OBJECTIVES

Develop techniques for integrating optical fiber sensors in composite restraint layers to monitor structural properties; Develop techniques for integrating CNT-graphene piezoresistive sensors into the outer layers of space habitat structure for impact detection; Fabricate a small-scale inflatable test article; Demonstrate ability to sense strain and impact events; Develop commercialization strategy and Phase II plans.

ACCOMPLISHMENTS

NOTABLE DELIVERABLES PROVIDED
An inflatable structure was fabricated in the style of inflatable space habitats
Integration techniques were determined for fiber optic and piezoresistive sensors
Damage detection was successfully performed with integrated fiber optic sensors in the Kevlar straps of the restraint layer of the inflatable prototype
Carbon nanotube (CNT)-Graphene piezoresistive patch sensors detected dynamic impact events and static damage percentages

KEY MILESTONES MET
Proved the feasibility of high-definition fiber optic sensing (HD-FOS) for structural health monitoring (SHM) of inflatable restraint layers made of Kevlar or Vectran straps
Proved the feasibility of impact detection in inflatable soft-good shielding layers using piezoresistive patches

FUTURE PLANNED DEVELOPMENTS

PLANNED POST-PHASE II PARTNERS
Luna plans to team with industry leaders in inflatable space habitat development, such as Bigelow Aerospace. Relationships developed during Phase II could lead to ongoing commercialization relationships with ILC Dover and Bally Ribbon Mills.

PLANNED/POSSIBLE MISSION INFUSION
From the NASA roadmap “12.2.1.6 Lander and Surface Habitat” is prime mission for insertion. Developed sensors could provide integrated SHM for future Design Reference Missions (DRM) to lunar surface, Mars moons, Mars orbit, and surface of Mars. These missions have a “technology need” date of 2021 or 2027, which should be attainable with this technology.

PLANNED/POSSIBLE COMMERCIALIZATION
Luna will pursue commercialization of the integrated SHM sensors for inclusion in future space habitat mission. In addition, terrestrial applications like SHM for inflatable tunnel plugs and the development of “smart straps” that can sense their load and health will also be pursued.

CONTRACT (CENTER) NNX16CJ43P (JSC) SOLICITATION-PHASE SBIR 2016-I

SUBTOPIC H5.03 Multifunctional Materials and Structures: Integrated Structural Health Monitoring for Long

SOLICITATION-PHASE TA 12.2.3 Reliability and Sustainment

TRL 1 2 3 4 5 6 7 8 9 IN OUT