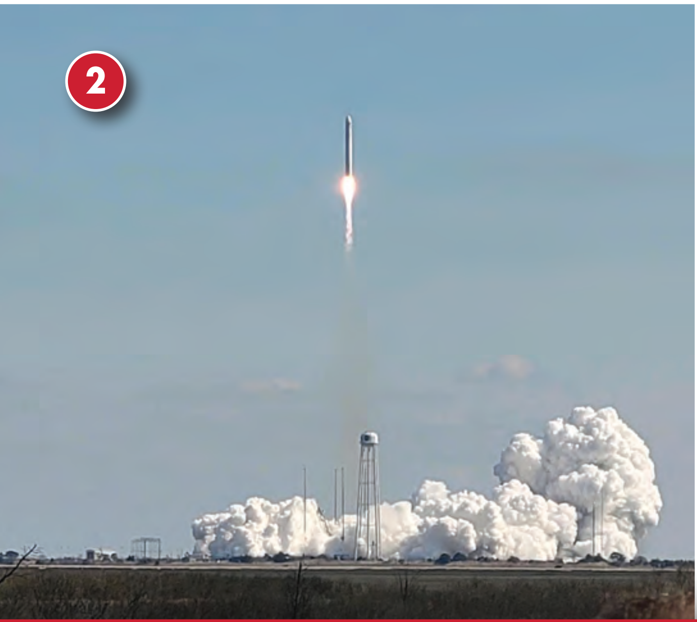

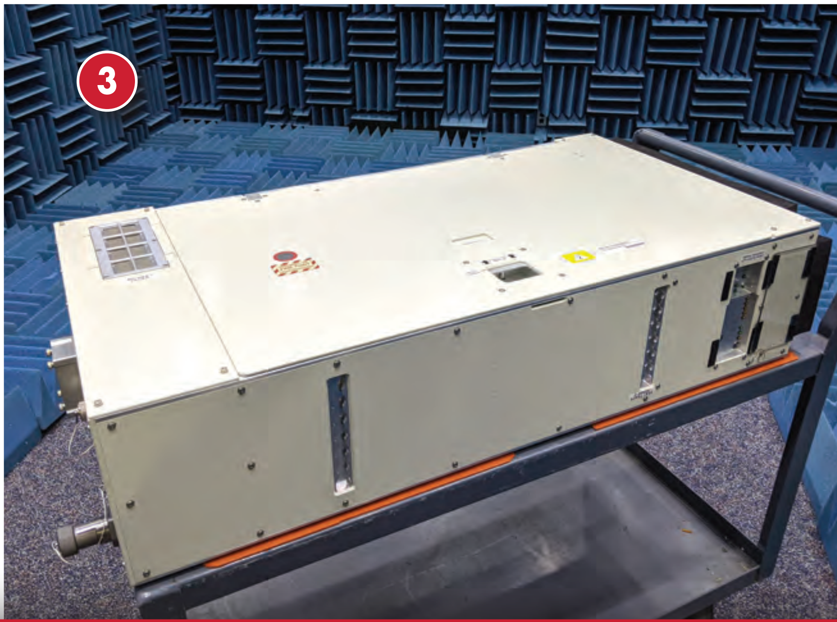

1) Ron Sable – Chairman of the Board Paragon Space Development Corporation, Grant Anderson – President & CEO, Co-Founder Paragon Space Development Corporation – Photo by Chris Mooney **2)** BPA Launch **3)** BPA Acoustic Test **4)** Paragon BPA Team at Launch

Creating Water Abundance in Space

Paragon Space Development's Landmark Technology to Revolutionize Missions

By Stephen Fleming

Space wants to kill you. It's either too hot or too cold, it's drenched in poisonous radiation and it doesn't have any air to breathe. Just surviving for more than a few seconds is an engineering challenge. But once the immediate threats are solved — where do you find water to drink?

For short missions, like the Apollo moon landings, the answer was simple. Missions brought along enough water to drink and to rehydrate freeze-dried astronaut meals. Washing was minimal. And a flush toilet was something to look forward to when returning to Earth.

But the United States and other nations have continuously occupied the International Space Station since Bill Clinton was U.S. president. Scott Kelly, brother of U.S. Sen. Mark Kelly of Arizona, spent over a year on the ISS and dozens of astronauts have lived aboard for six months or more. The National Academies of Sciences, Engineering and Medicine recommend that an adult should consume up to 3.7 liters of water per day—nearly one gallon. That's not counting strenuous activity like spacewalks. This means each crew member will literally drink his or her weight in water every 25 days.

For a crew of six, if water was managed like the Apollo missions, that would mean carrying up over 2000 gallons of water per year, at a launch cost of over $80 million. Supplying the same crew on a multi-year Mars mission, where the water would have to be rocketed to the red planet and back, would cost hundreds of millions of dollars. There had to be a better way.

There is. On Earth, water is recycled through a complex series of natural processes where wastewater is treated, returned to streams, flows to the ocean, evaporates into the atmosphere, then falls as rain to be captured and used again. That cycle takes place over multiple years and thousands of miles. In a closed environment like the space station, that must be done in a compact, power-efficient package.

The world's experts doing just that are at Paragon Space Development Corporation, headquartered in Tucson.

Some of Paragon's founding members came out of the Biosphere 2 project in the late 1990s—an early, overly ambitious attempt to develop life-support systems that could support humans in a sealed environment like a lunar or Martian colony. The Biosphere 2 project tried to generate everything needed to keep eight people alive for two years: breathable air, drinkable water and nutritious food, with no inputs from outside.

Due to some rushed engineering, the balance didn't work out and they had to inject oxygen into the system after 1.5 years. Biosphere 2 remains active today, as a busy University of Arizona research center focused on climate change. But two of the original "Biospherians" – Jane Poynter and Taber MacCallum joined with Grant Anderson, a hard-core techie working at Lockheed Martin designing the space station solar arrays, to form Paragon. In 2014, Anderson became the CEO of Paragon, where he remains today.

For over 27 years, Paragon's engineers have specialized in keeping humans alive in harsh environments. Paragon has worked on every major human space flight program since 1999. One of the company's latest projects is its Brine Processing System, which launched to the International Space Station on Feb. 20.

This system joins other Paragon hardware already on orbit, and it recycles astronaut urine to produce pure, drinkable water. Paragon's patented process uses forced convection of dry spacecraft cabin air plus dual-membrane distillation to purify and recover available water while filtering out contaminants.

The existing ISS systems recover between 75% and 90% of wastewater, but the new Paragon BPS is expected to hit 98% efficiency during its one-year trial--reducing the prohibitive 2000 gallon/year requirement to an easily-managed 40 gallons of replacement water.

Astronauts, commercial crew and tourists will soon be spending months and years on multiple space stations, the moon and eventually Mars and deep space. Humans need water to live, and the cost to ship enough to support long-duration missions is prohibitive. Reliable and efficient water recovery technology isn't as visually impressive as a rocket launch from Cape Canaveral—but it's an enormous technological challenge, and one that is critical to the exploration and settlement of outer space.

Paragon is also working on the next challenge--recovering, separating and cleaning water extracted from the moon and Mars--with more high-tech innovations. Based on Paragon's innovations, the long road to taking a drink of water in space starts right here in Tucson.

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