

**REPORT DOCUMENTATION PAGE**

Form Approved  
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.  
**PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

<b>1. REPORT DATE (DD-MM-YYYY)</b> 18-05-2021		<b>2. REPORT TYPE</b> SUMMARY REPORT		<b>3. DATES COVERED (From - To)</b> 2020-08-17 TO 2021-05-18	
<b>4. TITLE AND SUBTITLE</b> ACTIVE BLAST MITIGATION SYSTEM (ABMS) INTEGRATION TECHNOLOGY ADVANCEMENT SBIR PHASE I PROJECT SUMMARY				<b>5a. CONTRACT NUMBER</b> W56HZV20C0081	
				<b>5b. GRANT NUMBER</b> N/A	
				<b>5c. PROGRAM ELEMENT NUMBER</b> N/A	
<b>6. AUTHOR(S)</b> SCHULTZ, JESSE C SWARTZWELTER, SCOTT R				<b>5d. PROJECT NUMBER</b> N/A	
				<b>5e. TASK NUMBER</b> N/A	
				<b>5f. WORK UNIT NUMBER</b> N/A	
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> DEFENSE ENGINEERING SERVICES 4447 DORCHESTER ROAD, SUITE 100 NORTH CHARLESTON, SC 29405				<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b> SBIR W56HZV-20-C-0081 - SUMMARY	
<b>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b> US ARMY CONTRACTING COMMAND TACOM CONTRACTING CENTER 6501 EAST 11 MILE ROAD WARREN, MI 48397-5000				<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b> FCDD-GVR-GVSP-PDT / MS-263	
				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b> CLIN 0002	
<b>12. DISTRIBUTION/AVAILABILITY STATEMENT</b> A - UNLIMITED FOR PUBLIC RELEASE					
<b>13. SUPPLEMENTARY NOTES</b> N/A					
<b>14. ABSTRACT</b> DES has developed and evaluated the Active Blast Mitigation System (ABMS) integration design to the highest reasonable level of fidelity at the generic vehicle level to prove its viability and practicality moving forward into detailed, target vehicle platform-specific design in Phase II. This includes: the optimization of Tencate Active Blast Defeat System (ABDS) unit placement on the provided generic vehicle model to maximize vehicle occupant survivability; design of an interface mounting system to withstand both activation of the ABDS countermeasures and shock/vibration load; and physical prototyping and subsystem testing to validate analytical models and inform hardware selection.					
<b>15. SUBJECT TERMS</b> Active Blast Mitigation System, Active Blast Defeat System, ABMS, ABDS, Integration, Countermeasures, Survivability, Prototyping, Shock, Vibration					
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>	<b>18. NUMBER OF PAGES</b>	<b>19a. NAME OF RESPONSIBLE PERSON</b>
<b>a. REPORT</b>	<b>b. ABSTRACT</b>	<b>c. THIS PAGE</b>			JESSE SCHULTZ
U	U	U	UU	3	<b>19b. TELEPHONE NUMBER (Include area code)</b> (843) 814-6345

SBIR W56HZV-20-C-0081  
Active Blast Mitigation System (ABMS)  
Integration Technology Advancement  
SBIR Phase I Project Summary Report  
CLIN 0002

18 May 2021

*Jesse Schultz, Principal Investigator*  
*Defense Engineering Services*  
*4447 Dorchester Rd*  
*Suite 100*  
*North Charleston, SC 29405*  
*(843) 814-6345*  
[jesse.schultz@defengserv.com](mailto:jesse.schultz@defengserv.com)

## 1. Phase I Results

Defense Engineering Services (DES) successfully completed the Phase I goals and requirements in the integration of the Active Blast Mitigation System (ABMS) onto real-world vehicle platforms during the execution of this Small Business Innovation Research (SBIR) project. This includes:

1. Partnering with TenCate Advanced Armor to leverage past experience and analysis expertise to optimize placement of their Active Blast Defeat System (ABDS) units on the Government-furnished generic vehicle model to maximize vehicle occupant survivability.
2. Design and detailed analysis of an interface mounting system to withstand both activation of the ABDS countermeasures and shock/vibration loads during normal vehicle operation.
3. Physical prototyping and subsystem testing to validate analytical models and inform hardware selection.
4. Ballistic shot line analysis to ensure ABMS integration does not degrade occupant survivability from direct kinetic energy (KE) threats.

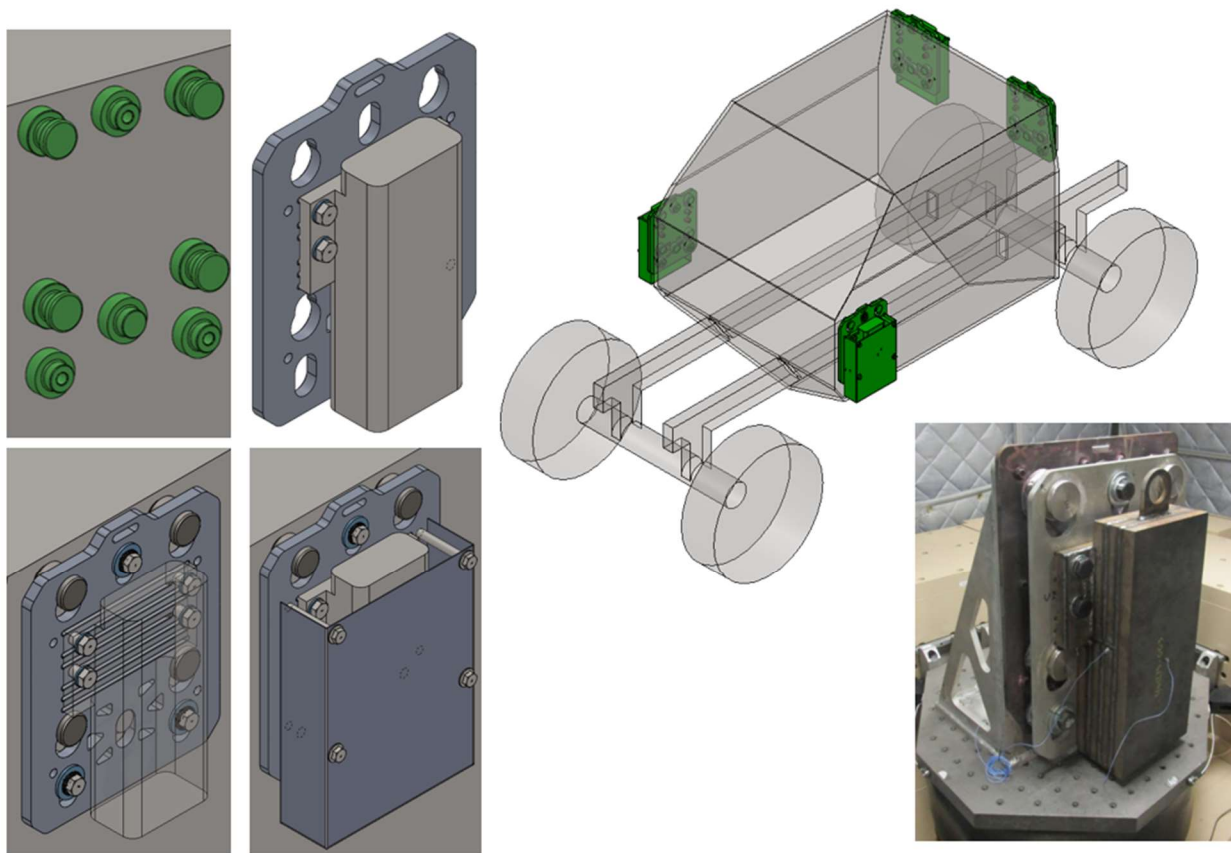


Figure 1: ABMS Integration Design Overview - Single Unit (left), Vehicle Placement (middle), Prototype Testing (right)

## 2. Phase I Technology Developed

The DES design mounts four (4) individual ABDS units to the vehicle, at the positions shown in Figure 1. DES chose these locations for ABMS integration to minimize system impacts on a specific target vehicle platform. The design adds a total of only 1285lbs. to the generic vehicle, including the ABDS units, with a minimal shift of the vehicle Center of Gravity (CG).

DES put heavy consideration of the installation setting and process into the design of the ABMS integration design. DES, the Contracting Officer’s Representative (COR), and Program Office representatives agreed that the most likely setting for ABMS integration is a depot-type facility, allowing for limited hot work (e.g. welding) and all necessary installation tools (e.g. hand & power tools, lifting equipment). The boss and interface plate design makes efficient use of this setting and allows for simple installation with minimal manual alignment.

After baseline vehicle de-integration and welding of the mounting bosses to the cab, the simple installation process can be completed in a short amount of time by two personnel with lift assist or a three-person lift without lift assist. The mounting bosses carry the weight of the ABDS unit during assembly and allow personnel to be “hands off” after initial placement.

### 3. Applications & Benefits

Shown in Table 1, extensive Underbody Improvised Explosive Device (UBIED) multiphysics simulations predict that the generic vehicle with ABMS improves occupant survivability up to 58% over baseline, depending on threat location, survivability metric, and occupant placement. Finite element analyses on new ABMS integration hardware ensured their structural integrity throughout the duration of a UBIED event and ABDS activation.

Table 1: ABMS Integration UBIED Survivability Improvements

	Percentage Improvement over Baseline	
	Driver Impact	Front Wheel Impact
	ABDS Improvement (%)	ABDS Improvement (%)
Rough Steady State Seat Velocity	58	29
Displacement at 100ms	46	26
Peak Lumbar	25	8
Lumbar Duration at 3,800kN	5	47
Tibia Peak	18	55
Seat Stroke	52	29

DES also analyzed, prototyped, and tested the ABMS integration design against the composite wheeled vehicle random vibration power spectral density (PSD) curve specified by applicable standards. Results show an infinite cycle life of ABMS integration components during normal vehicle operation. This was validated by physical shaker table testing on prototype hardware.

### 4. Anticipated Customer

DES developed and evaluated the ABMS integration design to the highest reasonable level of fidelity at the generic vehicle level. Phase II will take the proven design approach from Phase I and tailor it to any targeted vehicle platform chosen. The open-architecture nature of the design allows it to be easily adapted to a wide range of potential platforms from light to medium ground vehicles within any branch of the US Armed Forces.

### 5. Transition of Technology to Customer

DES will work with the COR and US Government Program Offices during the execution of Phases II and III of this SBIR to transition the developed technology. Phase III will provide a Level 3 Technical Data Package (TDP) adapted to specific vehicle platforms that can go into full rate production.