NASA SBIR 2019 Phase I Solicitation

H12.05 Reduced Oxygen Usage for Medical Events

Lead Center: JSC

Participating Center(s): GRC

Technology Area: TA6 Human Health, Life Support and Habitation Systems

Human exploration missions beyond low earth orbit (LEO) require a variety of medical interventions to address planned and un-planned operations. One intervention involves the delivery of medical grade oxygen, specifically during Advanced Life Support (ALS) protocols. NASA currently uses a pneumatic, portable ventilator where rate and volume can be independently controlled and oxygen is supplied via pressurized tanks on the Space Station. Computational models show that, when operating the device, the addition of oxygen into the close vehicle environment via enriched exhalation and/or blow-by quickly violates NASA Flight Rules to NOT exceed greater than 30% oxygen concentration. The Flight Rule was put in place to minimize the likelihood of a fire on NASA vehicles. Specifically, within 20-30 minutes on the International Space Station, a localized high percentage oxygen bubble forms around the patient and within 12 hours the entire cabin exceeds NASA Flight Rules regarding oxygen concentration. These limitations significantly impair NASA's ability to respond to ALS events and only worsen as vehicle volumes become smaller for the Orion Program, Commercial Crew Program, and future Exploration Programs (like Gateway).

NASA requires new technologies that will enable the delivery of medical grade oxygen while reducing/eliminating elevated oxygen concentration levels in the cabin atmosphere. Specifically, NASA seeks technologies/methods to reduce enriched oxygen exhalation and/or reduce oxygen blow-by. Examples of technology developments can include, but are not limited to, improved oxygen delivery (e.g., mask) design, improved ventilator modes, and/or shaped ventilator output (e.g., oxygen leading with air following).

For the above technology, research should, at a minimum, be conducted to analyze technical feasibility during Phase I and show a path toward Phase II demonstration and/or prototype hardware/process.

This technology would reduce the mass/volume/power required to deliver medical oxygen to a sick or injured astronaut and simultaneously reduce the spaceflight cabin fire hazard risk. It supports NASA's Human Research Program Exploration Medical Capabilities, the ISS Health Maintenance System, and the Commercial Crew Program.

References:

- https://www.nasa.gov/hrp/elements/exmc
- https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/N20110022379.xhtml
- https://www.nasa.gov/exploration/commercial/crew/index.html
- https://www.nasa.gov/directorates/heo/index.html