



NASA SBIR 2014 Phase I Solicitation

H12.01 Next Generation Oxygen Concentrator for Medical Scenarios

Lead Center: GRC

Participating Center(s): JSC

For exploration missions, a contingency system which concentrates the oxygen within the cabin environment and provides the required concentration of oxygen to the crewmember for various medical scenarios will be necessary. Oxygen concentration technology is being pursued to concentrate oxygen from the ambient environment so that oxygen is a consumable resource and the fire hazard of an elevated cabin oxygen atmosphere can be reduced. The goal of this project is to develop an oxygen concentration module that minimizes the hardware mass, volume, and power footprint while still performing at the required clinical capabilities.

An Oxygen Concentrator Module (OCM) with an adjustable positive pressure output 2-15 lpm of O₂ at 50% to >90% oxygen concentrations by volume has been recommended by the flight medical team. The unit must be able to operate continuously in microgravity and partial gravity exploration atmospheres that include the atmospheres of 14.7 psia/21% oxygen, 10.2 psia/26.5% oxygen, and 8.2 psia/34% oxygen by volume. The unit must run continuously on available spacecraft power, and be switchable between 28 VDC and 120 VDC. It must have adequate heat rejection so as to not exceed a touch temperature of 45°C. It is also highly desirable to have a portable low output capability for use in EVA pre-breathing or patient transfer between vehicles. Usage scenarios for oxygen treatment of smoke inhalation or toxic spills also predicated the need for an inlet filter on the unit that removes (converts/absorbs/filters) toxic gases from the delivered gas stream to the patient.

The OCM system should be capable of regulating the oxygenation of the patient using a closed loop feedback system that senses the oxygenation level of the patient tissues and adjusts the oxygen flow rate and/or oxygen concentration according to treatment protocols for the illness being treated. The system shall also be able to operate open loop in the event of feedback signal failure. The control variable(s) are not specified (rate/concentration) here since the basic unit's topology may dictate how the regulation is best achieved. Because the system may be configured during times of duress, it shall be user friendly to the caretaker by adopting a "plug and play" philosophy.

This SBIR Phase I development is to determine the architecture of such a system exhibiting the characteristics (high capacity flow range, closed-loop tissue oxygen control, and operations in microgravity or partial gravity exploration atmospheres), a description of the basic unit as a sub-system component, method of optimizing power over the range of flows and oxygen levels, redundancy and sparing for a long duration missions, and the relationship of the OCM system to caretaker (what does the caretaker need to do to fulfill the medical need?).

Phase I Requirements - Phase I should concentrate on developing the scientific, technical, and commercial merit and feasibility of the proposed innovation resulting in a feasibility report and concept, complete with analyses that discuss functionality in microgravity and at the proposed exploration atmospheres, algorithms for closed-loop oxygenation protocols, and inlet filtering of smoke or toxic gases.

NASA Deliverables - A concept for a microgravity and partial gravity exploration atmospheres oxygen concentrator

with a closed loop oxygenation flow rate system with inlet filtering of potential toxic ambient gases.

HRP IRP Risk - Risk of Unacceptable Health and Mission Outcomes Due to Limitations of In-flight Medical Capabilities.