

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 2000			
BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology				PROJECT 632822		
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
632822	Space Environmental Impact Tests	3,263	4,027	3,412	3,746	4,307	4,383	4,953	Continuing	TBD
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0
<p>(U) <u>A. Mission Description</u> This program's objectives are to improve the survivability and reliability of current and future DoD space systems, and develop and demonstrate cost-effective solutions to mitigate hazardous space-environmental interactions. These hazards include dangerous electrical discharges due to excess charge buildup on spacecraft components, degradation, and failure of structures and electronics due to long-term radiation doses, and single-event upsets (processor errors, memory corruption, etc.) due to high-energy penetrating radiation. As DoD dependence on space systems for mission critical operations and the use of unhardened commercial components increase, these effects will become more prevalent and serious. Advanced technology goals of this program are: (1) develop and demonstrate small, low-power, high performance space environmental monitoring systems; (2) provide improved specifications and analysis tools for design and application of advanced components and systems in DoD space systems; and (3) develop an autonomous on-board space-environmental hazard detection and control system to provide real-time warning and mitigation of space-environmental conditions likely to cause degraded satellite performance. These goals will be achieved through continued analysis and exploitation of data from current and past space experiments and through space flight of new experiments and prototype systems that investigate areas of concern to DoD spacecraft operations. Note: In FY 2000, Congress added \$0.4 million for space survivability.</p> <p>(U) <u>FY 1999 (\$ in Thousands)</u></p> <p>(U) \$1,959 Launched upgraded space plasma sensor and began development of a third-generation sensor for a flight with the Communications/Navigation Outage Forecast System (C/NOFS) to support Air Force Space Command environment specification and forecast systems.</p> <p>(U) \$644 Executed joint program with National Aeronautics and Space Administration (NASA) to improve high-voltage spacecraft charging hazard analysis tools for DoD and NASA spacecraft.</p> <p>(U) \$660 Supported joint United States/British Space Test Program to provide on-board hazard detection of space environmental conditions that degrade satellite performance. Began design of small passive spacecraft charge control system to eliminate spacecraft charging hazards.</p> <p>(U) \$3,263 Total</p>										
Project 632822			Page 1 of 4 Pages				Exhibit R-2 (PE 0603410F)			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		PROJECT
03 - Advanced Technology Development	0603410F Space Systems Environmental Interactions Technology	February 2000 632822
(U) <u>A. Mission Description Continued</u>		
(U) <u>FY 2000 (\$ in Thousands)</u>		
(U) \$1,200	Develop environmental sensors to specify and forecast scintillation and other hazardous space environmental conditions that degrade satellite systems and communications. Communications/navigation outage forecasting allows preemptive use of alternate links in times of outages to maintain communication for the warfighter. Specifying and predicting hazardous space conditions will allow improved system design, lifetime, and operational capabilities. Conduct space flight test to demonstrate capability of advanced space plasma sensor to detect environment irregularities that impact Command, Control, Communications, and Intelligence (C3I). Complete fabrication of space-based, all-sky camera for detecting solar disturbances; begin integration for space flight test. Complete fabrication of relativistic electron and proton detector with capabilities to determine spectral resolution of the most damaging high-energy particle populations.	
(U) \$1,325	Support initiatives to improve capability to specify and predict space environmental impacts on operational space systems such as spacecraft charging and meteor effects. Spacecraft design and space environment specification and analysis tools are required to improve space system performance, reduce cost, and provide for situational awareness and anomaly resolution for more miniaturized spacecraft, electromagnetic propulsion, and high-power systems. Complete and release dynamic Air Force geosynchronous space codes for space environment specification and effects determination. Complete spacecraft charging analysis tool for geosynchronous environments affecting many DoD communications and surveillance spacecraft. Develop web-based spacecraft charging design tool.	
(U) \$1,107	Develop technology to warn of spacecraft charging and other deleterious conditions for DoD and commercial spacecraft and investigate technologies for alteration of space particle environment. The ability to specify and warn of spacecraft charging and related hazards, which can cause component and system level failures, will prevent loss of space assets and capabilities and will provide a capability for a global situational awareness of hazards. Space particle control technology will permit the reduction of hazardous particle environments for naturally or artificially triggered events and the enhancement of particle environments to degrade hostile assets. Demonstrate capability of compact environment anomaly sensors to specify hazardous conditions local to the spacecraft on two space test flights in differing orbits and validate concept of operations to provide global situational awareness by cross-calibration.	
(U) \$395	Develop miniaturized chemical contamination and kinetic impact sensors for DoD operational spacecraft. Develop tools for space environmental effects specification and analysis compatible with DoD operational software systems. Advanced space optical systems, such as the planned space-based laser, are extremely sensitive to chemical contamination and require on-board, autonomous systems to monitor and warn of performance degradation. Develop space environment specification and analysis tools that are user-friendly, low-cost, and run on commonly available operational platforms. Design of space environment distributed anomaly sensor for space particle, chemical contamination, and kinetic impact hazards. Transition of leading Air Force space environment specification and analysis software to common Air Force operating system.	
(U) \$4,027	Total	
Project 632822	Page 2 of 4 Pages	Exhibit R-2 (PE 0603410F)

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 2000																														
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology																															
PROJECT 632822																																
<p>(U) <u>A. Mission Description Continued</u></p> <p>(U) <u>FY 2001 (\$ in Thousands)</u></p> <p>(U) \$1,396 Complete ground testing of space environmental sensor for flight with the Communications/Navigation Outage Forecast System (C/NOFS). Support integration, launch, and on-orbit operations of instrumentation to provide improved space radiation hazard specification and forecasting. Complete space test of plasma sensor prototype for C/NOFS spacecraft. Complete integration of space-based, all-sky camera to detect solar disturbances. Begin integration of relativistic electron and proton detector for mission to map the dynamic radiation belts and quantify the hazards to space systems.</p> <p>(U) \$1,071 Advance spacecraft survivability through collaborative experiments and development of design tools needed for advanced power, communications, and surveillance systems. Complete web-based spacecraft charging design tool. Begin analysis of miniaturized charge control system and space power tether system performance.</p> <p>(U) \$945 Develop technology to warn of spacecraft charging, chemical contamination, and kinetic impact hazards to DoD and commercial spacecraft. Develop technologies to mitigate the effect of the space environment on DoD space systems. Technologies to control the level of spacecraft charging and high-energy radiation effects will significantly improve space system reliability and availability, reduce operational costs, and provide techniques to degrade hostile space assets. Complete compact environment anomaly sensor validation. Demonstrate new compact environment anomaly sensor capabilities for geosynchronous orbit environments on Air Force operational satellites. Begin transition and integration of prototype miniaturized charge control system into spacecraft. Begin ground-tests of global particle enhancement and depletion technologies.</p> <p>(U) \$3,412 Total</p> <p>(U) <u>B. Budget Activity Justification</u> This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.</p> <p>(U) <u>C. Program Change Summary (\$ in Thousands)</u></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;"></th> <th style="text-align: center;"><u>FY 1999</u></th> <th style="text-align: center;"><u>FY 2000</u></th> <th style="text-align: center;"><u>FY 2001</u></th> <th style="text-align: center;"><u>Total Cost</u></th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 2000 PBR)</td> <td style="text-align: center;">3,436</td> <td style="text-align: center;">3,677</td> <td style="text-align: center;">4,021</td> <td></td> </tr> <tr> <td>(U) Appropriated Value</td> <td style="text-align: center;">3,457</td> <td style="text-align: center;">4,077</td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">a. Congressional/General Reductions</td> <td style="text-align: center;">-21</td> <td style="text-align: center;">-1</td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">b. Small Business Innovative Research</td> <td style="text-align: center;">-81</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>	(U) Previous President's Budget (FY 2000 PBR)	3,436	3,677	4,021		(U) Appropriated Value	3,457	4,077			(U) Adjustments to Appropriated Value					a. Congressional/General Reductions	-21	-1			b. Small Business Innovative Research	-81			
	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>																												
(U) Previous President's Budget (FY 2000 PBR)	3,436	3,677	4,021																													
(U) Appropriated Value	3,457	4,077																														
(U) Adjustments to Appropriated Value																																
a. Congressional/General Reductions	-21	-1																														
b. Small Business Innovative Research	-81																															
Project 632822	Page 3 of 4 Pages	Exhibit R-2 (PE 0603410F)																														

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE February 2000																																			
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603410F Space Systems Environmental Interactions Technology			PROJECT 632822																																			
<p>(U) <u>C. Program Change Summary (\$ in Thousands) Continued</u></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:55%;"></th> <th style="text-align: center;"><u>FY 1999</u></th> <th style="text-align: center;"><u>FY 2000</u></th> <th style="text-align: center;"><u>FY 2001</u></th> <th style="text-align: center;"><u>Total Cost</u></th> </tr> </thead> <tbody> <tr> <td> c. Omnibus or Other Above Threshold Reprogram</td> <td></td> <td style="text-align: center;">-22</td> <td></td> <td></td> </tr> <tr> <td> d. Below Threshold Reprogram</td> <td style="text-align: center;">-74</td> <td></td> <td></td> <td></td> </tr> <tr> <td> e. Rescissions</td> <td style="text-align: center;">-18</td> <td style="text-align: center;">-27</td> <td></td> <td></td> </tr> <tr> <td> f. Other</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Budget Years Since FY 2000 PBR</td> <td></td> <td></td> <td style="text-align: center;">-609</td> <td></td> </tr> <tr> <td>(U) Current Budget Submit/FY 2001 PBR</td> <td style="text-align: center;">3,263</td> <td style="text-align: center;">4,027</td> <td style="text-align: center;">3,412</td> <td style="text-align: center;">TBD</td> </tr> </tbody> </table> <p>(U) <u>Significant Program Changes:</u> Not Applicable.</p> <p>(U) <u>D. Other Program Funding Summary (\$ in Thousands)</u></p> <p>(U) Related Activities:</p> <p>(U) PE 0602601F, Spacecraft Technology.</p> <p>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p> <p>(U) <u>E. Acquisition Strategy</u> Not Applicable.</p> <p>(U) <u>F. Schedule Profile</u> Not Applicable.</p>		<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>	c. Omnibus or Other Above Threshold Reprogram		-22			d. Below Threshold Reprogram	-74				e. Rescissions	-18	-27			f. Other					(U) Adjustments to Budget Years Since FY 2000 PBR			-609		(U) Current Budget Submit/FY 2001 PBR	3,263	4,027	3,412	TBD				
	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>																																			
c. Omnibus or Other Above Threshold Reprogram		-22																																					
d. Below Threshold Reprogram	-74																																						
e. Rescissions	-18	-27																																					
f. Other																																							
(U) Adjustments to Budget Years Since FY 2000 PBR			-609																																				
(U) Current Budget Submit/FY 2001 PBR	3,263	4,027	3,412	TBD																																			
Project 632822	Page 4 of 4 Pages	Exhibit R-2 (PE 0603410F)																																					