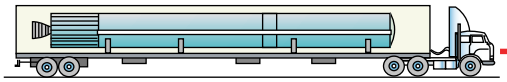
  – Nominal duration of 32.0 sec through mono-propellant blowdown

  – At end of nominal depletion burn second stage in a 110 x 661 nmi orbit with an inclination of 32.91 deg

Operational Flow at Eastern Range



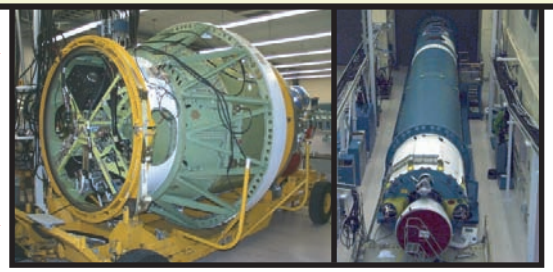
Total Vehicle Integration and Checkout at the Launch Site



• First stage from assembly plant

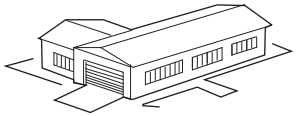
• Second-stage fairing interstage from assembly plant

Delta Mission Checkout (Hangar AO)



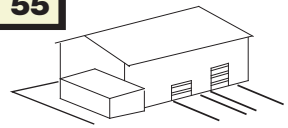
Delta II integration and checkout area
- Receive and inspect
- Mission integration and checkout
- Dual composite tests
- Storage
- Load on pad erection trailers

Horizontal Processing Facility

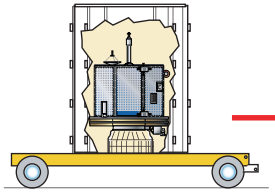


• Destruct installation

Area 55

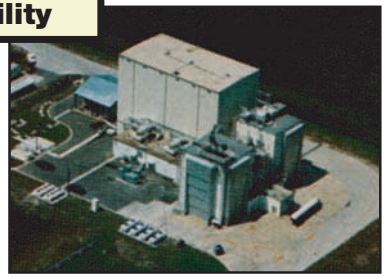


- Destruct installation
- Erection preparation
- Leak checks

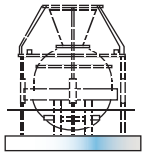


• Space vehicle

Processing Facility

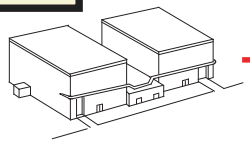


• Mate to upper stage

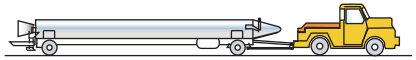


• Upper-stage motor

Area 59

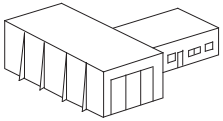


• Balance motor

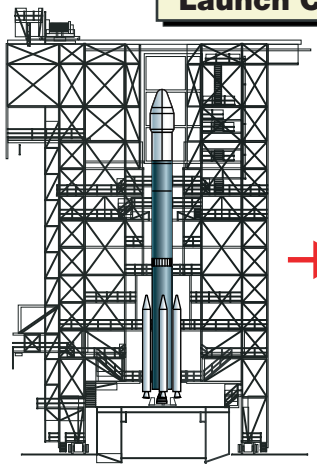


• GEM graphite-epoxy motors

Area 57



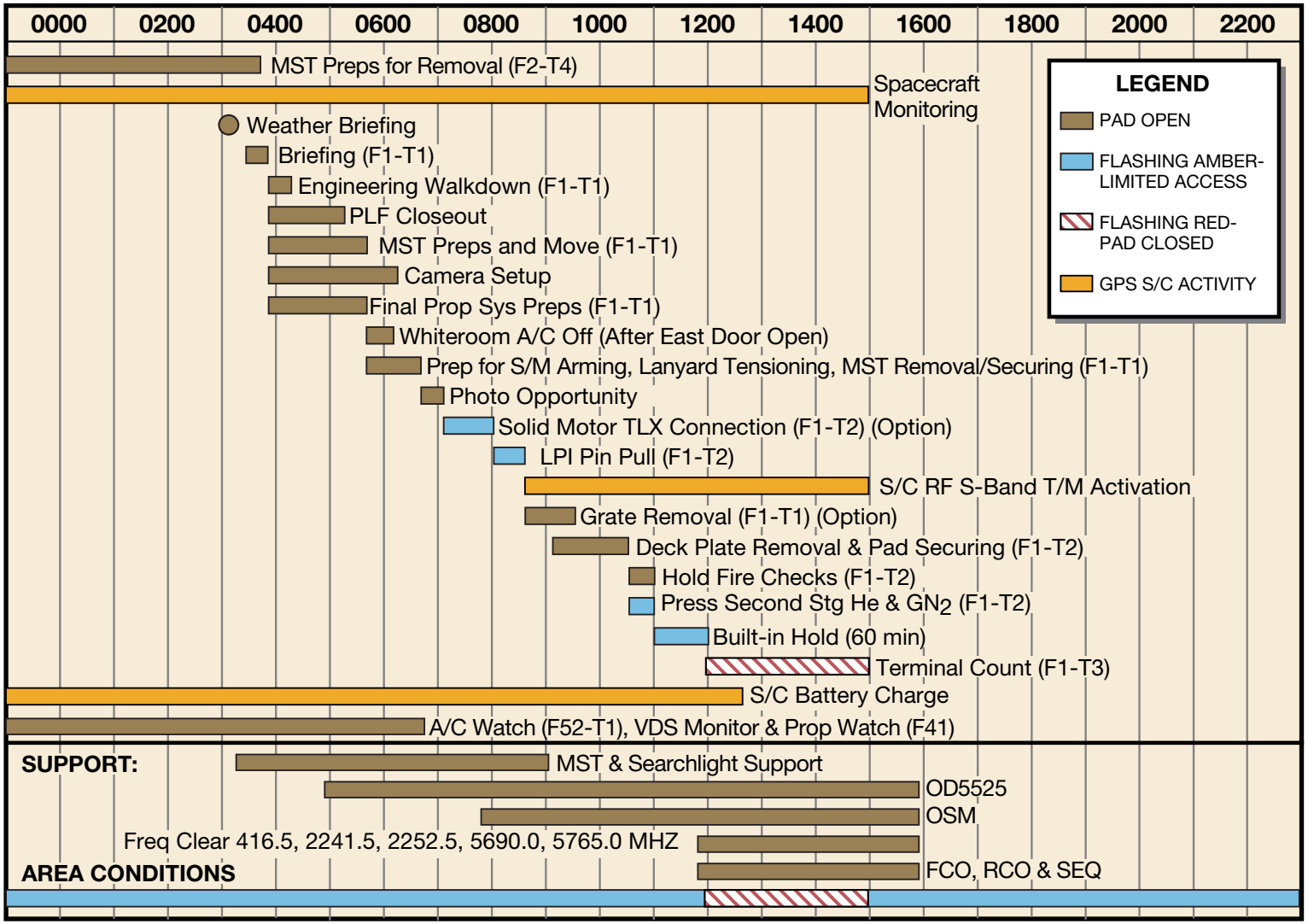
Launch Complex-17



- Erect and mate stages
- Install solid motors
- Check out subsystems
- Simulated flight test
- Preflight finalization

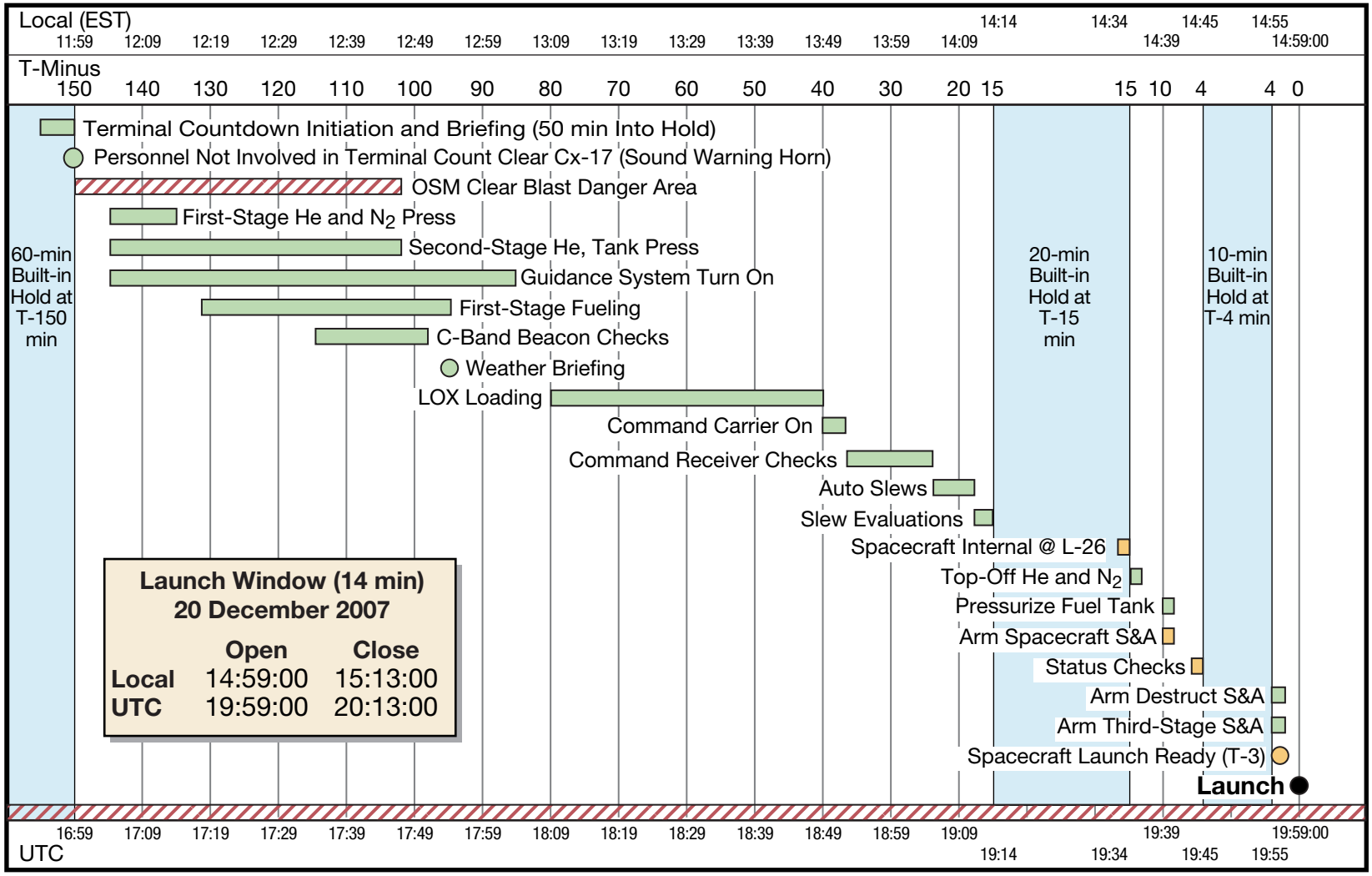
Delta Countdown

T-0 Day



Terminal Count

T-0 Day



Notes:


DELTA II
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45 LCSS
LRSW
45SW
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