National Aeronautics and Space Administration

PRODUCING STERILE IV FLUIDS ON THE INTERNATIONAL SPACE STATION: *INTRAVENOUS GENERATION MINI (IVGEN MINI) PROJECT*

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Disclosure Information

93rd Annual Scientific Meeting

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I have the following financial relationships to disclose:

- Project Manager, NASA Glenn Research Center

I will not discuss off-label use and/or investigational use in my presentation

The Need

- **Medical risk increases for future extended-duration exploration missions, in part due to:**
  - Increased mission duration (up to 3 years)
  - Limited to non-existent resupply
  - Reduced mass/volume allocation for the medical system
- **IV fluids support treatment of around 30% of the identified in-flight medical conditions most likely to occur and require mitigation to minimize impact to crew health outcomes or mission success.**
- **An in-situ capability of providing medical grade IV fluids reduces mass and volume of the medical system and ensures access to fluids within their shelf life.**
  - Terrestrial IV fluids shelf-life is ~16 months from the manufacture date

Key Capabilities of an IV Fluid Generation Module

Medical Treatment Demand

- Amount of fluid produced should be sufficient to treat 2 minor medical events (1 crew) and 1 major medical event (2 crew).
  - A minor medical event may require 1-2L of IV Fluid per incident.
  - A major medical event may require enough fluid for initial resuscitation as well as maintenance for up to 10 days (~40L), based on special consideration from a worst-case burn scenario.

Crew Considerations

- During a major medical event, crew would need to prioritize medical treatment and not have the ability to support highly manual operations. If IV Fluid stock is depleted, generation of new IV Fluid should be mostly automated (<4 hrs support).
  - Fluid should be generated at a minimum of 1.2 L/hr.

Quality

- The IV Fluid produced should meet US Pharmacopeia standards.
- The IV Fluids produced should have a shelf-life of at least 16 months.

Small Mass/Volume

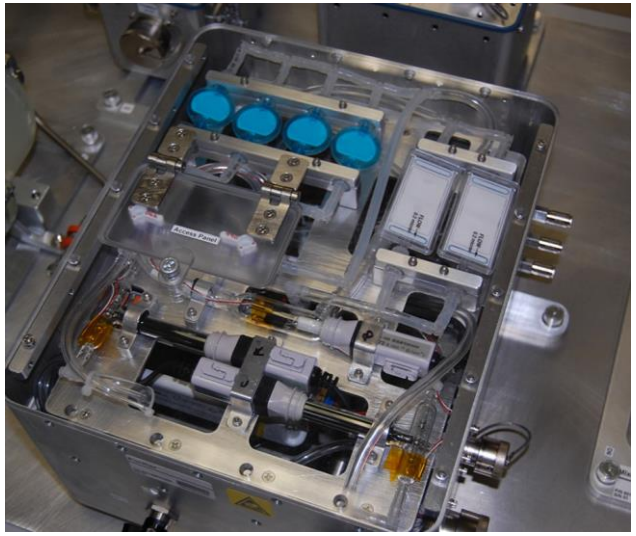
- The IVGen Mini should target an 80% mass/volume savings compared to IV Fluid inventory of 100L (<20kg, 20,000 cm^3).

IV Fluid Generation (IVGEN) - Miniaturization

This project builds upon the success & lessons learned of the original IVGEN project, demonstrated on ISS in 2010:

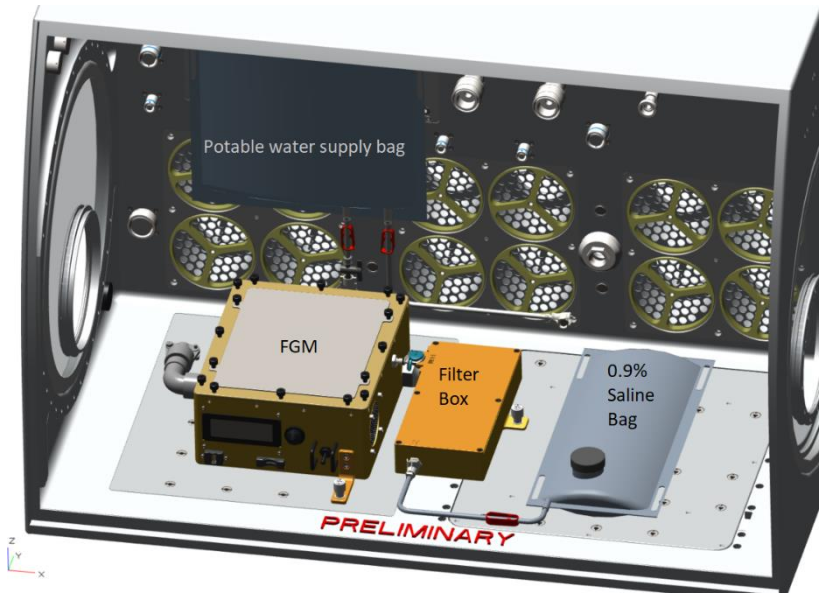
- **Compact water purification –** produce sterile-medical grade solution from potable drinking water
- **Mass & volume savings -** Eliminates need for gaseous nitrogen; replaced with potable water bags
- **Operational optimization –** reduce crew time & interaction through automation & increased fluid production rates
- **Refining filter design –** reduce amount of air in IV bag, which in turn reduces risk of an air embolism in patient

A successful demonstration of the IVGEN Mini hardware will increase the Technology Readiness Level (TRL) from 5 to a 7

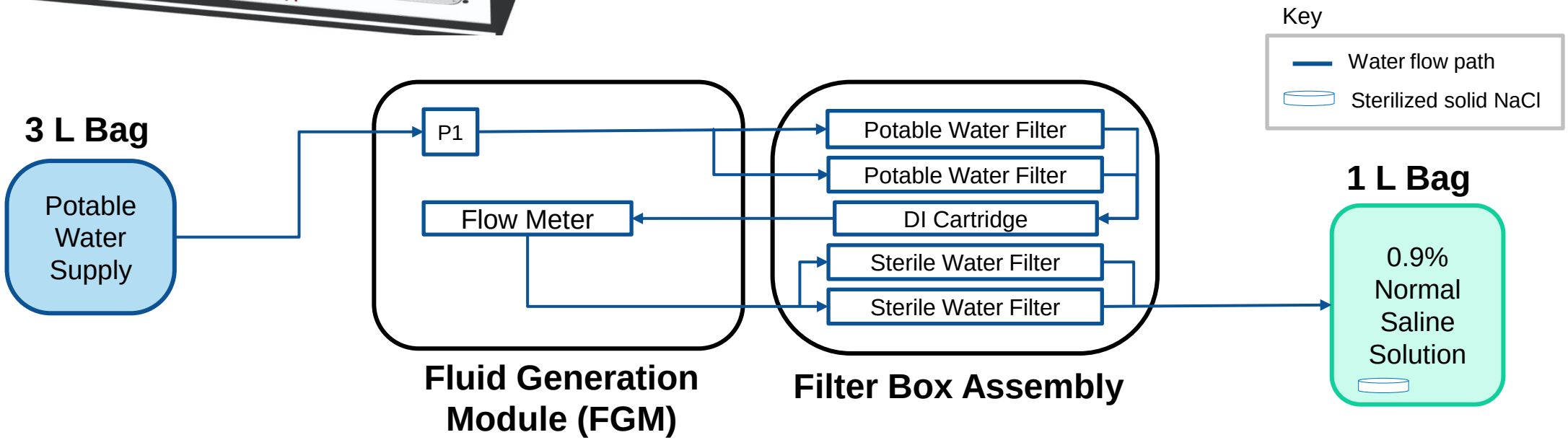


IVGEN hardware on ISS in 2010

High Level System Design



Filters & a deionizing cartridge remove air bubbles, bacteria, particulates, & other organic materials from the potable water to create purified water.



Example Use Case - Dehydration

Crew member experiences dehydration post lunar surface EVA

IV fluid resuscitation recommended by CMO

Following treatment, IV fluid must be replenished

IVGEN Mini Fluid Generation

- IVGEN Mini Setup
- Crew initiates fluid generation process
- Collect, inspect, label, & store 1L IV fluid bag
- Repeat process to produce up to 10L; Stow