**CESO 22-4: Parabolic and Suborbital Glovebox in Support of Space Crop Production**

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**Start TRL:** 3 **End TRL:** 4

**Prime STMD Taxonomy:**

TX06.3.5 Food Production, Processing, and Preservation

**Project Description:**

Space crop production research approaches and technologies can be validated for microgravity using parabolic or suborbital flight opportunities, and this will save considerable risk, time, and money for implementing new strategies in spaceflight. While the durations of microgravity in these tests are insufficient to grow crops, there are numerous examples of the value of microgravity testing for subsystems such as plant water and nutrient delivery, where multiphase fluid flow can be elucidated in short durations, and horticultural operations, such as harvesting and produce sanitation where containment and contamination can be assessed. Containment in any operational test is essential, as crop operations involve fluids and biological samples, which are potential hazards. This project consists of designing, developing, and constructing a parabolic/suborbital glovebox for experiment containment. The design involves modifications and upgrades to an existing glovebox developed at the University of Louisville. The University of Louisville glovebox was used by KSC researchers for space crop parabolic flight tests in 2021, and lessons learned from that testing have driven design modifications and improvements in the KSC-generated glovebox. Requirements were identified, parts were ordered, an operational science glovebox was fabricated, and a detailed materials specification list was generated. Analyses that are required for flight, remain to be performed to meet airworthiness requirements, and that work will have to be conducted in the future before use in flight.

**Anticipated Benefits:**

Access to a parabolic/suborbital glovebox will enable the development of hardware, operational testing, and proposals for validation and verification before implementing into more critical ISS, Gateway, surface, and transit missions. Additionally, ground testing with the glovebox will inform human factors and procedure development for space biology operations in a facility like the ISS Life Sciences Glovebox. This facility can be used for personnel training and operational testing. Given the amount of space crop and space biology hardware and experiment unique equipment being developed at KSC for future exploration missions, having a KSC-owned glovebox available for future testing will be an excellent investment to expand center capabilities.

**Project Closeout Summary:**

KSC team members designed and constructed a functional glovebox for use in parabolic or suborbital flight tests requiring the containment of fluids or biologicals. This glovebox design was based on a previous flight-tested version developed at the University of Louisville, with modifications and improvements based on KSC team member experiences in use and technological advancements. The new KSC glovebox allows three team members to work on contained experiments with secure hand and foot holds, maintaining team communication through audio headsets, video recording from multiple angles, and collecting other relevant data. The glovebox can be easily customized for a variety of payloads, with lighting and power available and

experiment-specific mounting plates that can be changed out to support different experiment uses. The glovebox progressed from design (TRL 3) through construction and is at TRL 5, ready for structural analysis validation which will be needed to advance this until airworthiness/flight readiness (TRL 6) and flight demonstration (TRL 7). Having this glovebox available at KSC will enable technology and component testing and human factors analysis and procedure development prior to implementing new technologies and approaches into ISS, gateway, surface, and transit missions.