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SPARKING THE SPACE ECONOMY

A flexible glass produced in space shows promise as a catalyst for building an economy in space. **PAGE 16**



Astronaut Kavandi's new mission

Janet Kavandi arrived at the Space Systems headquarters of Sierra Nevada Corp. in September to lead its space work as senior vice president of programs. Space Systems is in the midst of an ambitious growth plan as it prepares to launch cargo to the International Space Station and is vying for roles in human spaceflight, including NASA's proposed Artemis lunar missions. In an interview at the unit's headquarters in Colorado, **Amanda Miller asked Kavandi about these initiatives, how she became an astronaut and about milestones for women in aerospace.**

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▲ **Janet Kavandi,**
in front of the primary
structure for Sierra
Nevada Corp.'s first
Dream Chaser cargo
vehicle in October.
Sierra Nevada Corp.

When they went searching for a new linchpin of their company's Space Systems business area, Eren Ozmen and her husband Fatih chose Janet Kavandi, a three-time space shuttle astronaut and one of the foremost U.S. spaceflight safety experts.

Kavandi's flying days are over, but here at Sierra Nevada Corp.'s Space Systems headquarters in Louisville, Colorado, she tells me, "I'm here because I still think about flying in space." She says she's determined "to enable humanity to do more things in the exploration of space."

As senior vice president for programs, Kavandi reports to Fatih Ozmen, the acting executive vice president of Space Systems. Kavandi's passion for spaceflight and arrival in Louisville are perhaps most notable for this reason: SNC is on a tight deadline of less than two years to launch Dream Chaser, a cargo craft that looks like a mini-version of the shuttle orbiters that Kavandi flew aboard and which lands on a runway like the shuttle orbiters. Her mission, in part, will be to fulfill a NASA contract to resupply the International Space Station six times with one or perhaps both of the Dream Chaser vehicles NASA is helping to fund. She oversees SNC's spacecraft and space technology manufacturing programs, including the descent brake landing mechanism for the Mars 2020 rover scheduled for launch in July. The rover project and other efforts have swelled the Space Systems business area to facilities in five states.

Next line of business

Kavandi speaks with the thoughtful demeanor that one would expect of an astronaut with a doctorate in analytical chemistry, whose dissertation discussed pressure-indicating paints for wind tunnel tests and who operated the robotics to put together parts of the International Space Station.

She was cautious during our discussion, one of her first in-depth interviews since arriving in September from NASA's Glenn Research Center in Ohio, where she was director for three years. U.S. law forbids her for a year after leaving federal employment from saying anything to influence NASA. "I'm basically just trying to educate myself on the company as quickly as I can — learning the business, learning the objectives of what the owners want for their business," Kavandi says, referring to the Ozmens, naturalized U.S. citizens from Turkey.

Several months ago SNC began assembling the first of its Dream Chaser orbital spacecraft that will fly to the ISS autonomously and glide back for a runway landing at Kennedy Space Center's Launch

and Landing Facility in Florida. That's the same shuttle landing facility where Kavandi landed three times.

"I always admired this design and think that is something I'd really like to be a part of — to see that launch and land successfully. Part of the first year will be dedicated toward making that happen," Kavandi says. Dream Chaser is "a good candidate to get us into space reliably and not from the government — the government will contract it; they won't own it. I just think it's a very elegant solution to getting back and forth from space. And I think it could be a safer option of transporting cargo and potentially humans."

NASA rejected the crewed Dream Chaser design for the Commercial Crew program in 2014 in favor of the SpaceX Crew Dragon and the Boeing CST-100 Starliner. Neither of those craft have yet carried a crew. Meanwhile, SNC hasn't given up the dream of someday doing so with Dream Chaser.

Safety of the crew would, of course, be paramount for NASA, and this is an area where Kavandi has personal experience. "Should we ever have a contract to provide a crewed option, then, of course, that would be foremost in my mind, since that was my history," Kavandi says.

When the orbiter Columbia disintegrated over Texas in 2003 on its way back to Florida, Kavandi was the lead casualty assistance calls officer in charge of 25 astronauts who notified the families of those who had died in the catastrophe. The "CACOs" helped the families arrange memorial services and manage publicity after the accident.

Even with such risks, Kavandi remains enamored by spaceflight. "I spent a lot of time in the government [on spaceflight], and in the time that I have left in my useful life as a working citizen, I would like to contribute on the outside in that same way."

She thinks the Artemis astronaut missions to the moon, proposed by NASA, will open up new opportunities in the astronaut career field, especially because NASA wants to go in a "sustainable way," rather than collecting samples and then abandoning human exploration for another 50 years. The undertaking would be complex, but Kavandi states the goal simply: "Figure out how to survive," she says. "It would be to go and learn how to live on another planetary surface that has a very dusty environment. It's got no atmosphere. It's got intense radiation from the sun. You have to learn how to make your own water, grow your own food in some sort of shelter, use the — ISRU, they call it — in-situ resource utilization on the surface of the moon, maybe find the water that's in ice form at the poles and use that to make oxygen or melt it for consumable water."

All that will require trustworthy equipment, the



SNC HISTORY

Sierra Nevada Corp. set up the headquarters of its Space Systems business area in Louisville, Colorado, near the aerospace hub of Boulder, after acquiring two small space companies in 2008, one of which, SpaceDev, already had a facility there. The SpaceDev acquisition “added tremendous space heritage with products that had flown on more than 300 spacecraft over 20 years,” according to SNC’s company timeline. SNC’s owners Eren and Fatih Ozmen are married Turkish immigrants who bought the company in 1994, then just a small defense firm in Nevada. They’ve since acquired 14 more companies in the aviation, space and technology sectors, not counting those companies’ subsidiaries.

long-term target being not the moon but a red speck in the sky visible from the lunar surface. “The trick will be: OK, so these things broke. We’ll bring them back, we’ll redesign them, we’ll put them back on the surface. When they don’t break anymore, then we’re ready to push things to Mars.”

The red planet brings out the futurist in Kavandi: “If we want to ensure the survivability of the species in the long run, in case there is this comet or meteorite or something out there that we can’t avoid, and it smacks us like what happened to the dinosaurs — most of life was extinguished on the planet — so if we want to make sure that the human species might survive something like that, we could be on two planets, then we have a better chance that way. But it won’t be fast, and it won’t be in 10 years. It would be in a long period of time that we hopefully colonize, to a small extent, Mars.”

But first, the Ozmens want a role in Artemis. Space Systems has delivered a mockup to NASA of

its design for a habitat module that could one day expand the moon-orbiting Gateway where astronauts would stay before venturing to the lunar surface. In November, NASA announced that SNC is also one of the companies that will get to bid on Commercial Lunar Payload Services contracts to robotically deliver cargo to the surface of the moon.

Leading in the private sector

Kavandi worked at NASA from the time of her selection as an astronaut in 1994 until shortly before moving to Colorado from Ohio, where she was director of Glenn, a center known especially for its space propulsion research and development.

At SNC, part of her oversight role will include the Propulsion and Environmental Systems unit that builds SNC’s Vortex engines for the Dream Chaser spacecraft. SNC also is developing a version of the Vortex engines with the U.S. Air Force as an upper stage for launch vehicles.

After so many years in government, I wondered if she was feeling culture shock by now working for a NASA and Defense Department contractor. “It’s not quite as foreign as I thought it might be because my last role was running a NASA center, which is essentially running a business. You don’t have to make a profit, per se, but you do have to run it as if you were running a business. You can’t have a deficit. You have to manage your people. You have to manage your budget. You have to make good strategic decisions on where you invest and what you want your future to look like.”

Reaching space

Asked about her determination to become an astronaut, Kavandi conjures a memory. “I attribute it to some time I spent with my father. We lived in the country. We could see the stars at night. We could look up and wonder what it would be like to be in space. And there were satellites going over, and there were the first people flying in space at the time, and I think we talked about what it would be like to be up there and looking back at the Earth and what we might see.”

She knew that NASA — at the time the only option for an American who wanted to go to space — had two kinds of astronauts: military test pilots or scientists with doctorates. “I had to think about it from a Ph.D. scientist or engineer perspective, but not a test pilot, because there were no female test pilots” at the time in the U.S. “So I knew I had to have a Ph.D.” She went and got it from the University of Washington in 1990. She started applying to be a NASA astronaut while she earned her doctorate and was selected in 1994.

Kavandi’s career might have played out differently were it not for a high school teacher. “The



reason I chose chemistry was because of a particular instructor that I had who I just really enjoyed. She was a female, for one thing, and she was very strong-willed and strong-minded, and she was very blunt and very intelligent, and I just really liked her. I wanted to study under her, and so I chose chemistry in part because of her.”

Now that she has been to space, this has affected her view of Earth. As determined as she is to propel humanity into space, “another passion is helping to preserve the natural habitats that we have left on the planet,” she says. She is loving Colorado, and so is the Kavandi family. “My daughter is actually an environmental biologist, and she’s looking to come out here, too, because she sees a lot of potential use for a biologist here with that background. And also my son is already getting a job and moving out this way too.” Her husband, an airline pilot, “can live anywhere,” she adds.

▲ **A mockup of Sierra**

Nevada Corp.’s design for a human habitat module of the proposed lunar Gateway.

Amanda Miller

Women’s firsts

This year NASA conducted humanity’s first two-woman spacewalk, or extravehicular activity. “Eventually,” Kavandi says, such milestones “will not be a big deal. That’s where we have to get to, is a state where it’s not a big deal.” She sees progress. “Like I mentioned, when I was first thinking about being an astronaut, I had to think about it from a Ph.D. scientist or engineer perspective.” There were no women test pilots, “but now there are,” she notes. “When I chaired the Astronaut Selection Board, I selected two female test pilots because they were available, and they were outstanding candidates. And so, whereas before it was not an option, there are so many options now that women have, that we don’t even think about it.”

Women remain pioneers: “People who go into those fields help make it better for the people who follow them.” ★