BOEING

GeoEye

GeoEye-1

Boeing Launch Services

ULA™
United Launch Alliance

GeoEye-1

Boeing Launch Services and United Launch Alliance are honored to launch the first GeoEye satellite, GeoEye-1. GeoEye-1 will be launched aboard a Delta II launch vehicle from Vandenberg Air Force Base (VAFB). The launch vehicle will deliver the satellite into a circular Sun-synchronous orbit where the satellite will begin its mission of collecting multispectral or color images of the Earth for government and commercial customers.

United Launch Alliance provides the Delta II launch vehicle and mission services under a commercial launch service contract administered by Boeing Launch Services for GeoEye. We are pleased that GeoEye has selected the Delta II to launch the GeoEye-1 satellite. Our congratulations to the entire Delta team for their significant efforts that resulted in achieving this milestone.

Ken Heinly
President, Boeing Launch Services
The Boeing Company

Michael Gass
President and Chief Executive Officer
United Launch Alliance

GeoEye-1 System Overview

GeoEye-1 is equipped with the most advanced and sophisticated technology ever used in a commercial satellite system. The 4,300-pound satellite will be the world's highest resolution commercial Earth-imaging satellite, designed to take highly precise images of the Earth from 425 miles (684 kilometers) in space. The GeoEye-1 satellite consists of the spacecraft bus and a high-resolution Optical Sensor Assembly (OSA).

The GeoEye-1 bus is a mature design, employing qualified flight-heritage components successfully used on previous programs. The spacecraft has precision accuracy attitude and orbit determination sensors, eight reaction wheels, an 840 Gbit solid-state recorder, and high-speed downlinks.

The ITT-built OSA is a next-generation, wide-field-of-view pan and multispectral sensor integrated with a world-class 1.1-m Optical Telescope Unit (OTU).

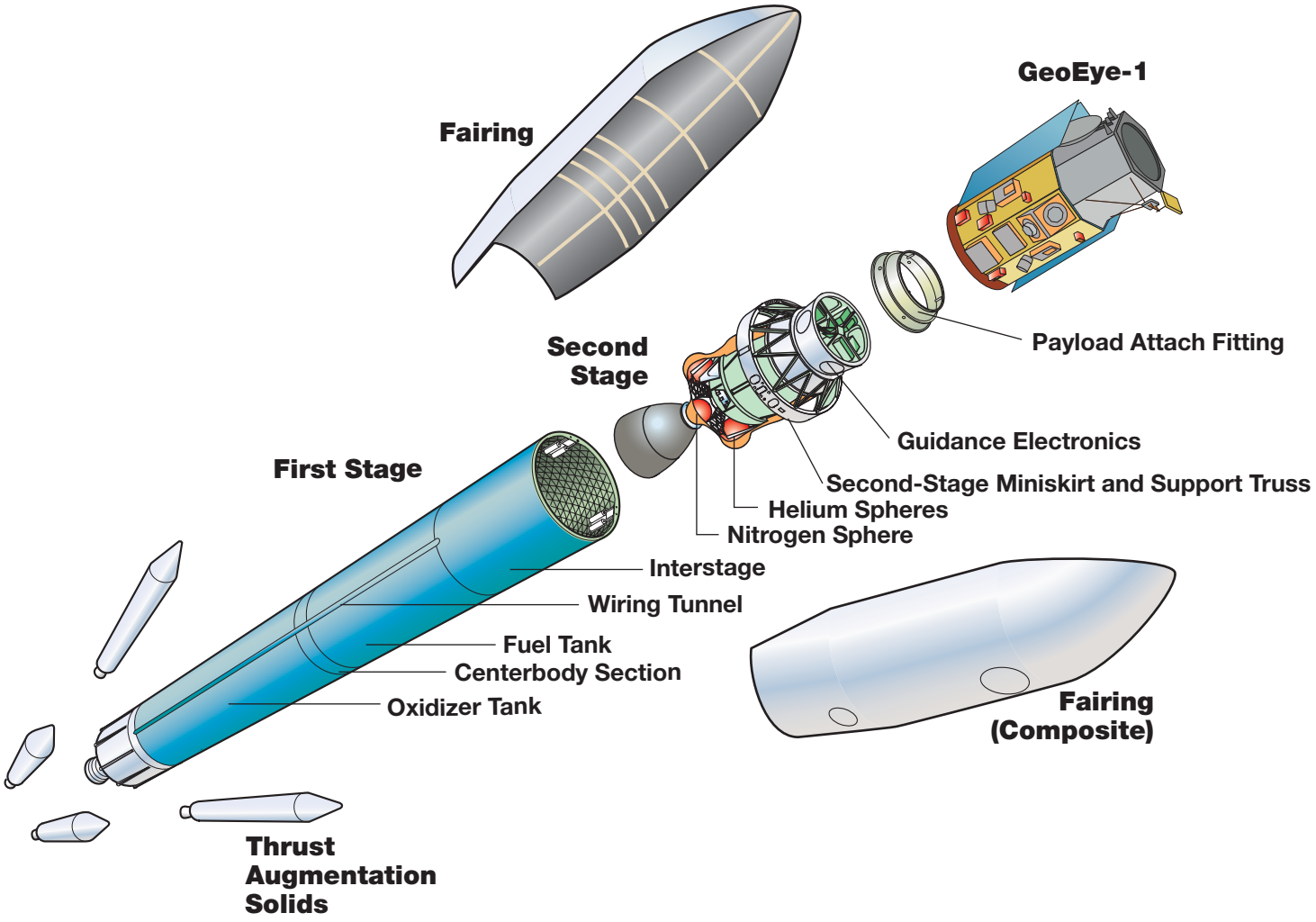
Mission Objectives

GeoEye-1 will serve a wide array of applications for defense, national and homeland security, air and marine transportation, oil and gas, mining, mapping and location-based services, state and local government planning, insurance and risk management, agriculture, and environmental monitoring.

GeoEye-1 will collect multispectral or color imagery at 1.65-meter ground resolution. While the satellite will also be able to collect imagery at 0.41-meter, GeoEye's operating license from the NOAA requires re-sampling the imagery to 0.5-meter for all customers not explicitly granted a waiver by the U.S. Government.

With the launch of GeoEye-1, customers will have assured access to high-resolution, high-quality commercial imagery well into the 2015 timeframe.

Delta II 7420-10 Launch Vehicle



Mission Requirements

• DTO Spacecraft Mass (lb/kg)	4239.5/1923
• Launch Window (hh:mm:ss)	11:50:57 – 11:52:21 a.m. PDT
• Orbit Requirements	
– Apogee Altitude (nmi/km)	3813.3/7062.14
– Perigee Altitude (nmi/km)	3813.3/7062.14
– Inclination (deg)	98.122
– MLT (hh:mm:ss)*	10:30:00
• Free Molecular Heating Rate (FMHR) at fairing jettison	<0.1 BTU/ft^2-sec (1135 W/m^2)
• Post-separation deposition of contaminants onto spacecraft	< 10 Angstroms

*Mean Local Time at the first descending node after spacecraft separation for launch at the opening of the launch window.

Flight Mode Description – Boost-to-Orbit

- 7420-10 launch from Vandenberg Air Force Base (VAFB) SLC-2W
- Flight azimuth of 196 degrees
- Four GEM solid motors ignited at liftoff
- GEM solid motors burnout at 1 min, 4.0 sec, and are jettisoned at 1 min, 22.5 sec to assure clearance of coastal oil platforms
- Dog-leg maneuver performed from 1 min, 25 sec to 2 min, 0 sec to attain required orbital inclination
- Main Engine Cutoff (MECO) occurs at 4 min, 24.0 sec after liftoff when the first-stage propellants are depleted
- Stage I–II separation occurs 8 sec after MECO
- Stage II ignition occurs 5.5 sec after Stage I–II separation
- Payload fairing jettison occurs at 4 min, 41.5 sec; free molecular heating rate < 0.1 BTU/ft^2-sec (1135 W/m^2)
- Command Receiver Decoders (CRDs) turned off at 7 min, 16.5 sec
- Stage II first burn cutoff (SECO-1) occurs at 11 min, 25.1 sec
  – Vehicle inserted into a 100 nmi x 380 nmi transfer orbit inclined at 98.06 deg
- Telemetry coverage provided by WR sites and Instrumented Aircraft (IA)

Sequence of Events – Boost-to-Orbit

Event	Time (hr:min:sec)
Liftoff	00:00:00.0
Mach 1	00:00:30.5
Maximum Dynamic Pressure	00:00:45.3
Solid Motor Burnout (4)	00:01:04.0
Solid Motor Separation (4)	00:01:22.5
Begin Dog-Leg Maneuver	00:01:25.0
End Dog-Leg Maneuver	00:02:00.0
Main Engine Cutoff (MECO)	00:04:24.0
Stage I–II separation	00:04:32.0
Stage II ignition	00:04:37.5
Jettison Fairing	00:04:41.5
CRD Turnoff	00:07:16.5
First Stage II Engine Cutoff (SECO-1)	00:11:25.1

Flight Mode Description – Coast to Spacecraft Separation

- Following SECO-1, vehicle reoriented to desired coast attitude
- Thermal conditioning roll maneuver of 1 deg/sec is performed
  - Direction reversed approximately halfway through the maneuver
- Following thermal maneuvers, vehicle is reoriented to second-stage restart attitude
- Second-stage restart burn occurs at 53 min, 20 sec over Hartebeesthoek (HBK), South Africa
- Restart burn duration of 13.5 sec injects spacecraft into desired orbit at SECO-2
- After SECO-2, second-stage oriented to desired spacecraft separation attitude
- Clampband released at 58 min, 10.5 sec
- Spacecraft separation occurs 30 sec later at 58 min, 40.5 sec when secondary latches are released
  - Telemetry coverage provided by Hartebeesthoek
  - At separation, spacecraft in required 684 km (369 nmi) circular Sun-synchronous orbit at an inclination of 98.122 deg

Sequence of Events – Coast to Spacecraft Separation

Event	Time (hr:min:sec)
Begin Maneuver to Coast Attitude	00:13:20.0
End Maneuver to Coast Attitude	00:17:30.0
Begin Coast Period	00:17:40.0
End Coast Period	00:46:30.0
Begin Maneuver to Restart Attitude	00:46:40.0
End Maneuver to Restart Attitude	00:50:50.0
Stage II Restart Burn Ignition	00:53:20.0
Second Cutoff – Stage II Engine (SECO-2)	00:53:33.5
Begin Maneuver to Separation Attitude	00:54:10.0
End Maneuver to Separation Attitude	00:57:10.0
Release GeoEye-1 Clampband	00:58:10.5
SC Separation (Release Latches)	00:58:40.5

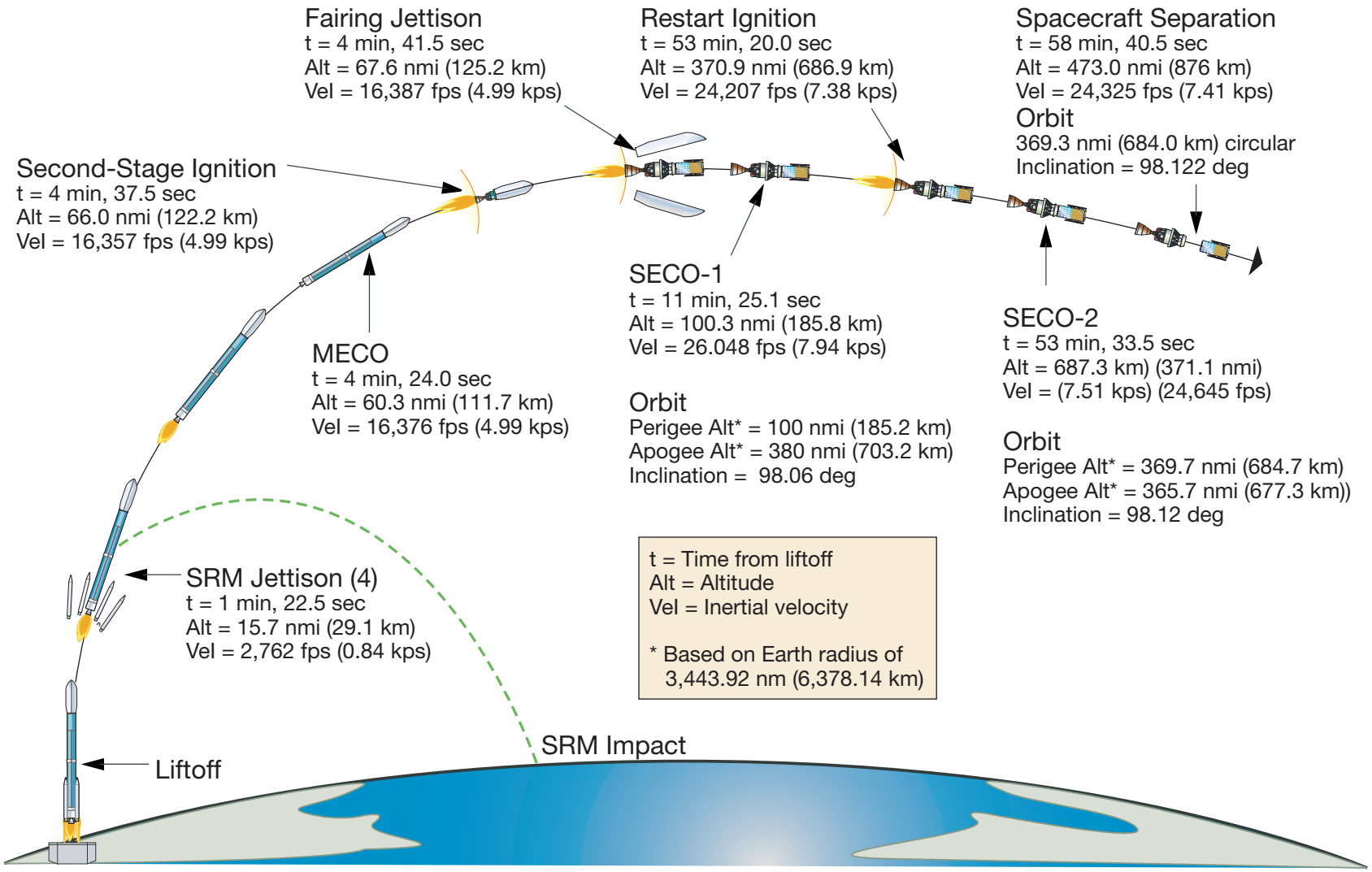
Flight Mode Description – Post-Separation

- Following spacecraft separation, a second-stage retro maneuver is initiated to move the stage away from the spacecraft
- Following a coast of 17.5 sec, a 5-min pitch/yaw maneuver reorients the vehicle to a cold gas evasive maneuver attitude
  - The 35-sec cold gas evasive maneuver imparts 2.4 fps impulse velocity to the second stage
- Following a 1-min, 15-sec coast, the vehicle is reoriented for a second restart (evasive) burn
  - Second-stage evasive burn occurs at 1 hr, 15 min, 50 sec, in view of Oakhanger, England tracking station
  - Nominal burn duration of 5.0 sec provides additional separation between second stage and spacecraft
  - Evasive burn puts vehicle into a 100 x 367 nmi orbit inclined at 97.8 deg
- Following the second-stage evasive burn, the vehicle is oriented perpendicular to the orbit plane for a second-stage depletion burn
  - Second-stage depletion burn occurs at 1 hr, 40 min, 10 sec in view of Hawaii tracking station
  - Nominal burn duration of 28.3 sec safes second stage by depleting remaining propellants
  - Removes second stage from the GeoEye-1 orbit plane
  - At end of nominal depletion, second stage is in a 100 x 357 nmi (185 x 661 km) orbit at an inclination of 95.2 deg
- Post-separation second-stage maneuvers and depletion burn are designed to ensure a worst case spacecraft contamination level of < 10 Angstroms

Sequence of Events – Post-Separation

Event	Time (hr:min:sec)
OrbView-5 Separation	00:58:40.5
Begin Stage II Retro	00:58:41.0
End Stage II Retro	00:59:22.5
Re-orient for Cold Gas Evasive Maneuver	00:59:40 – 01:04:40
Begin Cold Gas Evasive Maneuver	01:04:50.0
End Cold Gas Evasive Maneuver	01:05:25.0
Maneuver to Evasive Burn Attitude	01:06:40 - 01:14:30
Second Restart – Stage II (Evasive Burn)	01:15:50.0
Third Cutoff – Stage II Engine (SECO-3)	01:15:55.0
Maneuver to Depletion Burn Attitude	01:18:20 – 01:26:40
Third Restart – Stage II (Depletion Burn)	01:40:10.0
Fourth Cutoff – Stage II Engine (SECO-4)	01:40:38.3

Flight Profile



Orbit Trace – Boost-to-Orbit

Legend (time)

1 = Main Engine Cutoff
(4 min, 24 sec)

2 = SECO-1 (11 min, 25.1 sec)

WR Tracking Sites

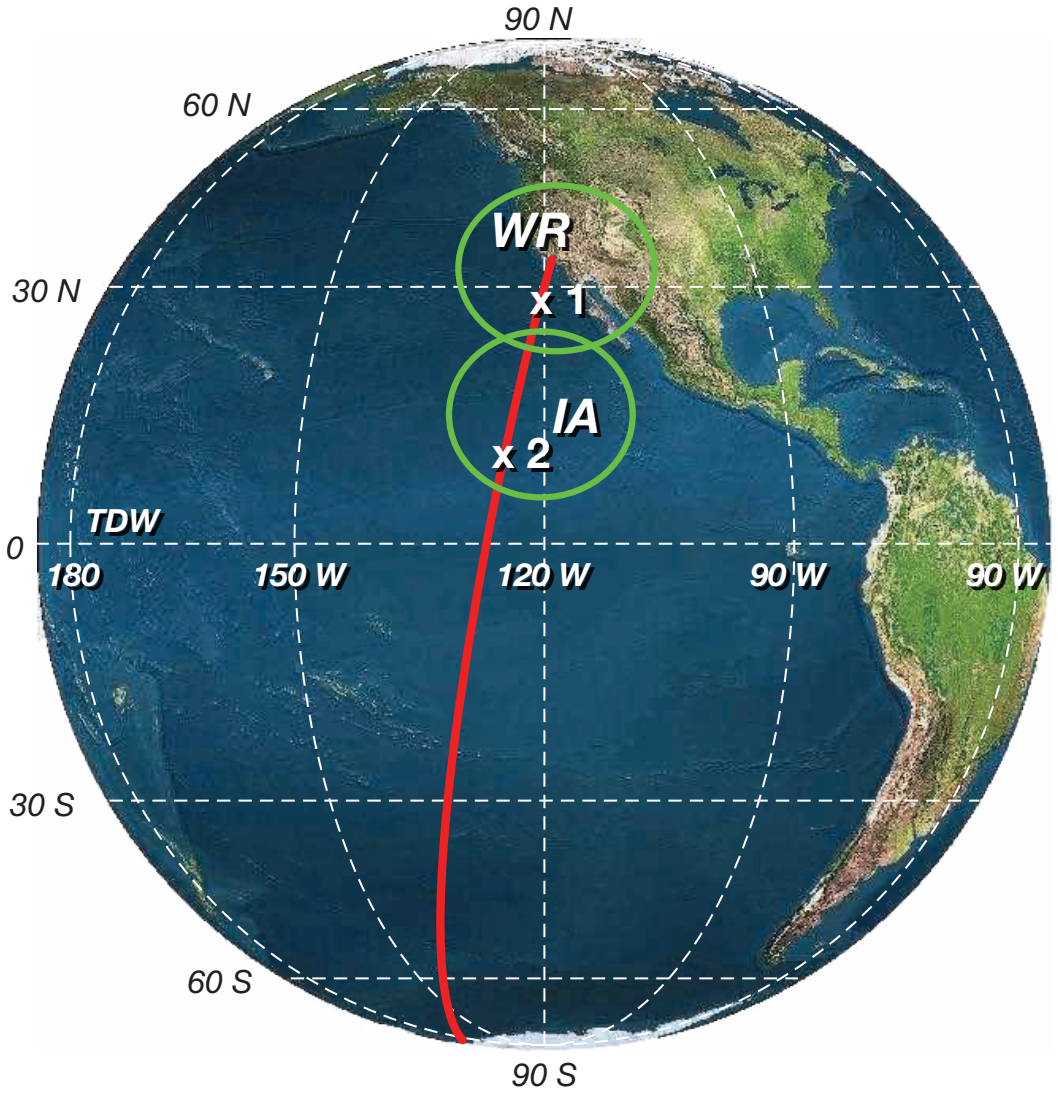
VTS – AFSCN Vandenberg

VTRS – VAFB Telemetry Receiving Station

SNI – NAWC San Nicolas Island

IA

Big Crow Instrumented Aircraft



Orbit Trace – Coast and Restart

Legend (time)

3 = First Restart (53 min, 20 sec)

4 = SECO-2 (53 min, 33.5 sec)

5 = GeoEye-1 Spacecraft Separation (58 min, 40.5 sec)

6 = Evasive Restart (1 hr, 15 min, 50 sec)

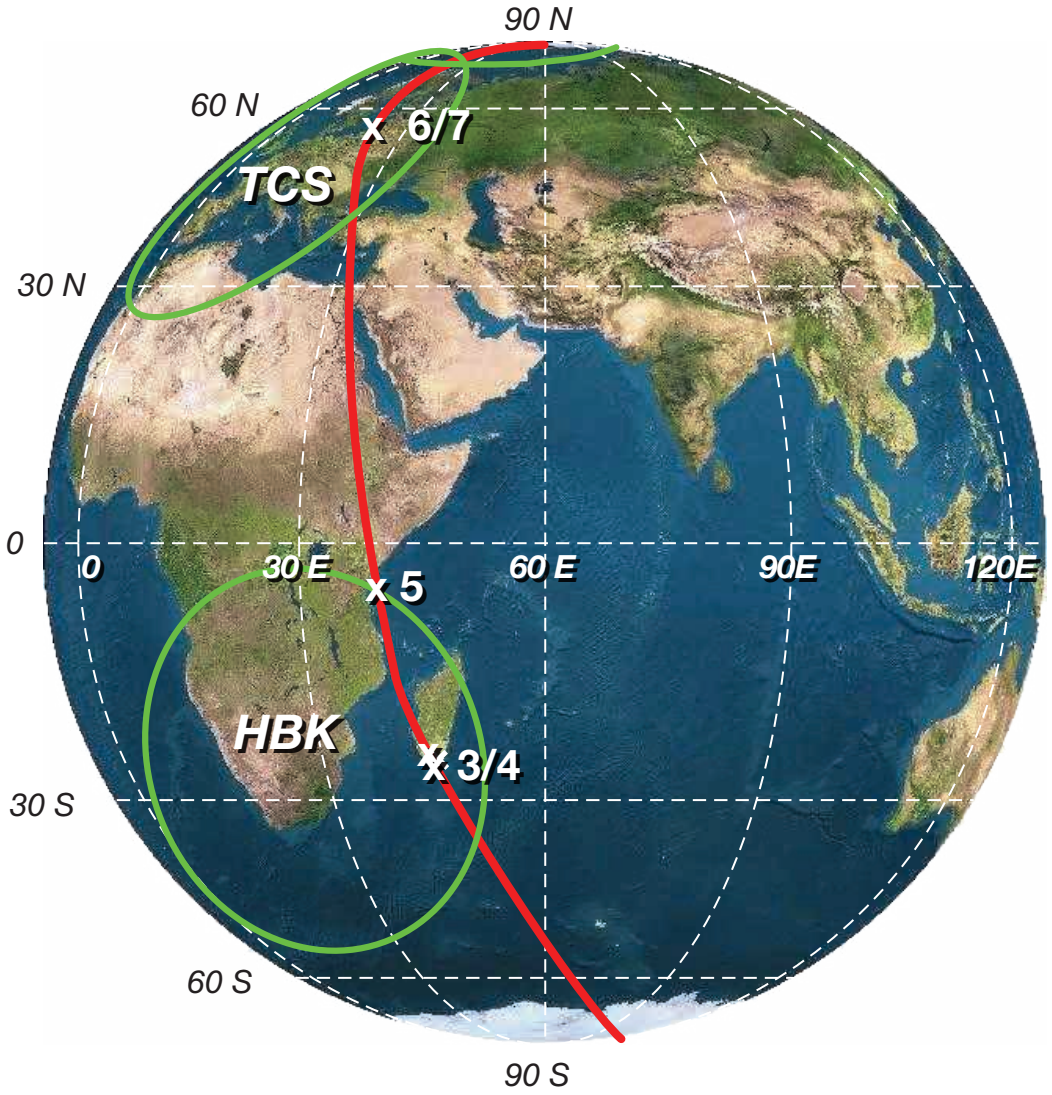
7 = Evasive Cutoff (1 hr, 15 min, 55 sec)

Downrange Tracking Sites

HBK – Hartebeesthoek

TCS – AFSCN Oakhanger, England

TTS – Thule, Greenland



Orbit Trace – Post-Separation

Legend (time)

6 – Evasive Restart
(1 hr, 15 min, 50 sec)

7 – Evasive Cutoff
(1 hr, 15 min, 55 sec)

8 – Depletion Restart
(1 hr, 40 min, 10 sec)

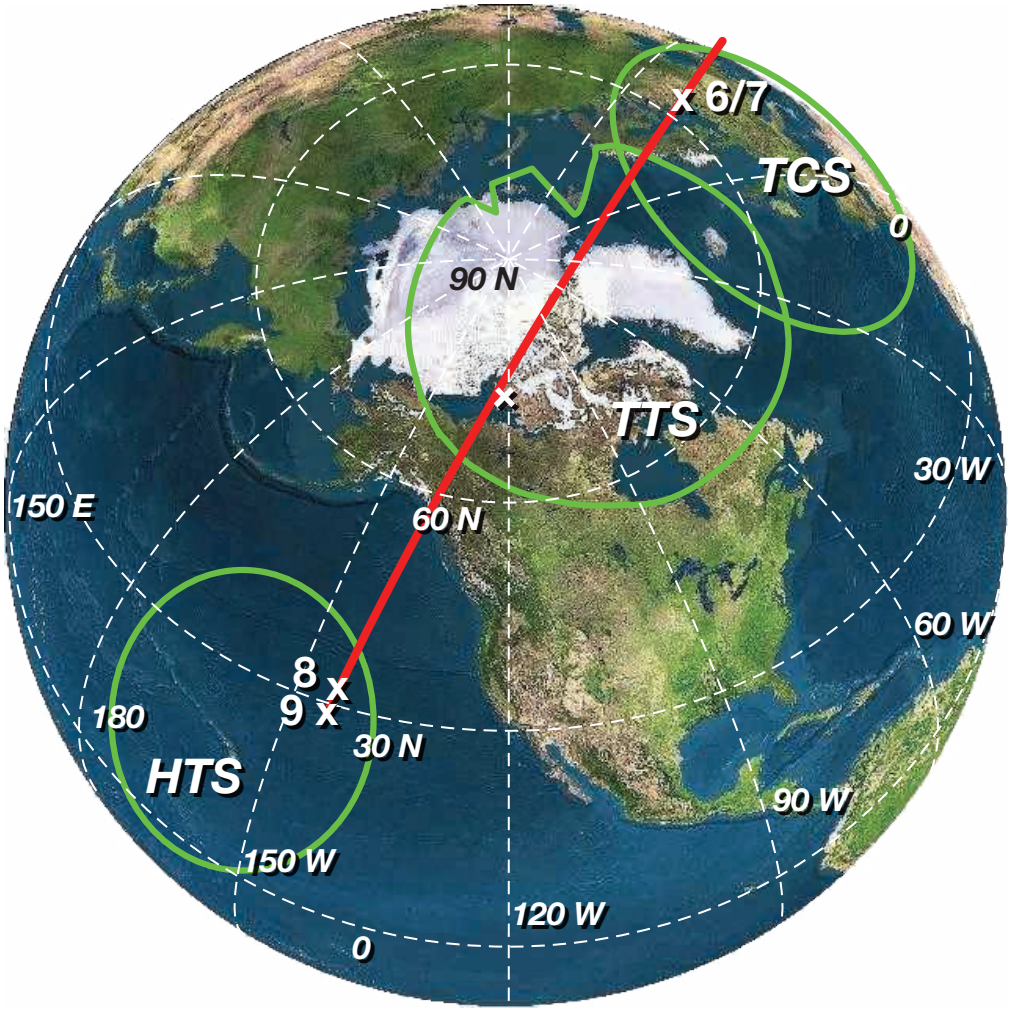
9 – Depletion Cutoff
(1 hr, 40 min, 38.3 sec)

Downrange Tracking Sites

TCS – AFSCN Oakhanger, England

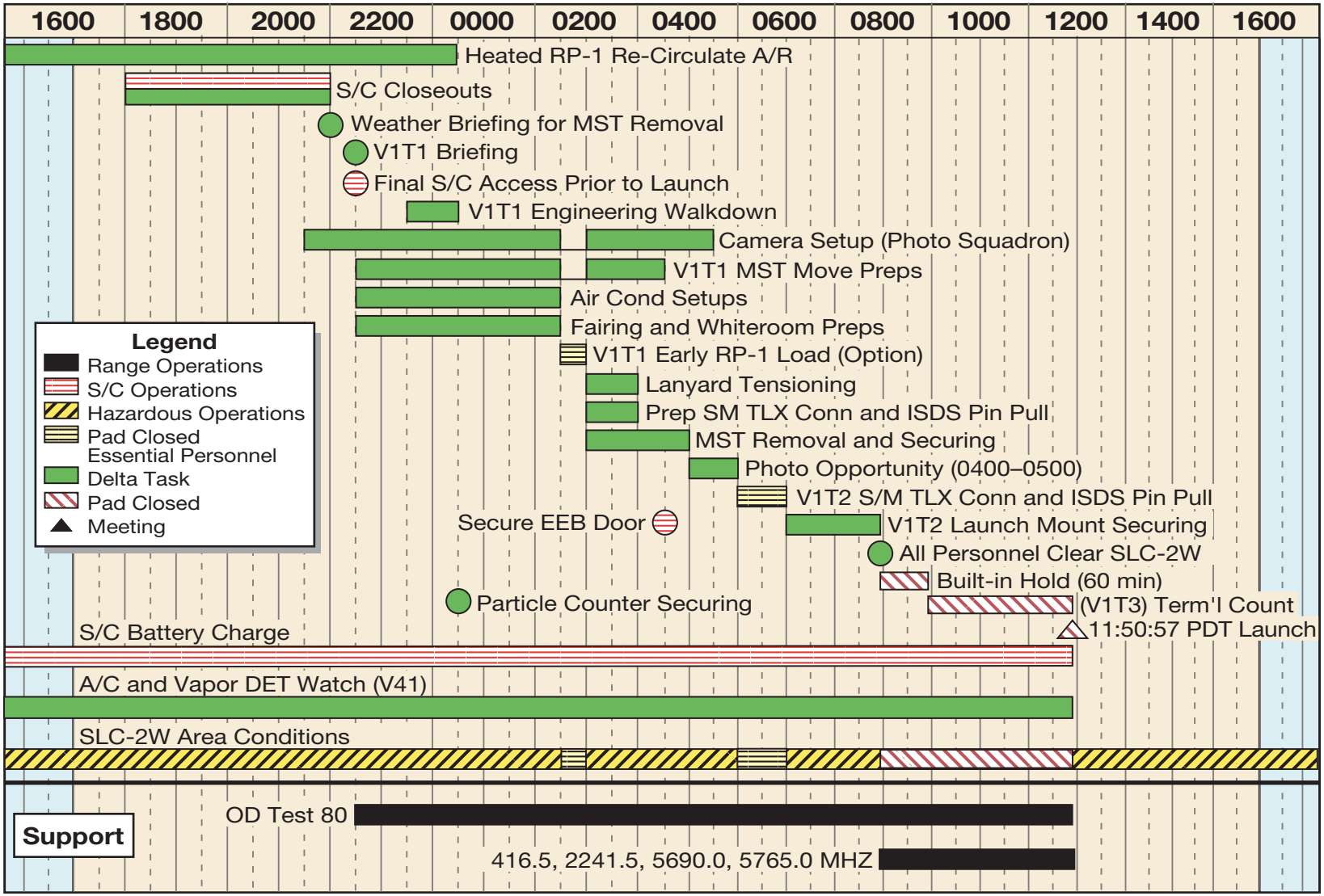
TTS – Thule, Greeland

HTS – Hawaii



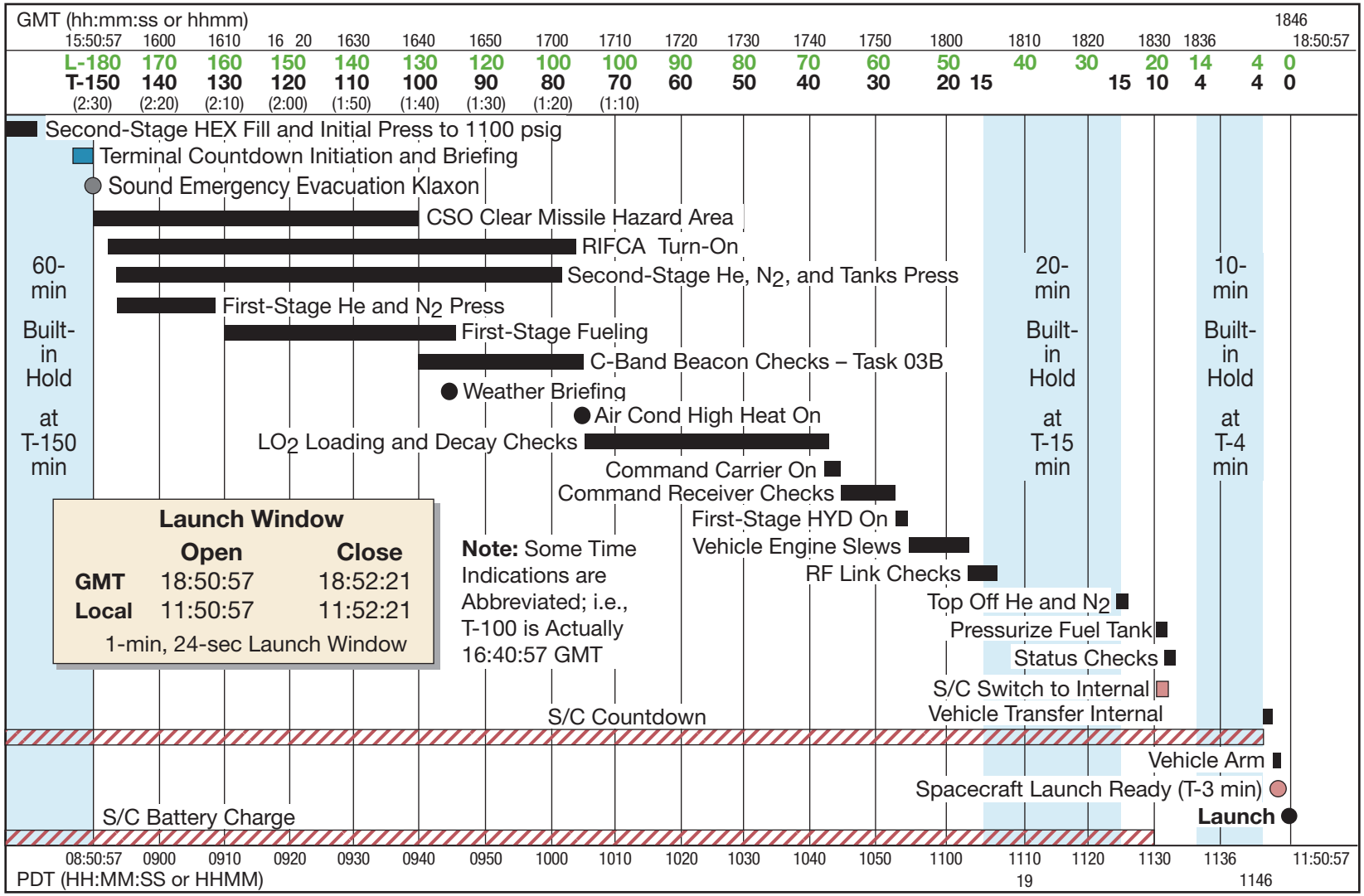
Delta Countdown

T-0 Day

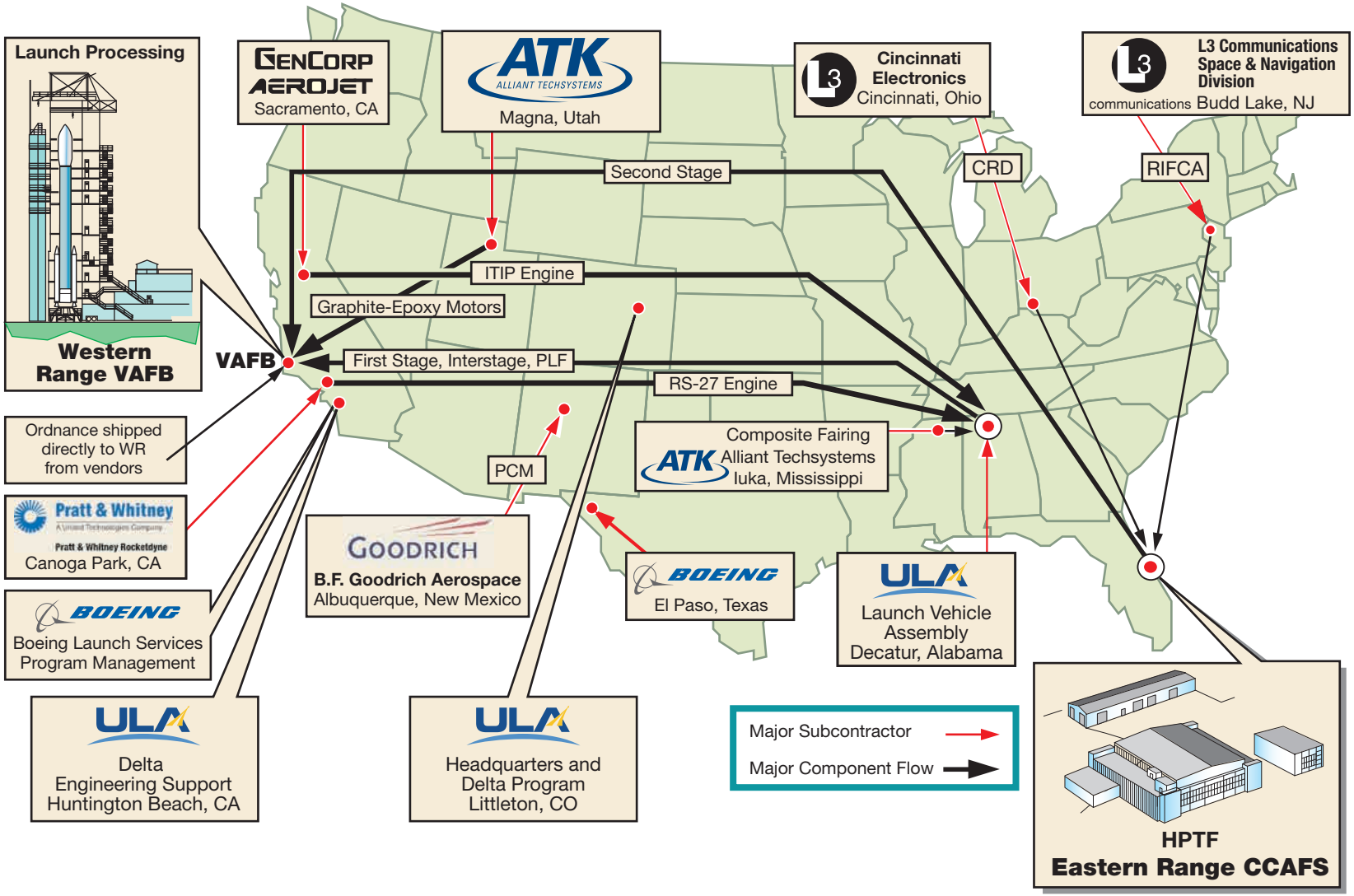


GeoEye-1 Terminal Count

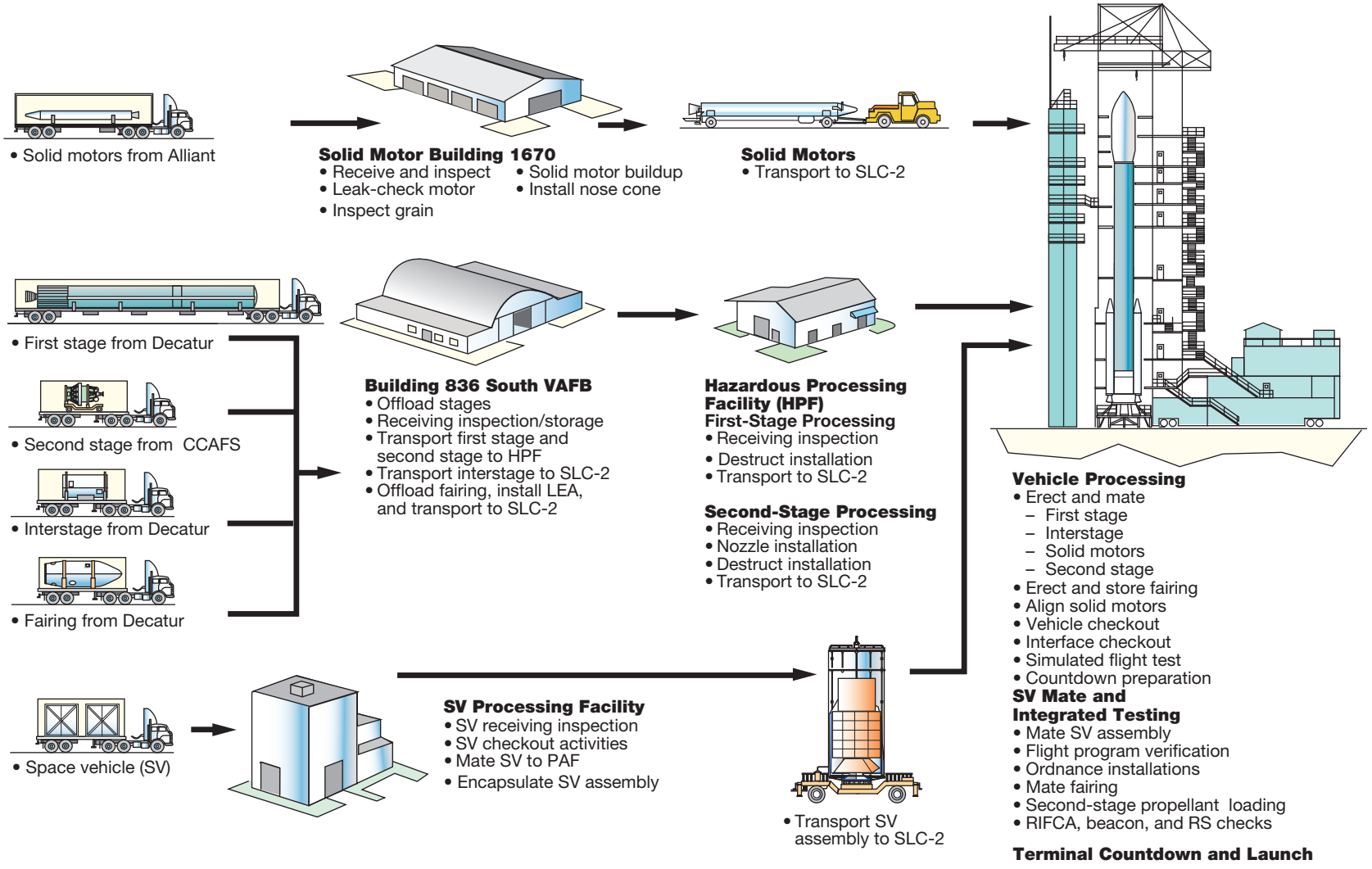
L -0 Day



Delta II Operational Flow at Western Range



Delta II Hardware Flow at VAFB



Notes:


DELTA II • GEOEYE-1 • The World's Highest Resolution and Most Accurate Commercial Earth-Imaging Satellite • Ground Resolution of 0.41 Meters
BOEING
GeoEye
ULA
United Launch Alliance
LAUNCH 2008

Boeing Launch Services

5301 Bolsa Avenue, Huntington Beach, CA 92647-2099 • www.boeing.com/launch

137204-014