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## Quest wins NASA contract for Phase II work on Wrapped MLI

Quest Thermal Group, having proven feasibility of their proprietary advanced Wrapped MLI (WMLI) insulation system for cryogenic feedlines, was awarded a two year SBIR Phase II contract to continue development and testing of WMLI. Phase II efforts will develop a new micromolded spacer specifically for wrapping piping, optimize the spacer and wrap geometries, develop new methods to install WMLI on complex tubing, and build and test WMLI as Vacuum Jacket Pipe insulation for Ground Support Equipment.



**NASA SBIR/STTR Technologies**  
Wrapped-MLI: Thermal Insulation for Cryogenic Feed



Lines

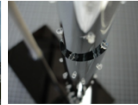
PI: Scott Dye, Quest Thermal Group, NNX10RA57P  
SBIR Phase II Proposal

### Identification and Significance of Innovation:

- New NASA vehicles (EDS, Orion, landers & orbiting fuel depots) need improved cryogenic propellant transfer & storage for long duration missions
- Current feed line Multi-Layer Insulation (MLI) performance is 10X worse per area than tank MLI insulation
- 40 – 50% of LH<sub>2</sub> is lost during a shuttle launch, about 150,000 gallons of LH<sub>2</sub> boils off during transfer, chill down & ground hold
- Wrapped-MLI (wMLI) is a high performance multilayer insulation designed for cryogenic piping that uses Quest's innovative discrete spacer technology to control layer spacing/density and reduce heat leak
- wMLI can provide 4X better thermal insulation than spiral-wrapped conventional MLI cryogenic piping insulation
- wMLI pipe blanket had a measured heat leak of 7.3 W/m<sup>2</sup> (5 layers, 0.4", 77K cold, 295K hot), or 27% of the heat leak of spiral wrapped conventional MLI with a heat leak of 26.6 W/m<sup>2</sup>
- wMLI could be the basis of improved cryogen transfer lines and Vacuum Insulated Pipe, & help provide improved cryogen fluid transfers



Images above show Wrapped MLI. Image left: wMLI prototype on test fixture. Below left: wMLI assembly fixture. Below right: layer spacing controlled by discrete spacers, good layer separation visible.



**Expected TRL at the end of Phase II Contract:** TRL6

### Technical Objectives and Work Plan:

- Design and develop a custom, molded polymer spacer
- Further develop assembly and installation processes
- Develop and test wMLI for 3 different piping diameters
- Conduct testing to optimize spacer and wrap geometries
- Perform thermal testing on 12 different wMLI test configurations
- Perform thermal testing on advanced 'clam-shell' netting MLI
- Design, develop and test wMLI in a Vacuum Insulated Pipe prototype for application in Ground Support Equipment

### NASA applications:

- Cryogenic propellant piping insulation for NASA vehicles, including EDS, Orion, cryo landers, cryo upper stage launch vehicles, orbiting fuel depots
- Cryogenic piping insulation for Ground Support Equipment for launch facilities, launch vehicles, cryogenic upper stages, LH<sub>2</sub> powered aircraft

### Non-NASA applications:

- Ground Support Equipment for commercial launch facilities and cryogenic upper stage launch vehicles such as Atlas and Delta IV
- Cryogenic fluid handling piping such as Vacuum Insulated Pipe
- Insulated cryogenic hoses for cryogen transfers to/from cryogenic dewars & tanks for research, medical and industrial uses.
- LN<sub>2</sub> handling applications for food & beverage for inerting and pressurizing
- LNG industrial insulated transfer pipes

### Contacts:

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