Dream Chaser for Research in LEO

Cargo Module
Launch System

Uncrewed Dream Chaser Vehicle

The Best Commercial Payload Services Solution in the World

Capable: 5,500kg upmass, both pressurized & unpressurized
Safe: Gentle reentry, runway landing, all non-toxic propulsion
Responsive: Both runway return with immediate post-land access & cargo disposal on every mission
Affordable: Highly (90%) reusable (15x), broad commercial services
Flexible: Cargo Disposal + runway return, both docking & berthing,
Mature: Leverages 40+ years of Shuttle/X-plane experience
### SNC’s Lifting Body: SAFER By Design

#### Dream Chaser

<table>
<thead>
<tr>
<th>Feature</th>
<th>Capsules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-g reentry (less than 1.5)</td>
<td>• High-g reentry (Soyuz nominal 4 g, emergency descent 11–15 g)</td>
</tr>
</tbody>
</table>
| Runway landing (standard aircraft commercial runway >7,200 ft.) | • High speed parachute deployment  
• Water or land landing with recovery operations |
| Reusable with minimal processing (15+ missions per vehicle) | • Limited reusability with impact loads  
• Salt water corrosion  
• Higher reentry heat  
• No prior capsule has been reused |
| No solid rocket motors or hazardous fuels    | • Hazardous fuels                                                        |
| Atmospheric flight capability provides large cross range for landings (>1,000 nmi) | • Limited atmospheric flight or cross-range capability                   |
| Can abort to runway landing at any time from launch to orbit | • High abort loads  
• Water landing required  
• Delayed crew recovery  
• Potential rough sea recovery |

#### The Dream Chaser Advantage: Providing the Capability to Address the Broader LEO Market
Expand Upon the NASA CRS2 Base

- Objective: Build-upon the Dream Chaser Cargo System CRS2 Baseline and Extend Mission & Market Capture Using this Funded System Capability and Customer-Driven Variants
Multiple Missions, Markets & Clients

- Dream Chaser Reusable Space Utility Vehicle (SUV) Enables Missions & Markets
- A Common SUV Platform Enables Multi-Mission Capability, Flexibility, Affordability
- 4 Market Types (Existing, Growth, Future, NextGen) and 9 Mission Markets are Planned

<table>
<thead>
<tr>
<th>Market</th>
<th>NASA</th>
<th>Interagency</th>
<th>International</th>
<th>Industry</th>
<th>Institutions/Academia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) ISS Cargo</td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td>2) Free Flight and Science Missions</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
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<tr>
<td>3) Technology Testbed</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>4) Interagency</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) On-Orbit Servicing, Assembly, Repair</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Commercial Platforms/Services</td>
<td>✓</td>
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<td></td>
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<tr>
<td>7) Remote Sensing</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) LEO Support for Space Exploration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9) ISS Crew, Tourism</td>
<td>✓</td>
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<th>Existing Markets</th>
<th>Growth Markets</th>
<th>Future Markets</th>
<th>Next Generation</th>
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<td></td>
<td>9) ISS Crew &amp; Tourism</td>
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</table>
DCCS Assures Access to the ISS with Multiple Launch Options

- Fault-tolerant folded wing design allows the Dream Chaser to fit inside Atlas/Ariane standard 5 meter fairings
- Compatible with multiple launch vehicles/ground systems
  - Atlas V
  - Falcon 9 Heavy
  - European Ariane 5/6
  - Japanese H-III
- Responsive cargo access and designed for multiple mission reusability exceeding the life requirements for ISS
Unique Features of DCCS Provide Operational & Research Benefits

- Gentle 1.5g re-entry and runway landing protects sensitive payloads
- Immediate post-landing access to critical science (< 3 hour handover)
- Non-toxic/non-hypergolic fluids support late cargo loading and accelerated access to science post-launch, immediately post-landing
- Only vehicle optimized for responsive return of sensitive microgravity, biology, space & life science payloads → Live mice up/down!
ORBITEC & SNC: Delivering Enabling R&D Capability

Provide value-oriented ECLS/TCS solutions
- Full subsystems for permanent habitation in Space
- Commercial Crew subsystems and systems
- Full Human Flight development, verification and testing

Flight Navigation lighting
- Commercial Crew opportunities
- Special military applications

Environmental Control, Accommodations, and Systems for Science
- ISS flight systems
  - Proven flight plant systems NASA and International customers
  - Developing advanced plant habitat systems with NASA
  - Rodent flight systems for science in microgravity

Instrumentation and Control Systems
- Commercial and flight control systems
  - Integrating controls at the subsystems and system level
  - Instrumentation and Controls for integrated systems
  - Instrumentation for commercial products

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Dream Chaser Multi-Mission Solutions
Customer-Defined Research Missions in LEO

Designed for Science Missions

- Selection of:
  - Launch Vehicle
  - Desired Landing Site
  - Orbit and Inclination
  - Mission Duration
  - Standard or Customized Hardware
  - Crewed, Uncrewed, or Tele-operational
- Frequent Flight and Re-Flight Opportunities
- Expedited and Cooperative Payload Integration
- Flexible Operating Requirements and Environments
- IP Control
• **Powered payloads**
  – Single and double lockers
  – Requires power, cmd/data, thermal services

• **Conditioned passive cargo in Double Cold Bags**
  – Access time requirements

• **Passive cargo**
  – 7 standard bag sizes
  – Conformal bags

Pressurized Cargo: 5,000kg Max

1 CTBE = 1.87 ft³
(Cargo Transfer Bag Equivalent)
Unpressurized Cargo: 1,500kg Max

- Requires power, command/data, thermal services
- Flight Releasable Attachment Mechanism (FRAM)-based cargo
- Direct Mount
  - Japanese Experiment Module Exposure Facility (JEM-EF) cargo
  - Other cargo
<table>
<thead>
<tr>
<th>Working in Space</th>
<th>Extended Duration (ED) Science—Space Discovery</th>
<th>Long Duration (LD) Science—Space Observation</th>
<th>Next-Generation Space Exploration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mission:</strong> Satellite servicing, deployment, refueling, retrieval, and deorbit/debris removal</td>
<td><strong>Mission:</strong> Microgravity laboratory for in situ science &amp; technology investigation</td>
<td><strong>Mission:</strong> Direct Earth or space observation missions from LEO</td>
<td><strong>Mission:</strong> Deep Space Exploration support missions from LEO</td>
</tr>
<tr>
<td><strong>Duration:</strong> 1–10 days</td>
<td><strong>Duration:</strong> Up to 28 days</td>
<td><strong>Duration:</strong> Up to 1 year</td>
<td><strong>Duration:</strong> Flexible</td>
</tr>
<tr>
<td><strong>Configuration:</strong> Crewed Dream Chaser modified to meet unique mission needs (e.g., robotic arms, airlock, satellite deployment capabilities)</td>
<td><strong>Configuration:</strong> Extended-duration Cargo vehicle modified to support internal science for up to 3 weeks and return</td>
<td><strong>Configuration:</strong> Long-duration uncrewed Cargo Vehicle modified to support Earth observation, space, and astronomical missions for up to 1 year and return</td>
<td><strong>Configuration:</strong> Dream Chaser Cargo or Crewed Vehicle modified to support Beyond LEO exploration missions (outfitting, test, sample curation) and return</td>
</tr>
</tbody>
</table>
Dream Chaser: Dare to Dream – It’s Your World!

www.SNCspace.com

Thank you!
NASA CRS2 Provides Flight Options

Program
- Commercial Resupply Services (CRS2)
  - Resupply cargo mission(s) to the International Space Station (ISS)
  - $14 billion contract award, Jan 2016
  - Flight rate: 4 to 5 missions per year
  - Budget – $1.0B-$1.4B per year for 2 or 3 potential providers

Customer
- NASA Johnson Space Center (JSC)
  - Competitive procurement
  - Multiple awards
  - Minimum of 6 flights guaranteed
- Award Date: Jan 2016
- Missions: 2019 - 2024

<table>
<thead>
<tr>
<th>Capability</th>
<th>Per Flight Range (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressurized Upmass Delivery</td>
<td>2500-5000</td>
</tr>
<tr>
<td>Pressurized Downmass Return</td>
<td>2500-5000</td>
</tr>
<tr>
<td>Pressurized Downmass Disposal</td>
<td>2500-5000</td>
</tr>
<tr>
<td>Accelerated Pressurized Downmass Return</td>
<td>Subset of 2500-5000</td>
</tr>
<tr>
<td>Unpressurized Upmass and Disposal</td>
<td>500-1500</td>
</tr>
</tbody>
</table>

CRS2 Only Uses 6 Flts of the 30+ Flt Dream Chaser Capability with 2 Airframes, thus leaving 24+ Flts available in 10 yrs (2020-2030)