

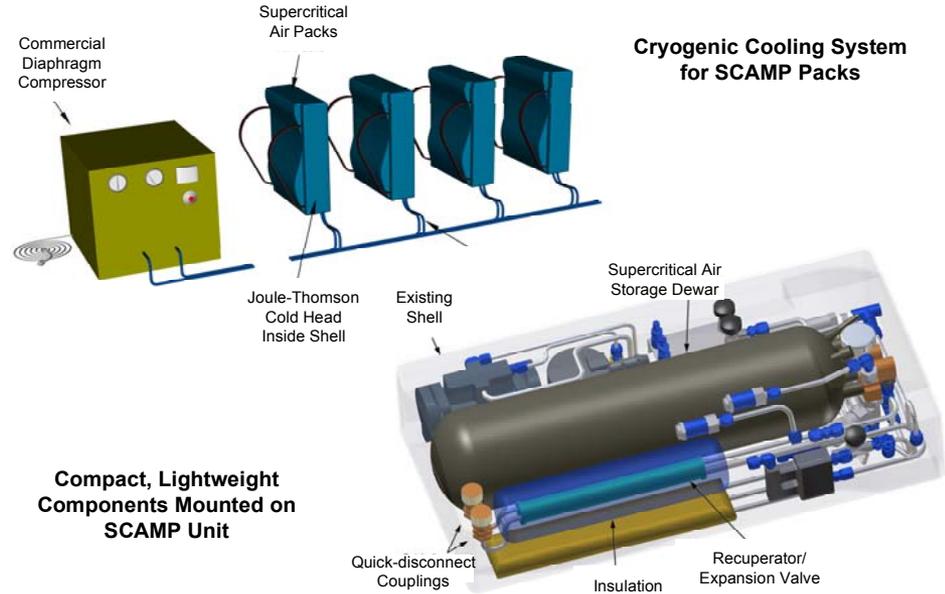
## Cryogenic Cooling System for Zero-Venting Storage of Supercritical Air Packs

PI: Dr. Michael G. Izenon / Creare Inc., Hanover, NH

Proposal No. 03-II F3.02-8982

### Identification and Significance of the Innovation

- Enable use of supercritical air packs at NASA KSC
  - Long-term storage of cryogenic air with no venting
  - Provide breathing air and cooling for ECUs and SCBA
  - Long-duration, lightweight, low pressure ⇒ safety
- Improve safety and effectiveness for spaceport operations
  - 6000-7000 propellant handling operations per year
  - Supercritical air has significant advantages compared to liquid air:
    - No oxygen enrichment
    - Operates in any orientation
    - Simple quantity measurement
  - Loss of air during storage is key roadblock to adopting supercritical air
- Phase II will develop optimal system for non-venting storage
  - Mixed-gas Joule-Thomson refrigeration cycle
  - Commercial diaphragm compressor
  - SCAMP-mounted, lightweight cold heads
  - Quick disconnect couplings always warm
  - Inexpensive, established technology



**Cryogenic Cooling System for SCAMP Packs**

**Compact, Lightweight Components Mounted on SCAMP Unit**

### Technical Objectives and Work Plan

- Improve safety/effectiveness by enabling use of supercritical air
  - Long-term storage with no venting
  - Safety: No mixing or leakage of mixed-gas refrigerant
  - Minimum carry weight
  - Rapid access/no cold disconnects/high reliability
  - Can be used to charge the packs as well
- Phase II work plan
  - Design and build the cryogenic cooler
  - Develop the control system
  - Integrate cold head with SCAMP pack
  - Demonstrate the integrated system:
    - Cooler performance
    - Storage with zero venting
    - Charging empty packs
    - Reliability/sensitivity to contamination

### NASA and Non-NASA Applications

- NASA applications
  - Rocket propellant handling/management at NASA KSC (6000-7000 per year)
  - Launchpad/landing strip rescue
  - Solid booster recovery
  - Future space exploration
    - Nonventing cryogen storage for future spacecraft and planetary bases
- Non-NASA applications
  - Military: Navy warm water diving, shipboard firefighting, operations in chem/bio protective suits
  - Homeland security:
    - Level A HAZMAT crews for civil defense and industrial applications
    - High rise and subway firefighting and search/rescue operations
  - SCBA for firefighting and rescue
  - Civilian diving

Contact: Michael G. Izenon, 603-643-3800, [mgi@creare.com](mailto:mgi@creare.com)