AEROSPACE
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Jet fuel from thin air

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ANALYSIS
From Apollo to Starship
PAGE 38

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AIAA
SHAPING THE FUTURE OF AEROSPACE

Coming soon: shirtsleeve EVAs

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▲ In this rendering, an engineer makes an excursion outside the Orbital Reef space station in the Genesis Single-Person Spacecraft.

Genesis Engineering Solutions

Of all the commercial space station plans, perhaps none would provide a more astonishing on-orbit experience than the Single-Person Spacecraft in which Blue Origin and Sierra Space of Colorado aim to have engineers and tourists fly in from their planned Orbital Reef station later this decade.

Under development by Genesis Engineering Solutions of Maryland, the SPS will allow solo space excursions without a spacesuit. No neutral buoyancy training nor time-consuming preparations for extravehicular activities, EVAs, will be needed.

A spacefarer in shirtsleeves would open an Orbital Reef interior hatch, move into the SPS — pressurized at the same 14.7 pounds per square inch as the station — and close the hatch. An engineer could control the SPS by hand, such as when working on the station's hull, or it could be flown by a teleoperator aboard Orbital Reef. The SPS could also fly autonomously, such as for space tourist excursions.

Comprising a cylindrical shell protected by ISS-grade micrometeoroid orbital shielding, the SPS will be topped by a broad, ultrastrong polycarbonate dome. "Turn your head full right in a spacesuit and you're looking at the side of the helmet. But the SPS dome will give you a real large field of view," says Brand Griffin, Genesis' SPS program manager and AIAA Space Architecture Technical Committee member. He adds that a test dome has passed every impact test engineers could throw at it.

Inside the SPS, the occupant will breathe a normal mixture of oxygen and nitrogen — no need for the pure oxygen that today's astronauts breathe before venturing on EVAs to purge the body of nitrogen to prevent the bends.

In research and development right now are the safety-critical systems, including propulsion, autonomy, sensors and the spacecraft's robotic manipulators and tooling systems, Griffin says. And Genesis isn't taking risks with brand new tech: "I'd rather, especially for a critical system, use proven technology."

For instance, the SPS will be propelled by 24 nitrogen cold-gas thrusters, similar to those on NASA's strap-on Manned Maneuvering Unit in which astronaut Bruce McCandless propelled himself, untethered, 100 meters clear of space shuttle Challenger in February 1984. The SPS version is now being tested on a free-flying module lofted by an air table, Griffin says.

Also being derived from existing tech are the highly dexterous manipulators and tools that Orbital Reef engineers will need on EVAs. Genesis is developing these tools that will be robotically selected from a caddy on the SPS's "chest" in collaboration with California-based SRI International, which has previously pioneered precision surgical and bomb-defusing robot technologies. Prototypes have "all performed very, very well in tests, doing things you could never do in a spacesuit," says Griffin.

During all piloted and robotic tasks, the SPS must sense and avoid the inhabited, pressurized Orbital Reef. Its automation and sensor packs are now in trials in a simulator. Genesis hopes to have a robotic test system, with space-rated manipulators, ready to fly by mid-2025.

If successful, the SPS could fly way beyond low-Earth orbit."It would work at the Lunar Gateway or perhaps on a transit mission to Mars," Griffin says. "It has broad applications." ★