Innovative Air Conditioning and Climate Control

Presentation to be delivered at:
Air Quality Technologies Event
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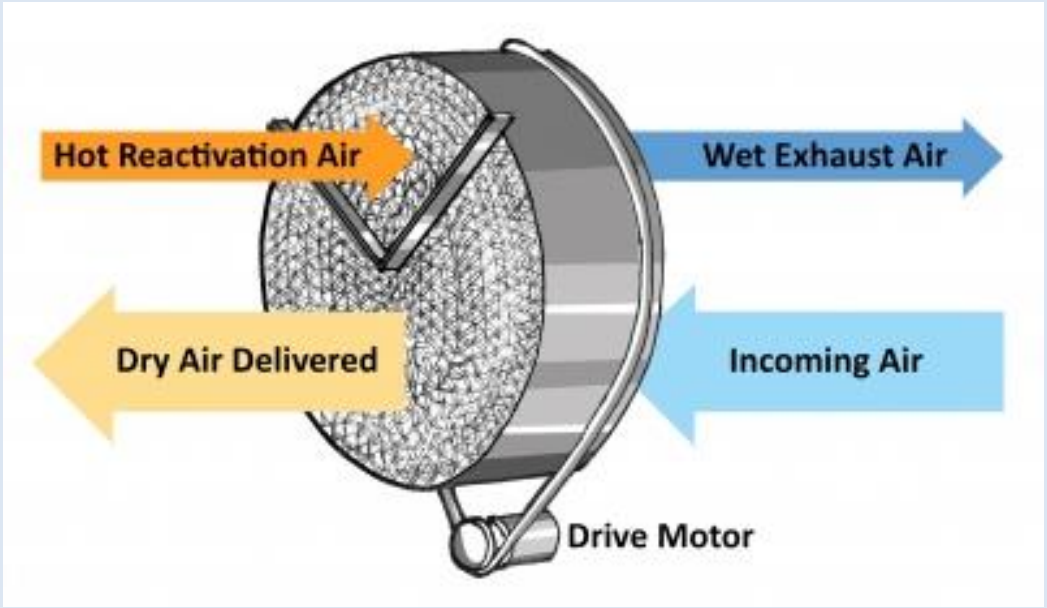
Presented by:
John Graf
john.c.graf@nasa.gov
281-483-9226

Summary: NASA needed to develop a desiccant wheel based humidity removal system to enable the long term testing of the Orion CO2 scrubber on the International Space Station. In the course of developing that system, we learned three things that are relevant to energy efficient air conditioning of office towers. NASA developed a conceptual design for a humidity removal system for an office tower environment. We are looking for interested partners to prototype and field test this concept.

Desiccant Wheels can dehumidify air and reduce air conditioning costs in office buildings that deliberately introduce outside air into the AC system

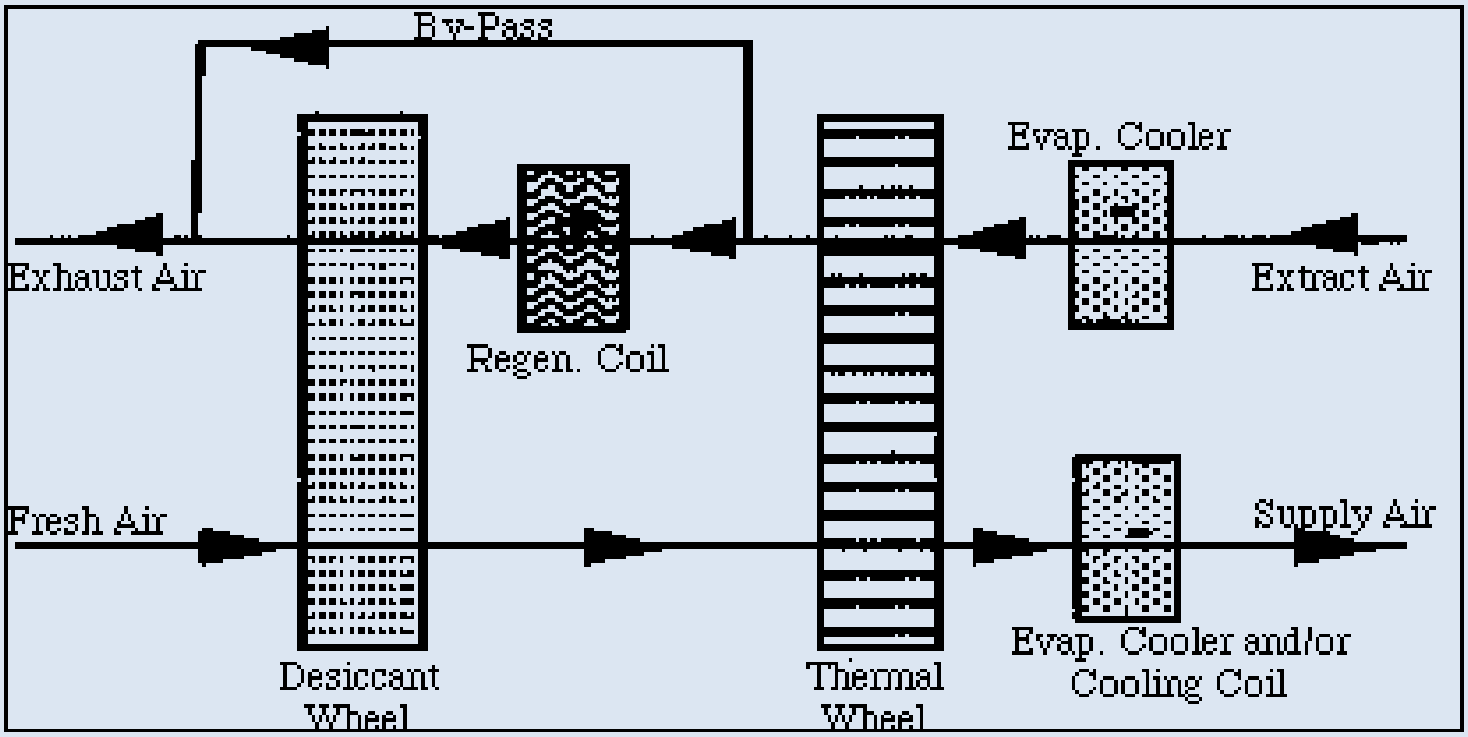
Single family homes ventilate by infiltration

Towers ventilate by bringing in outside air



Desiccant wheels are conceptually simple, and theoretically they can reduce energy costs by supplying dry air to AC units, but they are not widely used because they are not very effective. Wheels need cool, dry air to regenerate – and there is a shortage of cool dry air.

Two wheel systems with a desiccant wheel, and an enthalpy wheel are somewhat better (but these systems also suffer a shortage of cool, dry, air for regeneration



Schematic of a Desiccant Air Conditioning Plant

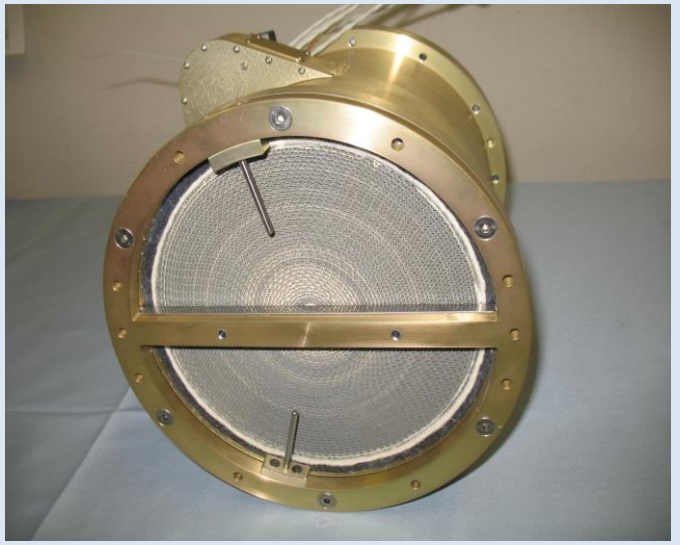
NASA is testing the CO_2 removal system for Orion on ISS (as a flight experiment)

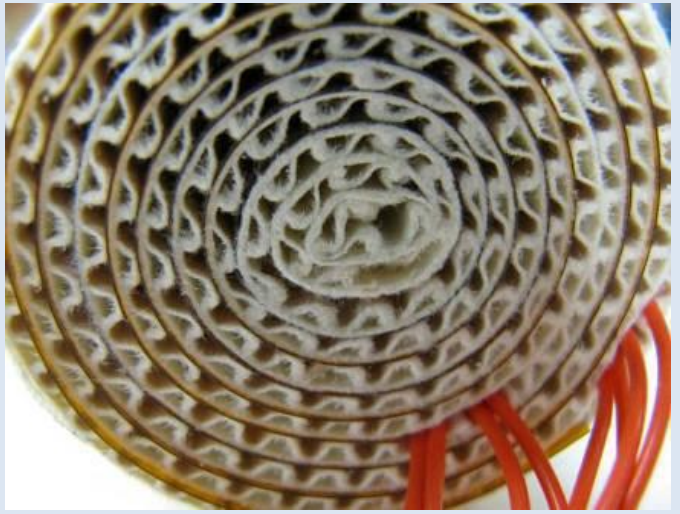
The Orion CO_2 removal system:
It is designed to vent CO_2 and humidity to space vacuum.

Astronaut Don Pettit installing the flight experiment hardware on the ISS.

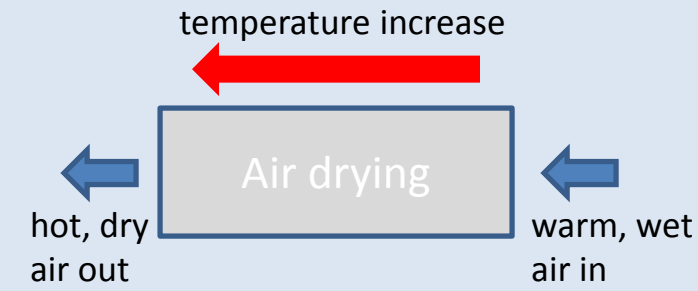
The International Space Station recycles humidity from the air into drinking water – it tested in the Orion configuration, the Orion CO2 removal unit would cause valuable humidity to be lost to space. A desiccant wheel based dehumidifier was developed to enable long term testing.

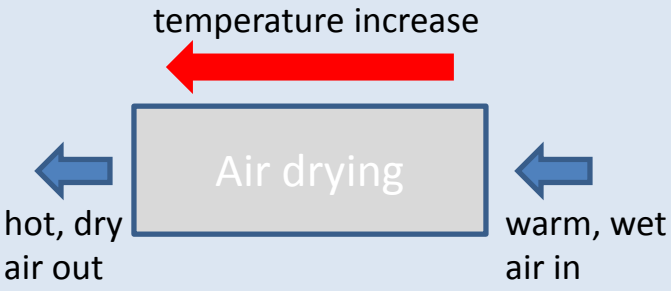
Development testing for ISS flight experiment desiccant system.

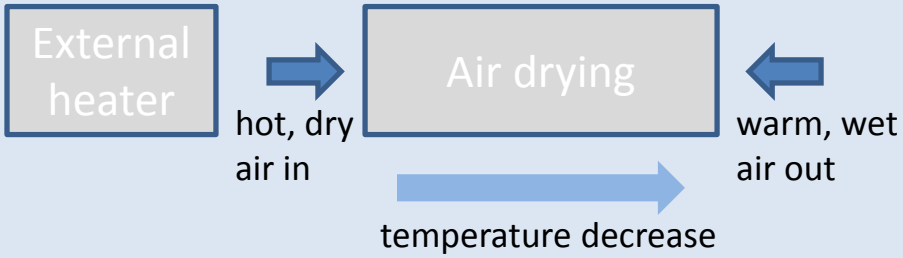




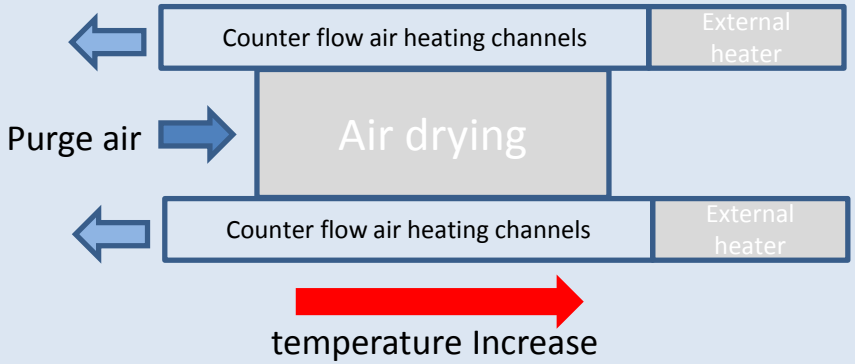
Things we learned about desiccant systems that apply to building AC: Traditional wheels supply heat from the outside, and push water chromatographically to the outlet – this is the least efficient way to dry out a wheel.





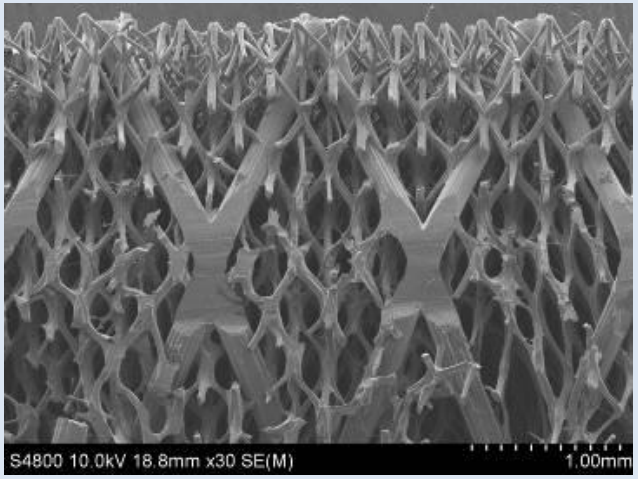


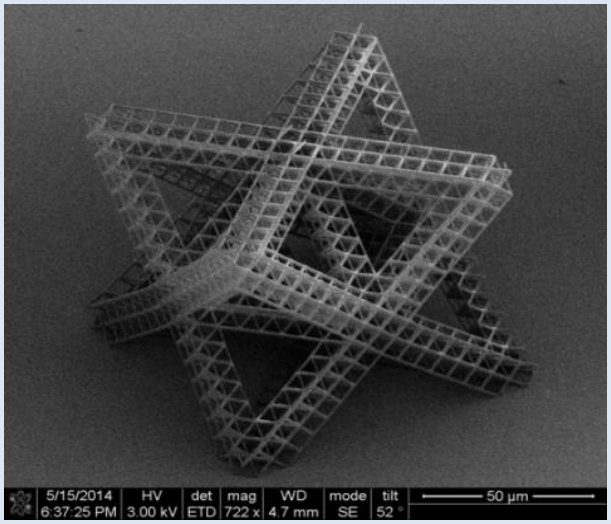
Traditional method
of heating (inefficient)

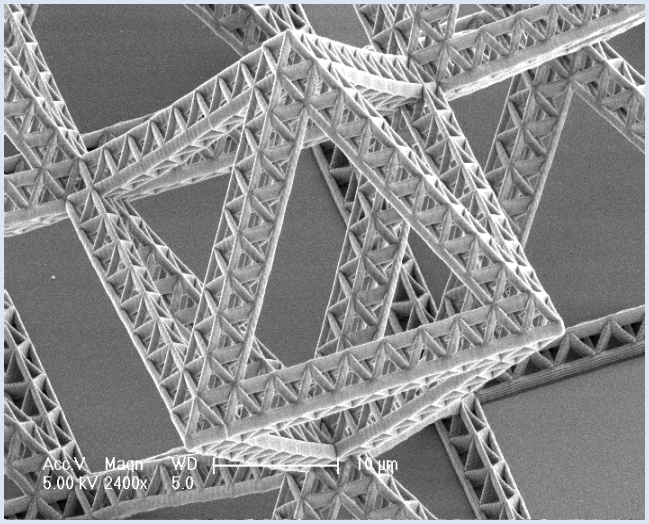


Proposed method
of heating (more efficient)

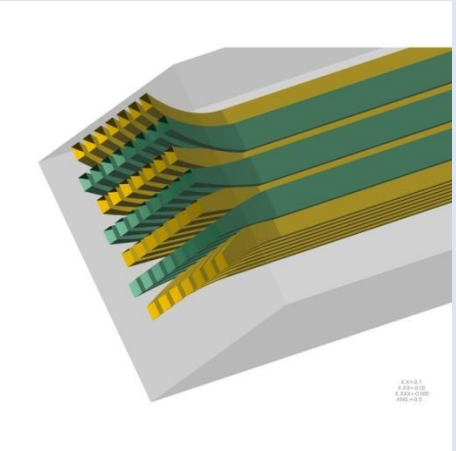
Things we learned about desiccant systems that apply to building AC: Lightweight structures can support thin films of silica gel desiccant. This results in lots of surface area and fast, effective heating, without too much energy spent heating and cooling support structures.

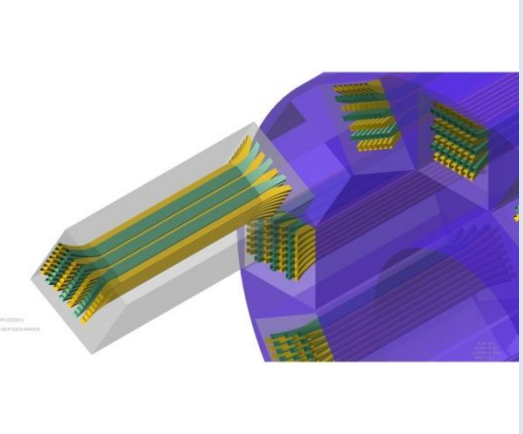


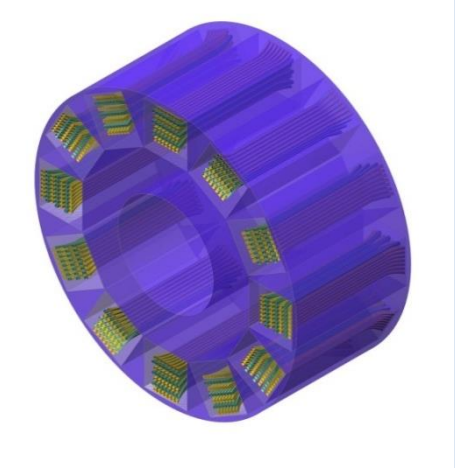


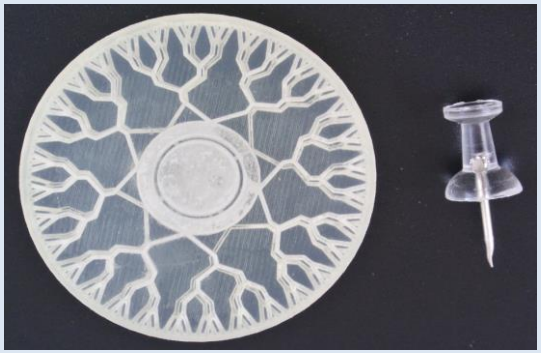


Things we learned about desiccant systems that apply to building AC: New techniques in additive manufacturing can make complex shapes – so complex internal flow paths can be assembled into systems with large simple ducts and headers.

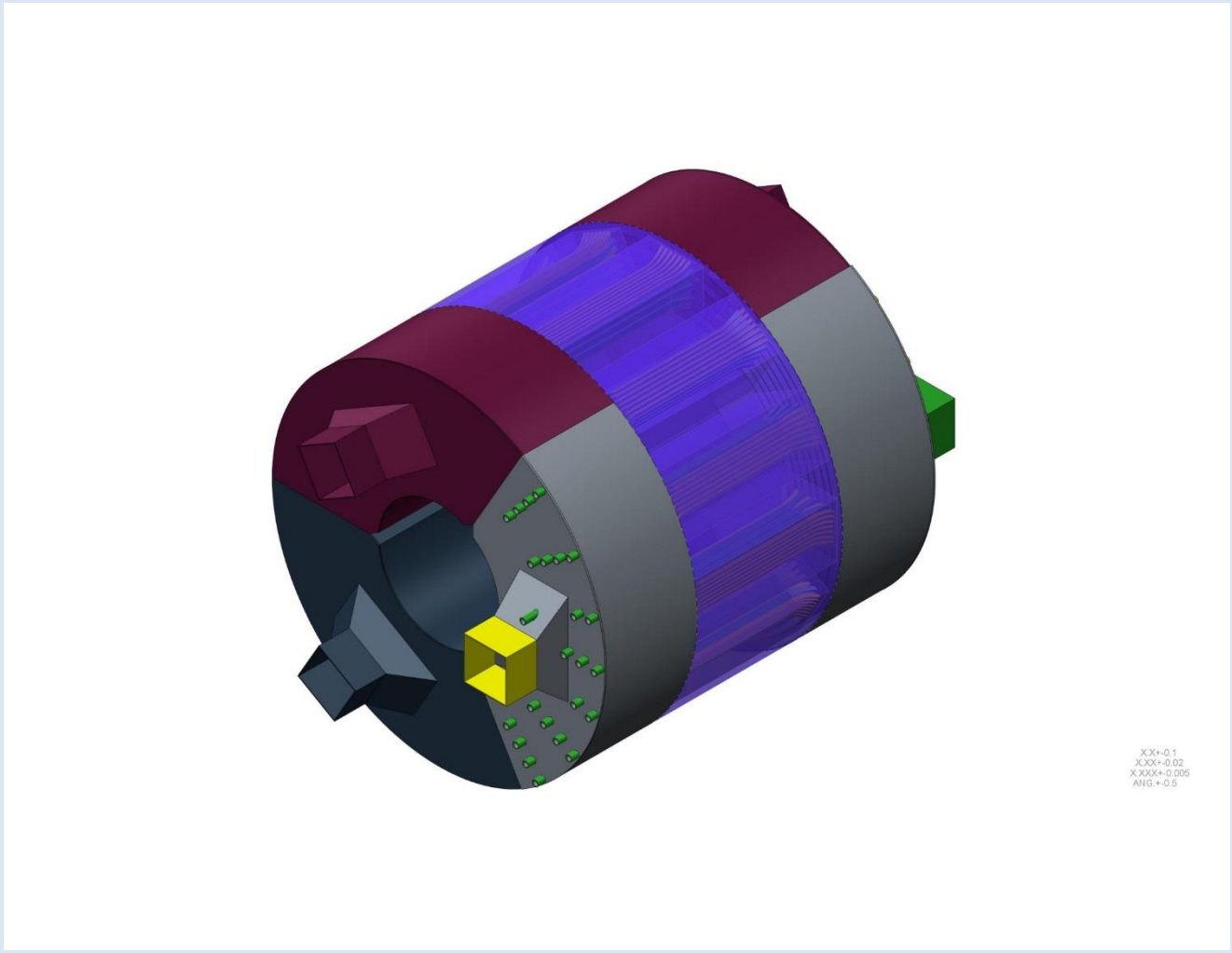




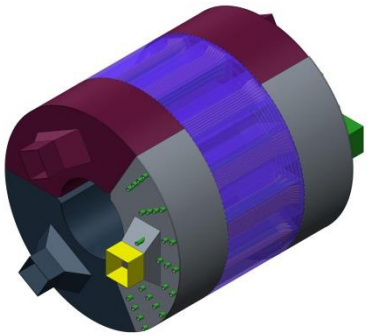


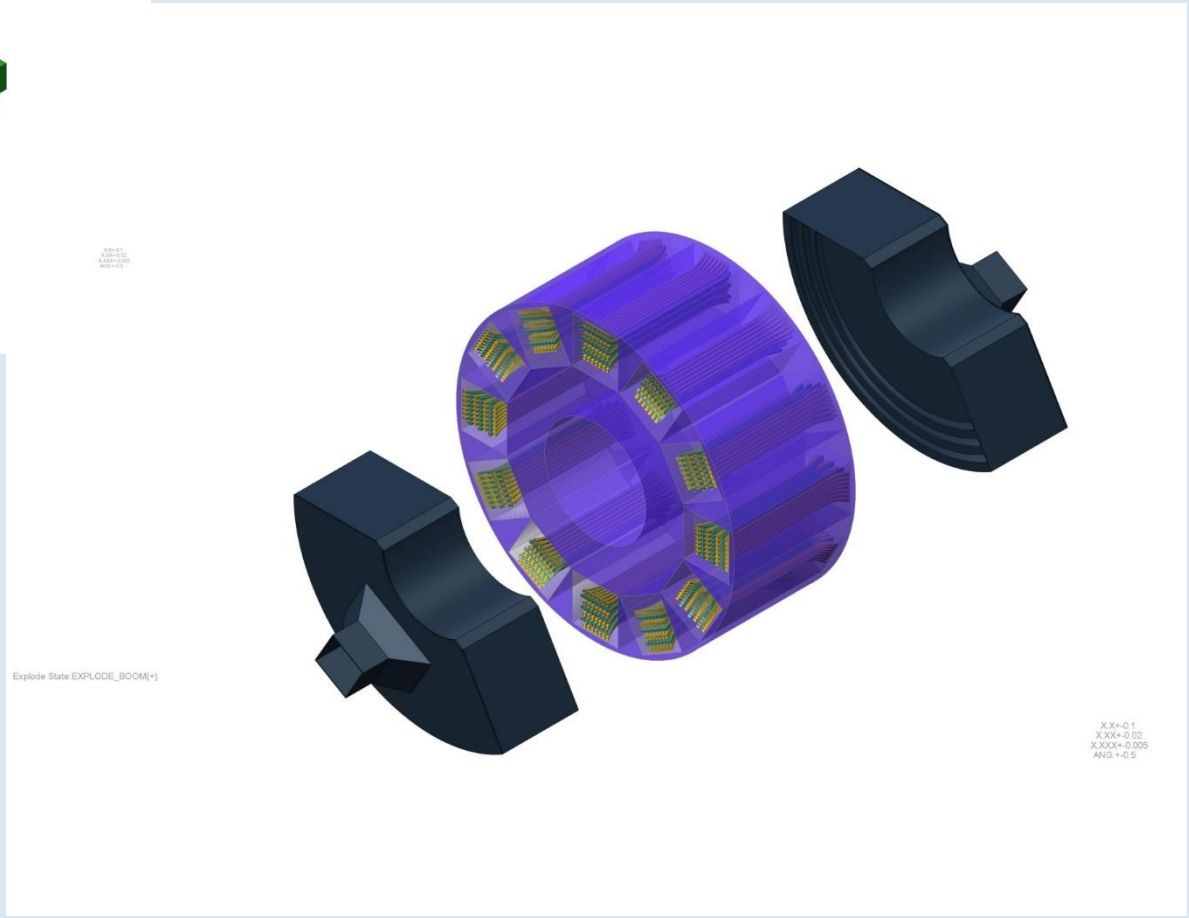


We have developed a conceptual design for a desiccant system that works in a building AC environment. But we have not done built or tested this system, because we haven't found an interested partner.

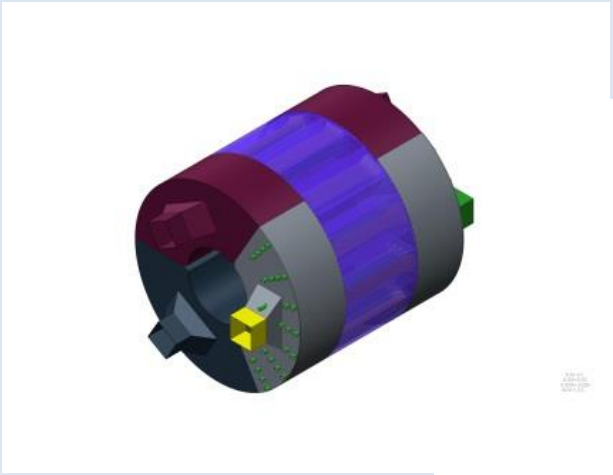


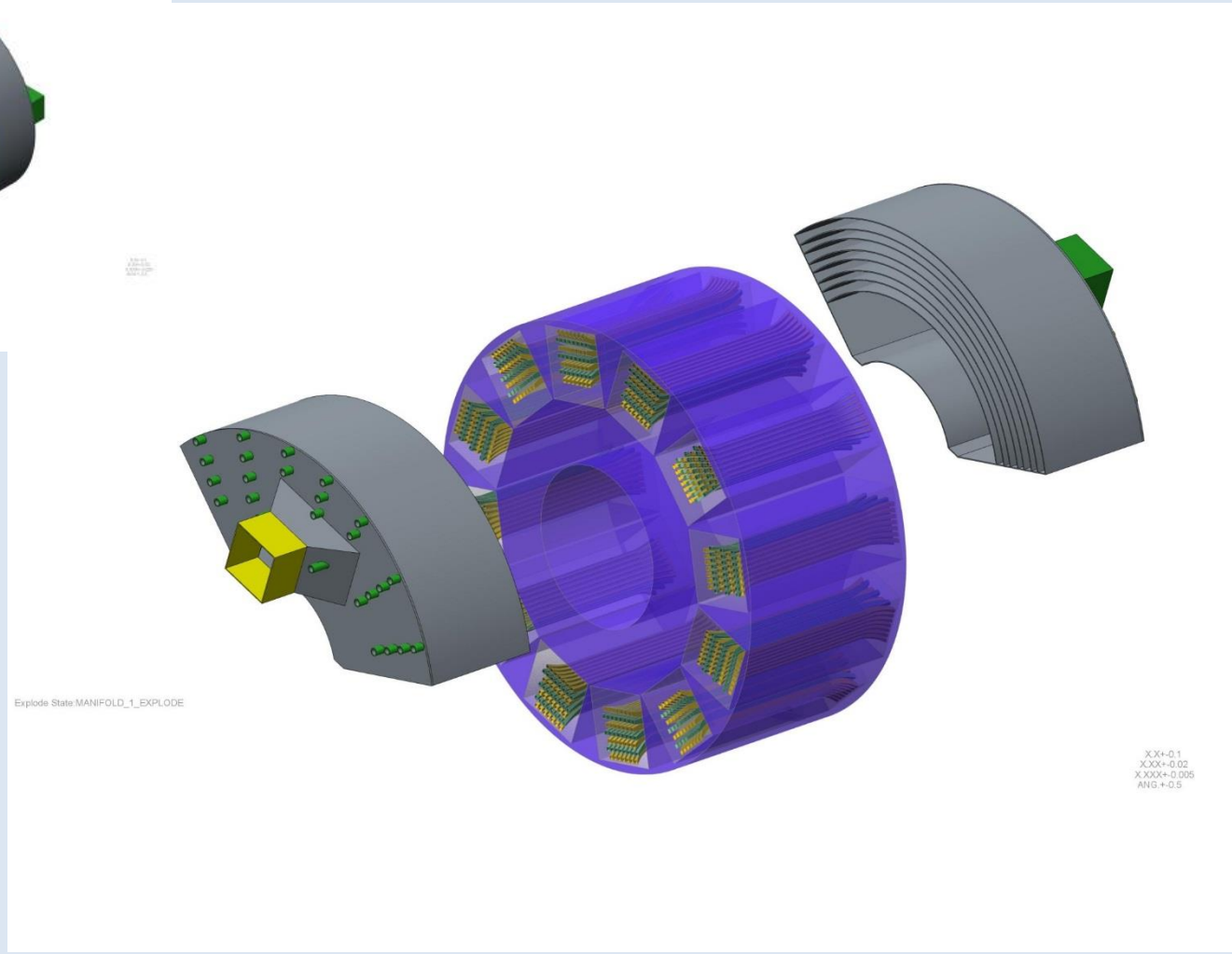
The new system uses a traditional configuration for humidity removal



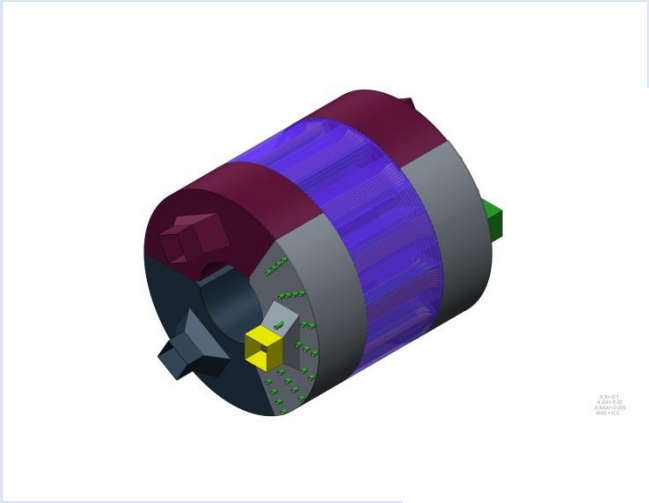


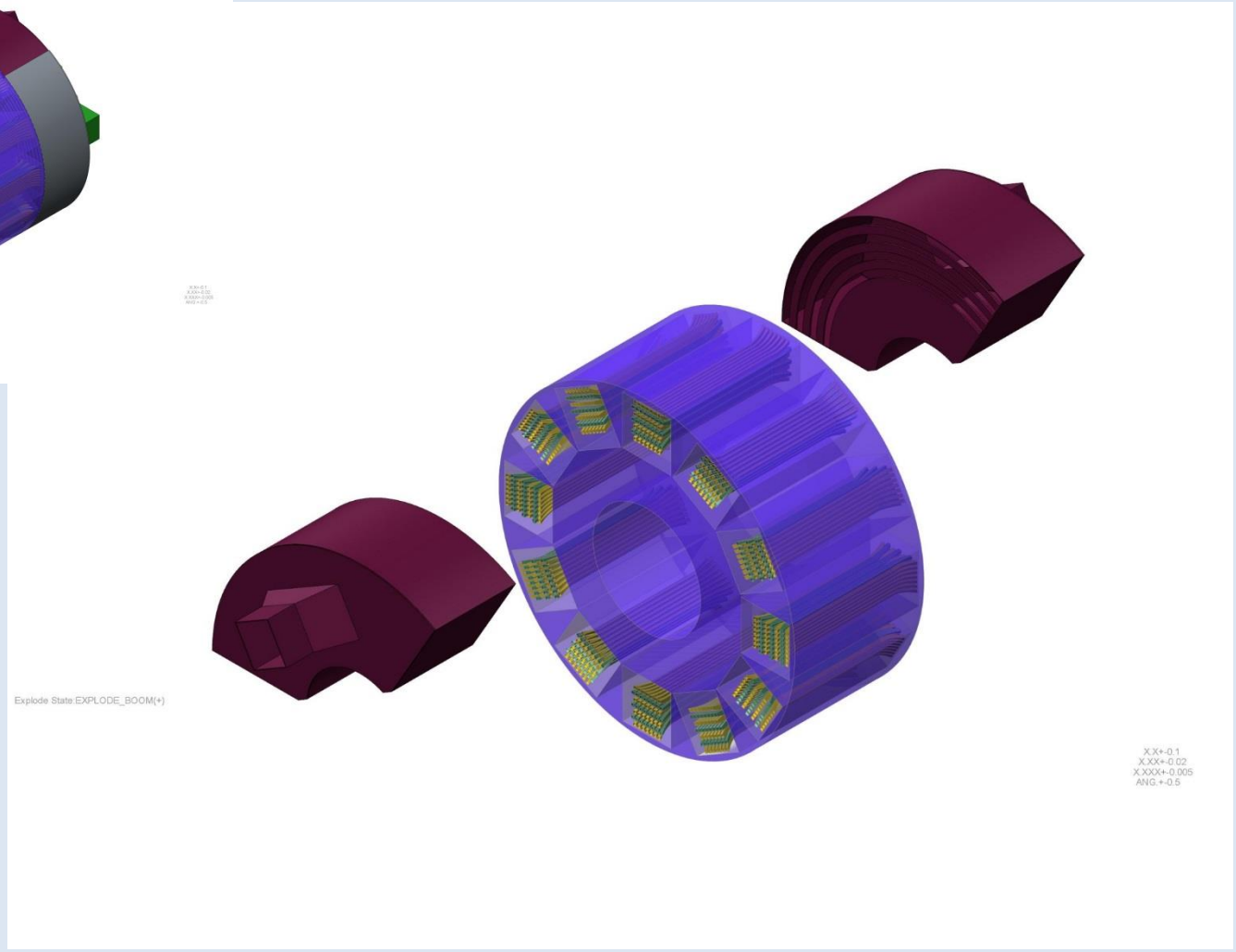
The new system uses a nested counter-flow system of heating for thermal regeneration





The new system uses cooling manifolds to allow the desiccant to cool to outside air temperature, using outside air as the source of cooling.





Summary

- If you are looking for a way reduce AC energy costs in an office tower environment, and you are interested in sponsoring a site installation test, we should talk.

john.c.graf@nasa.gov

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