

#### Space Tracking and Surveillance System Advanced Technology Risk Reduction

**Mission Overview** 

Delta II 7920-10C Vandenberg Air Force Base, CA Space Launch Complex-2 West









### **STSS ATRR**



United Launch Alliance (ULA) takes great pride in launching the Space Tracking and Surveillance System (STSS) Advanced Technology Risk Reduction (ATRR) mission for the United States Missile Defense Agency (MDA). STSS ATRR will be launched aboard a ULA Delta II 7920-10C launch vehicle from Vandenberg Air Force Base (VAFB), CA.

The STSS ATRR mission is a space-based sensor component of a layered Ballistic Missile Defense System (BMDS) to detect, track, and intercept ballistic missiles.

ULA provides the Delta II launch service under the NASA Launch Services (NLS) contract with the NASA Kennedy Space Center Launch Services Program. We are pleased that NASA once again selected the Delta II for this mission, after many successful commercial, foreign, and government launches to Earth orbit and destinations throughout the solar system. My congratulations to the entire Delta team for its continued efforts in achieving this milestone.

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Vernon L. Thorp NASA Program Manager United Launch Alliance



## STSS ATRR Mission Requirements



• Launch Period:

1 April – 1 October 2009

**One Daily** 

- Launch Attempts:
- Launch Window: 28 minutes
- Orbit: Polar, Near Circular
- Second Stage Probability of Commanded Shutdown:  $\geq$  99.7



# Delta II 7920-10C Launch Vehicle







### Flight Mode Description Boost to Orbit



- 7920-10C launch from Vandenberg Air Force Base SLC-2W
- Flight azimuth of 196 deg
- 6/3 GEM solid motors firing sequence
- Separation of ground-lit GEMs at 1 min, 26 sec and 1 min, 27 sec to ensure clearance of coastal oil platforms
- Dog-leg maneuver (1 min, 30 sec to 2 min, 12 sec) performed to attain required orbital inclination
- Main engine cutoff (MECO) occurs at first-stage propellant depletion; nominally at 4 min, 23.4 sec after liftoff
- First stage separated 8 sec after MECO; second stage ignited 5.5 sec later
- Payload fairing jettisoned when free molecular heating rate  $\leq$ 0.1 BTU/ft2-sec (1135 W/m2)
- Command Receiver Decoders (CRDs) turned off at 6 min, 20.5 sec
- Second stage, first burn places vehicle in initial Earth orbit
  - Instrumented Aircraft (IA) required for coverage of last portion of stage II burn



#### Sequence of Events Boost to Orbit



Event	Time (HR:MIN:SEC)
Liftoff	0:00:00.0
Mach 1	0:00:32.4
Maximum Dynamic Pressure	0:00:45.7
Solid Motor Burnout (6 ground-lit)	0:00:64.0
Solid Motor Ignition (3 air-lit)	0:00:65.5
Solid Motor Separation (3 ground-lit)	0:01:26.0
Solid Motor Separation (3 ground-lit)	0:01:27.0
Begin Dog-leg Maneuver	0:01:30.0
Solid Motor Burnout (3 air-lit)	0:02:09.7
Solid Motor Separation (3 air-lit)	0:02:11.5
End Dog-leg Maneuver	0:02:12.0
Main Engine Cutoff (MECO)	0:04:23.4
First-Stage Separation	0:04:31.4
Second-Stage Ignition	0:04:36.9
Jettison Fairing	0:04:41.0
Turn Off CRDs	0:06:20.5
First Cutoff – Second Stage (SECO-1)	0:10:04.6



## Flight Mode Description Coast and Restart



- Following SECO-1, vehicle reoriented to desired coast attitude
- No thermal conditioning roll required
- Following 28.5 min of coast, vehicle reoriented to second-stage restart burn attitude
- Second-stage restart occurs at 52 min, 51.9 sec over the Hartebeesthoek, South Africa tracking station
  - Restart burn duration of 21.1 sec
  - At end of the second stage restart burn, vehicle is in final Earth orbit
- Required orbit occurs at first ascending node after liftoff (1 hr, 0 min, 37.1 sec)
- Following second-stage restart, vehicle reoriented to desired attitude for spacecraft separation
- Spacecraft separation will occurs at 58 min, 0.0 sec over Hartebeesthoek tracking station
  - STSS ATRR uses a 6915 payload attach fitting (PAF) with a secondary latch system
  - PAF separation bolts released at 57 min, 30 sec, and secondary latches are released at 58 min, 0.0 sec separating the spacecraft



#### Sequence of Events Coast to Spacecraft Orbit Injection



Event	Time (HR:MIN:SEC)
First Cutoff – Second Stage (SECO-1)	0:10:04.6
Maneuver to Coast Attitude	0:11:00.0 - 0:16:00.0
STSS ATRR Coast Period	0:16:00.0 - 0:44:30.0
Maneuver to Restart Attitude	0:44:30.0 - 0:50:30.0
Second-Stage Restart Ignition	0:52:51.9
Second Cutoff – Second Stage (SECO-2)	0:53:13.0
Maneuver to Separation Attitude	0:54:03.0 – 0:56:40.0
Release Separation Bolts	0:57:30.0
Separate Spacecraft (Secondary Latch Release)	0:58:00.0



#### Orbit Trace Boost to Orbit





Legend (time, sec) 1 – Main Engine Cutoff (263.4) 2 – SECO-1 (604.6) Telemetry Sites VTS – AFSCN Vandenberg IA – Instrumented Aircraft

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### **Orbit Trace Coast to Restart**





Legend (time, sec) 3 – First Restart (3171.9) 4 – SECO-2 (3193.0) 5 – Spacecraft Separation (3480.0) Telemetry Sites HBK – Hartebeesthoek, South Africa

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## Flight Mode Description Post Separation



- Following spacecraft separation, second-stage retro initiated to move second stage away from spacecraft
  - Relative separation velocity of 1.0 fps from retro system
  - Helium retro nozzles canted at 35 deg from launch vehicle centerline
- Following a coast of 17 min, 58 sec, vehicle reoriented to second-stage evasive burn attitude
  - 5-second burn provides additional separation between second stage and the spacecraft
- Following evasive burn maneuver, vehicle reoriented to second-stage depletion burn attitude
- Second-stage depletion burn occurs at 1 hr, 43 min, and 20 sec over the Hawaii tracking station
  - Nominal burn duration of 1min, 34.2 sec
  - At end of nominal depletion burn, second stage in a 97 x 480 nmi (180 x 889 km) orbit with an inclination of 112.78 deg
- Second-stage maneuvers and depletion burn following STSS ATRR separation ensure a worst case spacecraft contamination level of <10 Angstrom



### Sequence of Events Post Separation



Event	Time (HR:MIN:SEC)
Separate Spacecraft	0:58:00.0
Begin Second-Stage Retro	0:58:00.5
End Second-Stage Retro	0:58:42.0
Maneuver to Evasive Burn Attitude	1:16:40.0 - 1:25:40.0
Second-Stage Evasive Burn Ignition	1:30:00.0
Second Cutoff – Second Stage (SECO-3)	1:30:05.0
Maneuver to Depletion Burn Attitude	1:33:00.00 - 1:41:40.0
Second-Stage Restart Ignition (Depletion Burn)	1:43:20.0
Depletion Cutoff – Second Stage (SECO-4)	1:44:54.2



#### Orbit Trace Post Separation





Legend (time, sec) 6 – Evasive Burn Ignition (5,400.0) 7 – SECO-3 (5,405.0) 8 – Depletion Burn Ignition (6,200.0) 9 – SECO-4 (6,294.2) Telemetry Sites TTS – Thule, Greenland HTS – Hawaii



#### **Delta II Countdown (T-0 Day)**







#### **Delta II Terminal Count (T-0 Day)**







#### Delta II Operational Flow at Western Range







#### Total Vehicle Integration & Checkout at the Launch Site





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