Fiscal Year:	FY 2009	**Task Last Updated:**	FY 05/15/2009
PI Name:	McQuillen, John		
Project Title:	IntraVenous Fluid GENeration for Exploration Missions (IVGEN)		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Operational and clinical research		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **ExMC**:Exploration Medical Capabilities		
Human Research Program Risks:	(1) **Medical Conditions**:Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	44135	**Congressional District:**	10
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	Directed Research
Start Date:	04/01/2006	**End Date:**	08/31/2011
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	1
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
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Flight Program:	ISS		
Flight Assignment:	ISS		
Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:			
Performance Goal No.:			
Performance Goal Text:			
	The ability to generate intravenous (IV) fluids for medical care from available spacecraft potable or technical water supplies will greatly reduce launch mass for NASA's future exploration class missions. In spite of designing and testing several systems, NASA has not yet met that goal. As a result, NASA’s Human Research program initiated a detailed effort examining several different technologies for first purifying water and then mixing effectively with appropriate solutes. IntraVenous Fluid GENeration for Exploration Missions (IVGEN) will demonstrate a microgravity compatible water purification to the standards required for intravenous administration, and a pharmaceutical mixing system. This hardware is a prototype that will allow flight surgeons more options to treat ill or injured crewmembers during future long-duration exploration missions.		

Task Description:	Trade studies were used to down-select different technologies based on minimizing mass, volume, and power requirements. Experiments were conducted in normal and short duration reduced gravity facilities to verify actual performance of the selected technologies. Pressure driven systems with a gas-liquid separator and a DI cartridge have been shown to generate Sterile Water for Injection per the USP standards. Furthermore, by pre-positioning a sterile magnetic stir bar and salt within an IV bag, the desired medical solution can be quickly and effectively generated. Given the limitations with both the normal gravity and ground-based reduced gravity testing, these results need to be verified on orbit using a prototope. Further, an appropriate system level test should be conducted prior to deployment. Accordingly, the objectives of this experiment include the following: • Produce an acceptable IV solution that meets USP requirements • Verify on orbit, using available microgravity-compatible technology and techniques, the acceptability of that solution, and • Obtain sufficient engineering data to permit scaling of the system per actual mission needs. • Demonstrate end-to-end system level performance
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	IVGEN technology could be used on Earth to generate purified water and IV fluid in Third World countries where medical resources are limited.
Task Progress:	Activity on this effort has been focused on the definition and development of a space-flight experiment for testing aboard the International Space Station in the Microgravity Science Glovebox. Tasks have included trade studies of available technologies; reduced gravity testing of mixing and filling techniques, gas-liquid separators, and bubble trapping within a specialized conductivity cell; and normal gravity testing of water purification techniques. Trade studies incorporated both analysis and reduced gravity and normal gravity experimentation as appropriate. Studies that were conducted included an examination of different fluid mixing techniques that would be applicable in reduced gravity. These techniques include bag to bag transfer of fluids, kneading of IV bag, magnetic stir bar and impellor technology. Eventually, the magnetic stir bar technique was selected and verified in reduced gravity. An additional trade study was conducted that examined water purification techniques such as distillation, reverse osmosis, ultrafiltration, deionizing packed beds, and microwave technology. Based on filtration performance, system size and weight, and power consumption, a technique using deionizing packed beds coupled with sterilizing filters was selected. Besides trades studies and experimental work, activities during the past year include generating an Exploration Investigation Requirements Document (EIRD) and conducting both a preliminary design review (PDR), critical design review (CDR)
Bibliography Type:	Description: (Last Updated: 09/07/2020)
Dissertations and Theses	Barlow KL. "Intravenous fluid mixing times quantified using planar laser-induced fluorescence." Master's Thesis, Case Western Reserve University, January 2007. , Jan-2007
NASA Technical Documents	Niederhaus CE, Miller FJ. "Intravenous Fluid Mixing in Normal, Partial, and Micro- Gravity: Down-selection of Mixing Methods." Washington, DC : National Aeronautics and Space Administration, 2008. NASA technical memorandum TM-2008-215000. https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080012740.pdf ; accessed 11/13/19. , Jan-2008
NASA Technical Documents	Niederhaus C, Barlow K, Griffin D, Miller F. "Medical Grade Water Generation for Intravenous Fluid Production on Exploration Missions." Washington, DC : National Aeronautics and Space Administration, 2008. NASA technical memorandum TM-2008-214999. https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080022376.pdf ; accessed 11/13/19. , May-2008