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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)									DATE February 1999	
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology						
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	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	55978	52074	41085	42820	45270	46584	49153	52188	Continuing	Continuing
A855 Topography, Image Intelligence, and Space Technology	8653	9022	9494	9722	10315	10788	11494	12162	Continuing	Continuing
AH71 Atmospherice Investigations	5574	5657	6270	6652	7068	7328	7928	8367	Continuing	Continuing
AT40 Mobility & Weapons Effects Technology	11602	12617	14896	15692	16586	16577	17126	18247	Continuing	Continuing
AT41 Military Facilities Engineering Technology	3371	3982	4165	4204	4505	4725	5042	5375	Continuing	Continuing
AT42 Cold Regions Engineering Technology	4423	4516	3677	3754	3945	4142	4311	4573	Continuing	Continuing
AT45 Energy Technology Applied to Military Facilities	2243	2386	2583	2796	2851	3024	3252	3464	Continuing	Continuing
AT46 Climate Change Fuel Cell Technology	7026	2967	0	0	0	0	0	0	0	9993
AT47 Molten Carbonate Fuel Cell Technology	6000	0	0	0	0	0	0	0	0	6000
AT48 Center for Geosciences and Atmospheric Research	7086	0	0	0	0	0	0	0	0	7086
AT49 University Partnering for Operational Support	0	2980	0	0	0	0	0	0	0	2980
AT50 Enhanced Geographic Synthetic Aperture	0	7947	0	0	0	0	0	0	0	7947

**A. Mission Description and Budget Item Justification:** The applied research conducted in this program provides technology in direct support of critical warfighter functions of mobility, countermobility, survivability, sustainment engineering, and topography needed to win on the modern battlefield. Research is conducted that supports the special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Key operational technologies developed are demonstrated to Army units under program element 0603734A (Military Engineering Advanced Technology). Results are tailored to support the material development, test, and acquisition community in evaluating the impacts of weather, terrain, and atmospheric obscurants on military operations. Research develops and exploits a wide range of innovative technologies and applies them to Defense unique planning, acquisition, revitalization, and sustainment processes. The goal of this research is to improve the efficiency and cost effectiveness as it relates to supporting the training/readiness/force projection missions in garrison and force sustainment

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missions in theaters of operation. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Defense Reliance Agreements on Civil Engineering and Battlespace Environments with oversight provided by the Joint Directors of Laboratories and Joint Engineers.

<b>B. Program Change Summary</b>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget ( <u>FY 1999</u> PB)	50802	37488	39998	40364
Appropriated Value	58422	52688		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1620	-614		
b. SBIR / STTR	-406			
c. Omnibus or Other Above Threshold Reductions	-134			
d. Below Threshold Reprogramming	-284			
e. Rescissions				
Adjustments to Budget Years Since <u>FY 1999</u> PB			+1087	+2456
Current Budget Submit ( <u>FY 2000 / 2001</u> PB)	55978	52074	41085	42820

Change Summary Explanation: Funding – FY 1999 – Several Congressional adds, totaling to a plus-up of 15200.

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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology					PROJECT A855	
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
A855 Topography, Image Intelligence, and Space Technology	8653	9022	9494	9722	10315	10788	11494	12162	Continuing	Continuing
<p><b>Mission Description and Justification:</b> This project funds technology to enhance the tactical commander's ability to effectively visualize the battlespace, to easily represent battlefield information, and to exploit his knowledge of combat relevant intelligence as a force multiplier to conduct and win Force XXI operations across the operational continuum. Information dominance is a key enabler for Army/Joint Vision 2010 concepts. Using tactical/strategic/space sensor data, together with terrain data bases as input, the technology program emphasizes automating the processes of detecting changes on the battlefield, identifying battle significant features, exploiting space based/remote sensing information (especially for deep operations and over denied areas), and integrating the impacts of the battlefield environment to significantly improve combat planning and operations. Development efforts will enable the commander to locate and position enemy and friendly forces in day/night all-weather conditions, provide crucial terrain data for command and control systems (C2) as well as modeling and simulation systems, and enhance the speed and accuracy of maneuver and weapon systems. The technology being developed will help those who move, shoot, and communicate on the battlefield to "fight smarter" through superior knowledge of the total battlefield terrain and environment. Work in this project significantly enhances the geospatial data management and dissemination capabilities of storing, formatting, transforming, and distributing extremely large volumes of terrain data at real or near-real times. Weather/atmospheric effects data is provided by the Army Research Laboratory Project AH71 in this PE. This project is managed by the U.S. Army Topographic Engineering Center, Alexandria, VA.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8653 - Developed initial capability for automated feature attribution based on multispectral imagery data. <ul style="list-style-type: none"> <li>- Linked 3-D model and texture library to database generation capability.</li> <li>- Developed parametric modeling capability for battlefield terrain simulation.</li> <li>- Developed procedures for ensuring that mapping, charting, and geodesy (MC&amp;G) software adheres to the Defense Information Infrastructure.</li> <li>- Developed new methods for portraying terrain analysis product reliability.</li> </ul> </li> </ul> <p>Total 8653</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 8919 - Incorporate/test initial spectral imagery and synthetic aperture radar automated feature extraction capabilities. <ul style="list-style-type: none"> <li>- Develop standards, initiate linear feature management development, and demonstrate the management, dissemination, and integration of point data and information.</li> <li>- Develop capabilities to support weapon selection by applying physics-based models to simulate applications and visualization capabilities.</li> <li>- Develop and explore processes to utilize a disparate array of geospatial information to support a family of common geospatial information representations.</li> <li>- Test and evaluate a vehicular advanced tactical navigator capability and initiate design of an off-vehicle advanced tactical navigator capability.</li> </ul> </li> </ul>										
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<p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 103 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 9022</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9494 -Incorporate automated feature extraction techniques from spectral, synthetic aperture radar and electro-optical sources into the digital stereo photogrammetric workstation.               <ul style="list-style-type: none"> <li>- Develop a capability to manage, disseminate, and integrate topographic point and line feature data.</li> <li>- Extend physics-based models and visualization capability to passive and active millimeter wave.</li> <li>- Complete design and tests of off-vehicle advanced tactical navigator.</li> </ul> </li> </ul> <p>Total 9494</p> <p><b>FY 2001 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9722 - Develop capability for automated feature attribution based on terrain reasoning.               <ul style="list-style-type: none"> <li>- Test and evaluate the ability to manage, disseminate and integrate point, line and aerial information under operational conditions.</li> <li>- Integrate model derived from infrared and millimeter wave sensor performance overlays into 3D visualization.</li> <li>- Develop the design for hardware and software for future land navigation capability.</li> </ul> </li> </ul> <p>Total 9722</p>		
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology					PROJECT AH71	
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AH71 Atmospheric Investigations	5574	5657	6270	6652	7068	7328	7928	8367	Continuing	Continuing
<p><b>Mission Description and Justification:</b> This project realistically models atmospheric effects on target acquisition, mobility, lethality, and survivability to provide weather limitations for design and operation of smart weapons, improved war game realism and tactics and improved intelligence preparation of the battlefield. It develops weather decision aids for the commander by: applying advanced computer techniques; incorporating new technology in meteorological sensor design; and developing data fusion techniques to horizontally integrate data from advanced weather sensors and non-weather sensors into decision aids to enhance combat power on the battlefield. This project supports Project Reliance theater data fusion and prediction, atmospheric effects assessment, and battlefield environmental effects joint programs.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3483 - Increased forecast accuracy of the Battlescale Forecast Model (BFM) by initializing with higher resolution Air Force and Navy model data and integrating into the Integrated Meteorological System (IMETS) for the Army Battle Command System (ABCS).                      - Developed the capability for the All Source Analysis System, the Digital Topographic Support System, the Advanced Mobile Profiling System, and the Maneuver Control System to concurrently retrieve and incorporate weather information in Intelligence Preparation of the Battlefield, trafficability, aviation, and nuclear/biological/chemical applications.                      - Converted the Electro-Optical Tactical Decision Aids including weapon zones, target acquisition ranges, and thermal reversal for integration with current tactical Weather Effects Decision Aids (WIDA).</li> <li>• 2091 - Demonstrated through the use of achieved data the accuracy achieved by moving the battlescale forecast model (BFM) to indirect fire control computers to correct for met effects over the entire trajectory for improved accuracy of artillery fires.                      - Completed the integration of the prototype MMS-Profiler computers and sensors with data retrieval, database, and BFM software on a suite of Army or equivalent computers.                      - Examined and devised computationally efficient algorithms for dynamic weather data transformations for parallel and scaleable processing architectures with the dynamic terrain data transformations developed in this PE under Project A855.</li> </ul> <p>Total 5574</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3133 - Evaluate converting the BFM to a nonhydrostatic model to improve predictions of severe weather.                      - Enhance forecaster decision aids with improved algorithms for predicting icing, turbulence, visibility, low cloud, and precipitation.                      - Incorporate existing acoustic detection algorithms into tactical decision aids using the BFM output to enable troops to determine the optimum placement of acoustic sensors for detection based on atmospheric conditions.                      - Incorporate an improved BFM for forecast representations in combat simulation and training, including clouds, fog, severe weather, and improved battlefield aerosol diffusion at tactical scales.</li> </ul>										
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<p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 1470 - Evaluate the Prototype MMS-Profiler's ability, at 4<sup>th</sup> Infantry Division Digitized rotation to provide target area trajectory meteorology for close and deep attack systems; begin insertion of software upgrades such as improved satellite sounding retrievals and BFM.</li> <li>• 1017 - Develop a user interface for 2-dimensional limited complex terrain/acoustic propagation model for integration into next generation IMETS and C2 systems.             <ul style="list-style-type: none"> <li>- Use transient turbulence theory to develop a high resolution, complex terrain transport and diffusion model which will permit simultaneous calculation of meteorology and hazards prediction with significantly reduced computation time by eliminating the stepwise procedure of traditional approaches for deployment in next generation IMETS and C2 systems.</li> <li>- Investigate visualization techniques for fusing multiple information sources into a unified visualization of weather with the rapid, dynamic, 3-D battlefield environment/terrain visualization capabilities.</li> </ul> </li> <li>• 37 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5657</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2421 - Complete the initial neural network method for retrieval of wind profiles from met satellite sounder data.             <ul style="list-style-type: none"> <li>- Deliver meteorological algorithm with documentation to the Army's Armament Research, Development, and Engineering Center (ARDEC) for enhanced fire support effectiveness.</li> <li>- Conduct verification and validation of battlescale forecast model with improved algorithms for predicting icing, low level clouds, turbulence, precipitation, and visibility for input to battlefield decision aids.</li> </ul> </li> <li>• 525 - Incorporate limited terrain effects into the Battlefield Acoustic Sensor Evaluation (BASE).             <ul style="list-style-type: none"> <li>- Develop a user interface for acoustic propagation in 2-D limited complex terrain for integration into next generation IMETS and command and control systems.</li> </ul> </li> <li>• 3324 - Incorporate Joint Technical Architecture Standards into IMETS applications to establish a consistent representation of weather and weather impact information on ABCS C2 systems.             <ul style="list-style-type: none"> <li>- Prepare, evaluate, test, and integrate meteorological forecast models, meteorological data bases, and weather impact decision aids into the Army's first digital division.</li> <li>- Integrate IMETS applications including weather data visualization, rule-based and physics-based weather impact models as client applications onto the ABCS C2 systems to provide an interactive capability and ability for ABCS to retrieve data on demand from IMETS meteorological data bases.</li> <li>- Incorporate meteorological satellite data extraction algorithms for surface state and precipitation into weather information data bases, visual displays, and decision aids.</li> <li>- Upgrade weather impact decision aid models with the characteristics and impacts of weather on threat platforms, weapons, sensors, and operations.</li> </ul> </li> </ul> <p>Total 6270</p>		
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<p><b>FY 2001 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2544 - Conduct verification and validation of neural network method for retrieval of wind profiles from met satellite sounder data. <ul style="list-style-type: none"> <li>- Integrate combined temperature retrieval method into MMS-Profiler processors for better temperature sounding capability.</li> <li>- Upgrade phased array wind radar antenna to include electronic beam steering that will replace electro-mechanical switches to provide a potential sounding-on-the-move capability for enhanced mobility.</li> <li>- Conduct verification and validation of battlescale forecast model modules for icing, low level clouds, and precipitation.</li> <li>- Deliver to ARDEC a new method of aiming artillery by applying met corrections along the entire trajectory for better accuracy and enhanced fire support effectiveness.</li> </ul> </li> <li>• 956 - Incorporate full terrain/turbulent scattering acoustic propagation model into next generation weather decision aid systems. <ul style="list-style-type: none"> <li>- Incorporate complex terrain acoustic propagation decision aid.</li> <li>- Integrate joint weather impacts into decision aids for the first digital division weather capability.</li> </ul> </li> <li>• 3152 - Port the IMETS meteorological forecast and weather impact decision aid applications to laptop and desktop computer systems for battlefield portability. <ul style="list-style-type: none"> <li>- Develop a weather data server for distributing IMETS gridded meteorological data and weather impacts data base information to ABCS clients at lower echelons where there is no full IMETS capability.</li> <li>- Install IMETS applications and upgrades on all ABCS C2 systems.</li> <li>- Implement a capability for IMETS to participate with both live and synthetic weather scenarios in live, virtual, and constructive simulation exercises leading to the first digital Army Corps.</li> </ul> </li> </ul> <p>Total 6652</p>		
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BUDGET ACTIVITY <b>2 - Applied Research</b>				PE NUMBER AND TITLE <b>0602784A Military Engineering Technology</b>					PROJECT <b>AT40</b>	
COST <i>(In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT40 Mobility & Weapons Effects Technology	11602	12617	14896	15692	16586	16577	17126	18247	Continuing	Continuing
<p><b>Mission Description and Justification:</b> This project will provide warfighters the technologies for: rapid establishment and repair of lines of communications by both light and heavy engineers in support of U.S. force deployment; designs, materials, and construction methods for battlefield, fixed, and forward base survivability against advanced conventional weapons and terrorist weapons; methodologies to predict and mitigate coastal effects on logistics -over-the-shore (LOTS) operations; reliable and cost-efficient roadways and airfields for CONUS installations to support force projection; camouflage, concealment, and deception for fixed and semi-fixed facilities to deny accurate acquisition and engagement by threat weapon systems; rapid obstacle and barrier creation; and accurate assessments of battlefield mobility for maneuver commanders (and materiel developers during virtual prototyping). Civil engineering science and technology in this project directly supports the Army's DoD Project Reliance S&amp;T responsibilities in airfields and pavements, survivability and protective structures, and sustainment engineering. The work is managed by the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 11602 - Developed simplified survivability analysis procedure for field fortifications; developed camouflage materials and light-weight material revetments for protection of aviation assets; developed/evaluated materials for large area, thermal signature tonedown.             <ul style="list-style-type: none"> <li>- Conducted 3-D lab-scale experiments of rapidly installed breakwater concepts for logistics-over-the-shore operations; developed initial methodology for rapid generation of river basin models for hydrologic forecasting; modeled effects of grid size and time step to determine operational limits.</li> <li>- Developed advanced pavements material characterization and classification procedures; developed new materials and methods for expedient airfield construction; evaluated epoxy/polymer materials for expedient strengthening of roadway surfaces.</li> <li>- Validated algorithms to infer structural attributes that are not available but required for bridge assessments; developed techniques for rapid soils properties determination; evaluated techniques for rapid repair of damaged bridges; developed model to predict roadway deterioration under military unique loads in emerging countries; evaluated techniques for assessing the throughput capacity of the transportation network.</li> <li>- Enhanced NATO Reference Mobility Model for replication of dynamic deformable soil-tire/track interactions; determined impact of mission specific digital terrain data on mobility predictions.</li> </ul> </li> </ul> <p>Total 11602</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 12617 - Develop techniques for troop evaluations of the structural integrity of small protective emplacements; evaluate concepts for application of sprayable multispectral camouflage, cover, and deception (CCD) tonedown agents for large area signature reduction; correlate target structural damage with target type, geometry, and materials and demolition method.</li> </ul>										
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<p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Develop analytic methodologies to predict down-axis ground shock from fully coupled detonations in slabs; complete static and dynamic laboratory experiments and associated analyses of square concrete structural components with large span-to-thickness ratios; develop and validate hardening techniques for roofs to resist vehicle bomb threats.</li> <li>- Design specifications for rapidly installed breakwater; incorporate algorithms into Riverine Analysis Model to calculate probability bands for hydrologic predictions; incorporate real-time nowcast data analyses into logistics-over-the-shore planning model.</li> <li>- Establish criteria and procedures for the use of local materials and equipment for construction of expedient airfields; validate analytic models capable of replicating dynamic pavements and materials response under vehicle loading and multiple tire interactions.</li> <li>- Develop an analytic capability for automated assessment and load classification of bridges; establish procedures for use of soil vitrification for soil stabilization; complete initial software for synergistic allocation of engineer assets within resource constraints to transportation infrastructure maintenance, repair, and construction tasks.</li> <li>- Develop soil constitutive relationships describing the traction performance of tires operating in coarse-grained soils; develop stress distribution model for tire/track/soil contact area; conduct in-situ field experiments to measure normal and tangential forces occurring at the vehicle/soil interface.</li> </ul> <p>Total            12617</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            13896 - Develop infrared signature manipulation techniques for use in expedient decoy construction; perform survivability analysis of protective concepts for key assets in forward logistic nodes.</li> <li>                      - Develop analytic methodologies to predict down axis ground shock from detonation partially above and in burster slab; develop and validate methods for hardening walls to resist terrorist mortar threats.</li> <li>                      - Complete final version of Coastal Integrated Throughput Model; incorporate snow melt capabilities into military hydrologic model.</li> <li>                      - Develop methodology for making short-term forecasts of soil strength based on predicted weather changes.</li> <li>                      - Integrate Improved Bridge Assessment Rehabilitation and Repair (IBARR) code with road assessment algorithms; establish criteria for off-road/bypass evaluation around damaged road networks.</li> <li>                      - Incorporate multiple-wheel interaction and dynamic response analysis into an advanced pavement analysis model.</li> <li>•            1000 - Develop techniques to predict the effects of asymmetric terrorist threats against dams and dam support structures.</li> </ul> <p>Total            14896</p> <p><b>FY 2001 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            14692 - Upgrade survivability analysis algorithms for blast and fragmentation effects to include CCD measures; troop evaluation of protective concepts for base clusters and forward logistic nodes.</li> <li>                      - Develop analytic methodologies to predict down-axis ground shock from detonation partially in and below burster slab; complete dynamic experiments and analyses of square concrete structural components with intermediate span to thickness ratios; develop methods for hardening roofs to resist terrorist mortar threats.</li> </ul>		
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**FY 2001 Planned Program: (continued)**

- Incorporate Coastal Integrated Throughput Model into military hydrologic models and a tactical logistics planning exercise to validate improved, robust basin delineation computer sub-routines.
- Develop operational unit level movement algorithms for representation of maneuver in Army models and simulations.
- Determine techniques for use of indigenous materials in maintenance, repair, and construction of roadways; develop procedures/guidance for engineer resourcing in repair/maintenance of roadways; develop bridge repair/retrofit materials and components; develop methodologies for assessment of impact on roadway components of vehicle speeds, tire pressures, loadings, etc.
- Incorporate reliability concepts into the pavement performance model, incorporate long-term behavior analysis into the advanced pavement analysis model.
- Develop prediction techniques for effects of asymmetric terrorists' threats against locks, levees, and flood control structures.

•	1000
Total	15692

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COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT41 Military Facilities Engineering Technology	3371	3982	4165	4204	4505	4725	5042	5375	Continuing	Continuing
<p><b>Mission Description and Justification:</b> This project exploits innovative developments in a wide range of technologies to achieve critically needed cost reductions in Army facility life cycle processes (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal). Current Army infrastructure operations, maintenance, and repair cost alone is about \$8.5 billion per year. The goal for the DoD Technology Area Plan is to reduce facility acquisition and maintenance and repair costs 15% by FY 2001 from a 1985 baseline. Meeting this critical goal is not possible without application of significant technology innovation. Products already developed and projected for the future have high civilian sector dual use potential. These include innovations in composite materials, concurrent engineering, collaborative decision support, corrosion resistant coatings, seismic vulnerability evaluations, and knowledge processing. Additionally, significant soldier retention benefits also accrue from providing professional work environments and high quality communities for military families. Under the DoD Project Reliance initiative, the Army is responsible for managing the conventional facilities research and development needs of all the military services through the Construction Engineering Research Laboratories, Champaign, Illinois.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3371 - Demonstrated the Open Collaborative Engineering framework for modular design and integrated military facility management.</li> <li>- Initiated development of ferromagnetic active tags to monitor status of military structural building systems.</li> <li>- Developed seismic evaluations and rehabilitation methods for military steel frame buildings.</li> </ul> <p>Total 3371</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3982 - Enhance the Modular Design for Systems to accommodate 80% of Army facility types.</li> <li>- Initiate development of self-repairing facings, coatings, and membranes for military buildings containing distributed reactive materials in inert casings which when released enable self-repair.</li> <li>- Develop criteria for upgrading seismically vulnerable, concrete frame, barracks structures.</li> </ul> <p>Total 3982</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4165 - Develop advanced structural integrity monitoring systems that provide information for assessing structural health, safety and remaining service life.</li> <li>- Develop design criteria for non-specific Electro-osmotic Pulse (EOP) system to prevent structural damage from chronic water seepage through floors, walls, and roofs.</li> <li>- Develop remote corrosion monitoring techniques for coated steel and steel reinforced concrete in water and soil.</li> </ul> <p>Total 4165</p>										
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**FY 2001 Planned Program:**

- 4204 - Develop procedures and protocol for use of ferrous shape memory alloy (SMA) rebar in concrete to provide durable, reduced cost reinforced concrete structures.
- Evaluate infrastructure to support collaborative processes (e.g., engineering activities in the facility design and installation management processes) with the Modular Design System (MDS) version 3.0.
- Develop design guidance for cost effective seismic rehabilitation of unreinforced masonry walls typically found at DoD installations.
- Evaluate a corrosion control selection system that will assist in the proper selection and use of corrosion control materials and technologies based on site conditions and design.

Total 4204

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COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT42 Cold Regions Engineering Technology	4423	4516	3677	3754	3945	4142	4311	4573	Continuing	Continuing
<p><b>Mission Description and Justification:</b> This project is the only DoD applied research program focused on the knowledge base and engineering principles needed to sustain an effective war fighting force in winter and the cold regions of the world, including combat support, combat engineering and base/facility construction, operation and maintenance. Research provides the basis for extending the operability of forces and materiel in cold weather and directly lowers high life-cycle costs and extends the service life of DoD facilities. Research supports readiness and effectiveness of DoD conventional, light and special operations forces in the Arctic, Alaska, Scandinavia, Korea, Japan, Europe, the U.S. northern tier and remote/high altitude environments. This program is a source of special technologies for civilian engineering and environmental applications not obtainable through the private sector and is essential to improving projection of power and operational capabilities in cold weather areas of the world. The work is managed by the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4423 - Generated dynamic integrated IR/MMW winter backgrounds for synthetic scene simulation .</li> <li>- Developed winter effects conditions models for use in Army combat simulations.</li> <li>- Developed methods for expedient stabilization of thawing soils for theater of operations main supply route development and maintenance.</li> </ul> <p>Total 4423</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3256 - Develop guidance for soil modifiers and geosynthetics for expedient, low-volume roads in thawing soils.</li> <li>- Identify engineering activities most sensitive to the winter environment in future combat simulations.</li> <li>- Develop finite element models of tires operating in wet, trafficked snow.</li> <li>- Develop map-based products for millimeter wave and infrared sensor performance for battlespace planning and operations.</li> <li>- Develop asphalt pavement temperature model.</li> <li>• 1200 - Congressionally funded project to develop technology for detection of in-flight, aircraft icing conditions.</li> <li>- Congressionally funded project to develop technology to improve mobility and mine detection along lines of communication in cold regions.</li> <li>• 60 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4516</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3677 - Develop winter climate index characterization manual for snow and soil freezing effects.</li> <li>- Conduct full-scale field study on performance of soil modifiers.</li> <li>- Demonstrate application of physics-based models and visualization to support weapons selection and battle maneuver.</li> </ul> <p>Total 3677</p>										
Project AT42			Page 13 of 21 Pages				Exhibit R-2A (PE 0602784A)			

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BUDGET ACTIVITY  
**2 - Applied Research**

PE NUMBER AND TITLE  
**0602784A Military Engineering Technology**

PROJECT  
**AT42**

**FY 2001 Planned Program:**

- 3754 - Integrate multi-spectral sensor performance products into 3D terrain visualization.  
- Evaluate thawed soil stabilization techniques for base camps and expedient roadways.  
- Complete large scale ice load map/capability including accreted snow and in-cloud icing.

Total 3754

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology				PROJECT AT45		
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT45 Energy Technology Applied to Military Facilities	2243	2386	2583	2796	2851	3024	3252	3464	Continuing	Continuing
<p><b>Mission Description Justification:</b> Energy is essential for the modern Army to meet its mission. The research conducted in this project provides the technology for providing energy efficient facilities, adapting new energy source technologies to military facilities, applying cost effective renewable energy technologies for Army uses, and improving the efficiency of Army central energy plants. Research focuses on leveraging industry technology investments and integrating a broad range of advanced technologies into a comprehensive system to meet the specialized needs of the Army utilities systems. Activities include modeling and simulation of thermal loops and electrical systems, developing new analytic techniques, and incorporating new system designs and hardware in conjunction with industry. Research products are transferred to the field and used in new construction and in upgrades of existing facilities. The Executive Order implementing the Energy Policy Act of 1992 requires the Army to reduce energy consumption 20% by 2001 from the 1985 baseline. New technologies and procedures also support Army goals for improved air quality, sustainable design, and expanding the use of energy savings performance contracts. This project is managed by the Construction Engineering Research Laboratories, Champaign, Illinois.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2243 - Developed methodology to optimize mix of centralized and decentralized energy supply options for Army facilities.</li> <li>- Developed application strategy for fuel cell technology.</li> <li>- Developed object/data model for use in exporting HVAC information to commercial 3-D design software.</li> <li>- Demonstrated building recommissioning at Fort Campbell, KY facilities in partnership with Louisville District Corps of Engineers.</li> </ul> <p>Total 2243</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2386 - Complete self-tuning adaptive control algorithms for utility plant automation.</li> <li>- Develop methodology for optimizing electrical distribution and supply to Army facilities.</li> <li>- Develop concurrent engineering principles for community design concepts between electrical and mechanical building systems.</li> </ul> <p>Total 2386</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2583 - Screening, design and application tools for hybrid cooling systems.</li> <li>- Complete design package with 3-D visualization and interference check.</li> <li>- Technical specifications for meeting utility automation goals.</li> <li>- Technology infusion process for building energy systems.</li> <li>- Process energy and pollution reduction (PEPR) program with expert system capabilities.</li> </ul> <p>Total 2583</p>										
Project AT45			Page 15 of 21 Pages				Exhibit R-2A (PE 0602784A)			

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BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602784A Military Engineering Technology</b>	PROJECT <b>AT45</b>
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**FY 2001 Planned Program:**

- 2796 - Field demonstration of utility automation system.
- Automate selection/design practice for hybrid cooling systems.
- Field demonstration of process energy and pollution reduction (PEPR) program.
- Conceptual design for regional planning tool for Army installation energy supply and demand.

Total 2796

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<b>ARMY RDT&amp;E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)</b>	DATE <b>February 1999</b>
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<b>BUDGET ACTIVITY</b> <b>2 - Applied Research</b>	<b>PE NUMBER AND TITLE</b> <b>0602784A Military Engineering Technology</b>	<b>PROJECT</b> <b>AT46</b>
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COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT46 Climate Change Fuel Cell Technology	7026	2967	0	0	0	0	0	0	0	9993

**Mission Description and Justification:** Funds for this project were provided by Congress in FY98 and FY99. Recent DoD demonstrations of stationary phosphoric acid fuel cells (PAFC) have shown them to be clean, reliable, efficient and high quality sources of energy. The purpose of this project is to provide additional research to reduce system capital cost, expand applications to megawatt size systems, and develop a capability to use for available fuels. This funding will increase DOD's ability to more effectively use clean and efficient combined heat and power technology and accelerate the use of fuel cell technology for military deployment and in-theater operations. The research will be jointly executed by the U.S. Army Construction Engineering Research Laboratories, U.S. Army Armament Research Development Center, U.S. Air Force Research Laboratory, and the National Defense Center for Environmental Excellence (NDCEE).

**FY 1998 Accomplishments:**

- 7026 - Work will continue in FY99 with FY98 funds. A test unit has been installed at NDCEE. Work will be completed in FY99 and will include:  
 Address power plant system's integration for multi-unit control.  
 Evaluate cost reduction for cell stack and power conditioners.  
 Develop plan for field demonstration at an Army site.

Total 7026

**FY 1999 Planned Program:**

- 2889 - This work will build on and complete tasks initiated in FY98 to include:  
 Implementing component testing at NDCEE  
 Validating methods of reforming available fuels (no non-DoD fuels)  
 Monitoring currently operational DoD PAFCs
- 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2967

**FY 2000 Planned Program:** Program not funded in FY 2000.

**FY 2001 Planned Program:** Program not funded in FY 2001.

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<b>ARMY RDT&amp;E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)</b>								DATE <b>February 1999</b>		
BUDGET ACTIVITY <b>2 - Applied Research</b>				PE NUMBER AND TITLE <b>0602784A Military Engineering Technology</b>				PROJECT <b>AT47</b>		
COST <i>(In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT47 Molten Carbonate Fuel Cell Technology	6000	0	0	0	0	0	0	0	0	6000
<p><b>Mission Description and Justification:</b> Recent DoD demonstrations of stationary phosphoric acid fuel cells (PAFC) have shown them to be clean, reliable, efficient and high quality sources of energy. The Department of Energy (DOE) molten carbonate fuel cell (MCFC) program objectives are to develop and demonstrate cost-effective fuel cell power generation, which can be commercialized initially using natural gas fuel. The DOE program focus is on MCFC, because it offers higher efficiencies, the potential for lower capital cost, and because of higher operating temperatures, are more suitable for combined heat and power applications than PAFCs. This technology will allow an even wider application of combined heat and power technology for the modernization of decaying utility infrastructure at DoD sites. DOE, in cooperation with the Electric Power Research Institute (EPRI), Gas Research Institute (GRI), and DoD, has previously funded product development tests (PDT) concurrently with system development at the Energy Research Corporation (ERC) and M-C Power (MCP). The initial MCFC PDTs were in California in 1997. ERC conducted a 2-MW PDT in Santa Clara, California, funded by the Santa Clara Demonstration Group, EPRI, and DOE. MCP conducted a 250-kW PDT in San Diego, California, funded by DOE, GRI, and San Diego Gas and Electric at the Miramar Naval Air Station.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 6000 - Work will carry-over into and be completed in FY99 with the FY98 funds and will include: <ul style="list-style-type: none"> <li>Modifications to cell stack, inverter, and power plant modules to reduce cost and improve performance.</li> <li>Fuel processor modifications for alternative fuels to meet Department of Army mobility fuel requirements.</li> <li>Developing plan for field demonstration of MCFC at an Army site.</li> <li>Completing research efforts with two HBCU/MIs for investigating MCFC performance parameters.</li> </ul> </li> </ul> <p>Total 6000</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 1999.</p> <p><b>FY 2000 Planned Program:</b> Program not funded in FY 2000.</p> <p><b>FY 2001 Planned Program:</b> Program not funded in FY 2001.</p>										
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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology					PROJECT AT48	
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT48 Center for Geosciences and Atmospheric Research	7086	0	0	0	0	0	0	0	0	7086
<p><b>Mission Description and Justification:</b> Through the Center for Geosciences and Atmospheric Research at Colorado State University, this project develops and transitions geoscience technology in hydrometeorology, cloud dynamics, remote sensing, and meteorological modeling to tri-service geosciences programs. The project impacts Army weather programs in terrain mobility and atmospheric tactical support, Air Force cloud research programs, and Navy meteorological modeling development. It provides direct support to the Defense Technology Objectives, Atmospheric Impacts on Sensors Systems, and On-Scene Weather Sensing and Prediction Capability.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 7086 - Established a cooperative agreement to execute a four year research program. <ul style="list-style-type: none"> <li>- Defined first year's goals for technology transfer and scientific exchange.</li> <li>- Established an effective transition of geosciences technology from the university to DoD labs through a program that uses but is not limited to bilateral temporary resident assignments of scientists and engineers from the university and DoD labs, extended seminar programs, and assisted software transfers.</li> <li>- Work will carry-over into and be completed in FY02 using the FY98 funds. Planned four year program will: <ul style="list-style-type: none"> <li>Adapt cloud drift winds model to profiler and Integrated Meteorological System (IMETS).</li> <li>Transition neural network cloud classification system to Air Force Combat Climatology Center.</li> <li>Adapt soil temperature and moisture remote sensing methods for incorporation into IMETS.</li> <li>Develop cloud microphysics radiative transfer methods to mesoscale models.</li> <li>Determine remote sensed bulk aerosol properties for visibility sensing.</li> <li>Assess cloud forecasting capability of percentage cover of low and mid-level clouds.</li> <li>Automate cloud drift wind determination.</li> <li>Integrate hydrometeorology and flood forecasting.</li> </ul> </li> </ul> </li> </ul> <p>Total 7086</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 1999.</p> <p><b>FY 2000 Planned Program:</b> Program not funded in FY 2000.</p> <p><b>FY 2001 Planned Program:</b> Program not funded in FY 2001.</p>										
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology					PROJECT AT49	
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT49 University Partnering for Operational Support	0	2980	0	0	0	0	0	0	0	2980
<p><b>Mission Description and Justification:</b> This program develops and applies operational, fine-scale forecast models of basic meteorological variables for inclusion in Air Force Weather Agency (AFWA) modeling capabilities supporting Army tactical requirements. These efforts include enhancements to operational mesoscale prediction models that predict and forecast icing, turbulence, soil moisture, surface fluxes as well as chemical/biological and smoke plume dispersion.</p> <p><b>FY 1998 Accomplishments:</b> Program not funded in FY 1998.</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2902 - Develop and complete enhanced fine scale arctic weather prediction using current models upgraded for use at higher resolutions for Army applications.               <ul style="list-style-type: none"> <li>- Develop and complete improved methods of forecasting icing and turbulence for Army air operations.</li> <li>- Develop and complete improved modeling of surface fluxes and soil moisture that affect army logistics operations.</li> <li>- Develop and complete improved high latitude bio/chem plume dispersion techniques that will enhance the capability to identify and predict chemical/biological agents atmospheric flow patterns.</li> <li>- Develop and complete improvements in the atmospheric path characterization capabilities that will enhance target detection and tracking.</li> </ul> </li> <li>• 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2980</p> <p><b>FY 2000 Planned Program:</b> Program not funded in FY 2000</p> <p><b>FY 2001 Planned Program:</b> Program not funded in FY 2001</p>										
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602784A Military Engineering Technology					PROJECT AT50	
COST (In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT50 Enhanced Geographic Synthetic Aperture	0	7947	0	0	0	0	0	0	0	7947
<p><b>Mission Description and Justification:</b> The program will develop and build a unique, dual frequency (X-band and P-band) airborne interferometric Synthetic Aperture Radar (SAR) and associated processing system for terrain mapping. The program will provide all-weather mapping under foliage and/or bare earth. Resulting products will enhance military operations dependent on timely, accurate, true ground surface elevation data. The effect of terrain on mobility can be evaluated more precisely with this capability. The program may yield a civil capability in land use, flood prediction, and environmental impact analyses.</p> <p><b>FY 1998 Accomplishments:</b> Program not funded in FY 1998 with Army funds. Program currently funded by DARPA in FY 1998 and will be transferred to the Army in FY 1999.</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7736 - Demonstrate and complete end-to-end product capability of X-band part of system for high resolution digital elevation model generation. X-band capability exists in current configuration.             <ul style="list-style-type: none"> <li>- Integrate P-band into the aircraft and verify operational capability.</li> <li>- Evaluate, modify, and complete upgrade of software to generate topographic products.</li> </ul> </li> <li>• 211 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7947</p> <p><b>FY 2000 Planned Program:</b> Program not funded in FY 2000</p> <p><b>FY 2001 Planned Program:</b> Program not funded in FY 2001</p>										

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