Department of the Navy SBIR/STTR Transition Program

WHEN

Contract Number: N68335-18-C-0013  Ending on: March 20, 2019

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Risk Level</th>
<th>Measure of Success</th>
<th>Ending TRL</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proof of concept demonstrated in Phase I</td>
<td>N/A</td>
<td>Achieved same or lower void volume % when compared to panels fabricated with DVD process</td>
<td>4</td>
<td>November 2016</td>
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<tr>
<td>Technology demonstrated with legacy repair materials</td>
<td>Med</td>
<td>Achieve same or lower void volume % than panels fabricated with legacy DVD tooling and process</td>
<td>4</td>
<td>November 2018</td>
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<tr>
<td>Technology demonstrated at Navy Depot</td>
<td>Med</td>
<td>Same or lower void volume % for Navy repair patch without need of DVD tooling</td>
<td>5</td>
<td>March 2019</td>
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<tr>
<td>If Phase II Option exercised, sub component repair and evaluation</td>
<td>Med</td>
<td>Equivalent or improved void volume percentage and mechanical strength when compared to identical component fabricated using DVD process</td>
<td>6</td>
<td>September 2019</td>
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<tr>
<td>If Phase II Option exercised, equivalency testing and full scale component repair and evaluation</td>
<td>Med</td>
<td>Equivalent or improved coupon mechanical properties and equivalent or improved component mechanical properties and equivalent or improved component mechanical strength</td>
<td>7</td>
<td>January 2021</td>
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WHAT

Operational Need and Improvement:
- Aerospace flush repairs require machining tapered cavity to remove damage, followed by bonding of mating (scarf) composite patch
- Double Vacuum Debulk (DVD) processes is currently utilized to fabricate patch for wet-resin composite repair
- DVD process requires special tooling, limits the size of the repair, is overly complicated and expensive, and creates logistical challenges when repairs are needed on aircraft in small detachments
- A repair process is desired that provides repair patches of the same or better quality [to current], but minimizes required support equipment and is less labor intensive

Specifications Required:
- Bonded repairs, requiring no additional support equipment, in uncontrolled environments
- Max patch preparation and cure time <8 h, with target of <4 h
- Repair patches of at least 15” x 15” and ≥ 0.120 in thick
- Porosity < 4% with Luna target of < 2%
- Complex curvature and shapes with radius of curvature ≤ 4 in
- Vertical or horizontal orientations; laminate and sandwich panel configurations

Technology Developed:
- For rapid technology insertion, Luna’s approach utilizes baseline composite repair materials with innovative process
- Luna’s single bag process uses a Breathable Resin Barrier (BRB) which permits air permeability but prevents resin penetration
- Air is continually evacuated over the entire surface of the laminate and uniform vacuum compaction pressure achieved
- Single simple vacuum bag fabrication yields low void/high-quality composite parts

Warfighter Value:
Luna’s BRB and single vacuum bag repair process eliminates special tooling, simplifies set-up, removes size restrictions, and can reduce repair time by more than 50%

HOW

Projected Business Model: Luna intends to manufacture via a toll producer or license the technology to a specialty fabric or composite fabrication material supplier or developer to DoD platform integrators. Luna will provide technical assistance and production scale-up support.

Company Objectives: Luna seeks partnerships with DoD Prime integrators and composite fabrication material suppliers for dem/val assessment of the technology as applied to both out of autoclave composite repair and component fabrication for aircraft, ships, and/or ground vehicles.

Potential Commercial Applications: The initial focus of this program will be on the development of an efficient and effective method for rapid, on-site repair of composite aerospace structures for the Navy. The technology will be directly implementable to Navy and other Department of Defense platforms which utilize composite materials. However, the impact on the broad composite commercial market could be enormous. The technology is applicable to virtually every industry where composites are utilized as it covers a wide range of composite material systems, fabrication processes, and applications. It is anticipated that an advanced breathable resin barrier will be developed to produce high-quality composite materials from simple vacuum bag fabrication processes. This will enable the escape of air and reaction gasses while maintaining uniform compaction force to eliminate voids and processing imperfections without the need of specialized and size limiting tooling. The technology will have extreme impact for out of autoclave fabrication methods, although it will be of benefit to autoclave processing as well. The use of these systems will provide economical composite manufacturing and repair options by reducing fabrication costs and increasing production capabilities.

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