ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

June 2001

BUDGET ACTIVITY
2 - APPLIED RESEARCH

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive Technology

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost		57684	88274	82441	0	0	0	0	0	0	0
C05	ARMOR APPLIED RESEARCH	8150	13333	15983	0	0	0	0	0	0	0
C84	AC84	0	0	983	0	0	0	0	0	0	0
H77	ADV AUTOMOTIVE TECH	29052	30811	16558	0	0	0	0	0	0	0
H91	TANK & AUTOMOTIVE TECH	20482	14729	19265	0	0	0	0	0	0	0
HH7	FUTURE COMBAT SYSTEMS - APPLIED RESEARCH	0	7681	19652	0	0	0	0	0	0	0
HH8	VOICE INTERACTIVE DEVICE	0	1982	0	0	0	0	0	0	0	0
T21	21ST CENTURY TRUCK (T21)	0	12802	10000	0	0	0	0	0	0	0
T26	HYBRID ELECTRIC HMMWV	0	6936	0	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification:

PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

The goal of this Program Element (PE) is to develop component technology to improve automotive and survivability capabilities of Army ground vehicle systems for the Objective Force. Technologies matured in this PE usually transition to PE 0603005A to demonstrate their technical feasibility and operational potential. This PE provides a portion of the Army's share of the Army/Defense Advanced Research Projects Agency (DARPA) collaborative Future Combat Systems (FCS) program. This funding supports both the FCS design and demonstration activities, and critical enabling technologies at DARPA. Army/DARPA FCS funding is identified within this PE under project HH7 and is also funded in projects 440 and 53G in PE 0603005A. To achieve the Army vision, the Army must be more strategically deployable and agile, with a smaller logistical footprint. In addition, these lighter ground vehicle systems must be more lethal, survivable and tactically mobile. Other major projects within this PE include: H91, which provides critical automotive enabling component technologies, such as active protection defeat mechanisms, that support FCS; C05, which addresses advanced, lighter armor technology for FCS and the Objective Force; and H77, which funds the National Automotive Center (NAC). The NAC leverages the large commercial investments in automotive technology research and development, and it pursues shared technology programs that focus on benefiting military ground vehicles. The PE 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. There is no duplication of effort within the Army, or DoD. The project is coordinated with the Marine Corps office through the Naval Surface Warfare Center; and with other ground vehicle developers within the Departments of Energy, Commerce and Transportation and the DARPA. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S.

Army Tank-Automotive and Armaments Command (TACOM) Tank-Automotive Research, Development and Engineering Center (TARDEC), DARPA, contractors and universities. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

B. Program Change Summary	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	54776	63589	64724	0
Appropriated Value	55249	89089	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1033	0	0	
c. Omnibus or Other Above Threshold Reductions	-159	0	0	
d. Below Threshold Reprogramming	3941	0	0	
e. Rescissions	-314	-815	0	
Adjustments to Budget Years Since FY2001 PB	0	0	17717	
Current Budget Submit (FY 2002/2003 PB)	57684	88274	82441	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for the Smart Truck Initiative (+3500) (H77), Alternative Vehicle Propulsion (+8000) (H77), the NAC Advanced Tactical Transportation Technology Initiative (+3000) (H77), the Hybrid Electric High Mobility Multipurpose Wheeled Vehicle (HMMWV) (+7000) (T26), Full Spectrum Active Protection (+2000) (H91), and Voice Instructional Device (+2000) (HH8).

(+3500) (H77) This continues Congressional adds to demonstrate various advanced automotive technologies pertaining to Smart Truck. No additional funding is required to complete this project.

(+8000) (H77) This one-year Congressional add was provided to test and mature a proton exchange membrane fuel cell propulsion for line haul trucks. No additional funding is required to complete this project.

(+3000) (H77) This one-year Congressional add was provided to test and mature a solid oxide fuel cells for auxiliary power units. No additional funding is required to complete this project.

(+7000) (T26) This continues several Congressional adds to provide for maturation and testing of a hybrid electric drive High Mobility Multipurpose Wheeled Vehicle (HMMWV). No additional funding is required to complete this project.

(+2000) (H91) This is the second Congressional add to provided maturation of active protection countermeasure technology (e.g., blast fragment warhead) to be evaluated as part of Full Spectrum Active Protection System. No additional funding is required to complete this project.

(+2000) (HH8) This one-year Congressional add project will design and develop a prototype voice activated computer solution for insertion into the Smart Truck technology demonstrator. No additional funding is required to complete this project.

FY 2002: Funding was added for 21st Century Trucks program (Project T21) (+10000); funds added for light weight armor for FCS (Project C05) (+2500); funds added to develop robust active protection defeat mechanisms to protect medium weight vehicles against chemical energy, kinetic energy, and high explosive anti-tank munitions (Project H91) (+5000).

FY 2003: Funding was added for light weight armor for FCS (Project C05) (+5085).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - APPLIED RESEARCH	**0602601A - Combat Vehicle and Automotive Technology**	**C05**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
C05	ARMOR APPLIED RESEARCH	8150	13333	15983	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project lays the technical foundation to solve critical armor deficiencies to transform the Army into a more deployable and survivable force. Emphasis is placed on armor technologies for FCS. In addition, this project researches and matures low-burden solutions for the protection of tactical vehicles in war and operations-other-than-war, focusing on appliqué armor for small arms and land mine protection. International cooperative research in mine blast characterization and vehicle response is also conducted within this project. Armor technologies will be researched to complement innovative, non-armor survivability techniques, such as laser and active protection, described in project AH91 within this PE. Efforts focus on the weight, space, performance, and cost for protection of combat and tactical vehicles against such threats as Kinetic Energy (KE) projectiles, explosively formed penetrators, chemical energy warheads, and blast and fragments from land mines. This project draws upon products from Army Research Laboratory programs in PE 0602618A (Ballistic Technology) and PE 0602105 (Materials), as well as innovative armors from industry. Starting in FY01, funding in the project has been increased to research significantly lighter, innovative armor solutions for FCS. This project also includes supporting work in armor materials, bringing together the collective expertise of the Department of Defense, the Department of Energy, industry and academic sources. Supporting work also includes researching and maturing of armor performance models to assess armor configurations against different threats, with sufficiently high fidelity to make their implementation in vehicles feasible and affordable. Major contractors include: SAIC, Albuquerque, NM; Southwest Research Institute, San Antonio, TX; University of Hawaii, Honolulu, HI. This program supports the Objective Force transition path of the TCP.

FY 2000 Accomplishments

- 2818 - Investigated armors for medium caliber KE threats that are 50% more space efficient than the 1996 state of the art, making possible more compact and deployable combat vehicles.
  - Researched and defined lightweight armor systems for protection against a spectrum of threats faced by vehicles in the less than 20 ton weight range.
- 3594 - Characterized the debris produced by KE and Chemical Energy (CE) threats that have been disrupted by prototype Active Protection System (APS) countermeasure warheads, to provide the foundation for the lightweight armors that will complement APS to protect combat vehicles.
  - Defined, through simulation and component testing, the structural and material requirements for light weight, integrated, multifunctional armor/structure systems.

FY 2000 Accomplishments (Continued)

- Integrated armor configurations from 0602618A/H80 and material and structure technology from 0602105A/H84 into multiple armor/structure systems for demonstration in FY 2001.

• 1796 - Completed fabrication and demonstration of armor for troop protection from blast mines while in a tactical vehicle.

- In partnership with United Kingdom (UK), developed a set of design tools to investigate unique electro-dynamic defeat, of anti-armor threats technology constructs, for combat vehicle upgrades and concepts.

Total 8208

FY 2001 Planned Program

• 5311 - Test the capability of armor systems with 30% greater weight efficiency than the 1996 state of the art, against horizontal KE and CE threats, and the determine the capability of these armors to withstand the threat debris from an APS countermeasure intercept.

- Investigate and test top attack armor systems to complement future APS with 30% greater weight efficiency than the 1996 state of the art.

• 4421 - Complete investigation of a series of integrated multifunctional armor/structure systems against the heavy machine gun threat that will offer 25% improved weight efficiency over the Composite Armored Vehicle (CAV), at a projected production cost less that 1.5 times that of the CAV.

- Investigate armor/structure systems with 30% improved weight efficiency against medium caliber KE and CE threats for validation in FY02.

• 3240 - Integrate existing physics-based and engineering-based models and design tools to provide industry the capability to design and validate FCS armors without extensive and costly testing.

- Support and provide U.S. national leadership to an international cooperative research program for mine blast characterization under The Technical Cooperation Program (TTCP).

- Conduct safety and user assessments.

- In partnership with UK, develop a set of design tools to investigate unique electrodynamic defeat of anti-armor threat technology constructs for combat vehicle upgrades and concepts.

• 361 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 13333

FY 2002 Planned Program

•	6592	- Mature second generation armor systems that will be available for FCS designs to defeat medium caliber cannon, hand held infantry weapons, and residual KE behind APS debris to approach meeting a weight efficiency goal of 80 lbs/sq ft; these armor systems will provide light combat vehicles with the survivability required on the future battlefield. - Investigate and test top attack armor systems to complement future APS with 30% greater weight efficiency than the 1996 state of the art.
•	4867	- Mature second generation of integrated multifunctional armor/structure systems against the heavy machine gun threat that will be available for FCS designs to approach meeting a weight efficiency goal of less than 20 lbs/sq ft. - Provide armor and model data for defeat of APS residual KE, medium caliber KE and CE threats which meet APS demo weight efficiency goal of 160 lbs/sq ft.
•	4524	- Integrate existing physics-based and engineering-based models and design tools to provide industry the capability to design and validate FCS armors without extensive and costly testing. - Acquire experimental data for use in existing mine survivability design codes; provide U.S. national leadership to an international cooperative research program for mine blast characterization under the TTCP.
Total	15983	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - APPLIED RESEARCH	**0602601A - Combat Vehicle and Automotive Technology**	**H77**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H77 ADV AUTOMOTIVE TECH	29052	30811	16558	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project funds the National Automotive Center (NAC), which leverages large commercial investments in automotive technology research and development and initiates shared technology programs that focus on benefiting military ground vehicle systems. The dual use technologies being developed will support the Army's wheeled vehicles legacy fleet that may comprise a substantial segment of the Future Combat Systems and the Objective Force. Improvements in the Legacy force are expected to rely heavily on dual-use technologies for advances in operational, performance and cost characteristics. The NAC, located at the Tank-Automotive and Armaments Command (TACOM), is part of the Tank Automotive Research, Development and Engineering Center (TARDEC). The NAC serves as the catalyst linking industry, academia and government agencies for the development and exchange of automotive technologies. The NAC executes collaborative research and development (R&D) contracts, cooperative agreements, and other initiatives to leverage commercial industry's investment in well-defined, high return-on-investment areas tied to key Army science and technology objectives for advanced land combat. The NAC focuses collaborative R&D contracts on key military automotive technology thrust areas to include: fuel efficiency, vehicle modernization, crew safety, maintenance, and logistics improvement and manufacturing innovation with the goal of (a) improving the performance and endurance of ground vehicle fleets, and (b) reducing ground vehicle design, manufacturing, production, and operating and support costs. Two-way industry/government technology transfer is pursued under Cooperative Research and Development Agreements (CRADAs). The NAC also leverages the Army's Dual-Use Science and Technology (DUS&T) resources. Industry joint investment under the NAC DUS&T programs exceeds $80M. The activities of the NAC are supported by other government agencies via a linkage created under Memoranda of Agreement. These linkages permit the NAC to consolidate the collective expertise of federal government departments such as Energy, Transportation and Commerce and other DoD agencies. The NAC performs basic research in PE 0601104A, project BH73 (National Automotive Center). Major contractors include: FOCUS: Hope, Detroit, MI; Environmental Institute of Michigan, Ann Arbor, MI; Oshkosh Truck Corporation, Oshkosh, WI; Lockheed Martin Inc., Lexington, MA; Rocky Research Inc., Boulder City, NV; USCAR-PNVG/Ford, Dearborn, MI; Cummins Engine Company, Columbus, IN; ICRC Energy Inc., Oakton, VA; Radian, Inc., Alexandria, VA; Baum, Romstedt Technology Research Corp. (BRTRC Inc.), Fairfax, VA; TASC Inc., Reading, MA; Southwest Research Institute, San Antonio, TX; Electronic Data Systems, Troy, MI; University of Wisconsin, Madison, WI; University of Iowa, Iowa City, IA; Evans and Southerland Inc., Salt Lake City, UT; IITRI, Chicago, IL; Lockheed Martin Control Systems, Johnson City, N.Y; Ford Motor Company, Dearborn, MI; Continental Teves, Inc., Auburn Hills, MI; Sunline Services Group, Thousand Palms, CA; Ultramer Inc., Massillon, OH; Mobile Medical International, St. Johnsburg, VT; Oakland University, Rochester, MI, General Dynamics Land Systems (GDLS), Muskegon, MI; and Parametric Technologies Corp, Waltham, MA. This program supports the Objective Force transition path of the TCP.

FY 2000 Accomplishments

- 12191 - Researched and investigated technologies to improve fuel efficiency through engine research, hybrid-electric drive Family of Medium Tactical Vehicles (FMTV), Class 8 parallel hybrid electric line haul truck, manufacturing innovation through man-in-the-loop simulation and collaborative design, development of the virtual distributed collaborative environment and creating a vehicle and heavy vehicle equipment virtual proving ground, and enhancing soldier safety through the development of the personal visualization environment.

  - Performed HMMWV vehicle endurance tests with reconfigured 6.2 liter engine, performed producibility study, conducted operational & savings (O&S) cost assessment and analysis.

- 3852 - Integrated key commercial automotive technologies (engine, brakes, air conditioning, diagnostics, crash protection) into the light and heavy wheeled demonstrators and engine, air conditioning, diagnostics technologies into the tracked vehicle demonstrator.

- 9640 - Performed congressionally directed program that completed the research of the diesel fuel reformer for a line-haul truck, integrated the reformer with a fuel cell engine on the current test truck, and conducted extended laboratory, track and on-road tests.

  - Evaluated subcontractor and supplier capability and availability for integration of electronic architecture into demonstrator vehicle.

  - Integrated and tested the optimized controls and subsystems with the diesel-fueled reformer and fuel cell power system.

- 3369 - Performed congressionally directed program that conducted market analysis of emerging vehicle electronic technologies for applicability to military wheeled vehicles.

Total 29052

FY 2001 Planned Program

- 5765 - Investigate and test automotive technologies in the areas of fuel efficiency, vehicle modernization, manufacturing, automotive logistics and maintenance improvement.

- 5581 - Integrate key commercial automotive technologies (engine, brakes, air conditioning, diagnostics, crash protection) into the light and heavy wheeled demonstrators and engine, air conditioning, diagnostics technologies into the tracked vehicle demonstrator.

- 4682 - Complete integration plan for hardware, software, informational, and human interfaces for the selected technologies.

- 3369 - Execute one-year congressional program to demonstrate various advanced automotive technologies pertaining to Smart Truck.

  - Produce initial and final designs for the electronic architecture and vehicle integration.

- 2888 - Execute one-year congressional program to develop Solid Oxide Fuel Cell technology.

FY 2001 Planned Program (Continued)

- 7705 - Execute one-year congressional program to research and develop improved techniques for reforming JP-8 and related fuels to make hydrogen for vehicle fuel cell propulsion systems.
  - Address areas on sulfur tolerance, startup and transient response times, efficiency, and operation in hot, dry climates.
  - Initiate the development and operation of fuel cell power heavy vehicle power systems.
  - Build two additional fuel cell powered trucks for in-service evaluations, one in military environment, and one in a commercial environment.
- 821 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 30811

FY 2002 Planned Program

- 10556 - Investigate and test automotive technologies in the areas of fuel efficiency, vehicle modernization, manufacturing, automotive logistics and maintenance improvement.
- 4002 - Integrate key commercial automotive technologies (engine, brakes, air conditioning, diagnostics, crash protection) into the light and heavy wheeled demonstrators and engine, air conditioning, diagnostics technologies into the tracked vehicle demonstrator.
- 2000 - Perform simulation based modeling and analysis in support of all areas of technology under investigation.

Total 16558

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - APPLIED RESEARCH	**0602601A - Combat Vehicle and Automotive Technology**	**H91**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H91 TANK & AUTOMOTIVE TECH	20482	14729	19265	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project provides innovative vehicle concepts and enabling technologies for the Objective Force and Future Combat Systems (FCS) and provide critical mobility, survivability and sustainability enhancements, required to achieve Army Transformation to the Objective Force. Program activities, such as conceptual designs, virtual prototyping, performance analyses and battlefield wargaming of ground vehicle systems, identify promising emerging technologies meeting approved and emerging U.S. Army Training and Doctrine Command (TRADOC) requirements. They also quantify benefits, burdens and trade-offs related to ground vehicle applications. The project includes ten areas: (1) vehicle concepts; (2) mobility; (3) integrated survivability (including active protection); (4) vehicle electronics (VETRONICS) and intra-vehicle digitization; (5) advanced vehicle structures; (6) simulation/analysis; (7) military fuels and lubricants; (8) water purification technology; and (9) mechanical (as opposed to electronic) countermine technology and (10) gap/obstacle crossing technology. Technologies are being pursued to address advanced mobility, survivability, advanced structures, and lethality requirements of lighter, digitized, more deployable vehicles requiring less Petroleum, Oil and Lubricants (POL). Activities are closely coordinated through TRADOC's Mounted and Dismounted Battlespace Battle Labs and the Directorate of Combat Developments for Transportation; Program Executive Office for Ground Combat and Support Systems; Army Research Laboratory (ARL), and the Defense Advanced Research Projects Agency (DARPA). Virtual prototyping provides seamless sharing of databases and engineering models, allowing more rapid and efficient integration, assessment and transfer of Department of Defense and commercial vehicle technologies. Vehicle electronics are based on adapting commercial electronic standards and architectures for combat vehicle battlefield unique requirements. The survivability technologies, which include non-armor approaches such as signature reduction, countermeasures, active protection, damage reduction, and laser protection, complement, but do not duplicate, work performed under the armor exploratory development project (DC05) in this PE. Other government agencies include: DARPA, Arlington, VA; Army Research Laboratory, Aberdeen, MD; Red River Army Depot, Texarkana, TX. Major contractors include: Detroit Diesel Corp., Redford, MI; Cadillac Gage Textron, New Orleans, LA; Soucy International, Drummondville, Quebec; Pentastar, Huntsville, AL; Michigan Technological University, Houghton, MI; United Defense Limited Partnership, San Jose, CA; University of Texas, Arlington, TX; Oakland University, Rochester Hills, MI; Gonzales Engineering, Troy, MI; Boeing Corporation, St. Louis, MO; Monterey Technologies Inc., Monterey, CA; DCS Corp, Alexandria, VA; Texas Instruments, Dallas, TX; Southwest Research Institute, San Antonio, TX; Separation Systems Inc., San Diego, CA, Scientific Systems, Boston, MA; University of California, Berkley, CA; General Dynamics Land Systems Division, Sterling Heights, MI; Chang Ind., Salt Lake City, UT, & Laverne, CA; TRW, Redondo Beach, CA, Sanders Lockheed Martin, Nashua, NH; Raytheon, Danbury, Conn., New Mexico Tech., Socorro, NM, Talking Lights Company, Cambridge, MA. This program supports the Objective Force transition path of the TCP.

FY 2000 Accomplishments

- 3963
  - Researched innovative Future Combat Systems concepts, performed tracked vs wheeled engineering analysis, and launched an integrated data environment for FCS.
  - Established solicitation, requirements and technology capabilities for the joint Army/DARPA FCS program.
  - Completed Future Heavy Tactical Truck Concept Study. Concepts ranged from fuel cell powered trucks and trailers to fully robotic systems.
  - Completed investigation of immersive visualization environments by networking with the user to show the technology application for concept trade-off analysis. Determined the best use for the technology developed in the vehicle system development process.
- 5011
  - Conducted field testing of the Electromechanical Suspension System (EMS) installed in a High Mobility Multipurpose Wheeled Vehicle HMMWV to evaluate active suspension under strenuous cross country conditions including steering and braking at high speeds; used the field test data to fully tune vehicle handling algorithm for safe cross country operations.
  - Investigated, tested and characterized advanced high temperature materials including ceramics, for insulation, low wear, improved durability and other key properties. Matured technology for high temperature combustion (more efficient), low heat rejection (enables smaller cooling systems) and advanced high temperature lubricants. Designed and fabricated advanced components for demonstrator engine. Completed first demonstrator engine build. (Cooperative Research Program with Japan).
  - Conducted baseline data gathering on composite bridging components through instrumented vehicle crossings on prototype composite bridging structures.
  - Performed analysis of marking technologies and requirements that identified criteria that will support near and far term vehicle systems and evaluated concept alternative for active marking technologies and defined architecture for integration into a mobile test bed.
- 4922
  - Fabricated and evaluated optical hardware for a retrofittable wide-angle optical viewing system that can incorporate laser-limiting materials to provide laser protection for vehicle periscopes.
  - Conducted successful active protection proof of principle countermeasure and radar field evaluations based on FY99 analysis, with specific emphasis on Kinetic Energy rod defeat.
  - Evaluated concept alternatives for semi-autonomous driving using robotics technology.
- 6586
  - Completed 1 year congressionally directed program to research and define FCS battle scenarios, model blue and red forces for of Combined Arms and Support Force Evaluation Model and other simulations.
  - Performed detailed technology assessments and subsystem integration studies for the FCS alternatives such as Assault, Fire Support, Command and Control, and robotics.

Total 20482

FY 2001 Planned Program

- 4570 - Jointly with DARPA, perform effectiveness, performance, cost and tradeoff analysis of innovative FCS system concepts to support the evaluation of the FCS contractor alternative concepts.

  - Mature system concepts validating the performance and cost implications of robotic vehicles in multiple roles that will be available for FCS; develop concepts for potential insertion to the Interim Brigade Combat Team and legacy force.

  - Establish and address emerging combat support requirements for tactical vehicles necessary to support the Objective Force; conduct trade-off studies and supporting performance and supportability analysis of heavy tactical vehicle concepts supporting the Objective Force; conduct simulation experiments using Army Materiel Command Research and Development Engineering Center Federation Architecture in conjunction with FCS and Objective Force efforts.

- 4468 - Complete electromechanical active suspension algorithm refinement on a HMMWV research test vehicle and investigate electromechanical active suspension application for hyper-mobility in combat vehicles that would be available for FCS; complete final 4-stroke demonstrator diesel engine build; conduct performance and durability optimization on demonstrator engine to achieve the high power density, low heat rejection and improved fuel economy goals established in the memorandum of understanding. (Cooperative Research Program with Japan.)

  - Demonstrate in laboratory increased vehicle range through fuel additives.

  - Conduct materials comparison studies of composites versus metallics and their applicability towards military bridging technologies and begin Virtual Prototyping simulations and studies of new and unique bridge launching techniques that will be available for the Objective Force.

  - Investigate, test and characterize obstacle marking and vehicle guidance systems based on FY2000 analysis; perform detailed assessments in vehicle interoperability, system deployability and cost to prepare for FY2002 test bed demonstration.

- 3795 - Integrate and evaluate Natick Research and Development Engineering Center laser protection materials into retrofittable wide-angle optical viewing system incorporating laser-limiting materials.

  - Conduct simulations to determine viable Full Spectrum Active Protection (FSAP) designs, based on preliminary proof-of-principle component demonstrations.

  - Design and fabricate improved FSAP countermeasure configured for notional delivery system and conduct field evaluations.

  - Assess armor/structure concepts developed under project DC05 to deal with adaptive threats.

- 1810 - Mature concepts for embedded unmanned system control from manned platforms to provide required capability for FCS.

  - Evaluate technique for potable water extraction from vehicle exhaust; optimize water from exhaust system components to reduce heat exchanger and demister size and weight.

FY 2001 Planned Program (Continued)

•	86	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	14729	

FY 2002 Planned Program

•	5121	- Assess emerging requirements of FCS, including the role of robotics; refine Government concepts and perform analysis in support of FY03 technology readiness decision; complete independent evaluation of FCS industry team concepts through the Integrated Product Team process. - Institutionalize real-time system and component level development collaboration environment for the Objective Force; these funds will be provided to and executed by the RDEC Federation.
•	4743	- Complete final 100 hour high output, low heat rejection compact 4-stroke diesel engine durability and performance demonstration to achieve the high power density, low heat rejection and improved fuel economy goals. (Cooperative Research Program with Japan.) - Complete laboratory demonstration of enhanced lubricants for fuel economy and with increased oil sump temperature; evaluate candidates on second series of multi-cylinders engine tests; determine formulations that can be evaluated in field tests. - Conclude materials studies of composites versus metallics; refine virtual prototype simulations of launching techniques; conduct Finite Element Modeling of weight reduction and enhancement studies. - Finalize design based on FY01 detailed assessments of obstacle marking and vehicle guidance systems in the areas of vehicle interoperability, system deployability and cost; participate in Joint Area Clearance Advanced Concepts Technology Demonstrator.
•	1096	- Evaluate/validate performance levels via component structural and ballistic tests; perform structural and weight analysis of candidate FCS vehicle designs.
•	3305	- Evaluate cognitive decision aids to reduce workload on multi-mission capable systems such as FCS; mature approach/architecture for implementation of cognitive decision aids in ground systems. - Construct FSAP subsystem models based on successful countermeasure demonstrations. - Complete HMMWV system level design for a mounted integrated water from exhaust system; test materials/components to show concepts in a humidity concentrator to reduce the size and energy requirements of a water from air generator.
•	5000	- Develop robust active protection kill mechanisms (e.g., multi-explosively formed penetrators) to protect light-medium weight ground vehicles (i.e., FCS) against anti-armor threats, including kinetic energy penetrators and high explosive anti-tank rounds.
Total	19265	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - APPLIED RESEARCH	**0602601A - Combat Vehicle and Automotive Technology**	**HH7**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
HH7	FUTURE COMBAT SYSTEMS - APPLIED RESEARCH	0	7681	19652	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project provides part of the Army's share of the Army/DARPA collaborative FCS program. The other Army funds are in project 440 and 53G of PE 0603005A. Project 53G contains the description of the joint FCS program. Funds in this project support ongoing contractual and government concept design efforts directed by DARPA, in accordance with the Memorandum of Agreement. Competing designs will be evaluated for their ability to perform combat missions across the full spectrum of operations. This program supports the Objective Force transition path of the TCP.

FY 2000 Accomplishments

Project not funded in FY 2000.

FY 2001 Planned Program

- 7681 - Provide funds in support of DARPA to research and define initial force concepts as a result of tradeoff assessment process.

  - Mature and evaluate innovative system concepts that reflect the force in a system of systems context; develop operational and technical models to represent the best system of systems concepts for FCS.

  - Perform effectiveness, performance, cost and technology tradeoff analyses on innovative system concepts developed in support of a strategically deployable, agile, survivable and tactically mobile force for the Army. Provide information to support the development of requirements and enabling technology for FCS.

  - Identify key enabling technologies to support FCS based Objective Force concept architectures.

  - Perform technical and operational experimentation in support of system of systems design.

Total 7681

FY 2002 Planned Program

•	3000	- Provide funds in support of DARPA for FCS concept development.
•	16652	- Provide funds in support of DARPA for development of FCS enabling technologies ($62436 in PE 0603005A, Project 440, also supports this effort.
		- Mature new and novel modeling and simulation techniques to support network-centric force architectures for a FCS-based Objective Force.
		- Define and apply new measures of effectiveness to evaluate Army transformation concepts.
		- Evaluate novel cooperative engagement, cooperative survivability, and command and control strategies for FCS-based tactics, techniques and procedures.
		- Initiate complete system design based upon selected concepts supporting the FCS Technology Readiness Decision in 2003.

Total 19652

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - APPLIED RESEARCH	**0602601A - Combat Vehicle and Automotive Technology**	**T21**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T21	21ST CENTURY TRUCK (T21)	0	12802	10000	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this project is to provide a collaborative Government and commercial truck manufacturing industry research and development initiative to investigate automotive component technologies for trucks which will be much more fuel efficient, less polluting, and safer to operate. These most promising components from this research will be incorporated into test rig vehicles and tested in commercial and military operational environments. This program supports the Objective Force transition path of the TCP.

FY 2000 Accomplishments

Project not funded in FY 2000.

FY 2001 Planned Program

- 7501 - Research and investigate high power density engines, lightweight engine/components, high temperature engine materials, engine coatings, coolants and cooling systems computer controlled energy management systems, electric traction motors, electric generators, high power motor controllers, integrated gate bipolar transistors, and advanced energy storage systems.
- 1800 - Integrate and test vehicle intelligence technologies that involve both information and control technology to improve fuel efficiency, driving efficiency, safety and quality of driving trucks.
- 1820 - Evaluate the use of alternative fuels to meet military requirements for fuels with high stored energy density, reduced emissions and that will facilitate the use of Solid Oxide Fuel Cell propulsion systems.
- 800 - Test and evaluate the application of current and new commercial materials technologies that result in increase payload, corrosion resistance, vehicle life cycle, durability and mobility.
- 500 - Conduct research in fuel cell technologies to include alternatives to diesel reformers and improvements in propulsion density, weight and cube of present generation fuel cells.
- 381 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12802

FY 2002 Planned Program

- 8000 Integrate, demonstrate, and test high power fuel efficient engines, lightweight engine/components, high temperature engine materials, engine coatings, coolants and cooling systems, computer controlled energy management systems, electric traction motors, electric generators, highpower motor controllers, integrated gate bipolar transistors, and advanced energy storage systems.
- 1000 - Integrate and test vehicle intelligence technologies involving information and control technology to improve fuel efficiency, driving efficiency, safety and quality of driving trucks.
- 1000 - Integrate, demonstrate, and test the use of alternative fuels to meet military requirements for fuels with high stored energy density, reduced emissions and that will facilitate the use of Solid Oxide Fuel Cell propulsion systems. This supports more stringent emissions protocols.

Total 10000