

DHS Science and Technology Directorate

Multifunctional Textiles for Advanced Personal Protective Equipment

Partnership with industry increases protective performance of first responder duty uniforms

The need for clothing and equipment that provides protection against “all hazards in an unpredictable response environment” was identified in the [Project Responder 3](#) report funded by the Department of Homeland Security Science and Technology Directorate (S&T) and the Federal Emergency Management Agency.

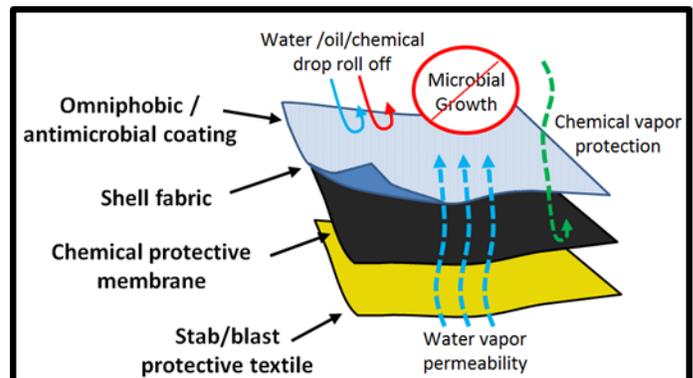
First responders often encounter unanticipated situations with unknown threats while wearing only their normal duty uniforms, which do not provide protection against atypical threats. First responders require a multi-threat base protective ensemble that can be worn as a normal duty uniform (i.e., “base ensemble”). In addition, it must be compatible with the specialized protective garments required to meet the needs of specific public safety disciplines (e.g., firefighting, law enforcement, EMS, etc.). Some specialties (e.g., explosive ordnance disposal, hazardous material response, etc.) will require a different level of performance and protection than this base ensemble system provides.

Currently no base ensembles meet this capability gap.

Developing a multifunctional textile system to protect first responders

S&T partnered with Luna Innovations and their manufacturing partner Vertical Source, Inc. to develop a lightweight base ensemble that can be worn daily and is capable of providing protection against multiple hazards for a limited period of time. The multilayer textile system consists of:

- a fluid-resistant textile treatment to repel water, chemicals and bodily fluids;
- an antimicrobial textile treatment to protect against a range of bacteria;
- a flame resistant textile layer;
- a chemical protective membrane; and
- a rip/tear protection layer.



Layering of various textile materials will offer first responders increased protection and comfort over current base ensemble.

Multiple layering arrangements were explored and utilized for the various material technologies to develop the optimal strategy to provide the greatest benefit in terms of protection and comfort to the first responder.

The best performing multifunctional textile arrangements were selected and optimized for performance. Testing was conducted for comfort, repellency, durability, strength, flame resistance, puncture resistance, chemical permeation and general wear and tear.

Input from S&T’s First Responder Resource Group influenced the design of the duty uniform. The fabrics developed were used to manufacture prototype first responder uniforms for system level wear testing.

Novel textiles and garment design will impact first responder safety

Development work for this project was completed in January 2018. A total of 250 certified prototype garments were delivered to S&T for operational wear testing and evaluation by responders, including international responders from the United Kingdom and Canada. The prototype garments are certified to the National Fire Protection Association 1975 Standard on Emergency Services Work Clothing Elements, 2014 Edition. Field testing is anticipated to begin in early FY 2018. Feedback from the field testing will be provided to Luna and Vertical Sources before commercialization.