



NASA SBIR 2020 Phase I Solicitation

H4.01 Exploration Portable Life Support System Component Challenges

Lead Center: JSC

Technology Area: TA15 Aeronautics

As the design for the new Exploration Extra-vehicular Mobility Unit (xEMU) is developed, there are obvious gaps in technologies, which need to be fulfilled to meet the new exploration requirements. Various Exploration Portable Life Support System (xPLSS) Hatch components are at a stall in technology development and require new innovative ideas. These xPLSS Hatch Components (through three scopes) are the focus areas for this solicitation in an attempt to integrate new technologies into the xPLSS. NASA has plans to go to the moon and as the mission extends further out of Lower Earth Orbit, durability and extensibility will become some of the most important requirements.

This subtopic is relevant to the Exploration Extravehicular Mobility Unit (xEMU), ISS, as well as commercial space companies. As a new Space Suit Exploration Portable Life Support System (xPLSS) is being designed, built, integrated and tested at JSC and integrated into the xEMU, solutions will have a direct infusion path as the xPLSS is matured to meet the design and performance goals.

Scope Title

Feedwater Supply Assembly

Scope Description

Sterile compliant bladder, capable of storing ultrapure feedwater with a relatively high cycle life: In order for the thermal control loop to operate properly, a water source is needed. An effective, efficient, sterile and durable feedwater bladder is essential. The suit pressure acts on this bladder and as water evaporates, the bladder resupplies the loop. The bladder must be clean and not leak particulates or polymer chains over long periods of quiescence. The water in the control loop contains a biocide and the bladder must not react with these chemicals to form potential contaminants. The maximum design pressure (MDP) for the system at a lunar environment will be 16 psid with a cycle life of $4 \times 156 = 624$ MDP. Having a bladder with these qualities not only buys down the safety risk of rupture, it promotes reliability at higher pressures and provides an avenue to extend Extravehicular Activity (EVA) length.

References

Feedwater Supply Assembly Requirements

Note to vendor: The following two drawings referenced in the above specification shall be provided if vendor is selected for award.

1. Feedwater Supply Assembly (FSA 431) Drawing SLN 13102397

<https://ntrs.nasa.gov/search.jsp?R=20190033446>

2. Auxiliary Feedwater Supply Assembly (FSA 531) Drawing SLN 13102398

<https://ntrs.nasa.gov/search.jsp?R=20190033446>

Scope Title

Bypass Relief Valve

Scope Description

Material dependent Relief Valve (RV) capable of re-calibration: The bypass relief valve cracks and flows from the pump outlet to the pump inlet, short-circuiting the pump when there is a blockage in the line. It is a safety feature designed to limit the head pressure that could be generated by the positive displacement pump, which is used in the primary and auxiliary thermal control loops. Materials, design pressures and re-calibration capabilities are a priority for this design. The desired housing material is titanium, which is a difficult metal to work with, but is a requirement as a preventative measure to avoid galvanic coupling between interfacing metals. To ensure the thermal loop pressure stays within a safe range, the crack and reseal pressures must be between 14-15 psid with a full flow of 220 lb/hr at <18 psid. The design should also include a method of setting or re-calibrating the cracking pressure in case there is drift over time. Replacement of the entire unit is not preferred due to accessibility and operational concerns.

References

Thermal Loop Bypass Relief Valve Requirements

Note to vendor: The following drawing referenced in the above specification shall be provided if vendor is selected for award.

- Bypass Relief Valve Assembly (RV-424/RV-524) SLN13102925
<https://ntrs.nasa.gov/search.jsp?R=20190033446>

Scope Title

Trace Contaminant Control

Scope Description

Trace contaminant removal capability: Non-regenerable activated carbon is the current state of the art for trace contamination control. However, this provides a logistics impact to future missions. The primary trace contaminants that must be removed include ammonia (NH₃), carbon monoxide (CO), formaldehyde (CH₂O), and methanethiol (also known as methyl mercaptan) (CH₃SH). The minimum objective would be to remove all of the significant compounds that threaten to exceed the 7-day Spacecraft Maximum Allowable Concentrations (SMAC) values during an EVA. The ideal solution would be a vacuum-regenerable sorbent that could be integrated with the Exploration Portable Life Support System (xPLSS) CO₂/H₂O removal system. This system performs regeneration or desorption by exposing the sorbent to a pressure swing from 4.3 psia to <1 torr over approximately 2 minutes. Temperatures remain in the 60-80°F range with a small amount of heat flux from the cross-coupled adsorbing bed. Additional heat input requirements from resistance heaters or other sources would negatively impact the system trade the more significant the value becomes.

References

Trace Contamination Control Cartridge Requirements

Note to vendor: The following drawing referenced in the above specification shall be provided if vendor is selected for award.

- Trace Contamination Control (TCC-360) Specification Control Drawing SLN13102266
<https://ntrs.nasa.gov/search.jsp?R=20190033446>

Expected TRL or TRL range at completion of the project for all scopes: 3 to 5

Desired Deliverables of Phase II for all scopes

Prototype

Desired Deliverables Description for all scopes

Phase I products: By the end of Phase I, it would be beneficial to have a concept design for infusion into the Exploration Portable Life Support System (xPLSS). Testing of the concept is desired at this Phase.

Phase II products: By the end of Phase II, a prototype ready for system-level testing in the xPLSS or in a representative loop of the PLSS is desired.

State of the Art and Critical Gaps

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Relevance / Science Traceability

It is relevant to the Exploration Extravehicular Mobility Unit (xEMU), ISS, as well as commercial space companies. As a new Space Suit Exploration Portable Life Support System (xPLSS) is being designed, built, integrated, and testing at JSC and integrated into the xEMU, solutions will have a direct infusion path as the xPLSS is matured in to meet the design and performance goals.