



# **Dream Chaser**

## **A Five-Part Series**

A One-on-One Interview  
With Sierra Nevada's  
VP-Space Systems  
Mark Sirangelo  
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By Ken Kremer, AmericaSpace



AmericaSpace

## Table of Contents

Part 1: Dream Chaser's Next Flight Tests Set for Fall 2014, Incorporating Sophisticated Flight Software	1
Part 2: First Private Dream Chaser Construction Pace Accelerates Toward 2016 Maiden Blastoff	11
Part 3: Flight Plans and Crews for Commercial Dream Chaser's First Flights	21
Part 4: Global Partnerships Pave Path Forward for Private International Dream Chaser for Multiple Purposes:	31
Part 5: Dream Chaser's SUV-Like Flexibility and Runway Landing Offer Competitive Advantages	41

## Web Sources

**Part 1:** Mark Sirangelo discussion of SNC's assembly and upcoming free-flight drop test program for the atmospheric test vehicle that will pave the path to the eventual Dream Chaser orbital vehicle, just as the Enterprise did for NASA's shuttle orbiters in the 1970s. <http://www.americaspace.com/?p=66787>

**Part 2:** SNC is boldly pushing forward with the orbital vehicle build, even before the winners of NASA's highly coveted and prestigious commercial crew vehicle contracts are announced by NASA. <http://www.americaspace.com/?p=66000>

**Part 3:** The flight plans and crew for the first two Dream Chaser missions in 2016 and 2017. <http://www.americaspace.com/?p=66192>

**Part 4:** SNC's international partnerships with ESA, DLR, JAXA, and 21 space agencies to enable future international variants of Dream Chaser. <http://www.americaspace.com/?p=66395>

**Part 5:** Dream Chaser's SUV-Like Flexibility and Runway Landing Offer Competitive Advantages. <http://www.americaspace.com/?p=66787>

## Part 1: Dream Chaser's Next Flight Tests Set for Fall 2014, Incorporating Sophisticated Flight Software



SNC's Dream Chaser atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Florida. Credit: Sierra Nevada Corporation (SNC)

The private Dream Chaser crew vehicle, aiming to launch U.S. astronauts back to space, will “resume test flights this fall with sophisticated orbital software” while simultaneously pushing forward with an ambitious “assembly program” of the orbital space plane vehicle destined for the maiden liftoff in 2016, Mark Sirangelo, corporate vice president of Sierra Nevada Corporation (SNC) Space Systems, told AmericaSpace in an exclusive, one-on-one interview about their human spaceflight efforts to build an efficient **astronaut transporter** for NASA.

“We are focused on being ready to launch in November 2016. We have a launch slot [reserved with United Launch Alliance for the **Atlas V rocket**],” Sirangelo said.

“We have begun the build of the first Dream Chaser orbital vehicle!”

Dream Chaser is a reusable manned space plane being developed by SNC to restore America’s capability to ferry American astronauts from American soil to low-Earth orbit and the International Space Station (ISS), with funding from the Commercial Crew Integrated Capability initiative (CCiCAP) under the auspices of NASA’s Commercial Crew Program (CCP).



Credit: Lockheed Martin

SNC's Dream Chaser® orbital structural airframe at Lockheed Martin in Ft. Worth. Credit: Lockheed Martin

We lost the ability to launch humans when the shuttle program ended three years ago. And Mark Sirangelo and the entire SNC team, spread across 30 U.S. states, are on a mission to right that with Dream Chaser.

“We think it’s about time that we get an American built vehicle launching from America to take U.S. astronauts to space. We feel like we are carrying the torch forward from the 135 shuttle flights and bringing the history of NASA along with us as we do this,” Sirangelo emphasized.

Three American aerospace firms—Sierra Nevada with Dream Chaser, **Boeing** with **CST-100**, and SpaceX with Dragon V2—are vying for NASA’s multi-billion dollar contracts to build private sector manned spaceships to fly astronauts to the space station by late 2017, using seed money from NASA’s Commercial Crew Program (CCP) in a public/private partnership.

So right now is an exciting time at Sierra Nevada, as we discussed the status of their activities boldly moving full speed ahead with development, flight test, and manufacturing efforts to get the winged Dream Chaser spaceship ready for the historic 2016 launch to orbit.

In fact SNC may leapfrog ahead of its competitors in the high stakes NASA competition to win the new commercial crew race to space by starting the “assembly of the orbital vehicle,” as well as checking out that vehicle’s “sophisticated flight software a full year ahead of schedule” via critical landing test flights starting in the near term, which will be carried out in both unmanned and manned modes.

“It’s very exciting. We have two Dream Chaser vehicles that are now in development,” Sirangelo said. “Atmospheric flight tests will begin later this year.”

This writer asked Sirangelo to describe the program ahead for both vehicles, which is essentially a mini-shuttle about one-third the size of NASA’s now retired space shuttle orbiters:

“One is the atmospheric flight test vehicle [ATV] which is essentially our version of the ‘Enterprise’ shuttle. That’s where we are doing all the tests making sure the vehicle can conduct its flight maneuvers, its landing maneuvers.”

The “Enterprise” was the full-scale shuttle pathfinder orbiter used by NASA to conduct critical approach and landing tests back in the 1970s to pave the way for the maiden flight by the “Columbia” orbiter in April 1981.

“The atmospheric flight test vehicle is due to start the second phase of its flight testing later this year,” Sirangelo elaborated.

“And secondly we have begun the build of the first orbital vehicle that will be on the first flight in November 2016. That has now been under work for about five months. And we have started delivering the first major pieces of that.”

“So it’s very exciting. We now have two vehicles. One flying and one going into its assembly stage. So it’s pretty fun.”



Dream Chaser going to work atop a ULA Atlas-V rocket. Image Credit: SNC

The Dream Chaser is Sierra Nevada's entry into NASA's high-priority Commercial Crew effort, aimed at fostering the development of a safe and reliable, next-generation crewed vehicle to replace the space shuttle after its forced retirement following the final mission of STS-135 in July 2011.

Since then, all American astronauts' only ride to the ISS has been aboard the cramped Russian Soyuz capsule and at a cost now exceeding \$70 million per seat under the latest cooperative agreement between NASA and Roscosmos, the Russian space agency.

During 2013, SNC conducted a series of high-altitude captive carry tests, as well as a single free flight drop test from a helicopter in October that year with Dream Chaser's engineering test vehicle (ETV).

The ETV is now undergoing significant modifications for use as the atmospheric test vehicle (ATV) that will incorporate and test new, advanced flight software that will be used in the actual orbital vehicle two years from now.

What changes are being made to convert the ETV used for the drop test into the ATV, and what is the significance? This writer asked.

"The vehicle used in the drop test [in 2013] is being upgraded so it can fly higher and faster," Sirangelo explained.

"On the [ATV] upgrades we are doing two main things. First, we are starting to bring on some of the software that we would use in orbit, which is a big move forward. So [in the ATV] we will essentially be flying with our orbital flight software. Secondly we will eventually have it flown with pilots."

"So right now it's essentially an autonomous vehicle. Then we will be bringing on board piloted capability for later in the test program."

When and where will the new series of drop tests begin, and when will it fly piloted?

"The next set of tests, which will be autonomous, will begin later this year," Sirangelo stated. An exact timeframe has not been set yet.

"They will be conducted at Edwards Air Force Base and the NASA Armstrong Flight Center in California."

"The first piloted tests will be done early next year [2015]."

How many pilots will be onboard when you reach that stage?

"One pilot. The vehicle is fully autonomous and fully piloted. So it will be thoroughly tested without a pilot first. Then we will put a pilot in there to conduct some additional

emergency maneuvers. So the pilot will have the autonomous system as a backup as well,” Sirangelo elaborated.



The Dream Chaser engineering test article coming in for an autonomous landing Saturday morning at Edwards Air Force Base, Calif. As the image clearly shows, the left landing gear did not deploy properly, causing the vehicle to sustain minor damage on landing. Photo Credit: SNC

About how many tests are foreseen, manned and unmanned?

“Well, it’s not really about a number. Its more about getting the results so we can finish [the CCiCAP milestones for NASA]. And so we are satisfied with the results.”

“It’s likely to be about three to six flights, something like that.”

*How will the atmospheric drop tests be conducted?*

“The next set of tests will be conducted from a high altitude helicopter, like we did the last set. We are still working to determine how we will conduct the higher altitude tests and are looking at a number of potential vehicles,” Sirangelo stated.

Please discuss the test results and lessons learned from the initial free flight drop test flight conducted in October 2013. The vehicle was released by an Erickson Air-Crane helicopter from an altitude of over 12,000 feet and glided autonomously for about a minute before touchdown on the Mojave desert landing strip on runway 22L at Edwards. The flight was marred at the very end when the Dream Chaser engineering test vehicle skidded off the runway when its left landing gear failed to deploy at the last second during touchdown.

“Well the drop test actually worked out better than what we thought. We had about 40 tests that we were tracking and we got the results from all 40 of them. In part because we had actually put instruments on the vehicle that were necessary to do that and get the data, even though we weren’t really trying to get them [all 40] done in one test.”



“We hadn’t actually planned to get all those results in one test. But we wound up getting such good data that NASA approved us on all the initial tests that we were supposed to do. So it was actually pretty successful,” he said.

The drop tests are among the 15 milestones SNC must complete to receive continued funding under NASA’s CCiCAP award, valued at \$227 million. NASA approved the October 2013 free flight drop test and trajectory data results as Milestone 4a.

SNC has now fulfilled virtually all of its contracted commercial crew milestones and is nearing the end of the CCiCAP program.

Describe the CCiCAP milestones left to complete and the extension you requested in order to make a significant programmatic advance.



Former astronaut Lee Archambault prepares for a Dream Chaser Crew Systems Test. Photo Credit: SNC

“We are 92 percent done with the CCiCAP milestones for NASA. We have one more CCiCAP milestone left that will be done in the next couple of weeks called Milestone 15. So we have another flight test, the drop test, we’re doing later this Fall that will finish it out,” Sirangelo said.

“So we are pretty much finished and at the end of the [CCiCAP] program.”

“For the drop test milestone there were two parts. We had proven the data part. What we actually asked for was an extension on the second piece, on the flight test, so we can upgrade the vehicle to incorporate some additional work on it which is effectively the orbital flight software.”

“It may sound small, but it’s actually a ‘big deal’ and really important to the program.”

“So we will actually be testing the software for orbit for the [Nov. 2016] orbital flight—about one year sooner than otherwise expected.”

“So we pushed the drop test flight back a little bit. But we are accelerating the software development!”

“We wanted to get something more and do another flight test, but do it with the upgraded software. We wanted to upgrade the software. That was not part of the original CCiCAP program!”

“It’s something we added on our own. And it was a nice compromise between us and NASA.”

“So we took a little bit of a delay [in completing Milestone 15]. But the flight will be much more sophisticated!” Sirangelo explained.

So that orbital software upgrade should help you significantly in being ready on time for your targeted orbital flight in November 2016?

“Yes, that’s quite right!”

“So yes, the point is that while these interim milestones are important, the really big and important one is to be ready to go in November 2016.”

“And that’s what we are focused in on. Making sure we are ‘flight ready on time’. This software work now will enable us to cut time off that launch schedule which is far more important to us.”

So is November 2016 definitely your target orbital launch date for Dream Chaser?

“Yes! We bought the rocket. We put an initial deposit on it and as you get closer to launch you put up more money.”

“So, we have a launch slot! And that’s really important. Because without a slot, you can’t fly even if you have a rocket.”

NASA officials have stated they expect to award the next round of commercial crew contracts, dubbed Commercial Crew Transportation Capability (CCtCap), to one or more companies for funding, likely around September.



Artist's illustration of the Dream Chaser crew transportation vehicle docked to the ISS. Image Credit: Sierra Nevada Space Systems

By incorporating orbital flight software in the drop tests this fall, SNC seeks to accelerate the development program toward accomplishing the orbital flight test. Indeed SNC's launch date is slightly ahead of the January 2017 unmanned orbital flight test announced by Boeing. Read this writer's recent interviews with astronaut Chris Ferguson [here](#) and [here](#). SpaceX has spoken of conducting a flight test sometime in 2016, but has not yet specified an exact date.

SNC is also the first of the three commercial crew competitors to start construction of the actual flight-worthy orbital vehicle, going to space in just over two years.

What are the details about the 2016 launch? International partners? And what's the outlook if no NASA contract?



Scale models of NASA's Commercial Crew program vehicles and launchers; Boeing CST-100, Sierra Nevada Dream Chaser, SpaceX Dragon. Credit: Ken Kremer/kenkremer.com

## Part 2: First Private Dream Chaser Construction Pace Accelerates Toward 2016 Maiden Blastoff



SNC's Commercial Dream Chaser atmospheric test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

Construction of the **first commercial Dream Chaser** space plane that will propel Americans back to space from American soil is well underway and accelerating to insure “its ready for the first launch in November 2016,” Mark Sirangelo, corporate vice president of Sierra Nevada Corporation (SNC) Space Systems, told AmericaSpace in Part 2 of our exclusive, one-on-one interview about their human spaceflight efforts to build a credible and affordable **astronaut taxi** for NASA.

“We have been laying the foundation with many relationships. And we are working on a global basis,” Sirangelo emphasized. “All the elements are there and they are tangible and touchable, not theoretical.”

In **Part 1** of this series, Sirangelo described SNC’s assembly and upcoming free flight drop test program for the atmospheric test vehicle that will pave the path to the eventual Dream Chaser orbital vehicle, just as the Enterprise did for NASA’s shuttle orbiters in the 1970s.

In Part 2, we’ll focus on how SNC is boldly pushing forward with the orbital vehicle build even before the winners of NASA’s highly coveted and prestigious commercial crew vehicle contracts are announced by NASA.

“The three big things ahead of us are the continuation of the atmospheric flight test program this fall [2014], the delivery of the orbital vehicle [2015] and the preparations to ready for the first launch [2016],” Sirangelo said.



SNC's Dream Chaser blasts off atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

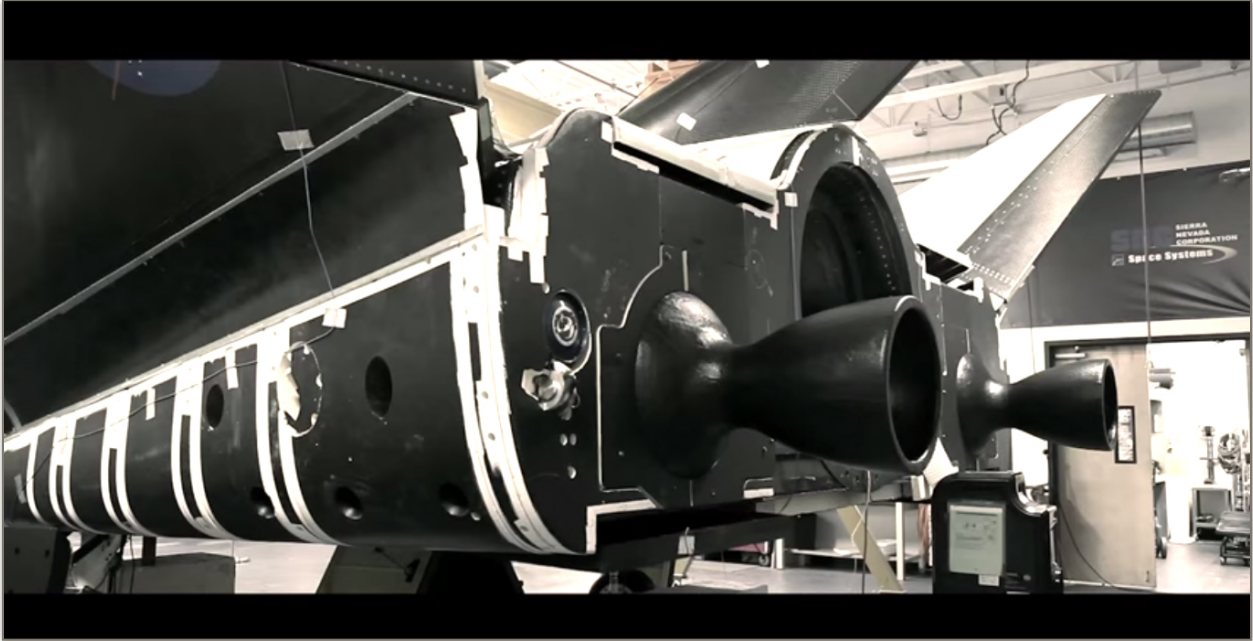
And rather impressively, SNC has already commenced building the inaugural Dream Chaser winged orbital vehicle and purchased the **Atlas V rocket launcher**, despite receiving only half the NASA funding awarded to their other two competitors building capsules—SpaceX with the Dragon V2 and **Boeing** with the **CST-100**—in the current funding period from the agency's Commercial Crew Integrated Capability initiative (CCiCAP) under the auspices of NASA's Commercial Crew Program (CCP).

SNC has received \$227.5 million in the current round of CCiCAP funding from NASA, versus about \$480 million for Boeing and \$460 million for SpaceX.

The high stakes announcement from NASA's Commercial Crew Program office of the multi-billion-dollar contract winners moving forward to build America's next crew vehicles in the next program phase, known as Commercial Crew Transportation Capability (CCTCap), is expected between late August and September.

The goal is to restore America's manned spaceflight access to the International Space Station (ISS) using American vehicles and rockets launched from American soil by the end of 2017, if not sooner—and end our self-imposed dependency on Russia.

Dream Chaser is a reusable lifting-body design spaceship that will carry a mix of cargo and up to a seven crewmembers to the ISS. It will also be able to land on commercial runways anywhere in the world.



SNC's Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

SNC is on an accelerating arc that, if all goes well, has the Dream Chaser assembly and inaugural blastoff somewhat in front of Boeing's announced January 2017 launch and SpaceX's undefined plans for perhaps launching something in 2016.

Read my recent AmericaSpace interviews with astronaut Chris Ferguson, now Boeing's Crew and Mission Operations director, for complete details regarding the CST-100: [here](#) and [here](#).

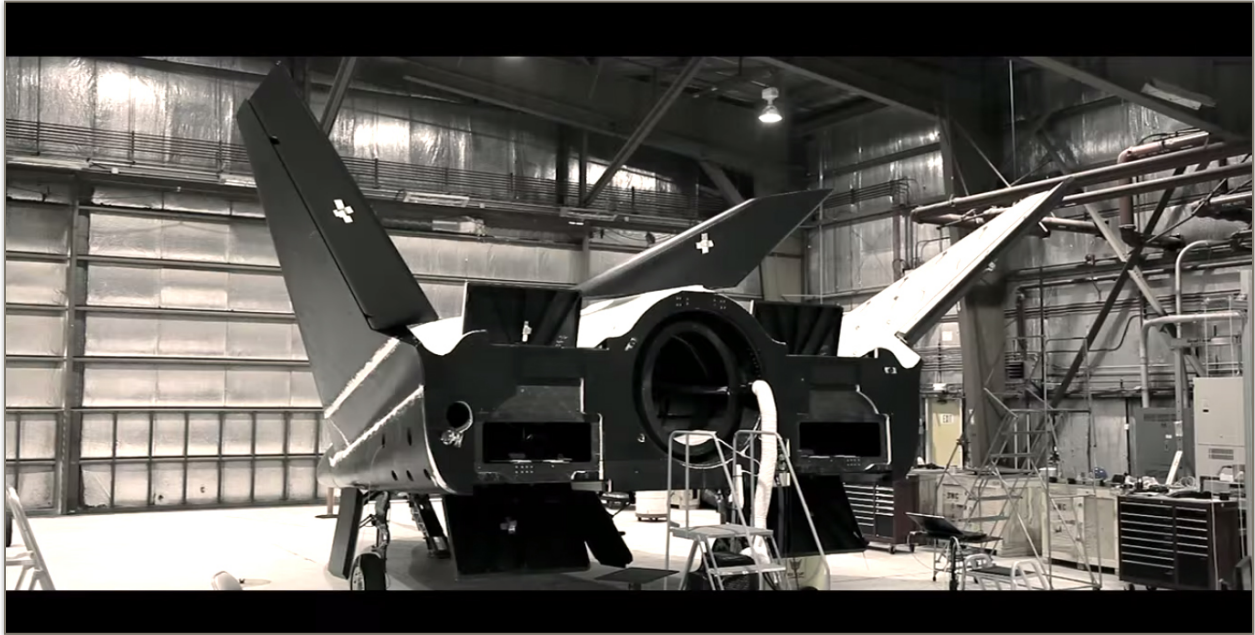
*SNC's Dream Chaser program seems to me to be the most advanced of the three competitors, as far as fabricating the orbital vehicle and announcing a manifested launch date in just over two years time, this writer remarked.*

"Yes, I believe we are the first ones [of the three CCiCAP competitors] actually doing an orbital launch. And we are the first ones starting the orbital vehicle build. So we have both the rocket and the vehicle now under construction. And the [Atlas V] launch site will soon be under construction. So the elements are all there that are tangible and touchable," Sirangelo stated.

"It's not something that's [just] theoretical! I think part of what you want to look for is what evidence is there of an 'orbital vehicle' under design and construction. We are a little over two years out, here in August. It's not too far away."

“We are pretty near to making that happen.” (Including the accelerated software development for the orbital vehicle: see **Part 1**.)

“We have all the [launch] elements in place. The vehicle has a schedule to get there. The rocket has a schedule to get there. Mission operations are on schedule and there are a lot of obvious public things going on that demonstrate that.”



SNC's commercial Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

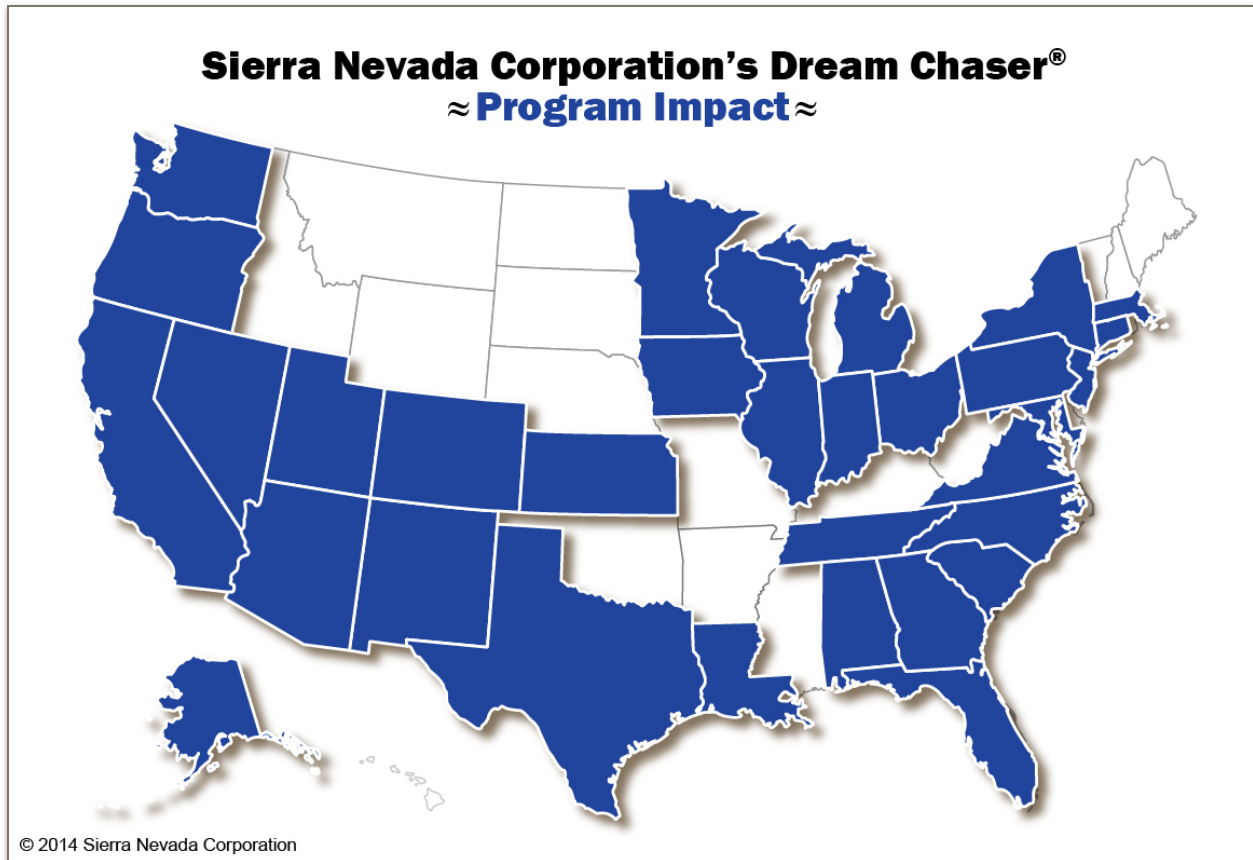
SNC has methodically laid the foundation to the vehicle's future construction, operation, and expanding capabilities by organizing a nationwide team and partnering with diverse entities to manufacture and launch the winged space plane; they call it the Dream Chaser “Dream Team.”

“We have quite a large team of about 30 companies working for us in building the vehicle as part of our Dream Chaser ‘Dream Team’,” Sirangelo stated.

“There are 32 states and 30 companies with employment on this program, nine U.S. universities, nine NASA centers, as well as international partners involved in the program as our ‘Dream Team’.”

Among the major Dream Team aerospace industry partners are Lockheed Martin, United Launch Alliance, Draper Laboratory, Aerojet Rocketdyne, MacDonald Dettwiler & Associates Ltd. (MDA), UTC Aerospace Systems, Jacobs, Moog Broad Reach, Siemens PLM Software, Southwest Research Institute, and many others.





The Dream Chaser “Dream Team” program now involves 32 states, 30 companies, nine universities, and nine NASA centers across the U.S., as well as international partners. Credit: Sierra Nevada Corporation (SNC)

All efforts are geared to achieving an on-time maiden launch on Nov. 1, 2016, atop a United Launch Alliance Atlas V rocket from Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla.

Please describe the status of construction of the orbital test vehicle and pieces coming from Lockheed Martin at NASA’s Michoud Assembly Facility (MAF) in New Orleans to Lockheed’s Ft. Worth, Texas, facility.

“We have begun the build of the first Dream Chaser orbital vehicle that will be on the first flight in November 2016!” Sirangelo explained.

“That has now been under work for about five months. And we have started delivering the first major pieces of that.”

“Lockheed Martin is one of our partner vendors and is building the Dream Chaser’s composite structure at MAF. Essentially it’s the chassis of the vehicle.”

“MAF is the same place as Orion’s structures are built by Lockheed. MAF has been a longstanding facility for NASA for the shuttle tanks. So it’s interesting that its now the

place where SLS, Orion and now our commercial crew vehicle are being built in the same complex, which is a little known fact. So all three major parts of NASA's human spaceflight program are being built at MAF."

"Lockheed can use the same type of high quality tooling used for Orion also for some of the initial composite structures on Dream Chaser. Those pieces then go to the Lockheed facility in Ft Worth, Texas, which is where they build the Joint Strike Fighter and the F-16. So it's finished and quality checked and finally cured there. They have the biggest autoclaves in the country at Ft Worth."



Credit: Lockheed Martin

SNC's Dream Chaser® orbital structural airframe at Lockheed Martin in Ft. Worth. Credit: Lockheed Martin

"So we are using both the most sophisticated facility's group for fighter aircraft as well as getting the same type facilities used for Orion, and getting the benefit of that Orion history for us as well."

"So Lockheed's contribution is the composite structure."

What's the approximate timetable for fabricating, completing, and delivering the orbital test vehicle for the first flight?

"The major structures will be done and delivered by the end of this year. Then we will start populating it. We have pieces coming in from all over the country. So the primary structures will be delivered later this year."

"Then we will be assembling it throughout next year so it's ready for the 2016 flight. So somewhere around 12 to 18 months is when it will be done."

Where is the vehicle's final assembly site?

"The final assembly is in our SNC facility in Louisville, Colo. We have major subcomponents subcontracted from experts in all those areas. And some we do ourselves. Then we are responsible for assembling it all together."

*Now let's focus on the **Atlas V rocket**. How committed is SNC to the November 2016 maiden orbital launch date for Dream Chaser?*

"Yes! We bought the rocket. We put an initial deposit on it and as you get closer to launch you put up more money," Sirangelo stated. "We are focused on being ready to launch in November 2016."

"We have a launch slot [reserved with United Launch Alliance for the Atlas V rocket]. And that's really important. They are allocated for the year. Because without a slot, you can't fly even if you have a rocket."

*Why did you choose the Atlas (also chosen by Boeing to launch their CST-100 capsule)?*

"We chose the Atlas V because it is the safest and most used rocket that's out there. And when we are dealing with crew or even critical cargo we wanted to start with something that was as safe and predictable as any rocket that's out there."

"Dream Chaser is designed to be 'rocket agnostic' so it can launch on different launch vehicles, that's the same as for very big satellites."

So Dream Chaser can also be launched on ULA's Delta IV. But the Delta and anything else would need to be man rated. In Part 3 we'll discuss the possibilities for other international vehicles.

*Describe the type of Atlas and whether you need any solids. Boeing requires two strap-on solids to launch their CST-100.*

"We are flying an Atlas V 412, with a dual engine Centaur upper stage. We are lighter [compared to CST-100] and don't need a second solid."



Dream Chaser propelled to space by ULA Atlas V Rocket 2nd stage after liftoff from Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

Can you explain why there is no shroud around Dream Chaser at launch (in answer to readers' questions from Part 1)?

"A shroud is not needed. This has been tested thoroughly over 5 years and through many wind tunnel tests on the full launch stack in three separate testing centers." Sirangelo replied.

"The lifting body of the DC does not produce any concerning lift at the angle of the Atlas V profile."

Describe your work with ULA on the new crew access tower and access arm to be built to enable manned launches of Dream Chaser and CST-100 from the Atlas V pad at Space Launch Complex 41 in Florida.

"We and Boeing and ULA are looking together to do the tower work as necessary. It's a three way thing and we are both working together cooperatively with ULA to make it happen."

Given the different sizes and geometries of the vehicles, what are the changes to the crew walkway allowing direct crew access to Dream Chaser versus the CST-100?

"It's basically just a different entry point for the vehicle. The tower and the modifications are similar," Sirangelo said.



SNC's Dream Chaser atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

For complete details regarding the Atlas pad 41 modifications, read the AmericaSpace interview with ULA executives [here](#).

“From start to finish its roughly about 18 months of work,” Howard Biegler, ULA’s Human Launch Services Lead, said during an exclusive onsite interview atop the Atlas pad at Space Launch Complex 41 on Cape Canaveral Air Force Station, Fla.

America totally lost the ability to launch humans when the shuttle program ended three years ago with the STS-135 mission commanded by Chris Ferguson.

Since then we have been 100 percent dependent on the Russia Soyuz capsule for rides to the International Space Station (ISS) and back, at a cost now exceeding \$70 million per seat.

Mark Sirangelo and the entire SNC team, spread across 30 U.S. states, are on a mission to right that with Dream Chaser—and at a vastly reduced cost to the U.S. taxpayer.

“We think it’s about time that we get an American built vehicle launching from America to take U.S. astronauts to space. We feel like we are carrying the torch forward from the 135 shuttle flights and bringing the history of NASA along with us as we do this,” Sirangelo emphasized.

So, what's the outlook for Dream Chaser if SNC does not receive the NASA contract under the Commercial Crew Transportation Capability (CCtCap) initiative? What are the details about the 2017 manned launch? International partners?

## Part 3: Flight Plans and Crews for Commercial Dream Chaser's First Flights



Dream Chaser blazes to orbit and the ISS after separation from ULA Atlas V Rocket 2nd stage and liftoff from Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

With the pace of assembly accelerating for the first **private Dream Chaser space plane**, plans for its maiden blastoff on an “orbital test flight on a fully autonomous mission in Nov. 2016” are moving forward, **Mark Sirangelo**, corporate vice president of Sierra Nevada Corporation (SNC) Space Systems, told AmericaSpace in Part 3 of our exclusive, one-on-one interview about their efforts to build a cost-effective **astronaut taxi** to the International Space Station (ISS).

The first unmanned flight will be followed by the launch of the first manned Dream Chaser before the end of 2017, under NASA’s current timetable, Sirangelo stated.

The first manned Dream Chaser will launch with a two-person crew that is virtually certain to include one of two veteran former NASA astronauts and space shuttle commanders, now on staff at Sierra Nevada as managers and test pilots, Sirangelo elaborated.



Commercial Dream Chaser approaches runway at Shuttle Landing Facility (SLF) on return from ISS mission in this artist's concept. Credit: Sierra Nevada Corporation (SNC)

Dream Chaser is a reusable manned space plane being developed by SNC to restore America's indigenous capability to ferry American astronauts from American soil to low-Earth orbit and the International Space Station (ISS), with funding from the Commercial Crew Integrated Capability initiative (CCiCAP) under the auspices of NASA's Commercial Crew Program (CCP).

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In **Part 2**, we focused on how SNC is boldly pushing forward with the orbital vehicle build, even before the winners of NASA's highly coveted and prestigious commercial crew vehicle contracts are announced by NASA.

Now we'll discuss the flight plans and crew for the first two missions in 2016 and 2017.

Describe the flight plans for the November 2016 unmanned flight and how the control will differ from the October 2013 free flight drop test.



“The first flight will be an orbital unmanned test. And it is fully autonomous. It’s not a UAV. We are not ground controlling it. The November 2016 flight is a fully autonomous mission and is controlled by the spaceship.”

“The first drop test mission [in Oct 26 2013] was not a fully autonomous mission. It was ground controlled.”



SNC’s Dream Chaser blasts off atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

What are the on-orbit flight goals for Dream Chaser’s 2016 mission? It’s likely to be at least several orbits and perhaps even days long.

“For the November 2016 flight it will be a full orbital flight. We are launching using a **full Atlas V** in the same flight configuration as we would use to go to the space station with. We are flying on an Atlas V 412. The first stage has one strap on solid. We are lighter [compared to CST-100] and don’t need a second solid. The second stage uses a dual engine Centaur.”

“We will do an orbital flight with a series of checkouts of important elements of the vehicle and then we are flying it back home.”

For complete details regarding the Atlas V pad 41 modifications, read the AmericaSpace interview with ULA executives [here](#).

Boeing’s **Chris Ferguson** said in an AmericaSpace interview that Boeing would like to go all the way to the ISS with the CST-100 on the first unmanned flight, if they satisfy NASA’s requirements. What are your plans for Dream Chaser?

“It’s unlikely that NASA will let any of us go the ISS without having their first flight demonstrated. But that’s still in the future.”

*Would the next flight after the November 2016 unmanned test flight fly with an astronaut crew?*

“Yes, the next flight would be a manned flight.”

Would that first manned flight go to the ISS? And what does that mean for system certification with NASA?

“We are hoping that NASA would want us to go the ISS. And then with those two flights—unmanned and manned—we would be fully certified by NASA for flight operations.”

But the actual manned launch date is entirely dependent on the U.S. Congress appropriating the funds for CCP requested by the Obama Administration.

To date, Congress has given NASA barely half its funding request and thereby already forced about an 18-month delay of the first manned commercial crew spacecraft to the ISS from 2015 to 2017, Chris Ferguson said in an earlier interview about the CST-100. The same is true for Sierra Nevada and SpaceX.

So the date of first launch could slip further into 2018, unless and until Congress acts!

NASA’s commercial crew outlook for the coming fiscal year is more promising, but Congress has thus far failed to pass a NASA budget, or much of anything else either.

In the time since the shuttle’s retirement in 2011, the U.S. is 100 percent dependent on the Russia Soyuz capsule for astronaut rides to the International Space Station (ISS) and back, at a cost now exceeding \$70 million per seat.



SNC's Dream Chaser blasts off atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

Dream Chaser is a reusable lifting-body design spaceship that will carry a mix of cargo and up to a seven crewmembers to the ISS. It will also be able to land on commercial runways anywhere in the world.

Who will be the astronauts on the first manned flight in 2017? SNC currently has two space shuttle flyers involved with Dream Chaser.

“It’s a little unclear at this time. Our two flight people [now] are Steve Lindsey, our senior program manager, and Lee Archambault.”

“Steve is a five time shuttle pilot and was the head of the astronaut office for three years.”

Lindsey was the commander of the final flight of Space Shuttle Discovery that launched on Feb. 24, 2011, and delivered the Permanent Multipurpose Module Leonardo, as well as Robonaut 2 to the ISS.

He was also a veteran of missions STS-87, STS-95, STS-104, and STS-121, and a three-time shuttle commander with over 1500 hours in space.

“Our flight director is Lee Archambault.”

Archambault is a veteran of two shuttle flights, STS-117 as pilot and STS-119 as commander. He has spent a combined 27 days in space. Both missions were ISS

assembly flights carrying critical parts and hardware, including truss segments and the huge solar arrays.

“Lee is managing the flight test program and is likely to be one of the pilots as well.”

The upcoming free-flight drop test program this fall and into 2015—unmanned and manned—is detailed in **Part 1**.

Would the 2017 manned flight be a mixed crew of SNC test pilots and NASA astronauts? Boeing’s Chris Ferguson indicated in an interview that NASA might be leaning toward a mixed crew, which would be a change from NASA’s earlier thinking on it being two company test pilots.

“It’s a little unclear at this time. NASA has to decide whether they want to have one of their people on this first flight or not.”

“We will know that later. We don’t know that at this time.”

Could both Steve and Lee fly on that first manned flight in 2017?

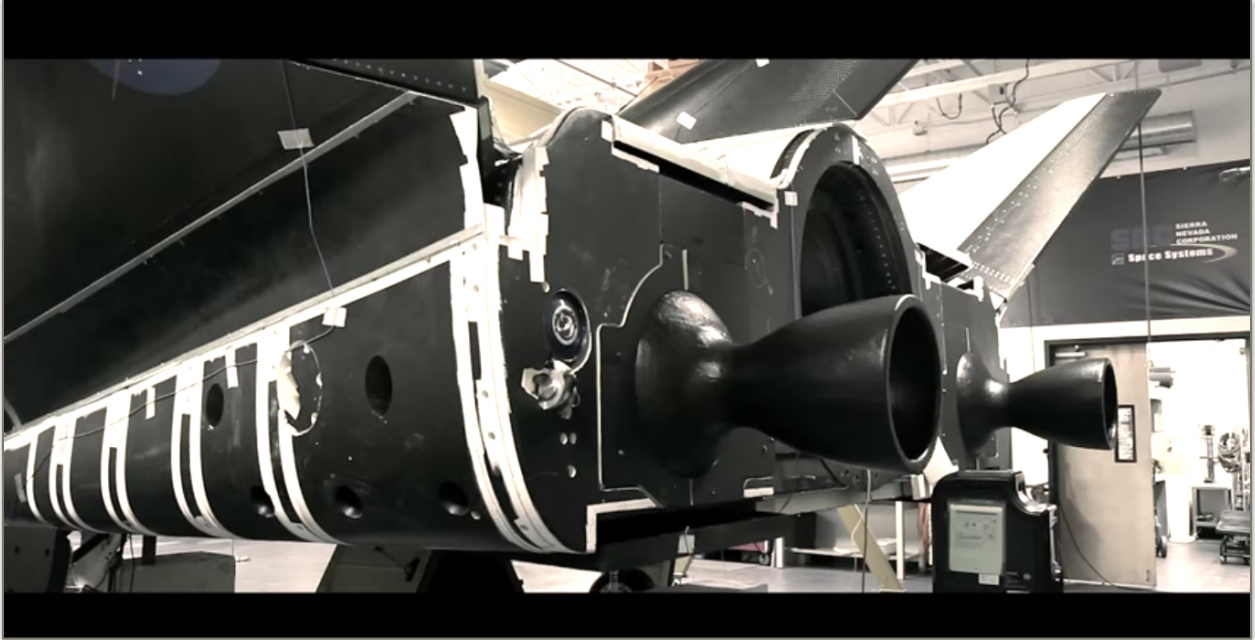
“We haven’t decided that yet. They are both capable. We’ll make those decisions when we get there.”

Have you changed the Dream Chaser’s propulsion system from a hybrid solid/liquid system to an all liquid system as some have claimed recently, and as readers asked in **Part 1**?

“We have not announced a change in propulsion systems and that was not a quote from us.”

“It was likely meant to refer to our acquisition of Orbitec as we now have an expanded base of propulsion solutions and are exploring their use for future Dream Chaser variants.”

“There is no schedule change related to engines.”



SNC's Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

Describe the abort modes and plans for abort tests?

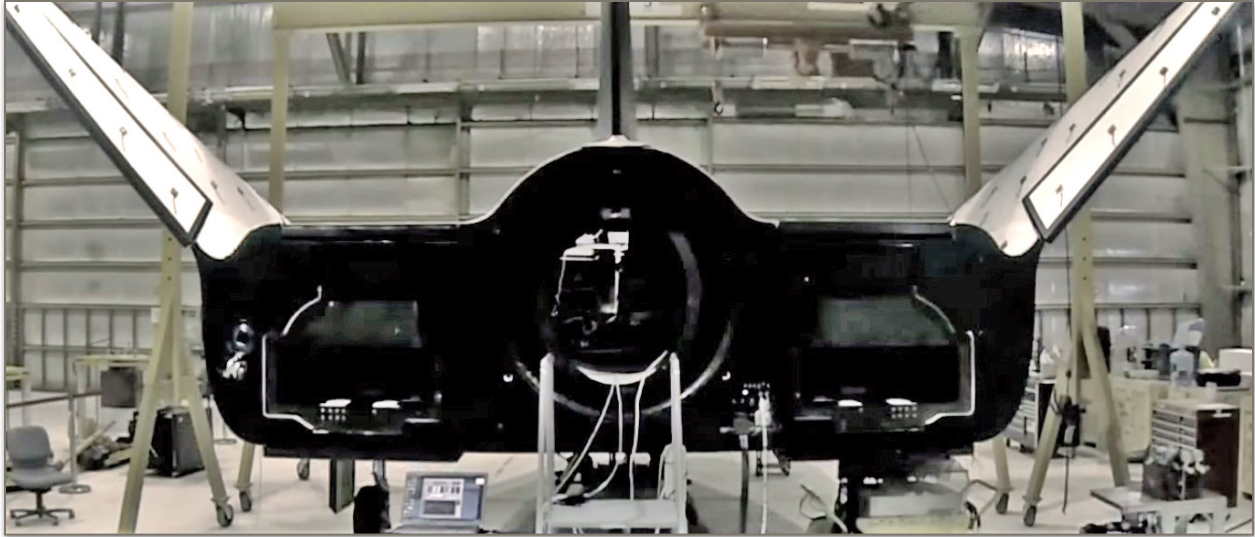
“One of the major features of Dream Chaser is its ability to abort safely to a runway landing from anywhere on the launch profile.”

“We call that having no black zones. This provides the highest degree of safety for the crew and also preserves vehicle and any payload that it may be carrying.”

“We are planning various abort element testing in the next phase but can't release timing at this point.”

Why did you choose the Atlas V rocket, also chosen by Boeing to launch their CST-100 capsule?

“We chose the Atlas V because it is the safest and most used rocket that's out there. And when we are dealing with crew or even critical cargo we wanted to start with something that was as safe and predictable as any rocket that's out there.”



Rear view of SNC's commercial Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

NASA's Commercial Crew Program office is expected to announce the winner(s) of the high stakes, multi-billion dollar contract to build America's next crew vehicles in the next program phase, known as Commercial Crew Transportation Capability (CCtCap), "sometime around the end of August/September," NASA News spokesman Allard Beutel reconfirmed to this writer today.

"We don't have a scheduled date for the commercial crew award(s)."

*What happens to Dream Chaser if Sierra Nevada does not receive the CCtCAP contract from NASA? Do you go ahead anyway or stop?*

"I get asked that question every day. The answer is we have to see why we didn't get it. And then we have to determine what are our cost course to push forward," Sirangelo replied.

"We have a lot of the hardware in place and a lot of things moving [read parts 1 and 2]. We believe we have a path with other relationships to continue."

"But it's going to be a question, for all three companies, is we have to evaluate what happened. Was it money issues or technical or something else. So we are not saying at this time what we are going to do or not do."

"The closer we get to flight the more likely it is we can do other work also. NASA is an important part of this. But we have been laying the foundation with other relationships as well."

"We have all the elements to be able to go ahead. Whether we go ahead is a matter of whether there is a business case for it. We can't say at this time."



Dream Chaser set to dock at the ISS in this artist's concept. Credit: Sierra Nevada Corporation (SNC)

So no matter what happens, Sierra Nevada has laid the foundation to move forward by beginning to build the orbital vehicle and attracting numerous partners globally.

So there's much more to this story. Find out how Dream Chaser could survive no matter what happens with CCP – in Part 4!

What are the details about future upgrades and variants of Dream Chaser?  
International partners?

Is Dream Chaser reusable? How flexible is it?

Any implications for flying autonomous?

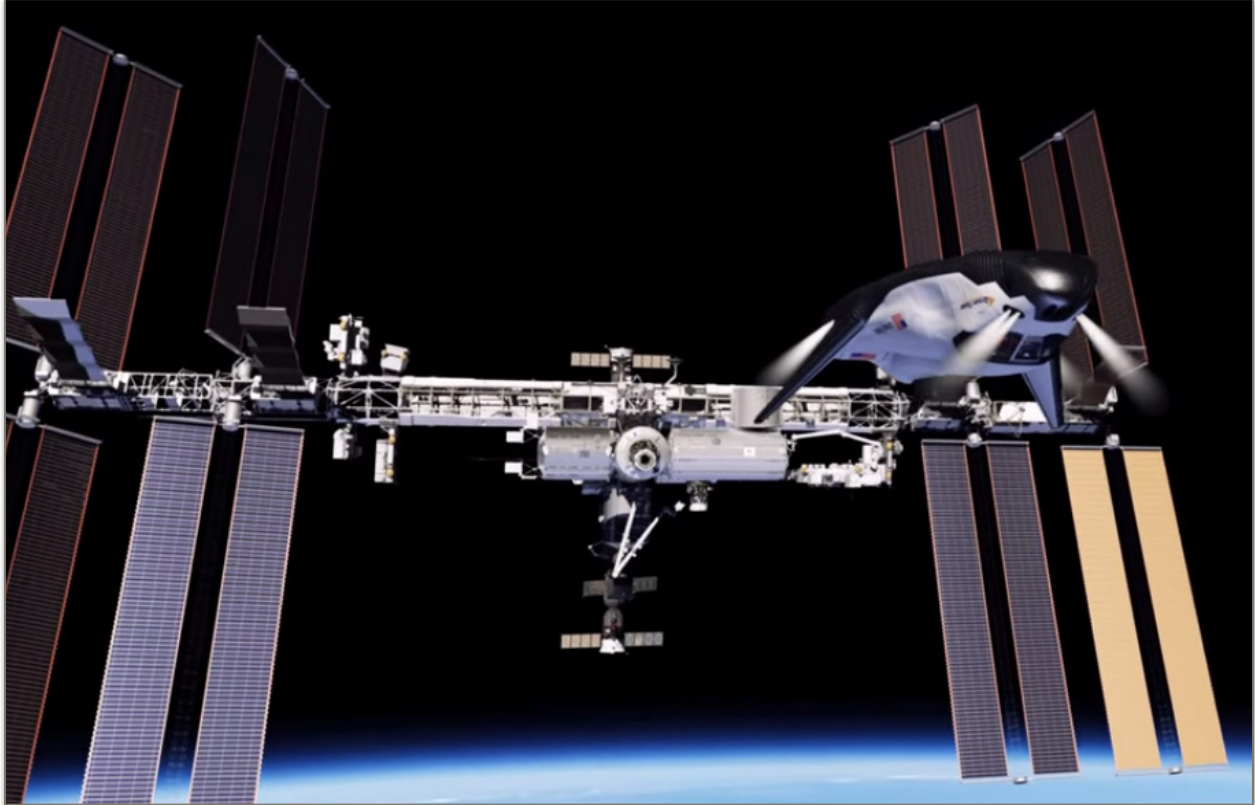
What advantages does it offer compared to its other competitors, both of which are capsules: the Boeing CST-100 and SpaceX Dragon V2?



Final launch of Space Shuttle Discovery on the STS-133 mission to the ISS was commanded by astronaut Steve Lindsey in February 2011, who now serves as Senior Program manager for SNC's Dream Chaser crew program. Credit: Ken Kremer – kenkremer.com



## Part 4: Global Partnerships Pave Path Forward for Private International Dream Chaser for Multiple Purposes:



Global partnerships could one day lead to European or Japanese versions of the Dream Chaser docking at the ISS in this artist's concept. Credit: Sierra Nevada Corporation (SNC)

By amassing “global partnerships with 21 space agencies,” the **private Dream Chaser** space plane has a solid foundation and “a path to continue” forward, **Mark Sirangelo**, corporate vice president of Sierra Nevada Corporation (SNC) Space Systems, told AmericaSpace in Part 4 of our exclusive, one-on-one interview about the company’s efforts to build a cost-effective and potentially international version of their “**astronaut taxi**” to the International Space Station (ISS), as well as multiple exciting missions beyond!

“We have 21 space agencies that have a connection to the program now, which is pretty incredible,” Sirangelo stated. “We have a path with these other relationships to continue.”

“A European or Japanese version of **Dream Chaser** is possible in the future.”

Dream Chaser's inaugural launch atop an **Atlas V rocket** from Florida is slated for November 2016 on an unmanned orbital test flight. Furthermore, SNC has already begun **building the orbital vehicle** and has purchased the rocket.



SNC's Dream Chaser blasts off atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

Over the past months SNC has laid the foundation for a global expansion through a series of agreements with new international partners, including ESA (European Space Agency), DLR (German Aerospace Agency), and JAXA (Japanese Aerospace and Exploration Agency).

SNC has used NASA's ISS model as the basis for how to build effective global partnerships, and those global space agencies also need to find new ways to pay NASA for maintaining their ISS funding commitments into the future, since its longevity was recently extended to at least 2024.

And the international partners may in fact also hold the key to paving the path forward for the Dream Chaser program, regardless of the outcome of NASA's imminent and momentous downselect decision concerning who wins the contract to build the private "space taxis" aimed at restarting manned blastoffs from U.S. launch pads.

**Part 3** of the Mark Sirangelo interview concluded with these questions: What happens to Dream Chaser if Sierra Nevada does not receive the CCTCAP commercial crew contract from NASA? Do you go ahead anyway or stop?

"We have all the elements to be able to go ahead. Whether we go ahead is a matter of whether there is a business case for it. We can't say at this time," Sirangelo replied.

“NASA is an important part of this. But we have been laying the foundation with other relationships as well.”

Here’s how: Europe and Japan can contribute money, technology, launchers, and even new variants of the Dream Chaser that could be critical not just to the vehicle’s viability, but also to the very survival of the ISS itself, as well as opening up an array of entirely new mission concepts for science and exploration.

“We are trying to help these global space agencies, help ourselves and also give NASA support for maintaining the ISS as long as possible,” Sirangelo elaborated.

“Dream Chaser is not just designed for the ISS mission. There are multiple uses of the Dream Chaser beyond the ISS.”



SNC’s Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

Dream Chaser is a winged, manned space plane being developed by SNC to restore America’s capability to ferry American astronauts from American soil to low-Earth orbit and the International Space Station (ISS)—with funding from NASA’s Commercial Crew Integrated Capability initiative (CCiCAP) under the auspices of the agency’s commercial crew program.

Three American aerospace firms—Sierra Nevada with Dream Chaser, **Boeing** with **CST-100**, and SpaceX with Dragon V2—are vying for NASA’s multi-billion dollar contracts to build private sector manned spaceships to fly astronauts to the space station by late 2017, using seed money from NASA’s Commercial Crew Program (CCP) in a public/private partnership.

NASA's Commercial Crew Program office is expected to announce the winner(s) of the high stakes contract to build America's next crew vehicles in the next program phase, known as Commercial Crew Transportation Capability (CCTCap), "sometime around the end of August/September," NASA News spokesman Allard Beutel reconfirmed.

The first "orbital test flight on a fully autonomous mission in November 2016" will be followed by the launch of the first manned Dream Chaser before the end of 2017, under NASA's current timetable, Sirangelo said.

"All the elements are there and are tangible and touchable, not theoretical," Sirangelo stated.

Dream Chaser is a reusable lifting-body design spaceship that will carry a mix of cargo and up to a seven crew members to the ISS. It will also be able to land on commercial runways anywhere in the world.

So let's talk about SNC's interesting and ambitious Dream Chaser plans for international cooperation with ESA (European Space Agency), DLR (German Aerospace Agency), and the Japanese Aerospace and Exploration Agency (JAXA), which appears to have exciting possibilities in multiple arenas. What can they provide for Dream Chaser?

"We are very fortunate in that we now actually have 21 space agencies that have a connection to the program, which is pretty incredible. They are direct relationships."

"Up to this time ESA and JAXA had mostly worked through their own companies in their own countries or directly with NASA."

"So what we realized is that NASA had done an extraordinary job building a global partnership around the ISS. Part of that was reliant on their (ESA & JAXA) ability to get flights for their astronauts on the shuttle through a barter system where they could do work on the shuttle or provide cargo vehicles for the ISS like with the Japanese HTV and European ATV."

"But as you look to the future that becomes a little more problematical because the ATV is no longer flying, the HTV is winding down and there are no more barter seats on the shuttle."

"So we said to ourselves why don't we see if we can go out to these agencies and see if they would be interested in keeping that spirit alive doing work in LEO, but by working with us in a partnership instead of directly with NASA."

"It turned out to be a pretty good idea. They are all interested in maintaining going to LEO for their people and technology. But they didn't have an easy way to do that. So we can provide that conduit [with Dream Chaser]."

“This would also keep their interest in the ISS going. And those agencies contribute a substantial amount of money to the future of the ISS. But if they don’t have local interest in doing that, it becomes harder for them to make those contributions.”



Commercial Dream Chaser approaches runway at Shuttle Landing Facility (SLF) on return from ISS mission in this artist’s concept. Credit: Sierra Nevada Corporation (SNC)

So SNC has methodically laid the foundation to the vehicle’s future construction, operation, and expanding capabilities by organizing a global team of diverse entities to manufacture and launch the winged space plane both inside and outside the U.S. that will have far-reaching implications for those countries and the ISS, not just SNC.

Former Astronaut Frank Culbertson, who now leads Orbital Sciences Antares/Cygnus program of ISS resupply missions, said in an interview that he “hopes the ISS could operate until 2050,” if it is maintained.

“So what we are trying to do is help these global space agencies, help ourselves and also give NASA support for maintaining the ISS as long as possible,” Sirangelo said.

“So that was the goal and its working out in that way.”

Explain what they offer to Dream Chaser. And are there possibilities beyond the ISS?

“In each of the countries, we are looking at their existing technologies and seeing if there is a way to incorporate them into our design.”

“There are multiple uses of the Dream Chaser.”

“Dream Chaser is not just designed for the ISS mission. It could be a repair mission or an independent laboratory [flying in orbit]. It could be a servicing mission or construction vehicle to help build things.”

“And in each of those different variants there are possibilities to bring on the technologies and expertise that are global. Much like Japan and Europe built modules for the ISS, and they have a lot of expertise on how to do that.”

“For example we need to learn how to change the inside of the Dream Chaser into a working laboratory.”

“Europe had a long standing history with lifting bodies. So having the benefit of their research in our program makes us smarter and better.”

“And we have room for a seven member crew on our vehicle. So if we have an extra seat or two we might be able to provide flight opportunities to these countries that is consistent to what the shuttle did.”



Dream Chaser blazes to orbit and the ISS after separation from ULA Atlas V Rocket 2nd stage and liftoff from Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

Explain how they can contribute if you already have Dream Chaser designed, for the most part, and are already in the process of building the first orbital vehicle? (Note: Read more about the orbital vehicle construction details in **Part 2** of this series.)

“Well it is true that we have a lot of it together. But there will also be a life process with the vehicle. Just like with the F-15, for example, which has had 8 ‘variants’ for example.”

“So you continue to upgrade the vehicle as you move forward. That’s one path.”

“And as we look at ‘variants’ for our vehicle for different missions beside the crew vehicle, there are things we haven’t done yet like robotics, servicing and there are opportunities for new technologies for the different variants that could come from these other countries.”

Other possibilities include microgravity and biomedical science, spacecraft and telescope servicing, debris removal, and materials manufacturing.

Let’s discuss taking this to the next step. Are there possibilities for some type of international variants of the Dream Chaser?

“In the future when we are working on a global basis, it is possible for us to explore the use of a variant that’s a European or Japanese version of Dream Chaser.”

What are the possibilities for launching Dream Chaser or variants on the Japanese JAXA H2B or ESA’s Ariane V compared to the ULA Atlas V? And why did you choose the Atlas V, also chosen by Boeing to launch their CST-100 capsule?

“We chose the Atlas V because it is the safest and most used rocket that’s out there. And when we are dealing with crew or even critical cargo we wanted to start with something that was as safe and predictable as any rocket that’s out there.”

“However, when we are working on a global basis it is possible to explore using Dream Chaser or a variant that’s either a European or Japanese version of Dream Chaser that could launch off their domestic rockets, like the H2B or the Ariane V.”

“Dream Chaser is designed to be ‘rocket agnostic’ so it can launch on different launch vehicles, that’s the same as for very big satellites.”

What are the possibilities with the Ariane V rocket? It’s not human rated. Can you launch people?

“Yes, the Ariane V could lift the Dream Chaser, not in a human capacity but in an unmanned capacity.”

“Well most people don’t know that there has never been a human rated rocket in the world.”

“The human rating standard that NASA has set out [in the Commercial Crew Program] is the first time some entity has gone through that. The rockets that have been used were certified mostly by the fact that they had flown a lot. Not because they actually passed a certification program. And that includes the Soyuz, too. You have to wonder if even it would pass if they had to go through the same sort of certification that we have to go through.”

Therefore, if you were to launch on either the H2B or Ariane V, it would definitely be unmanned for cargo purposes?

“Yes.”

Dream Chaser can launch unmanned because it’s designed to be fully autonomous. The first orbital test flight set for November 2016 will be unmanned. Astronauts won’t fly aboard until the second flight, set for blastoff before the end of 2017.

“With those two flights—unmanned in 2016 & manned in 2017—we would be fully certified by NASA for flight operations.”

Could you eventually launch a manned Dream Chaser on either the H2B or Ariane V? Are you exploring that possibility to launch with people in the future?

“That’s not part of the discussions at this time.”

Could Dream Chaser land in Europe or Japan if you launch on one of their rockets?

“Dream Chaser can land anywhere. Its designed for commercial runways. It can land in Europe at multiple airfields, for example the landing strip in Spain used during the Space Shuttle era. That one is easy because its already been tested.”

What’s the timetable for cooperation with ESA and Japan?

“We don’t have that yet, because it’s really just started. First we are looking at what is possible technology wise. Then we’ll explore more in detail of what is possible. It’s a couple of years down the road.”



Dream Chaser set to dock at the ISS in this artist’s concept. Credit: Sierra Nevada Corporation (SNC)



For complete details on the SNC Dream Chaser, be sure to read the entire interview series with Mark Sirangelo.

In **Part 1** of this series, Sirangelo described SNC's assembly and upcoming free-flight drop test program for the atmospheric test vehicle that will pave the path to the eventual Dream Chaser orbital vehicle, just as the Enterprise did for NASA's shuttle orbiters in the 1970s.

**Part 2** focused on how SNC is boldly pushing forward with the orbital vehicle build, even before the winners of NASA's highly coveted and prestigious commercial crew vehicle contracts are announced by NASA.

**Part 3** discussed the flight plans and crew for the first two missions in 2016 and 2017.

And in Part 5 we'll learn even more.

Is Dream Chaser reusable? How flexible is it?

Any implications for flying autonomous?

What advantages does it offer compared to its other competitors, both of which are capsules (the Boeing CST-100 and SpaceX Dragon V2)?



SNC's Dream Chaser atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Florida. Credit: Sierra Nevada Corporation (SNC)

Global partnerships like the ISS and Dream Chaser are the perfect examples for how humanity can work together for the common good to expand our presence further into space and send humans to Mars.

## Part 5: Dream Chaser's SUV-Like Flexibility and Runway Landing Offer Competitive Advantages



Astronaut crew exits commercial Dream Chaser after touchdown at Shuttle Landing Facility (SLF) or other commercial runways, on return from ISS mission in this artist's concept. Credit: Sierra Nevada Corporation (SNC)  
Story updated

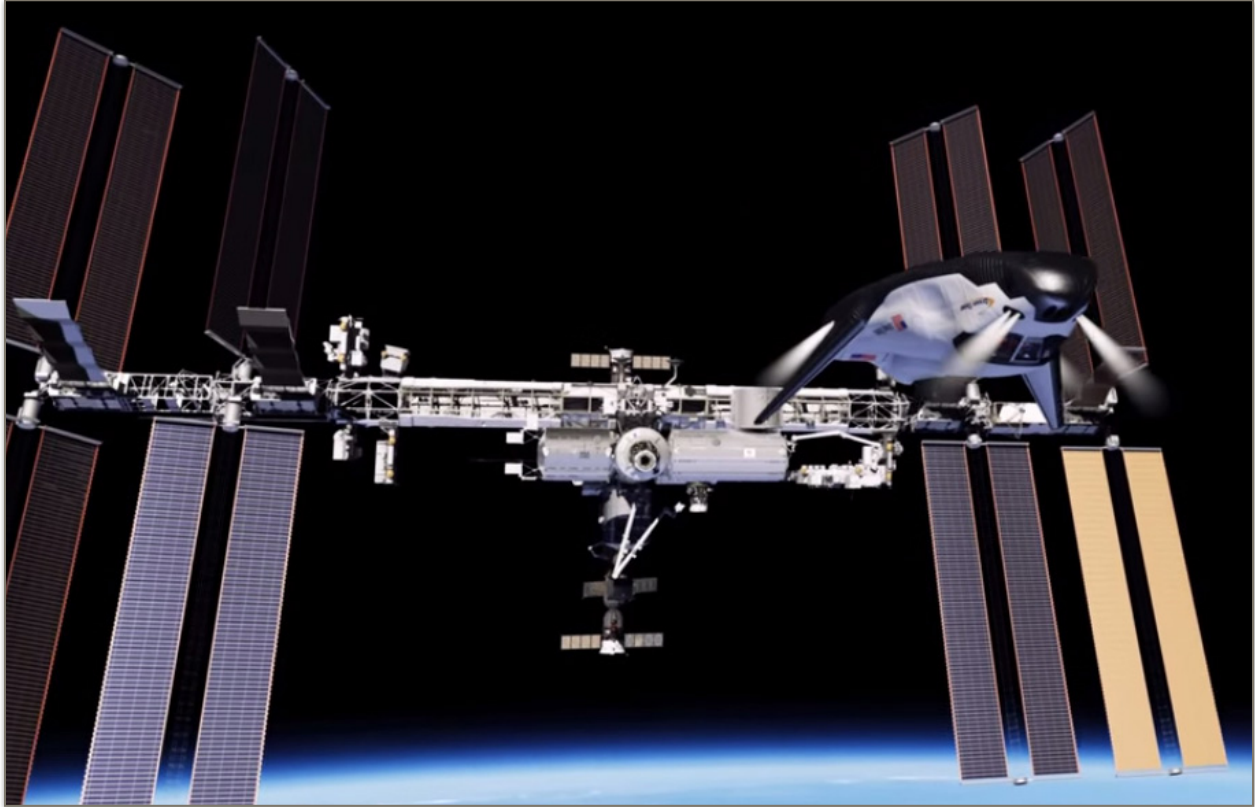
The **winged Dream Chaser's** "SUV-like" flexibility to act as both a **crew transporter** and "specialized research laboratory," combined with a global "runway landing capability," offer significant competitive advantages in terms of science and safety in the "**new space race**" to quickly develop a cost-effective "**space taxi**" for NASA, Mark Sirangelo, corporate vice president of Sierra Nevada Corporation (SNC) Space Systems, told AmericaSpace in concluding Part 5 of our exclusive, one-on-one interview series.

Dream Chaser's spacious and flexible interior design allows a multitude of practical research benefits such as flying a uniquely specialized science lab in orbit for studies that can't be done inside the International Space Station (ISS), for technical as well as safety factors. The ISS's entire reason for existence is to benefit science and expand our exploration of the cosmos in ways not otherwise possible.

"We call it a space utility vehicle like an SUV. You can take seven people or you can take the seats down to add more cargo for an interchangeable activity," Sirangelo said.

“For example you might want to test something on the station that isn’t testable on the station right now.”

“It’s a supplemental research vehicle that could have dedicated equipment.”



Global partnerships could one day lead to European or Japanese versions of the Dream Chaser docking at the ISS in this artist’s concept. Credit: Sierra Nevada Corporation (SNC)

Dream Chaser is a reusable, manned space plane being developed by SNC to restore America’s capability to ferry American astronauts **from American soil** to low-Earth orbit and the International Space Station (ISS)—with funding from NASA’s Commercial Crew Integrated Capability initiative (CCiCAP) under the auspices of the agency’s commercial crew program.

The lifting body spacecraft is essentially a mini-shuttle about one-third the size of NASA’s now retired space shuttle orbiters, and thus has the totally unique capability to land on runways worldwide. That’s a feat its other competitors—developing capsules—can’t match and which simultaneously offers ample positives for science and potentially saving lives.

“A runway landing offers immediacy in case of returning sick astronauts or critical research samples .... to a researchers’ home city.”

“Dream Chaser can land anywhere. Its designed for commercial runways.”

Furthermore, it could “stay on orbit for a year or longer.” And since it flies autonomously, cargo-only versions to resupply the ISS like Cygnus and Dragon are also entirely within the realm of possibilities down the road.



Dream Chaser set to dock at the ISS in this artist's concept. Credit: Sierra Nevada Corporation (SNC)

Three American aerospace firms—Sierra Nevada with Dream Chaser, **Boeing** with **CST-100**, and SpaceX with Dragon V2—are vying for NASA's multi-billion dollar contracts to build the private sector spaceships to fly astronauts to the space station by late 2017, using seed money from NASA's Commercial Crew Program (CCP) in a public/private partnership.

Describe the Dream Chaser's flexibility regarding crew size and cargo.

“We call it a space utility vehicle like an SUV. So you can take seven people or you can take the seats down to add more cargo for an interchangeable activity. The mix of crew and cargo will be whatever that mission needs. The question is more, if we don't have people then we can take up cargo. It's reconfigurable inside so we can be all crew or all cargo without redesigning the vehicle.”



SNC's Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

Let's delve into using the inside of Dream Chaser as a science laboratory, something very appealing from a scientist's perspective. How big is it?

"We are looking at variants for our vehicle for different missions besides the crew vehicle. You continue to upgrade the vehicle as you move forward."

"The inside space is about the same volume as one of the modules brought up to the station on the shuttle. We need to learn how to change the inside of the Dream Chaser into a working laboratory. Opportunities for new technologies, like a laboratory, robotics and servicing for the different variants could also come from other countries."

And as we discussed in detail in **Part 4**, Sierra Nevada has laid the foundation for the vehicle's future global expansion by exploring the reconfiguration or construction of international versions of Dream Chaser with 21 space agencies, including ESA (European Space Agency), DLR (German Aerospace Agency), and JAXA (Japanese Aerospace and Exploration Agency).

How long can Dream Chaser stay in space? Describe its unique capabilities as a research laboratory and more.

"Dream Chaser has the capability of staying on orbit for over a year, or longer, uncrewed. So once it gets up to the station the idea is we could be a supplemental research vehicle that could have dedicated equipment on it, because we can fly it back home."

“For example, you might want to test something on the station that isn’t testable on the station right now, using different kinds of instruments, sensors or pods for the experiments. We could outfit Dream Chaser for that and let it be on orbit for whatever duration it needed. And then bring it back with the experiments.”

“And then we could outfit the vehicle for the next type of experiment. That’s for something you can’t do for the space station.”

Well, one year or more on orbit for Dream Chaser would be considerably longer than the other space taxis, like Dragon V2 and **CST-100**, which meet NASA’s minimum requirement for a stay in space of about one-half year or so.

*Describe its capability as a lifeboat and for quick getaways, and the resulting science implications?*

“We have a very unique station capability that no one else has. We can come back from the station in six to eight hours generally and land at a runway in America—at less than two Gs!”

“For example if one is transporting critical experiments or sick astronauts or something that really requires special or quick handling, we can do that more rapidly than anyone in the world. And we can bring it back to a runway in Florida (KSC) or conceivably in Texas [near NASA’s Johnson Space Center or elsewhere] or some other place in the U.S.”

“Whereas our other competitors are landing in the water or far out in the desert somewhere. And they are coming in as a capsule does, at considerably higher G forces.”

“So if you are working on the next breakthrough in bioscience, and you want to make sure you bring it home, what would you rather do? Bring it home in a quarter of the time and a third or half the G forces to a runway in the U.S. versus going out to the ocean or desert somewhere!”

“So that’s the type of thing we feel we have an advantage on.”

“To date, SpaceX has taken something like 30 or more hours to return samples after the Dragon’s splashdown.”



The Dream Chaser engineering test article coming in for an autonomous landing during October 2013 at Edwards Air Force Base, Calif. As the image clearly shows, the left landing gear did not deploy properly, causing the vehicle to sustain minor damage on landing. Photo Credit: SNC

So that ability to bring delicate research samples home quicker and gentler could be a boon and fantastic benefit for the science experiments!?

“Yes, we can not only bring it home faster, safer, and with less stress but we can also bring to your home city where you can pick it up, such as for the team at Texas Medical Center that are doing bioscience and biomedical research.”

*Describe Dream Chaser’s capability for different types of missions.*

“Dream Chaser is designed for two types of launches. And it is designed to be ‘rocket agnostic’ so it can launch on different launch vehicles.”

“One is for human launches which requires certification for human flight. Then there are the cargo/laboratory uncrewed flights. And that is certainly possible for us.”

For details about launching on the primary Atlas booster from Florida and alternatives, like Delta, Ariane V, and H2B, read the earlier parts of this series. Boeing’s CST-100 will also launch atop the Atlas V. Read the ULA interview story regarding the Atlas V rocket and required pad modifications [here](#).





SNC's Dream Chaser atop ULA Atlas V Rocket on Space Launch Complex 41 at Cape Canaveral Air Force Station, Fla. Credit: Sierra Nevada Corporation (SNC)

Well, in that case of an unmanned version of Dream Chaser, then it seems like you could bid on NASA's next CRS (Commercial Resupply Services) contract, is that right? Boeing is also considering that option. (Read the interview with Boeing's Chris Ferguson [here](#).)

"Yes, we could!"

Describe the details of Dream Chaser's reusability?

"We have a very strong case on reusability."

"We are expecting to get 30 or more flights out of one of our vehicles. To date there hasn't been a capsule yet that's been reused and gone back up to space in 60 years of capsules."

"The others say they can reuse the capsules. But there are stresses. I'm not saying they can't do it. But you have to go a long way before you put people back in the vehicle, and then get it back up. They will have to prove a lot."

"Whereas the Shuttle Discovery had 39 missions, as complex a vehicle as the shuttle was and do it with '70s technology."

"So it's a big benefit from us. We are reconfigurable inside the vehicle so we can be all crew or all cargo without redesigning the vehicle."

“So reusing is not easy. But 39 missions of the same spacecraft is not something to sneeze at. And it probably could have flown more missions if there were more needed. The vehicle wasn’t stopped because of its inability to go back up. It was stopped because ET tank production stopped.”

How many Dream Chaser vehicles do you plan to build? Boeing is projecting about three CST-100 capsules and about 10 flights each. (Note: Read this writer’s interviews with Chris Ferguson [here](#) and [here](#).) SpaceX also says the Dragon will be reusable.

“Well, it’s like aircraft and depends on the need. Initially we think we’ll start with about three to five vehicles, flying about 30 flights each.”

What is the projected turnaround time between flights?

“We think about 45 days to 60 days. It also depends on rocket launch slot availability. Part of it is you can be ready to fly, but do you have the launch [pad] availability. So we think we could do 4 to 6 flights per year on a vehicle, to be conservative.”

It should be noted that the commercial crew flights for NASA have to complete for launch slots with all of ULA’s other unmanned launches off pad 41 at Cape Canaveral, Fla., for various customers besides NASA. ULA does not have a pad solely dedicated to commercial crew launches.

The shuttle turnaround time generally varied between about three months and longer by comparison during its three decades of operation.

“Dream Chaser is better than that. We’re like a regional jet. We have a lot more modern equipment. The computers are far more programmable. Its smaller and less complex.”

*What’s ahead for Dream Chaser?*

“The three big things ahead of us are the continuation of the atmospheric flight test program this fall, the delivery of the orbital vehicle and the preparations to ready for the first launch,” Sirangelo said.

Dream Chaser’s **inaugural launch** atop an Atlas V rocket from Florida is slated for November 2016 on a fully autonomous, unmanned orbital test flight. That will be followed by the launch of the first manned Dream Chaser before the end of 2017, under NASA’s current timetable.

Furthermore, SNC has already begun building the orbital vehicle and bought the Atlas V rocket.

The Dream Chaser design builds on the experience gained from NASA Langley’s earlier exploratory engineering work with the HL-20 manned lifting-body vehicle.



Dream Chaser blazes to orbit and the ISS after separation from ULA Atlas V Rocket 2nd stage and liftoff from Cape Canaveral Air Force Station, Florida. Credit: Sierra Nevada Corporation (SNC)

For complete details on the SNC Dream Chaser, be sure to read the entire five-part interview series with Mark Sirangelo.

**Part 1** Mark Sirangelo described SNC's assembly and upcoming free-flight drop test program for the atmospheric test vehicle that will pave the path to the eventual Dream Chaser orbital vehicle, just as the Enterprise did for NASA's shuttle orbiters in the 1970s.

**Part 2** is focused on how SNC is boldly pushing forward with the orbital vehicle build, even before the winners of NASA's highly coveted and prestigious commercial crew vehicle contracts are announced by NASA.

**Part 3** discussed the flight plans and crew for the first two missions in 2016 and 2017.

**Part 4** discussed SNC's international partnerships with ESA, DLR, JAXA, and 21 space agencies to enable future international variants of Dream Chaser.

**Part 5** discussed Dream Chaser's SUV-Like Flexibility and Runway Landing Offer Competitive Advantages.



SNC's commercial Dream Chaser test vehicle under construction. Credit: Sierra Nevada Corporation (SNC)

America totally lost the ability to launch humans when the shuttle program ended three years ago, following the final launch of Space Shuttle Atlantis in 2011 on the STS-135 mission to the ISS, commanded by Chris Ferguson.

Mark Sirangelo, as well as his staff of veteran space shuttle commanders Steve Lindsey and Lee Archambault, and the entire SNC "Dream Team" spread across 30 U.S. states are on a mission to right that with Dream Chaser.

"We think it's about time that we get an American built vehicle launching from America to take U.S. astronauts to space. We feel like we are carrying the torch forward from the 135 shuttle flights and bringing the history of NASA along with us as we do this," Sirangelo emphasized.

Finally, all three aerospace teams await NASA's high stakes decision. NASA's Commercial Crew Program office is expected to announce the contact winner(s) to build America's next crew vehicles in the next program phase, known as Commercial Crew Transportation Capability (CCtCap), "sometime in September," NASA News spokesman Allard Beutel confirmed.



Dream Chaser media briefing from 2011 at the Kennedy Space Center press site with Mark Sirangelo, vice president of Sierra Nevada Corporation (center), Robert Cabana, Director of Kennedy Space Center (left), and Charles Bolden, NASA Administrator (right). Credit: Ken Kremer – [kenkremer.com](http://kenkremer.com)



Scale models of NASA's Commercial Crew program vehicles and launchers; Boeing CST-100, Sierra Nevada Dream Chaser, SpaceX Dragon. Credit: Ken Kremer/[kenkremer.com](http://kenkremer.com)