Expeditionary Basing and Collective Protection Directorate

Fabric Structures Team Overview

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JOCOTAS November 19, 2015

US ARMY RDECOM

Briefing Clear UD PAO #: U15-515

Fabric Structures Team Overview & Introduction

FST Goal: **Mature technologies for fabric shelter systems providing increased protection, improved habitability/quality of life, and reduced logistics burden.**

Technologies:

Advanced Fabric Structures including Airbeam Shelters :
- Maintenance Shelters
- Mobile Warehouses
- Large Command Posts
- CB Medical
- Backpackable
- Self-sustainment

Insulation, energy & organizational equipment
- Insulation
- Radiant Floor Heating
- Water demand reduction systems
- Black Waste, Solid Waste, Waste-to-Energy
- Non-woven Materials
- Energy Harvesting/Storage

Collective Protection – CB Defense:
- Overpressure/Negative Pressure Shelters
- CB Fabrics
- Reactive Airlocks
- Self-Decontaminating Fabrics

The Team:
- **Liz Swisher- Team Leader, Electrical Engineer**
- **Kristian Donahue - Chemical Engineer**
- **Robin Szczuka – Chemical Engineer**
- **Chris Aall – Mechanical Engineer**
- **Allyson Stoyle – Chemical Engineer**
- **Patti Cummings – Admin Support**





Team Projects by Budget Category

Current Portfolio/Core Funded Projects:

VT4/VT5:

Water Demand Reduction (ends FY15)

Exploration of Non-Woven Textiles (ends FY16)

Improved Fired Safety for Expeditionary Shelters (ends FY18)

Expeditionary Black Waste Treatment Technologies (ends FY16 w/ support in FY17)

Hands-Off Expeditionary Tent – HEXT (ends FY16)

Next Generation Multi-Functional Materials for Rigid & Soft-wall Shelters (FY16 – 19)

Team Projects by Budget Category

Current Customer Funded Projects:

Rapid Innovation Fund:
MILHUT(ends FY15/early FY16)
Self Sustaining Module (SLiM) (ended late FY15)

ManTech:
PopUp Bio-Insulation (ends FY17)

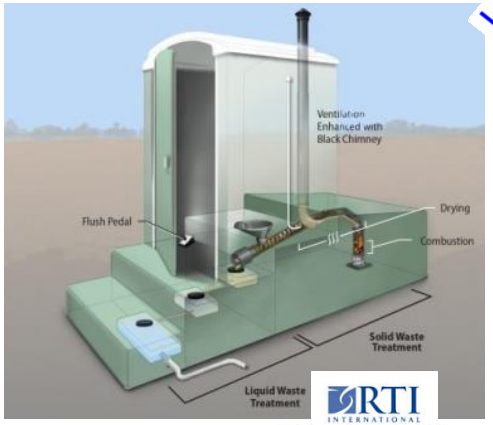
SBIR:
Radiant Floor Heating – 2 phase 1 efforts (ends FY17)

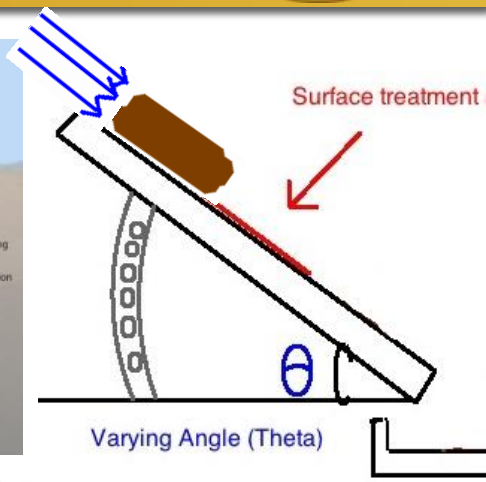
DTRA (Defense Threat Reduction Agency):
Aerosol System Test (ends FY16)

Water Demand Reduction Technologies

Latrines

- Established relationship with RTI and the Bill & Melinda Gates Foundation "Reinvent the Toilet" initiative
- Electrochemical urine disinfection module being evaluated
- Investigated hydrophobic super-slippery coatings



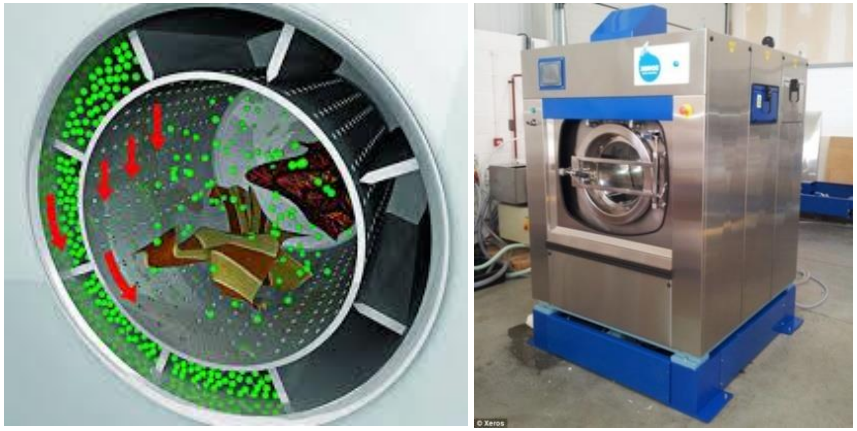


Showers

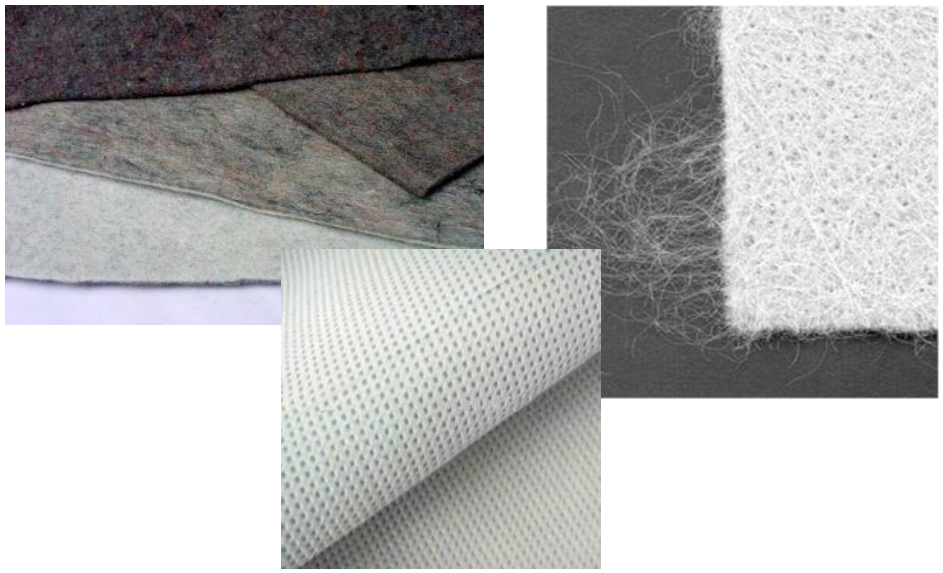
- Quantitative test method developed and verified
- Undergoing qualitative evaluation of shower heads

Laundry

- Xeros pelletized laundry system
- 70% less water per load
- No need for heating of water



Non-Woven Textiles



Schedule & Cost

Major Milestones	FY15	FY16
Custom nonwoven deliverable from Warwick Mills		
Contract award for follow-on RDT&E		
Warwick investigation and testing of commercially available and applicable nonwovens		
Tracking of NSRDEC textile innovation		
Determine applications and risk		
Investigate concepts and designs for prototypes		
Build and test prototype system		
Final reporting and documentation		

Purpose: Investigate research advances by industry and academia in multi-functional nonwoven textiles. Evaluate cutting edge technologies that have progressed beyond basic research and determine their potential application within expeditionary basecamps. Optimize textile properties within the most promising identified substrates incorporating application specific requirements.

Product(s):

- Database of nonwoven fabrics from industry, academia as well as within the military.
- Custom nonwoven fabric that has application specifically to shelters.
- Investigation of industry nonwoven materials and the application to basecamps (including an EMI liner “Kit”) .
- Final report documenting:
  - •nonwoven textile technologies investigated and potential for base camp applications
  - •technical assessment, testing approach and test results
  - •textile modification strategy and approach
  - •draft performance specification to capture physical properties

Payoff:

- Cost saving through simplified manufacturing with the ability to have a disposable shelter and/or components.
- Innovative applications at a lower cost and higher surface area for substrate variation and biocidal or chemical deposition.

Improved Fire Safety in Expeditionary Shelters

Problem:

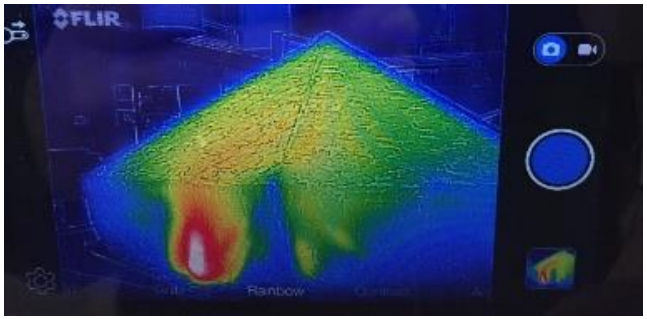
Current flame test standards for rigid and soft wall shelters may not adequately predict safety. Flame test methods do not adequately address tent material interactions or new rigid composite shelter material skins. Improved methods are needed to provide adequate time to safety exist an expeditionary shelter during a fire.

Impact on Warfighter

Improved Safety, Reduced Injuries/Death, Optimized material performance

Payoff

- Method that addresses flammability of rigid wall composite walls
- Test method that accounts for material interactions.
- Coatings and materials that slow the spread of fire (i.e. intumescent coatings).



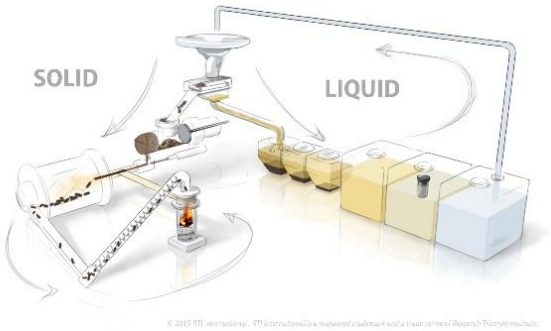
Effort Accomplishments

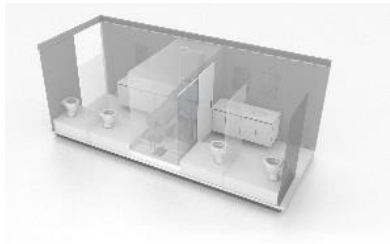
- Identified and Reviewed relevant standards and burn studies
- Conducted swatch level testing on legacy and new candidate materials
- Developed partnership with Academia (WPI)
- Studied and conducted testing using intumescent coatings

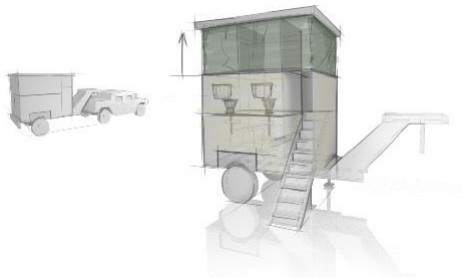
Expeditionary Black Waste Treatment Technologies

Description:
Investigate integrated technology approaches for handling and treatment of black waste generated at expeditionary, forward located combat outposts and base camps.

Problem:
Management of waste is a large logistics burden on military base camps of all sizes. Treatment in forward areas consists of collection barrels which are manually dragged out, flooded with fuel and burned.







Impact to Warfighter: Reduced fuel consumption, Improved health and hygiene, Reduced logistics burden.

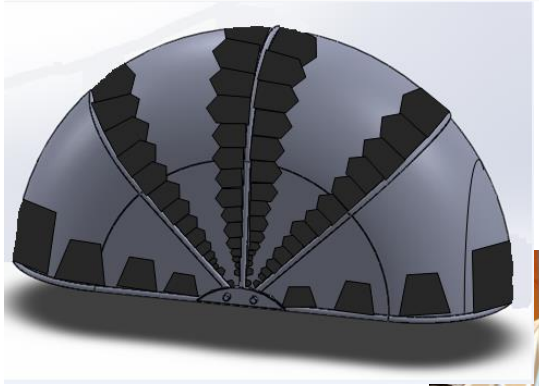
Technical Approach:

- *Separate water at source*
- *Dry waste to optimum water % for fuel*
- *No filters, minimal maintenance*
- *Low power with the goal of net zero energy expenditure*

Effort Accomplishments

- Solid waste latrine prototype demonstrating separation at source, waste processing, mixing, burning and drying.
- Collaborations with Gates Foundation/RTI for “Reinvent the Toilet Challenge.”

Hands-Off Expeditionary Tent (HEXT) Frame Concepts



Purpose: Investigate non-traditional tent support systems that incorporate quick, self-deployable automated techniques such as hydraulics, robotics, electronic controls etc.

Product(s):

- Market investigation
- Student research project
- Concepts, designs and prototyping of non-inflatable rapidly deployable tent frame technology that is lightweight with a low packing volume for storage and transportability
- Final report documenting program initiatives and outcomes

Payoff:

•Reduction in the time and manpower required to deploy a tent system without sacrificing durability and shelter performance

•Maintaining affordability in comparison to current TEMPER Airbeam systems

Pop-Up Bio Insulation

What is the Problem?:

Current 1-ply thermal liners offer low thermal benefit (~R1) so fuel use is very high for heating and cooling of shelters. Quilted liners have better insulation values (R 5-7) but trap moisture causing mold and mildew. Quilts also have high packing volume so poor logistics limit their use.

Impact on warfighter:

- Reduces fuel costs, packing volume, logistic burden, mildew growth

Technical Landscape:

- High >7 R-value with 10X smaller packing volume of same class insulation
- Modular, easy-to-install liner panels
- Intrinsically fire-retardant liner
- Rechargeable chloramine surface prevents mildew and reduces the spread of infection caused by surface to surface transfer

HDT Airbeam Supported TEMPER

Eureka , RDS-635

Effort Accomplishments:

3 - Full scale prototype liners have been fabricated and evaluated for thermal performance at two test sites (Alaska CRTC & Holloman AFB) – Heating and Cooling Efficiency evaluated

-Test results from CRTC showed a fuel savings of up to 1.7gal/day-shelter while maintaining an internal temperature 8°F warmer compared to baseline (HDT 250g Camel Liner)

Next prototype:

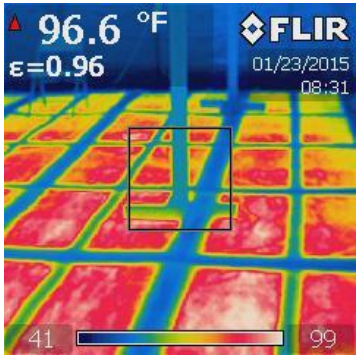
-Liner will remain installed in shelter during strike/erect cycles. Durability will be evaluated.

-Radiant barrier will also be incorporated.

-Testing will be conducted this winter at CRTC

Major Collaborations: US Army ManTech Office – Provided funding for liner development, OSD Operational Energy Plans & Programs Office - Providing funding for conducting full scale testing, PM Force Sustainment Systems- Transition Partner

Shelter Radiant Heating System (SRHS)



Power Distribution

Thermostat

Test bed @ BCIL, Ft. Devens, MA

Purpose: To reduce the energy required to power shelter heating systems, which in turn would reduce the logistical burden of fuel resupply. This effort focuses on the design, development and maturation of a radiant floor heating system that would efficiently heat an Airbeam shelter in cold weather climates, either replacing or in addition to current Environmental Control Units (ECUs). The introduction of energy efficient Positive Temperature Coefficient (PTC) technology has allowed electrical resistance radiant heating to be used instead of the traditional bulky hydronic systems.

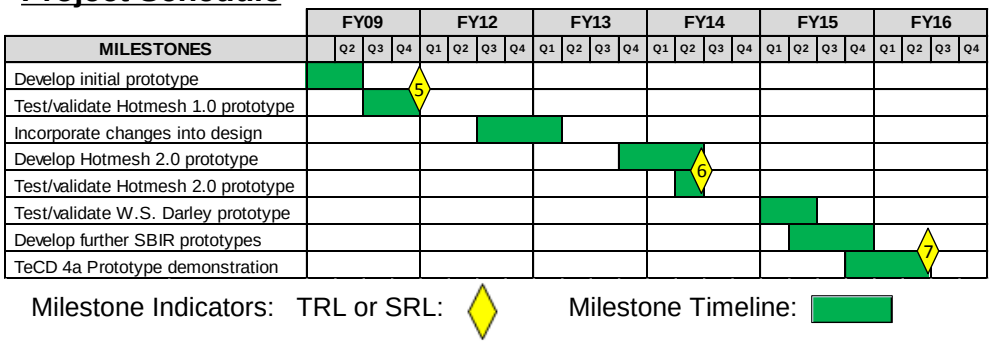
Results/Products:

- Design and manufacturing process that is financially feasible and proficient.
- Energy efficient radiant floor heating system prototype(s) that are lightweight, deployable, portable and durable.
- Integrated safety measures to mitigate concerns regarding potential shock hazards (impermeable encapsulating material and an ultra-sensitive “smart” breaker system).
- Zone temperature control to increase inhabitant personal space comfort.

Payoff:

- Reduced fuel transport requirements due to 25% energy reduction.
- 100% silent environmental control of shelter interior.
- Increased soldier comfort levels by eliminating hot spots created by forced hot air heating systems.
- Significant reduction of the logistical burden associated with cumbersome ECUs and ducting.
- Quicker deployment of basecamps in cold climates.
- Transition to Product Manager – Force Sustainment Systems (PdM-FSS) and Force Provider, Future Medical Shelter System and Joint Expeditionary Collective Protection

Project Schedule



Self Sustaining Living Module - SLiM

What is the Problem?:
Current base camp infrastructure and equipment cannot be readily deployed and is not easily transportable – especially for remote operations within austere environments at the squad and platoon level. There is a desire to provide greater quality of life and habitation/hygiene capabilities to the Warfighter stationed at small intermediate patrol bases and Assembly Areas.

Impact on warfighter:
Increased transportability of sheltering/life support capabilities, decreased energy consumption and logistics burden, increased mission readiness and soldier quality of life

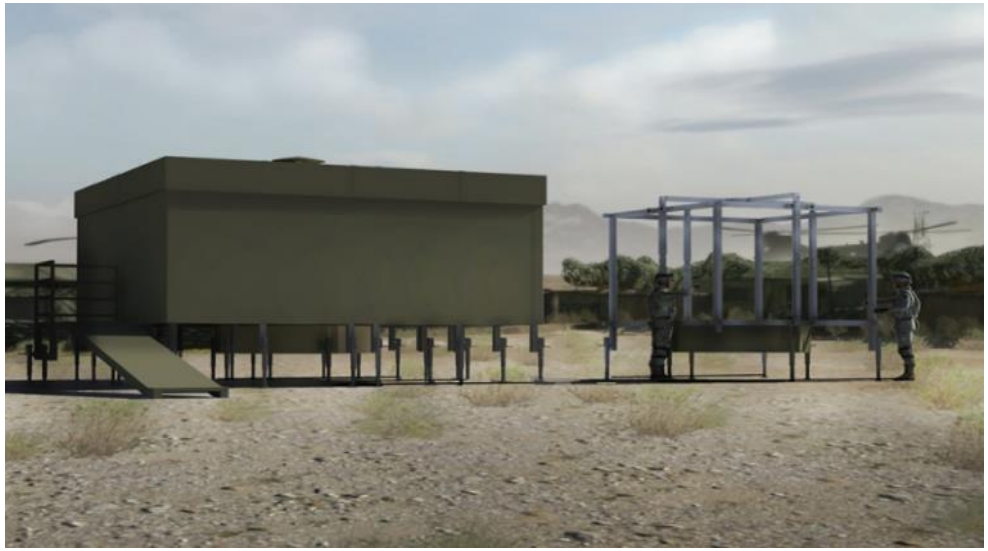
Technical Landscape:
- High energy efficiency shelter system (anticipated structural R-value >20)
- Modular, build-on-site, 100% man-portable (excluding the current 10K generator)
- Energy and water harvesting
- Includes HVAC, billeting/lighting/mission planning

Effort Accomplishments:

One full scale prototype of the SLiM billeting module has been delivered and will be tested at NSRDEC throughout the fall/winter (2015/2016). Prototype system is fully functional and includes a microgrid system. Currently seeking funding to develop/fabricate the hygiene module.

Major Collaborations: Rapid Innovation Fund Office – Provided funding for system development. Tracked technology by the SLB-STO-D. PM Force Sustainment Systems & MSCoE Endorsed effort through SLB-STO-D (TTA). CASCOM TTA. Looking for customer to fund the development of Hygiene Module.

SLiM



Conceptual Rendering of FieldUse and Assembly

Wall Interior Layout

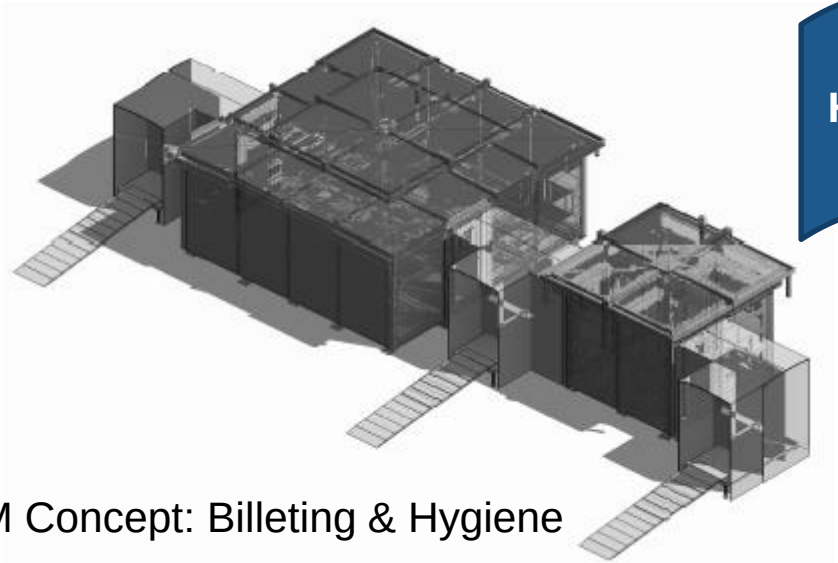
Vacuum insulated panel, Polyfoam, Fiber Reinforced Polymer exterior

Schedule & Cost

MILESTONES	FY12	FY13	FY14	FY15
Concept Design & Breadboard Model				
Design Refinement				
Fabrication and Integration of Technologies				
Full System Validation and Review				
TeCD 4a Demonstration				6

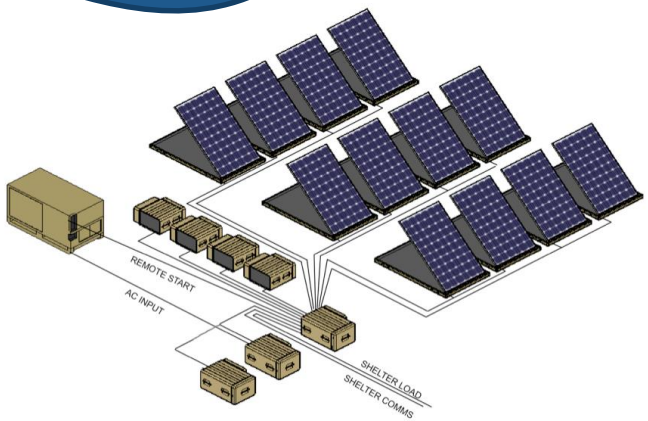
Milestone Indicators: TRL or SRL: Milestone Timeline:

SLiM Major Components

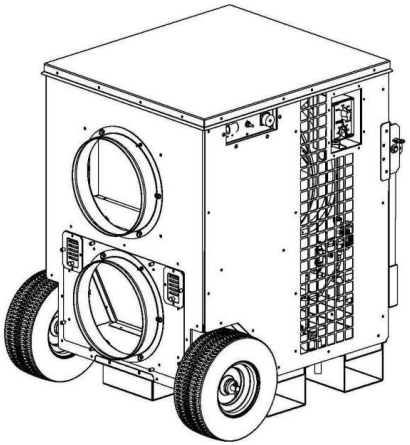


SLiM Concept: Billeting & Hygiene

Hygiene Module has not yet been fabricated!!



Zerobase Microgrid



Nordic ECU (HDT) 18K BTU

SHC – 35K BTU (HDT)

MInimized Logistics Habitat UniT (MiLHUT)




Schedule

MILESTONES	FY14	FY15	FY16
Requirements Definition			
Component Selection			
System Design & Analysis			
Gen I Protoype Fab & Eval			
Support To USG Test & Trials	5		
Gen II Protoype Fab & Eval			
Support To USG Test & Trials			6
Contract Modification			
TOTAL PE/Project			

Milestone Indicators: TRL or SRL: ◆ Milestone Timeline: ▬

Purpose: Develop a self-sufficient habitation unit for platoon-sized deployments. System shall provide immediate hygiene and habitation functionality with little to no setup and assembly. In addition, MILHUT aims to reduce the reliance on fuel and water resupply, while providing 100% remediation of all waste generated by the system. A byproduct of this system is enhanced welfare and morale, thereby increasing Warfighter mission readiness.

Background: Advanced through NSRDEC 6.2 S&T and follow-on Rapid Innovation Fund (RIF) investment with Industry partner Technical Products, Inc., Sterling, MA

Products:

- 3 x TRICON-based system that pairs with a 32ft Airbeam shelter, supporting 20 persons
- System exhibits water reuse, total waste stream incineration, and 100% self-sufficient operation
- Energy from: 44kWh battery bank, 10kW solar array, 10kW generator, and grid-tie capable
- HVAC provided by pre-installed evaporative cooler (high efficiency), Rankine cycle AC, and fuel-fired forced hot air
- Smart user interface for monitoring and control

MInimized Logistics Habitat UniT (MiLHUT)

Questions?