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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)							DATE February 2000		
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology					
COST (In Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	58706	130525	148114	117403	189498	199930	166801	Continuing	Continuing
DC62 DC62	16198	0	0	0	0	0	0	0	16198
DC66 DC66	0	960	2835	4723	2631	999	1028	Continuing	Continuing
D221 Combat Vehicle Survivability	681	20440	28322	25726	19293	21535	9890	Continuing	Continuing
D440 Advanced Combat Vehicle Technology	23134	60956	104719	72380	146540	161052	150929	Continuing	Continuing
D441 Combat Vehicle Mobility Technology	4655	8091	7479	4699	5949	2951	0	0	33824
D497 Combat Vehicle Electronics	7006	5747	2997	5594	6225	5871	0	0	33440
D502 HAECO II	772	5885	0	0	0	0	0	0	6657
D506 Aluminum Metal Matrix Composite (NAC)	3853	6866	0	0	0	0	0	0	10719
D507 PLS Commercial Engine (NAC)	2407	0	0	0	0	0	0	0	2407
D515 Robotic Ground Systems	0	0	1762	4281	8860	7522	4954	Continuing	Continuing
D532 Abrams Engine	0	4905	0	0	0	0	0	0	4905
D533 Technology Transfer Center	0	7847	0	0	0	0	0	0	7847
D539 Mobile Parts Hospital	0	2943	0	0	0	0	0	0	2943
D540 Improved HMMWV Research	0	5885	0	0	0	0	0	0	5885

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BUDGET ACTIVITY
3 - Advanced Technology Development

PE NUMBER AND TITLE
**0603005A Combat Vehicle and Automotive
Advanced Technology**

A. Mission Description and Budget Item Justification: The Army's new vision calls for strategic dominance across the entire spectrum of operations. This spectrum of likely operations describes the need for a force that is deployable, agile, versatile, lethal, survivable and sustainable. Three Major efforts provide technologies to achieve this vision: Future Combat Systems (FCS), the Army's top priority S&T program; Future Scout and Cavalry System (FSCS) Advanced Technology Demonstration (ATD), which provides multiple advanced technologies that are essential to the success of FCS; and Active Protection Systems (APS), which have been strongly endorsed by the Army Science Board in a 1999 Summer Study on "Full Spectrum Protection for 2025- era Ground Vehicles." Technology Areas supported by this PE include: vehicle survivability, mobility, intra-vehicular digital electronics, and integration of diverse vehicle technologies developed by the Army, other DoD laboratories and industry. These technologies are demonstrated to and experimented by various Army warfighter organizations through a series of vehicle component and system level technology demonstrations. This program is managed primarily by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI. This program adheres to Tri-Service Reliance Agreements on advanced materials; fuels and lubricants; and ground vehicles; with oversight and coordination provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with PE 0602601A (Combat Vehicle and Automotive Technology) and contains no unwarranted duplication of effort among the Military Departments. Furthermore, the project is coordinated with the Marine Corps office through the Naval Surface Warfare Center; the Naval Research Lab; Air Force Armaments Command; and with other ground vehicle developers within the Departments of Energy, Commerce, Transportation, and the Defense Advanced Research Projects Agency (DARPA).

B. Program Change Summary	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget (FY 2000/2001 PB)	61300	90941	97200
Appropriated Value	61735	131941	
Adjustments to Appropriated Value			
a. Congressional General Reductions	-435		
b. SBIR / STTR	-1455		
c. Omnibus or Other Above Threshold Reductions	-246	-511	
d. Below Threshold Reprogramming	-893		
e. Rescissions		-905	
Adjustments to Budget Years Since FY 2000/2001 PB			+4914
New Army Transformation Adjustment		TBD	+46000
Current Budget Submit (FY 2001 PB)	58706	130525	148114

Change Summary Explanation: Funding: FY 2001 – The 4914 increase reflects a funding restructure of a classified program (+1900), an increase for FSCS (+3850), and other minor adjustments (-836). Projects 221 and 440 were adjusted (+46000) to reflect the New Army Transformation.

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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D221		
<i>COST (In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
D221 Combat Vehicle Survivability	681	20440	28322	25726	19293	21535	9890	Continuing	Continuing	
<p>Mission Description and Justification: This project derives the technology needed to transform the Army into a survivable force. Advanced technologies for APS that provide protection against ground combat vehicles (e.g., smart, precision guided and other munitions) will be integrated and demonstrated. Active Protection efforts will be focused on demonstrating the necessary threat sensors, software algorithms, and hard kill countermeasures needed for an APS that is initially effective against Chemical Energy (CE) munitions (e.g., shaped charge warheads) and top attack munitions, with an ultimate goal of demonstrating an effective countermeasure against Kinetic Energy (KE) (i.e., long rod). Defeat of KE threats by an APS poses an especially difficult challenge due to the velocity, small cross section and robustness of the long rod penetrator. APS is viewed as having tremendous potential for providing enhanced protection of all combat vehicles and is an especially attractive solution for lightweight vehicle classes. Within this program, the Army has evaluated several competing approaches, one of which is a Congressionally directed fabrication/demonstration of a foreign vehicle self-protection system. Survivability technologies that are integrated and lab and field demonstrated under this project include those transitioned from the following exploratory developmental programs: active protection countermeasure technology development PE 0601102A (Defense Research Sciences)/ Project AH43 and BH57; sensors and countermeasures PE 0602270A (Electronic Warfare Technology)/ Project A442. Major contractors include: United Defense LP. of San Jose (prime), CA; Sanders, a Lockheed Martin Company in Nashua, NH.; TRW of Redondo Beach, CA.; Hughes Danbury, Danbury Conn.; General Dynamics Land Systems, Warren, MI.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 681 - Classified program support. <p>Total 681</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 1301 - In-house program office support for APS development and advanced technologies integration contract and matrix support team efforts. • 18279 - Demonstrate detailed design, and perform APS development and testing under contract with United Defense Limited Partnership (UDLP) <ul style="list-style-type: none"> - Complete critical drawings and demonstrate fabrication of advanced technologies and APS by contractor. - Conduct component integration of all sensors and countermeasures integrated electronically and tested in subcontractor subsystem systems integration laboratory (SIL). - Demonstrate vehicle system integration with all subsystems integrated on vehicle platform; integrate software into vehicle platform and check for functionality and safety; exercise overall system on contractor vehicle SIL. • 103 - Other government agency support. • 135 - Purchase threat munitions test assets. • 97 - Systems engineering support (Booz Allen Hamilton / ICRC Energy). 										
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology	PROJECT D221
<p>FY 2000 Planned Program: (continued)</p> <ul style="list-style-type: none"> • 525 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 20440</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 1441 - In-house program office support for APS development and advanced technologies integration contract and matrix support team. • 16495 - Continue Near Term APS development and testing of APS/advanced technologies under contract with UDLP; begin APS component integration. <ul style="list-style-type: none"> - Continue vehicle system integration and complete final in-shop checkout. - Perform system and subsystem performance testing with software safety and functionality test in field; perform emulation and simulation tests to incrementally exercise the system and test all functional attributes and debug software as necessary; perform live threat defeat to quantify system level performance; assess functional integration, sensor fusion, and countermeasure selection and performance. • 174 - Other government agency support. • 169 - Test support. • 99 - Systems engineering support (Booz Allen Hamilton / ICRC Energy). • 4972 - Funds will be used in support of the New Army Vision/Transformation. <ul style="list-style-type: none"> - This congressionally directed program demonstrates and assesses unique Full Spectrum Active Protection (FSAP) technologies to provide a single kill mechanism to defeat all classes of threats, focusing on KE defeat. - Develop FSAP concept to provide hemispherical protection against all threats for light, medium and heavy ground combat vehicles. • 4972 - Funds will be used in support of the New Army Vision/Transformation. <ul style="list-style-type: none"> - This congressionally directed program utilizes survivability optimization modeling to select signature technology suites and develop hardware integration concepts for emerging signature management technologies. - Conduct an initial test evaluation of emerging signature management technologies to quantify performance and burden levels. - Develop the design of signature management hardware for full scale performance and field test evaluation in FY02. <p>Total 28322</p>		
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000					
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D440				
COST (In Thousands)				FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D440 Advanced Combat Vehicle Technology				23134	60956	104719	72380	146540	161052	150929	Continuing	Continuing
<p>Mission Description and Justification: This project demonstrates the operational potential, technical feasibility and maturity of advanced combat vehicle technologies for potential product improvements to currently fielded and next generation combat vehicles. The objectives are to demonstrate innovative combat vehicle configurations, technologies and integration techniques through Integrated Product and Process Development (IPPD), yielding hardware technology demonstrations, computer simulations and full-scale demonstrations to accomplish a more rapid and seamless transition of advanced technologies to systems applications. All demonstrations include user and developer teaming in field and/or laboratory environments. The major near term initiative funded by this project is the FSCS ATD, which transitioned from applied research PE 0602601A (Combat Vehicle and Automotive Technology) to this project in FY98. This ATD integrates advanced technologies, including sensors, survivability, advanced mobility technologies and communications into a robust vehicle platform. The FSCS ATD will then undergo technical and user evaluations. The FSCS ATD is a joint United States/United Kingdom (US/UK) FSCS/Tactical Reconnaissance Armored Combat Equipment Requirement (TRACER) program. A Memorandum of Understanding (MOU) was signed in July 1998. The acquisition strategy for the ATD resulted in both countries funding equal shares of contracts awarded to two competitive US/UK consortia in January 1999. Both countries have harmonized the User Requirements. A joint three-star review is planned 24 months after contract award to review and approve the final operational trade-offs prior to finalizing the ATD design configuration. The two consortia are: SIKa Team (Lockheed Martin (Orlando, FL)/British Aerospace (UK) joint venture with General Dynamics Land Systems (Sterling Heights, MI), Vickers (UK), and Northrop Grumman (Baltimore, MD) as subcontractors); LANCER Team (GEC Marconi (UK) prime contractor with United Defense Limited Partnership (San Jose, CA), GKN Defense (UK) and Raytheon Systems (McKinney, TX) as subcontractors). As the FSCS ATD comes to an end in FY02, emphasis will shift to the FCS. The user experimentation completed under the FSCS ATD will be a major influencing factor in the contractors approach to FCS. The FSCS ATD retains strong support by the US Army and United Kingdom and remains fully funded through completion of the ATD in FY02. Technologies and lessons learned about integration of these technologies on a C-130 transportable platform are vitally important to reduce risk and accelerate development and fielding of the FCS. FSCS also provides options for enhancing the interim force with state-of-the-art platform (e.g., survivability, mobility, electronic architecture) and advanced sensor technologies. The FCS will demonstrate the capabilities of a system of systems network centric (vis a vis platform centered) force to perform in an environment requiring multi-functional, reconfigurable capabilities. It will provide an optimized simulation validated system integrating advanced technologies to maximize joint interoperability, strategic transportability and commonality of mission roles including direct and indirect fire, air defense, reconnaissance, troop transport, counter mobility, non-lethal and C2 on the move. Contracts for the concept designs phase are to be awarded in May 2000. In 2000 technology assessments and risk reduction activities will be initiated for selected high payoff activities.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 19261 - Conducted source selection and awarded FSCS ATD contracts to two US/UK consortia to complete FSCS preliminary design and interface control, began detailed design, began development of FSCS/TRACER vehicle concepts for engineering models, began development of FSCS ATD hardware and software, performed weapon systems trade-off studies and begin weapon systems development for FSCS/TRACER. - Transitioned the implementation of vehicle electronics (VETRONICS) open systems architecture to the FSCS ATD contractors. 												
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<p>FY 1999 Accomplishments: (continued)</p> <ul style="list-style-type: none"> • 3873 - Began development of electronic interfaces between major subsystems of FSCS/TRACER (e.g., target acquisition, communication, crew control and displays, etc.) and incorporate sensor suite, crew station, and electronic interface into contractors design/SIL for FSCS ATD. • 3873 - Conducted system requirement analysis for Command, Control, Communications, Computers, and Intelligence (C4I) workload • 3873 - Initiated effort to implement simulation and modeling concepts to support FSCS ATD contractor efforts. • 3873 - Supported and participated in Government/contractor integrated product teams (IPTs). • 3873 - Developed model to enable Government and contractors to determine system cooling requirements given vehicle and propulsion system characteristics. <p>Total 23134</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 18719 - Evaluate the affordability of hardware and software alternatives and system concepts by both contractors. • 18719 - Complete sub-system and system trade studies to define cost effective hardware configurations by both contractors. • 18719 - Develop FSCS simulations and virtual prototypes by both contractors. • 18719 - Define software requirements by both contractors. • 26272 - Conduct Ministry of Defense/Department of Defense System Design Reviews • 26272 - Procure hardware and conduct fabrication of sub-system assemblies by both contractors. • 26272 - Design, procure and assemble SIL by both contractors. • 26272 - Demonstrate sub-system testing and evaluation by both contractors. • 26272 - Demonstrate analysis of survivability design alternatives by both contractors. • 5699 - Perform Cost as an Independent Variable (CAIV) analysis and trade studies. • 5699 - Complete analysis to support refinement of Combined Operational Requirements Document. • 5699 - Complete Cooperative Analysis of Alternatives (CAoA) to support 3-Star Review. • 5699 - Continue support and participation in Government/contractor IPTs. • 2898 - Continue modeling and simulation concepts in support of FSCS ATD contractor efforts. • 2898 - Investigate application of Joint Tactical Radio System (JTRS) to FSCS. • 2898 - This congressionally directed program initiates technology risk reduction activities for FCS with contractors/Award Contracts. • 2898 - Conduct development and installation SIL for FCS. • 2898 - Develop FCS software simulation and virtual environment for concept evaluation. • 2898 - Demonstrate FCS interface/capability of system and subsystem level components in a multimission environment. 		
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology	PROJECT D440
<p>FY 2000 Planned Program: (continued)</p> <ul style="list-style-type: none"> • 2898 - This congressionally directed program uses CAV composite technology as the base or level 1 survivability level to develop concepts for multiple levels of additional modular armor and integrated into advanced structures for FCS. Determine the resulting cost-benefit at the vehicle level. • 1572 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 60956</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 19108 - Complete all FSCS trade studies and finalize cost effective alternatives by both contractors. <ul style="list-style-type: none"> - Provide affordability data for US/UK 3-Star Affordability Review by both contractors. - Incorporate simulation and virtual prototyping results into their development process by both contractors. - Complete sub-system and SIL fabrication by both contractors. • 42465 - Perform FSCS demonstrator vehicle fabrication and integration by both contractors. <ul style="list-style-type: none"> - Fabricate and evaluate survivability designs by both contractors. - Complete sub-system test and evaluation by both contractors. - Conduct contractor system shakedown test and evaluation efforts by both contractors. • 7357 - Prepare and conduct FSCS 3-Star Affordability Review. <ul style="list-style-type: none"> - Prepare and release RFP for engineering and manufacturing development (EMD) phase. - Participate in contractor system and sub-system testing and evaluation. - Continue support and participation in Government/contractor IPTs. • 35789 - Funds will be used in support of FCS and the New Army Vision/Transformation. <ul style="list-style-type: none"> - Complete Installation of Simulation Lab - Demonstrate Use of and complete Architecture for Integrated Data Environment. - Demonstrate Use of SIL for Component Risk Reduction and Validation. - Design and Build Virtual Test Environment. - Demonstrate Virtual Test Environment . - Robotics Risk Reduction. <p>Total 104719</p>		
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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D441				
COST (In Thousands)				FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D441 Combat Vehicle Mobility Technology				4655	8091	7479	4699	5949	2951	0	0	33824
<p>Mission Description and Justification: This project demonstrates the mobility technologies (suspension , track, engines, transmissions, and auxiliaries) vital for lighter, agile, deployable, and more fuel efficient ground combat vehicles. It funds an advanced mobility technology demonstration comprised of several independent technologies. The principal elements of the mobility demonstrations in FY00 are active and semi-active suspension, electric drive, and lightweight track. Military requirements for vehicle mobility are unique because of (1) a need for a stable, smooth ride at high speeds (greater than 20 mph) over rough, cross country terrain, (2) a need for the mobility components to be as small and as light as to possible enable compact vehicle designs that are less vulnerable to detection, acquisition and attack by threat weapons, and (3) a need to protect vehicle subsystems under armor, which complicate the design of engine air intake and exhaust systems. High speed is required to accomplish the maneuver-dominant warfare envisioned in the Air-Land battle doctrine. A smooth ride is necessary for weapon targeting on the move and for crew endurance. The lighter and smaller vehicles are necessary for enhancing deployability and lessening the logistics burden (fuel), but lighter vehicles will have significantly lower ride performance and mobility limits without new mobility technology advances compared to larger, heavier vehicles. For the next decade, the mobility thrusts required to compensate for smaller and lighter systems are: electric drive (small internal propulsion size and weight), active suspension (increased vehicle stability and higher speed on rough terrain), compact efficient transmissions and lightweight track (reduced system weight and track noise). Electric drive offers unique new capabilities, such as high torque and quiet operation; however, it presents new challenges, especially in cooling of electronic components. Funding in this area is being leveraged through two joint Army/DARPA programs called the Combat Hybrid Power System (CHPS) and the Electric Drive Vehicle Demo Program. The latter program will transition to this Army project in FY00. The objective of the CHPS program is to design, develop and demonstrate, in a SIL, a robust electrical power architecture that can meet the requirements of future vehicles ranging from light tactical wheeled vehicles to close combat vehicles. In-house efforts are accomplished by TARDEC, Warren, MI and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Other government agencies include: Waterways Experiment Station, Vicksburg, MS; Army Research Laboratory, Adelphi MD. Major contractors include: General Dynamics Land Systems Muskegon Operations, Muskegon, MI; Pentastar Huntsville, AL; United Defense Limited Partnership, San Jose, CA; Michigan Technological University, Houghton MI; General Electric, Schenectady, NY; Cadillac Gage Textron, New Orleans, LA.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 3840 - In coordination with DARPA and ARL, tested and evaluated Silicon Carbide (SiC) power devices for motor drive controller. <ul style="list-style-type: none"> - Test preparations fielded for active suspension with preview sensor and algorithms underway. - Tracked tensioning system for medium combat vehicle application tested. - Developed lightweight, low maintenance band track for 25 ton combat vehicle. - Upgrades fabricated for compact high efficiency mechanical transmission laboratory evaluation. • 815 - In coordination with DARPA, integrated and tested 1st generation CHPS architecture components in a System Integration Laboratory (SIL). <p>Total 4655</p>												
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology	PROJECT D441
<p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 3294 - Configure and install on High Mobility Multi-Wheeled Vehicle (HMMWV) optimal preview sensor for active suspension. <ul style="list-style-type: none"> - Procure, install and evaluate compressible fluid suspension on HMMWV. - Select and evaluate electric drive components of the combat hybrid power system for installation on a mobility testbed. - Refine and demonstrate the design of SiC motor drive controller. - Fabricate and test lightweight band track for 25 ton vehicle. - Perform shakedown and performance testing of compact, high efficiency mechanical transmission in the lab. • 2687 - Transition the CHPS SIL and Virtual Prototype from DARPA to the Army/TARDEC. <ul style="list-style-type: none"> - Update the DARPA CHPS Virtual Prototype models based upon information obtained from SIL assessments. - Complete the DARPA CHPS program by demonstrating in the completed SIL the feasibility of a hybrid architecture. • 1950 - Begin integration of advanced components (high power/high energy pulse forming network, flywheel, high temperature/fast response converters and advanced high energy density batteries) in CHPS for assessment in the SIL. • 160 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 8091</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 2705 - Test and refine preview feature of an active suspension system. <ul style="list-style-type: none"> - Demonstrate and test components of the CHPS hardware on a mobility test bed. - Complete design of 2nd generation high efficiency transmission. - Fabricate turbocharger, high temperature tribology componentry, cold start system and fuel injection system for application to commercial diesel engines for combat vehicles. - Develop band track with enhanced mine resistant characteristics. • 3075 - Develop new system level and component level vehicle power requirements based on the next planned Army combat vehicle. <ul style="list-style-type: none"> - Allocate these requirements down to the vehicle hybrid electric power architecture. - Using the CHPS virtual prototype modeling tools, design vehicle-specific hybrid electric architecture. - Build advanced componentry reflecting FCS for incorporation into SIL architecture. • 1699 - Test advanced components (high power/high energy pulse forming network, flywheel, high temperature/fast response converters and advanced high energy density batteries) in CHPS for performance assessment in the SIL. <p>Total 7479</p>		
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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D497				
COST (In Thousands)				FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D497 Combat Vehicle Electronics				7006	5747	2997	5594	6225	5871	0	0	33440
<p>Mission Description and Justification: This project develops and demonstrates vehicle electronics hardware and software technologies that will yield increased crew efficiencies and performance, or reduced crew size, and advances open systems architectures for ground vehicle weapon systems. These technologies include: three-dimensional (3D) audio, voice recognition, headtrackers, advanced software architecture, reusable software Application Program Interface (API), embedded simulation, and indirect and semi-autonomous driving (using available robotics technologies). Investments are in embedded training, mission rehearsal, decision aids, automation of crew functions, and ergonomic crew station designs. The program will be conducted in three phases that continually build on advancing technologies into a mobile reduced crew testbed vehicle. The first phase will develop and integrate 3D audio, voice recognition, a commander's headtracker, and an initial open systems architecture/software API and embedded simulation baseline into the testbed. It will culminate in a FY00 vehicle demonstration of a 50% crew efficiency enhancement, a 15% reduction in software cost with a 5X improvement in architecture throughput and embedded simulation integration feasibility. The second phase will advance the voice recognition, architecture/API and embedded simulation baseline and develop and integrate the semi-autonomous robotics technologies into the testbed. It will culminate in an FY04 vehicle demonstration of a 100% increase in crew efficiency (or 50% reduction in crew size) by driving and commanding the vehicle from a single crew station, a 30% reduction in software cost with a 10X increase in architecture throughput, and embedded simulation capable of full mission rehearsal. This program will build on and leverage technologies from the FSCS ATD, the Joint Robotics Demo III Program, the Crusader and the Crewman's Associate ATD. Major contract efforts will include: DCS Corp, Alexandria, VA, for software architecture; Oasis, Troy, MI, for embedded simulation; RST, Westminster, MD, and Utah State for robotics technologies; and GDLS, Sterling Heights, MI, for testbed integration and voice recognition.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 250 - Designed vehicle test bed system electronics architecture. • 3826 - Evaluated, selected, and initiated procurement of 3D audio, headtracker, voice recognition, indirect vision driving, architecture and embedded simulation technologies. • 900 - Defined testbed software architecture and top level software design; designed and coded the first drop of the common software operating environment based on real time Common Object Request Broken Architecture (CORBA). • 100 - Conducted solid modeling analysis of crew station structure and positioning within testbed vehicle; defined and designed two identical crew stations for testbed. • 180 - Prepared test bed for crew station mechanical integration. • 600 - Defined and designed graphical operating environment and reusable combat vehicle graphics tool kit. • 700 - Defined and designed vehicle test bed embedded simulation system; procure embedded simulation image generation hardware. • 150 - Defined and designed test environment equipment and scenario. 												
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<p>FY 1999 Accomplishments: (continued)</p> <ul style="list-style-type: none"> • 100 - Procured Pos/Nav and GPS system, mass memory unit, and intercom system for test bed vehicle. • 200 - Created concept for crew station integration into TARDEC virtual prototyping environment. <p>Total 7006</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 1558 - Complete and integrate crew stations into testbed. • 1753 - Complete software development, code and test of: mission rehearsal, graphics tool kit, graphics operating environment, user interface device drivers, drive by wire algorithms, commanders Graphics User Interface (GUI) and test simulation functions. • 633 - Complete unit test and systems integration testing of test bed vehicle systems. • 263 - Integrate and test technologies into vehicle testbed. • 195 - Prepare test site for vehicle demo. • 214 - Integrate synchronized Modular Semi-Automated Forces (MODSAF) and after action review software into embedded simulation system. • 477 - Create 3D visual terrain data base of test site and integrate database into test bed vehicle. • 536 - Demonstrate indirect vision, voice recognition, three-dimensional audio, advanced architecture and embedded simulation technologies in vehicle testbed. • 118 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 5747</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 399 - Conduct vehicle test bed data reduction, test results analysis and identify lessons learned. • 399 - Synthesize lessons learned into Phase II test bed vehicle requirements. • 499 - Design advanced architecture and embedded simulation system. • 499 - Define semi-autonomous driving concept and begin design. • 702 - Design advanced Phase II crew stations. • 150 - Define requirements and concept for vehicle remote control for dismounted operations. • 349 - Define and evaluate a second crew station and define gunnery functions. <p>Total 2997</p>		
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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D502		
<i>COST (In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
D502 HAECO II	772	5885	0	0	0	0	0	0	6657	
<p><u>Mission Description and Justification:</u> This Congressionally directed program, which was funded in FY95 and FY97, received a one-year plus-up in FY00. This project supports the development and Army testing of the combined diesel/turbine (giesel) prototype engine. The Army contracted with the Hope-Anderson Engine Company (HAECO) to develop one giesel engine in the 300 to 600 horsepower range for delivery to the Army for testing at the U.S. Army Tank-Automotive and Armaments Command (TACOM). The contractor is HAECO Partners Ltd., Hillsboro, Ohio.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 772 - Modified contract to continue development of giesel prototype engine for Government evaluation. Demonstrated the giesel prototype at 300hp at the contractor's facility. <p>Total 772</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 5727 - Complete improvements of the existing giesel engine design. Complete testing and evaluation. <ul style="list-style-type: none"> - Complete application of Giesel technology into the DDC 6V53T engine. - Complete application of Giesel technology into the high power density opposed piston engine. • 158 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 5885</p> <p>FY 2001 Planned Program: Project not funded in FY 2001.</p>										
Project D502			<i>Page 12 of 19 Pages</i>			Exhibit R-2A (PE 0603005A)				

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000					
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D506				
COST (In Thousands)				FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D506 Aluminum Metal Matrix Composite (NAC)				3853	6866	0	0	0	0	0	0	10719
<p>Mission Description and Justification: This Congressionally directed program, which received a one year add in FY00, will demonstrate a manufacturing capability to strengthen track shoes by embedding SiC whiskers within the shoes. The scale up of the SiC whisker manufacturing capability has been completed, including a specification for the whiskers, optimization study, beneficiation trials, and furnace design and installation. Laboratory testing has been completed and the optimum whisker loading has been determined. The tooling required for the fabrication of the whisker and the squeeze cast shoe body has been designed and fabricated. In FY99, one vehicle set of track shoes of both the single pin and double pin design was cast, machined, assembled and shipped to Keweenaw Research Center for preliminary field evaluations. The optimum rubber compound (blend of EPDM and NBR) has been selected and laboratory tested for the pin bushings and track pads. A preliminary economic analysis has been conducted and coordinated with the Bradley Fighting Vehicle Program Manager. The project will produce a viable design for track shoes with increased strength and durability.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 3472 - Completed wear testing of SiC reinforced aluminum metal matrix samples to determine material properties; completed final design of single pin track shoe for Bradley vehicle; completed manufacturing development work for a single pin track shoe for the Bradley vehicle, fabricated squeeze casting tooling, and developed preliminary analysis. • 381 - Participated in Simulation Based Acquisition demonstration for the Total Life Cycle (SIM-TLC). <p>Total 3853</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 6682 - Complete preliminary field evaluation testing, fabricate track for validation testing, conduct validation testing and fabricate track shoes for qualification testing at government test sites. • 184 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 6866</p> <p>FY 2001 Planned Program: Project not funded in FY 2001.</p>												
Project D506				Page 13 of 19 Pages				Exhibit R-2A (PE 0603005A)				

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000			
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D507		
<i>COST (In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
D507 PLS Commercial Engine (NAC)	2407	0	0	0	0	0	0	0	2407	
<p><u>Mission Description and Justification:</u> This one-year congressionally directed program demonstrated a heavy truck propulsion system through the leveraging and utilization of commercial engine technologies. This program supported the Program Manager for Heavy Tactical Vehicles (PM HTV) acquisition plans for heavy truck propulsion systems future pre-production contract(s) in 2002, and production contract(s) in 2004. This effort was intended to assure a complementary blend of propulsion capabilities and engine configurations based on both commercial market forces and military requirements is achieved.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 2169 - Conducted a competitive solicitation to upgrade the level of technology and to provide additional improvement in the reduction of harmful emissions (All major engine manufactures were invited to submit proposals). - Performed and completed engine evaluation. • 238 - Performed SIM-TLC. <p>Total 2407</p> <p>FY 2000 Planned Program: Project not funded in FY 2000.</p> <p>FY 2001 Planned Program: Project not funded in FY 2001.</p>										
Project D507			<i>Page 14 of 19 Pages</i>				Exhibit R-2A (PE 0603005A)			

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000			
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D515		
<i>COST (In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
D515 Robotic Ground Systems	0	0	1762	4281	8860	7522	4954	Continuing	Continuing	
<p><u>Mission Description and Justification</u> The Army supports development of robotic platforms to augment manned, ground and aerial reconnaissance systems, and robotic sentries for tactical headquarters and logistical nodes. In response, this project funds demonstrations of unmanned land systems for multiple tactical and logistics applications by the Army and, possibly, other services. Near-term efforts are oriented toward designs for a future combat fighting team that may employ automated, semi-automated, and manned systems. The Army's approach builds upon previous and ongoing investments, such as the Demo III program, under the Joint Robotics Program, and the Crewman's Associate Advanced Technology Demonstrator. There is no duplication of effort within the Army or DoD. Technologies proven in any robotic demonstration are expected to be transferable to other unmanned platforms as well as manned platforms to reduce operator workload.</p> <p>FY 1999 Accomplishments: Project not funded in FY 1999.</p> <p>FY 2000 Planned Program: Project not funded in FY 2000.</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 1762 - Begin vehicle design and define technology interfaces with Army Research Laboratory and Industry; award primary vehicle integration contract. - Evaluate mission alternatives and select vehicle platform for technology integration. <p>Total 1762</p>										
Project D515			<i>Page 15 of 19 Pages</i>			Exhibit R-2A (PE 0603005A)				

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000			
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D532		
COST <i>(In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
D532 Abrams Engine	0	4905	0	0	0	0	0	0	4905	
<p><u>Mission Description and Justification:</u> This one year congressionally directed program provides a jump-start for a new propulsion system for production and phased integration into the Abrams tank fleet with potential application to the Crusader program. The objective is to reduce Abrams Operating and Support (O&S) costs. Additionally, a new propulsion system will yield a lighter, more reliable, more fuel efficient, and easier to repair engine, replacing the current AGT 1500 tank engine designed in the 1960's and produced through 1992.</p> <p>FY 1999 Accomplishments: Project not funded in FY 1999.</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 4470 - Design and demonstrate a new propulsion system for Abrams tank fleet completed. • 303 - Provide Government support. • 132 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 4905</p> <p>FY 2001 Planned Program: Project not funded in FY 2001</p>										
Project D532			<i>Page 16 of 19 Pages</i>			Exhibit R-2A (PE 0603005A)				

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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D533				
COST (In Thousands)				FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D533 Technology Transfer Center				0	7847	0	0	0	0	0	0	7847
<p>Mission Description and Justification: This one year congressionally directed program will transition developments in advanced high performance aerospace metallic alloys and processing/joining methods to demanding ground combat and tactical vehicle structures and armor in order to achieve the major weight reductions required by future ground systems for deployability, mobility and survivability. The performance of conventional alloys used in ground vehicles for decades has been literally "maxed out". The ground vehicle design community must now exploit high performance materials and structures if they expect to achieve any significant gain.</p> <p>FY 1999 Accomplishments: Project not funded in FY 1999.</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 2864 - Establish ballistic performance of Aluminum-Lithium alloys known as Weldalite (space shuttle center tank) of alloy plate, across full range of armor piercing and fragment threats. • 2864 - Complete development of the solid-state welding process known as Friction Stir Welding, for Weldalite alloy plate, over the full range of plate thickness. <ul style="list-style-type: none"> - Establish physical, mechanical and ballistic response of Friction Stir weldments. • 1908 - Complete development of an advanced fusion welding processes for Single-Melt, low-cost grade of titanium alloys. <ul style="list-style-type: none"> - Establish physical, mechanical and ballistic response of titanium ballistic structures. • 211 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 7847</p> <p>FY 2001 Planned Program: Project not funded in FY 2001</p>												
Project D533				Page 17 of 19 Pages				Exhibit R-2A (PE 0603005A)				

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 2000
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology	PROJECT D539
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<i>COST (In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D539 Mobile Parts Hospital	0	2943	0	0	0	0	0	0	2943

Mission Description and Justification: This one year congressionally directed program will design and demonstrate off-site capability to fabricate parts on demand. The Mobile Parts Hospital (MPH) will be capable of reverse engineering, scanning, or electronically measuring current and non available parts that have or do not have engineering data available. This data will allow the MPH to quickly (near real time) fabricate the part to maintain vehicle combat readiness. This capability will be demonstrated at a self-contained mini parts fabrication center while deployed at a remote site.

FY 1999 Accomplishments: Project not funded in FY 1999.

FY 2000 Planned Program:

- 2864 - Complete designing, demonstration, and validation of the off-site capability to fabricate parts on demand. Provide the MPH with reverse engineering and simulation hardware and software to reverse engineer individual automotive repair parts which will be converted into machine language that will then be fed into a forming and/or flexible machine to produce the parts.
 - 79 - Small Business Innovative Research/Small Business Technology Transfer Programs.
- Total 2943

FY 2001 Planned Program: Project not funded in FY 2001

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000			
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology				PROJECT D540		
<i>COST (In Thousands)</i>	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost	
D540 Improved HMMWV Research	0	5885	0	0	0	0	0	0	5885	
<p><u>Mission Description and Justification:</u> The objective of this one year congressionally directed program is to explore new and innovative technical solutions to existing shortcomings within the current designs of the Light Tactical Vehicle Fleet. These solutions could be found through enhanced manufacturing processes/improved/optimized materials; or complete redesign of the existing platform with its components. The aging light tactical vehicle fleet continues to have a O&S cost growth directly related to age. Innovative approaches in achieving this program's objective should result in technologies directly transferable into vehicles being used or planned to be used in the light fleet.</p> <p>FY 1999 Accomplishments: Project not funded in FY 1999.</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 5727 - Establish partnering within auto industry to develop and influence efforts on ultra-light steel and the influence on weight, corrosion control, and vehicle design and manufacturing architecture. <ul style="list-style-type: none"> - Complete research for state of the art and beyond technologies and establish map for implementing into Army's inventory. - Complete research of dual use platforms and determine risks involved in achieving acceptable reliability and durability into Army's operational environments. - Complete economic analyses that assures new technologies and/or platforms would enhance performance of vehicles at reduced costs. • 158 - Small Business Innovative Research/Small Business Technology Transfer Programs. <p>Total 5885</p> <p>FY 2001 Planned Program: Project not funded in FY 2001</p>										
Project D540			<i>Page 19 of 19 Pages</i>			Exhibit R-2A (PE 0603005A)				