Corporate Summary

• 100% Privately Owned by Mgt
• 3,000 Employees
• 2013 Revenue ~$2 Billion
• Average 10 year growth of 20%
• Continuous Profits for 14 years
• Twice the Industry Average R&D
• 25 Years of Space Flight Heritage
• 420+ Space Missions
• 4,000 Products with No Failures
• Largest small-sat producer in world for 100-500 kg range
• Launching Every 3 Weeks on Avg.
• 70+ Successful NASA Missions
• Business in over 20 Countries
Aviation Technologies & Aircraft Development

- Autonomous Aerial Refueling
- Enhanced Flight Vision Systems
- FAA Certified Repair and Maintenance Operation
- Largest Convertor of US Government Aircraft Over 280 aircraft in current operations
- Leader in Special Mission Unmanned and Autonomous Airborne Assets
Space Systems Product Lines

**Spacecraft Systems**
- Multi-Mission Space Vehicle
- DARPA F6
- TacSat-2
- ORBCOMM Gen 2
- DSX

**Space Technologies**
- Deployable Structures
- Docking and Capture
- Pointing and Control
- Restraint
- Solar Array Drives
- Gimbals

**Space Exploration**
- Dream Chaser Vehicle For Commercial Crew Transportation

**Propulsion Systems**
- Green Hybrid Engines for Suborbital & Orbital Launch
- Green & Solar Thermal Satellite Propulsion
- Orbit Transfer
Mission Examples

Cygnus Cargo Vehicle
- PCB

Lunar Reconnaissance Orbiter
- Antenna gimbal actuators

NPP Orbiter
- SADA
- SADE

Orbital Express Capture System
**NASA’s Shift to Commercial Services**

**Space Shuttle**
- Carried 7 person crew
- 25,000 kg Cargo Capacity
- Primary purpose was to build the ISS

Vehicles owned and operated by commercial companies...NASA just buys services.
Evolution of Dream Chaser

**NASA’s HL-20 Spacecraft (Russian BOR-4 heritage)**
- >1200 wind tunnel tests
- Abort landing simulations
- Trajectory studies
- Ergonomics and egress
- Handling evaluations
- Fabrication and operations

**Building Upon Space Shuttle Heritage**
- Leverages 40 yrs of Shuttle design, technology development, and operational experience
- Reusable, Reconfigurable Runway-Landing Vehicle
- Ideally Suited to Host a Range of Other Missions

**SNC’s Dream Chaser Vehicle**
- Incorporates years of research, design, development, and testing
- Modern materials, Aerodynamic data
- Improved flight control surface design
- Significant CFD analysis, Wind Tunnels
- Trajectory refinement
- Component and wind tunnel testing
- Launch vehicle integration
- Flight simulation
• Transports 4 crew to and from the ISS (conditioned or deconditioned)
  ➢ Meets/exceeds NASA pressurized cargo requirements
  ➢ Capability to transport 7 crew,
  ➢ Inherent Low-g CRS capability
• Non-toxic Main Propulsion used for 3\textsuperscript{rd} stage ascent, launch abort, orbital maneuvers (e.g. Deorbit)
• <1.5g re-entry profile and >1000 nm cross-range capability
• Integrated on the Atlas V launch vehicle
  ➢ Mature, reliable, On-Time
  ➢ 46 consecutive successful Atlas V launches (100+ Atlas family)
Dream Chaser

Concept of Operations

- Flight Day 1 docking
- Flight Day 2 nominal docking
- Flight Day 3 docking
  - One additional docking attempt

Manual Dock at primary docking port or backup docking port

- Nominal deorbit 6 hours after undock
- 24-hour reentry delay following ISS separation

ISS capabilities:
- 210-day docked duration with flyaround
- Docking port relocation
- 24 hours without ISS services
- 6-hour self-sufficient safe haven

- Launch from designated launch site
- Late cargo load capability
- Pad and ascent abort capabilities ending in runway landing

- Pilot-controlled reentry and landing
- Capable of controlled automated entry, descent, and landing
- Crew bailout capability

- Nominal landing at primary landing site
- Removal of time-sensitive cargo within 30 minutes of landing at primary landing site
- Land at alternative landing sites if primary landing site not available
- Capability for unassisted crew egress

Nominal Mission  Contingency Capability  Emergency Capability
## Dream Chaser
### Summary Capabilities

<table>
<thead>
<tr>
<th>Capability</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>Seven crew capable; ISS DRM assumes four crew members up/down</td>
</tr>
<tr>
<td>De-conditioned Crew</td>
<td>Seats support recumbent de-conditioned crew return</td>
</tr>
<tr>
<td>G-Sensitive Crew and Cargo</td>
<td>Low-g reentry and soft runway landing</td>
</tr>
<tr>
<td>Atlas V 412 Abort Capability</td>
<td>DC MPS provides safe separation, lands on 8000+ foot runway (ECAL/TAL)</td>
</tr>
<tr>
<td>Docked Time</td>
<td>210-day docked stay</td>
</tr>
<tr>
<td>Shared Consumables</td>
<td>Optimal mass configuration by sharing common fluids between MPS, RCS, and ATCS (Unused abort oxidizer utilized for on-orbit operations)</td>
</tr>
<tr>
<td>Cargo Up/Down Mass</td>
<td>900 lbm of pressurized cargo with four-person crew, late pad and quick post-landing access</td>
</tr>
<tr>
<td>Maximum Dynamic Pressure</td>
<td>Demonstrated Atlas V throttling limits maximum dynamic pressure to a very low value of 245 psf, which reduces flight loads and increases abort effectiveness (1/3 of Shuttle)</td>
</tr>
<tr>
<td>Nominal Delta-V margin</td>
<td>44% excess usable capability due to main propulsion sized for aborts</td>
</tr>
<tr>
<td>Cross Range</td>
<td>1000nm+ cross-range from Entry Interface (Shuttle like capability)</td>
</tr>
<tr>
<td>Flexible DeOrbit Capability</td>
<td>Daily next PLS deorbit capability, any orbit de-orbit capability for contingencies</td>
</tr>
<tr>
<td>Planned Runway Operations</td>
<td>KSC/SLF nominal, EDW alternate; &gt;8000 ft runway for contingencies</td>
</tr>
<tr>
<td>Post Landing Recovery</td>
<td>Immediate crew egress and access to sensitive payloads, no specialized landing ground support equipment (GSE)</td>
</tr>
<tr>
<td>Mission and Ground Operations</td>
<td>Builds on NASA experience with other human spaceflight programs (facilities, processes/standards, and personnel)</td>
</tr>
<tr>
<td>Launch Vehicle</td>
<td>Atlas 412, with extremely successful flight history</td>
</tr>
</tbody>
</table>
Advantages of SNC’s Lifting Body Spacecraft

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-g atmospheric re-entry</td>
<td>Protects sensitive experiments and impaired crew</td>
</tr>
<tr>
<td>All non-toxic fuels and no hazardous operations</td>
<td>Leads to cost, environmental, and operational benefits</td>
</tr>
<tr>
<td>Highly maneuverable vehicle w/on-board propulsion system</td>
<td>Allows for a wide range of missions for NASA and other customers</td>
</tr>
<tr>
<td>Ability to safely return crew to a runway landing at any time</td>
<td>Improves emergency operations</td>
</tr>
<tr>
<td>Significant reusable dry mass</td>
<td>Reduces costs</td>
</tr>
<tr>
<td>Standard commercial runway landing</td>
<td>Allows for immediate access to critical returning ISS experiments or distressed/injured crew</td>
</tr>
</tbody>
</table>
Expanding Multinational Presence

Strong partnerships in North America and Europe already, Japan is our top priority for the Asia-Pacific region.

Best of Breed in Industry, Government and Academia
Program Impact
Suppliers and Employment in over 30 States

Small and Disadvantaged Business Map
Dream Chaser Development Status

- Completed 30 Milestones under the Commercial Crew Program
- Highly successful Certification Products Contract (CPC) execution
- Engineering Test Article (ETA) Built, Tested & Flown; Next Flt Dec ‘14
- Orbital Test Vehicle (OTV) Under Construction (Structures at MAF/Ft. Worth,), First Orbital Flight November, 2016
Continued Significant Maturation of Subsystems since January 2014

- Arcjet Testing
- Automated Fiber Placement of Ring Frame
- Actuator Control Unit CDR
- Cabin Assembly Molds
- Mechanical Impact Testing
- Cabin Tool Half
- Mockup Evaluations
- MPS Hot Fire
- RCA Engine Hot Fire
- WH/MS 9a on test stand
Historic First Flight: 26 Oct 13
Dream Chaser’s Historic First Flight

Exactly 36 Years After Shuttle Enterprise Makes it Final Landing

Space Shuttle Enterprise  
*October 26, 1977*  
Edwards AFB

Dream Chaser Vehicle  
*October 26, 2013*  
Edwards AFB

Play Dream Chaser Sizzle Video…
The ETA was released above the center of the dropbox but within the desired constraints.

Once the ETA acquired the correct glideslope it tracked within several feet of the nominal simulation run.

White = Nominal simulation from Boeing with Flight Software V3.02

Blue = ETA actual flight

http://www.youtube.com/watch?v=QgdFotAkUEU&feature=c4-overview&list=UUtwQ156POAv4Hnso14OwyMA.
ETA Flight Path

ETA Free Flight Drop Trajectory

- ETA FF Data
- Desired Trajectory Simulation

Dream Chaser Actual Flight Path
First Orbital Launch
November 2016
What Kid ever wanted to Play with a paper capsule?