BACKGROUND

- Natick Soldier Research and Development and Engineering Center (NSRDEC) is working to improve protective capability of CB garments while reducing thermal burden for the wearer and providing military utility. Material technologies are making significant gains in improving thermal burden reduction and protective performance but gains are not always being realized at the system level due to insufficient garment design. The importance of CB garment design has been highlighted in recent efforts conducted by NSRDEC to include Integrated Protective Fabric Systems (IPFS) CBLITE garments, IPFS garment hood improvements, and, most recently Tactical All Hazards Ensemble (TacHazE). Material usage and placement, interfaces with other protective items, and design features impact both the protection and thermal performance of a garment system.

- NSRDEC’s chemical biological garment design Science & Technology efforts aim to improve protective capability of garments while reducing thermal burden for the Warfighter. Material technologies are making significant gains in improving thermal burden reduction and protective performance but gains are not always being realized at the system level because materials alone do not drive performance; overall garment system design to include fit, closures, interfaces, and material placement contribute to performance.

IMPROVE PROTECTION: INTERFACE DESIGN OF IPFS GARMENTS

- System Level Vapor Protection: Secondary layer at interface improved protection by creating a tortuous path. Soft stretchy material at interface conformed to body contours and adapted to movement.
- System Level Aerosol Protection: Integrated Hood/ Mask Design improved protection.
- Separate, Detachable Hood: Some users prefer a hood that is detachable from the CB garment. Detachable hoods can offer same aerosol protection as attached hood if neckline is addressed.

ACKNOWLEDGEMENTS

We thank DTRA/STO-CBD for their continued support of the IPFS and TacHazE programs. We thank our partners in this work: TexShield, Priority Designs, Research Triangle Institute, Ultratech, ECBC, Tennier, W.L. Gore, Kokatat, International Textile Group, Sledfast, Caligon.

TABLE 1: THERMAL MANIKIN RESULTS (BASELINE)

| Thermal Manikin Results | Total thermal performance: Experimental garment very close to standard duty combat uniform in thermal performance |

<table>
<thead>
<tr>
<th>MOPP 1 (Stationary, 0.4 m/s)</th>
<th>MOPP 2 (Articulated, 2.0 m/s)</th>
<th>Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cid</td>
<td>sid</td>
<td>cid</td>
</tr>
<tr>
<td>1.65</td>
<td>0.25</td>
<td>NT</td>
</tr>
<tr>
<td>1.53</td>
<td>0.34</td>
<td>0.90</td>
</tr>
<tr>
<td>1.57</td>
<td>0.22</td>
<td>0.93</td>
</tr>
<tr>
<td>2.53</td>
<td>0.15</td>
<td>NT</td>
</tr>
</tbody>
</table>

* worn with CB protective gloves, mask and boots

PROVIDE MILITARY UTILITY, HIGHER LEVEL OF PROTECTION: TACTICAL ALL HAZARDS ENSEMBLE (TacHazE)

- Military utility is possible by reducing footprint of garment:
  - Conformal design, enabled by stretch material and additional seams
  - Protection for wearer separate from protection for respiratory system

- Garment required to integrate with multiple subsystems:
  - Microclimate Cooling System
  - Full Spectrum Respiratory Protection System
  - Physiological status monitoring
  - Hydration system
  - All carried or worn equipment
  - Protective gloves and boots