

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1998	
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology					
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	72,925	54,899	42,571	47,005	50,961	53,980	53,781	Continuing	Continuing
1026 Space Structures and Controls Technology	1,058	940	1,788	3,181	3,937	3,516	3,571	Continuing	Continuing
2181 Space Electronics and Software Technology	11,975	12,707	12,982	14,758	13,996	15,182	13,375	Continuing	Continuing
3784 Space Sensors and Satellite Communication Technology	2,177	2,710	1,760	3,556	4,273	3,865	3,930	Continuing	Continuing
3834 Integrated Space Technology Demonstrations	37,847	17,739	20,447	18,255	19,034	20,780	21,867	Continuing	Continuing
4400 Satellite Survivability Technology	5,734	5,310	826	1,294	2,021	3,271	3,514	Continuing	Continuing
4599 Reusable Launch Vehicle Technology	9,579	11,715	0	0	0	0	0	TBD	TBD
682J Space Power and Thermal Management Technology	4,555	3,778	4,768	5,961	7,700	7,366	7,524	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program develops advanced spacecraft technologies such as structures, electronics, thermal, power, and sensors; and demonstrates them in an appropriate fashion (i.e., component or system, ground, or flight). The broad goals of the program are to decrease the time for innovative space technology to be transitioned to the warfighter and to reduce the associated development costs and risks of future Air Force space-based systems. Developmental efforts are focused on six high-payoff, satellite technology areas: (1) reusable launch vehicle technologies; (2) advanced space structures and structural controls; (3) hardened space electronics and satellite control software; (4) advanced passive/active space-based sensors and satellite communications; (5) compact, low-cost space power and thermal management; and (6) satellite survivability. Note: Congress added \$37 million in FY 1997 (\$10 million for Reusable Launch Vehicle (RLV) technology, \$25 million for Microsat development, and \$2 million for Miniature Threat Reporting System) and \$17.5 million in FY 1998 (\$5 million for Low-Cost Launch Vehicle Technologies [previously funded in PE 0603302F/0634373], \$7.5 million for Solar Thermionics Orbital Transfer Vehicle, and \$5 million for Miniature Threat Reporting System) which explains the perceived decrease in FYs 1999 and out. In FYs 1999 and out, additional emphasis has been placed on evolutionary growth in space technologies. Funds added by the Congress in FY 1998 for RLV (Military Spaceplane) and Microsat (Clementine 2) were line item vetoed by the President. Note: Project 4599 was previously called Project 0003, Reusable Launch Vehicle Technology. However, in FY 1996, this project was moved to PE 0603302F, Space and Missile Launch Technology, and renamed Launch Vehicle Technology to allow for Air Force investigation of all reusable and expendable launch technologies. In FY 1997, the only funds remaining in Project 0003 in PE 0603401F were the funds added by Congress specifically for Reusable Launch Vehicle

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technology. To avoid confusion with Project 0003, Launch Vehicle Technology, in PE 0603302F, Project 0003 in PE 0603401F was renumbered Project 4599, keeping its Reusable Launch Vehicle title. In FY 1998, the low-cost launch vehicle technology development program was moved from PE 0603302F, Project 4373, to this project.

(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total Cost</u>
(U) Previous President's Budget (FY 1998 PB)	73,215	40,846	44,679	Cont
(U) Appropriated Value	76,637	98,346		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-1,728	-2,112		
b. SBIR	-1,694	-1,335		
c. Omnibus/Other Above Threshold Reprogrammings				
d. Below Threshold Reprogrammings	-290			
e. Recissions				
f. Line Item Veto		-40,000		
(U) Adjustments to Budget Year Since FY 1998 PB			-2,108	
(U) Current Budget Submit/FY 1999 PB	72,925	54,899	42,571	Cont

(U) Change Summary Explanation:
 Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

 Schedule: Not Applicable.

 Technical: Not Applicable.

(U) C. **Other Program Funding Summary:** Not Applicable.

(U) D. **Schedule Profile:** Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 1026
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COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1026 Space Structures and Controls Technology	1,058	940	1,788	3,181	3,937	3,516	3,571	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project demonstrates advanced composite structures and structural control technologies for future Air Force space and missile systems. Prior to FY 1995, the Air Force relied on Ballistic Missile Defense Organization (BMDO) funding to address its needs in this technology area. As BMDO budgets have declined, so has their funding in this area, necessitating an increased Air Force investment to maintain critical spacecraft structures and controls technologies. Advanced space structure component efforts focus on the demonstration of new composite structure technologies. The goal is to significantly improve the payload mass fraction and reduce overall spacecraft fabrication time and cost. This project also pays for the development of advanced passive and active spacecraft structural control technologies. Structural vibration and shock suppression technologies are intended to significantly enhance space platform stability, improving the focusing/imaging ability of space-based optical components such as focal plane arrays developed in Project 3784 or solar cells developed in Project 682J.

(U) FY 1997 (\$ in Thousands):

- (U) \$484 Developed advanced spacecraft structure technologies.
 - (U) Completed first phase of multifunctional structure technology demonstration.
 - (U) Developed advanced lightweight spacecraft structure for MightySat.
- (U) \$244 Developed advanced spacecraft structural control and mechanisms technologies.
 - (U) Completed first phase of joint technology demonstration program to isolate sensitive payloads from on-orbit disturbances. System to be flight demonstrated on Space Test Research Vehicle 2 (STRV2.)
 - (U) Continued joint program to develop advanced mechanisms which will revolutionize the design of solar array subsystems. System will be flight demonstrated in FY 1999 as part of National Aeronautics and Space Administration (NASA) Earth Observation-1 (EO-1) mission.
- (U) \$330 Developed advanced spacecraft launch vibration isolation system.
 - (U) Completed preliminary design of launch vibration isolation system. System to support first military Evolved Expendable Launch Vehicle (EELV) launch in FY 2001.
- (U) \$1,058 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 1026
(U) <u>FY 1998 (\$ in Thousands):</u>		
– (U)	\$21	Develop advanced spacecraft structure technologies.
		– (U) Initiate conformal grid stiffened cryogenic propellant tank program.
– (U)	\$340	Develop advanced spacecraft structural control and mechanisms technologies.
		– (U) Complete flight demonstration program to isolate sensitive payloads from on-orbit disturbances on Space Test Research Vehicle 2 (STRV2.)
		– (U) Complete joint program to develop advanced mechanisms which will revolutionize the design of solar array subsystems. System will be flight demonstrated in FY 1999 as part of National Aeronautics and Space Administration (NASA) Earth Observation-1 (EO-1) mission.
– (U)	\$579	Develop advanced spacecraft launch vibration isolation system.
		– (U) Complete design of launch vibration isolation system and begin fabrication to support first military Evolved Expendable Launch Vehicle (EELV) launch in FY 2001.
– (U)	\$940	Total
(U) <u>FY 1999 (\$ in Thousands):</u>		
– (U)	\$755	Develop advanced spacecraft structures technologies.
		– (U) Initiate lightweight space-based antenna structure flight experiment.
– (U)	\$441	Develop advanced spacecraft structural control and mechanisms technologies.
		– (U) Complete flight demonstration of component isolation system program to isolate sensitive payloads from on-orbit disturbances.
		– (U) Fabricate and qualify miniature isolation system for sensors and communications systems.
– (U)	\$592	Develop advanced spacecraft launch vibration isolation system.
		– (U) Fabricate and qualify the launch vibration isolation system to support first military EELV launch in FY 2001.
– (U)	\$1,788	Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 1026
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(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total Cost</u>
(U) Previous President's Budget (FY 1998 PB)	1,058	987	2,544	Cont
(U) Current Budget Submit/FY 1999 PB	1,058	940	1,788	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 1998		
BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology				PROJECT 2181	
<i>COST (\$ In Thousands)</i>	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2181 Space Electronics and Software Technology	11,975	12,707	12,982	14,758	13,996	15,182	13,375	Continuing	Continuing
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This project funds the demonstration and evaluation of electronic hardware and software. Improved space-qualifiable electronics and software for data and signal processing are to be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., hardening) commercial data and signal processor technologies for use in Air Force space systems. Advanced electronic packaging technologies that reduce weight and volume are being developed for military space applications. Space data processor technologies like the Advanced Technology Insertion Module (ATIM 32-bit) technology are developed and demonstrated. The Advanced Spaceborne Computer Module (ASCM), ATIM's 16-bit predecessor, is currently baselined into 65 DoD, National Aeronautics and Space Administration (NASA), and commercial programs. Also developed and demonstrated are space signal processor technologies like the Hardened Ada Signal Processor (HASP) program. For mid-term applications, the Improved Space Computer Program (ISCP) will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century DoD satellites. Low-cost, easily modifiable software and hardware architectures for ground control, satellite components, and autonomous satellite operations are also developed. The Multi-mission Advanced Ground Intelligent Control (MAGIC) program in this project has developed a low-cost, flexible architecture for satellite control and mission operations. In the long-term, this project area focuses on developing an integrated avionics-like architecture for satellites where high-speed data busses centralize many of the functions now distributed on the spacecraft. Additionally, this project demonstrates very low-power electronics allowing dramatic size, weight, and power reductions for future Air Force Space applications.</p>									
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	2181
<p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$6,722 Developed space-qualifiable, advanced low-power, hardened data processors and memory technologies. <ul style="list-style-type: none"> - (U) Fabricated space-qualifiable 32-bit processor-based computers and demonstrated the full range of performance capabilities. - (U) Designed an advanced, high throughput, low-power data processor based on commercial technology. - (U) \$1,242 Developed space-qualifiable, hardened signal processor electronics technologies. <ul style="list-style-type: none"> - (U) Fabricated silicon on insulator (SOI) version of space-qualifiable digital signal processor. - (U) Evaluated the ability of both bulk silicon and SOI versions of the digital signal processor to perform in the space environment. - (U) \$1,337 Developed space-qualifiable, advanced, mixed-signal electronics packaging technology such as three-dimensional (3-D) wafer scale integration. <ul style="list-style-type: none"> - (U) Began demonstration of integrated sensor processing 3-D electronics assembly in robust space-qualifiable configuration. - (U) Began demonstration of improved multi-chip module technology by constructing a complex multi-processor system. - (U) \$2,483 Developed reusable, standardized satellite operations software. <ul style="list-style-type: none"> - (U) Continued enhancing multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expanded software to include independent decision making capability. - (U) Continued development of technologies for artificial intelligence assisted satellite operator systems. - (U) Continued software support of the satellite command and control system upgrade. - (U) \$191 Designed and developed space-qualifiable silicon components using advanced micro-electro-mechanical systems (MEMS) techniques. <ul style="list-style-type: none"> - Evaluated the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment. - Designed advanced experimental MEMS devices and demonstrated their performance in a space environment. - (U) \$11,975 Total 		
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 2181
<p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$8,611 Develop affordable, space-qualifiable, low-power, high performance microelectronic technologies (processors, memories, gate arrays, etc.). <ul style="list-style-type: none"> – (U) Complete space-qualifiable 32-bit processor-based components and demonstrate the full range of performance capabilities. – (U) Continue design of an advanced, high throughput, low-power data processor based on commercial technology. – (U) Complete design of silicon-on-insulator (SOI) version of the space-qualifiable digital signal processor. – (U) Complete evaluation of the ability of both bulk silicon and SOI versions of the digital signal processor to perform in the space environment. – (U) \$1,142 Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices. <ul style="list-style-type: none"> – (U) Continue developing integrated three-dimensional (3-D) sensor processing electronics in robust space-qualifiable configuration. – (U) Continue improving multi-chip module technology by constructing a complex multi-processor system; evaluate in space environment. – (U) \$2,643 Develop reusable, standardized satellite operations software. <ul style="list-style-type: none"> – (U) Complete enhancements for multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expansion of software to include independent decision making capability. – (U) Complete development of artificial intelligence assisted satellite operator systems. – (U) Initiate development of integrated applications for modeling and simulation technologies. – (U) Continue software support of the satellite command and control system upgrade; initiate software engineering effort for space-based autonomous operations. – (U) \$311 Design and develop space-qualifiable silicon components using advanced micro-electro-mechanical systems (MEMS) techniques. <ul style="list-style-type: none"> – (U) Continue to evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment. – (U) Complete design advanced experimental MEMS devices and demonstrate their performance in a space environment. – (U) Continue fabrication of solid state micro-mechanical guidance instruments. – (U) \$12,707 Total 		
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BUDGET ACTIVITY		February 1998
3 - Advanced Technology Development	PE NUMBER AND TITLE	PROJECT
	0603401F Advanced Spacecraft Technology	2181
(U) <u>FY 1999 (\$ in Thousands):</u>		
- (U) \$8,660	Develop affordable, space-qualifiable, low-power, high performance microelectronic technologies (processors, memories, gate arrays, etc.).	
	- (U) Continue design of an advanced, high throughput, low-power data processor based on commercial technology.	
	- (U) Develop integrated space computer version of advanced digital signal processor to perform in the space environment.	
	- (U) Initiate development of advanced next-generation digital signal processing technology and scaleable multi-processor arrays.	
	- (U) Develop space-qualifiable high-performance electronics that provide maximum flexibility to space system designers (e.g., high-gate-count field programmable gate arrays).	
- (U) \$1,147	Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices.	
	- (U) Continue integrated three-dimensional (3-D) sensor processing electronics assembly in robust space-qualifiable configuration.	
	- (U) Continue improving multi-chip module technology by constructing a complex multi-processor system; evaluate in space environment.	
- (U) \$2,223	Develop reusable, standardized satellite operations software.	
	- (U) Continue to integrate and test space-based autonomous satellite operations software system technologies.	
	- (U) Continue development of integrated applications for modeling and simulation technologies.	
	- (U) Continue software support of the satellite command and control system upgrade.	
- (U) \$39	Design and develop space-qualifiable silicon components using advanced micro-electro-mechanical systems (MEMS) techniques.	
	- (U) Continue to evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.	
	- (U) Complete design of advanced experimental MEMS devices and demonstrate their performance in a space environment.	
- (U) \$913	Develop real-time space simulation for training and Concept of Operations (CONOPs).	
	- (U) Enhance simulation architecture for real-time and variable fidelity operations.	
	- (U) Continue development of advanced bus health and status models for autonomous operations.	
	- (U) Upgrade fidelity of surveillance payload models.	
- (U) \$12,982	Total	

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 2181		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>				
	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total</u> <u>Cost</u>
(U) Previous President's Budget (FY 1998 PB)	11,975	13,632	13,036	Cont
(U) Current Budget Submit/FY 1999 PB	11,975	12,707	12,982	Cont
(U) Change Summary Explanation:				
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.				
Schedule: Not Applicable.				
Technical: Not Applicable.				
(U) C. <u>Other Program Funding Summary:</u>				
(U) Related Activities:				
- (U) PE 0303601F, MILSTAR Satellite Communications System.				
- (U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).				
- (U) PE 0602601F, Phillips Laboratory.				
- (U) PE 0603311F, Ballistic Missile Technology.				
- (U) PE 0603215C, Limited Defense System.				
- (U) PE 0603218C, Research and Support.				
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.				
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program (RAMTIP).				
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.				
(U) D. <u>Schedule Profile:</u> Not Applicable.				
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 3784
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COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3784 Space Sensors and Satellite Communication Technology	2,177	2,710	1,760	3,556	4,273	3,865	3,930	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project funds the development of military space-based ground surveillance and satellite communication technologies. The project's work focuses on advancing space-based applications of commercial sensors and communication technologies while improving the performance, schedule, maturity, cost, and/or risk reduction. The focus of the space sensor effort is to meet spaceborne sensor needs for national missile defense and intelligence, surveillance, and reconnaissance missions. The focus of the satellite communications effort is to develop radio frequency (RF) technologies for future military, intra-space, and space-ground communication systems. This project seeks to improve affordability, reliability, and performance while significantly reducing space sensor and satellite communication size, weight, cost, and cooling and power requirements.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,007 Developed space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.
 - (U) Investigated state-of-the-art techniques for raising the operating temperature (120K or higher) of mid-wave infrared detectors.
 - (U) Initiated investigation of technologies for scaling mercury cadmium telluride (HgCdTe) focal plane arrays to 1024 by 1024 array size.
- (U) \$650 Developed space-based radar technology investment plans.
 - (U) Began development and evaluation of potential antenna architectures.
 - (U) Continued assessment of operational utility of candidate space-based surveillance technologies.
- (U) \$258 Developed simulation models for Space-Based Radar (SBR) system.
 - (U) Assessed potential distributed interactive simulation compatible models for application to SBR scenarios.
 - (U) Initiated development of distributed interactive simulation models for SBR.
- (U) \$262 Developed satellite communication technology which supports space communications needs.
 - (U) Completed assessment of commercial communication technology for transition to military systems.
- (U) \$2,177 Total

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(U) FY 1998 (\$ in Thousands):

- (U) \$1,515 Develop space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.
 - (U) Initiate design and development effort for mid-wave infrared detectors with higher operating temperatures (120 to 140K) .
 - (U) Complete investigation of scaling technologies for mercury cadmium telluride focal plane arrays.
 - (U) Investigate efforts to increase yield and reliability of large format infrared focal plane arrays.
- (U) \$904 Develop space-based radar technology investment plans.
 - (U) Continue development and evaluation of potential antenna architectures and radar concepts.
 - (U) Continue to assess the operational utility of candidate space-based surveillance technologies.
 - (U) Begin development of testbed for Space-Based Radar (SBR) system integration and operational evaluation.
- (U) \$291 Develop simulation models for SBR system.
 - Continued development of distributed interactive simulation models for SBR.
- (U) \$2,710 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$300 Develop space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.
 - (U) Complete fabrication of short-wave and mid-wave focal plane infrared detectors with higher operating temperatures (120 to 140K).
 - (U) Evaluate and provide design recommendations on the short-wave and mid-wave focal plane infrared detectors with higher operating temperatures (120 to 140K).
- (U) \$970 Develop space-based radar technology investment plans.
 - (U) Complete development and evaluation of potential antenna architectures and radar concepts.
 - (U) Continue to assess the operational utility of candidate space-based surveillance technologies.
 - (U) Continue development of testbed for SBR system integration and operational evaluation.
- (U) \$490 Develop simulation models for SBR system.
 - Complete development of distributed interactive simulation models for SBR.
- (U) \$1,760 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 3784															
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> <th style="text-align: center;"><u>Total</u> <u>Cost</u></th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td style="text-align: center;">2,423</td> <td style="text-align: center;">2,848</td> <td style="text-align: center;">3,295</td> <td style="text-align: center;">Cont</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td style="text-align: center;">2,177</td> <td style="text-align: center;">2,710</td> <td style="text-align: center;">1,760</td> <td style="text-align: center;">Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation: Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> - (U) PE 0303601F, MILSTAR Satellite Communications System. - (U) PE 0602601F, Phillips Laboratory. - (U) PE 0602702F, Command/Control/Communication Technology. - (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies. - (U) PE 0604711F, Extremely High Frequency Satellite Communications Research and Development. - (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>				<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total</u> <u>Cost</u>	(U) Previous President's Budget (FY 1998 PB)	2,423	2,848	3,295	Cont	(U) Current Budget Submit/FY 1999 PB	2,177	2,710	1,760	Cont
	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total</u> <u>Cost</u>													
(U) Previous President's Budget (FY 1998 PB)	2,423	2,848	3,295	Cont													
(U) Current Budget Submit/FY 1999 PB	2,177	2,710	1,760	Cont													
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 3834
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COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3834 Integrated Space Technology Demonstrations	37,847	17,739	20,447	18,255	19,034	20,780	21,867	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: The Integrated Space Technology Demonstration (ISTD) program is a series of demonstrations, or projects established to address the latest Air Force Space Command (AFSPC) Mission Area Plan (MAP) deficiencies. The ISTD program provides for the integration of government and commercially developed technologies onto satellites. The ISTD seeks to validate and demonstrate the value of these new technologies to address new space tactics, techniques, procedures, doctrine, and possibly revolutionize future acquisitions of DoD space systems. The ISTD program will enhance commercial and civil space assets in a cost-effective manner, allowing the warfighter to assess the utility of new space technologies through leveraging opportunities and, when required, through dedicated space flight demonstrations.

The highly successful Technology for Autonomous Operational Survivability (TAOS) satellite was the first of the ISTD series. TAOS was launched in March 1994 and is currently demonstrating advanced warfighter concepts and the viability of advanced computers, autonomous navigation hardware/software, laser sensors, radar sensors, and data busses in space. TAOS has allowed operators and users, for the first time, to directly conduct space exercises in conjunction with the Air Force Research Laboratory (AFRL). External customer funding will be used in FY1998 and out to continue TAOS operations until the satellite ceases to function.

In FY 1995, the ISTD program office initiated a cooperative agreement with National Aeronautics and Space Administration's (NASA) Small Spacecraft Technology Initiative (SSTI) program to leverage the NASA Clark satellite with Air Force funding and technologies. AFRL and NASA agreed to integrate an S-band transmitter on Clark to allow command and control of the satellite along with reception of imaging payload data from a mobile ground station controlled by the warfighter. Clark is set for launch in February 1998. In general, the ISTD series of space technology demonstrations will allow users to assess new space technologies, which, when integrated, will become technology options for future space systems. The Warfighter (WF-1) contract started in August to develop the capability of using hyperspectral imaging from space to detect tactical targets and perform battlefield characterization.

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 3834
(U) <u>FY 1997 (\$ in Thousands):</u>		
– (U) \$1,513	Completed the Technology for Autonomous Operational Survivability (TAOS) flight demonstration. – (U) Completed TAOS final report. – (U) Extended TAOS close-out to December 1997 to allow time to start a new contract for on-orbit mission continuation. All FY 1998 operations will be customer funded.	
– (U) \$471	Prepared for joint Air Force/ National Aeronautics and Space Administration (NASA) on-orbit technology assessments and data collection of the Clark spacecraft.	
– (U) \$10,966	Conducted Integrated Space Technology Demonstration (ISTD) series program. – (U) Awarded contract for the ISTD Warfighter-1 hyperspectral technology demonstration project. – (U) Began design of Warfighter-1 payload and mobile ground station. – (U) Began procurement of long-lead items for payload and mobile ground station requirements. – (U) Began development and modification of algorithms for Warfighter-1 satellite payload and ground station.	
– (U) \$ 1,006	Developed simulation applications for integrated satellite payloads, mission utility, and system engineering. – (U) Delivered real-time surveillance payload simulations.	
– (U) \$23,891	Developed and demonstrated miniaturized space technologies. – (U) Selected a mission and developed component technologies for the Clementine 2 microsatellite technology development. – (U) Continued development and integration of spacecraft subsystems, bus system design, bi-propellant system, and non-toxic propulsion system for the Clementine 2 spacecraft.	
– (U) \$37,847	Total	
(U) <u>FY 1998 (\$ in Thousands):</u>		
– (U) \$378	Perform joint Air Force/NASA on-orbit technology assessments and data collection of the Clark spacecraft.	
– (U) \$16,455	Conduct ISTD series program. – (U) Continue design and begin fabrication of Warfighter-1 payload and mobile ground station. – (U) Continue procurement of long lead items for payload and mobile ground station requirements. – (U) Continue development and modification of algorithms for Warfighter-1 satellite payload and ground station. – (U) Start initial planning for suite of technologies to be demonstrated in Warfighter-2.	
– (U) \$906	Develop simulation applications for integrated satellite payloads, mission utility, and system engineering. – (U) Continue development of advanced surveillance payload simulations.	
– (U) \$17,739	Total	
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 3834
<p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$100 Complete joint Air Force/National Aeronautics and Space Administration (NASA) on-orbit technology assessments and data collection of the Clark spacecraft, close out mission, and develop final report on technology and military utility assessment. - (U) \$19,072 Conduct Integrated Space Technology Demonstration (ISTD) series program. <ul style="list-style-type: none"> - (U) Complete design, fabrication, and integration of Warfighter-1 payload and mobile ground station. - (U) Perform integration and test of Warfighter-1 payload to Orbview 3 spacecraft. - (U) Ship space vehicle to launch site and begin integration of Warfighter-1/Orbview 3 space vehicle to launch vehicle. - (U) Continue development and modification of algorithms for Warfighter-1 satellite payload and ground station. - (U) Perform suite of technologies demonstrated in Warfighter-2. - (U) \$490 Develop advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems and develop precision navigation systems for future intercontinental ballistic missiles (ICBM) delivered conventional munitions. <ul style="list-style-type: none"> - (U) Develop, integrate, and test Global Positioning System/Inertial Navigation System (GPS/INS) in plasma and jamming environments for precision ICBM navigation. - (U) \$785 Develop advanced navigation technology to support range instrumentation and improve safety requirements. <ul style="list-style-type: none"> - (U) Develop, integrate, and test GPS-based navigation packages coupled directly with INS that survive and reacquire after the plasma blackout during reentry, and improve the accuracy, range, and safety of ballistic missiles. - (U) \$20,447 Total 		
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 3834
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(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total Cost</u>
(U) Previous President's Budget (FY 1998 PB)	37,847	18,788	20,358	Cont
(U) Current Budget Submit/FY 1999 PB	37,847	17,739	20,447	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4400
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COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4400 Satellite Survivability Technology	5,734	5,310	826	1,294	2,021	3,271	3,514	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project funds the development and demonstration of technologies required to assure operation of U.S. space assets in potentially hostile warfighting environments. Work performed includes assessment of critical components, subsystems, and systems' threat susceptibility and vulnerability. This project also develops technologies to mitigate identified vulnerabilities. Further, technology options are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment. Efforts under this project will be closely integrated with exploratory space technologies such as those developed under PE 0602601F, Project 8809, and advanced space technologies developed under this PE in Projects 1026, 2181, 3784, and 682J. Where appropriate, end products include integrated demonstrations with technologies developed in Project 3834. Through this project, the Air Force assumes responsibility for critical spacecraft survivability technology from the Ballistic Missile Defense Organization (BMDO). Note: Congressional funds for the Miniaturized Satellite Threat Reporting System (MSTRS) were provided in FY 1997 (\$2 million) and in FY 1998 (\$5 million).

(U) FY 1997 (\$ in Thousands):

- (U) \$1,261 Assessed selected directed energy weapon threat environment susceptibility/vulnerability of critical space-based sensor and communications subsystems.
 - (U) Performed an assessment of laser and radio frequency (RF) weapon susceptibilities for spacecraft subsystems including mission optical sensors and communications payloads.
 - (U) Performed an experimental assessment of a Charge Coupled Device (CCD) sensor's susceptibility to RF illumination.
 - (U) Initiated development of a multi-threat sensor performance modeling tool.
- (U) \$1,204 Performed RF threat warning space-based sensor design, fabrication, and test.
 - (U) Integrated radar warning and intrusion/interference detector concepts.
 - (U) Completed antenna and snapshot recorder designs; initiated software design for digital receiver.
 - (U) Initiated fabrication of prototype antenna design.
- (U) \$2,065 Augmented baseline Threat Warning/Attack Reporting (TW/AR) by adding a broad-band Radar Warning Receiver for MSTRS.
 - (U) Completed preliminary design of RF front end and digital electronics for space experiment.
 - (U) Initiated fabrication of hardware including the microwave assembly, successive detection logarithmic amplifier, and microwave receiver.
- (U) \$1,204 Selected, for evaluation, laser weapon detection technologies for satellites in hostile environments.
 - (U) Completed TW/AR laser threat assessment and laser detection trade study.
 - (U) Initiated laser detector fabrication and functional test.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4400
– (U)	\$5,734	Total
(U) <u>FY 1998 (\$ in Thousands):</u>		
– (U)	\$182	Continue susceptibility/vulnerability assessments of critical space-based subsystems to ambient/enhanced space environments and directed energy weapon threats.
– (U)		– (U) Update susceptibility/vulnerability assessments of hostile/stressing ambient/enhanced space environment on subsystem performance.
– (U)	\$182	Refine directed energy multi-threat sensor performance modeling tool.
– (U)	\$187	Evaluate protection implications of selected advanced spacecraft technologies.
– (U)	\$1,428	Design integrated Monolithic Microwave Integrated Circuit (MMIC) microwave pre-selector assembly and four multi-chip modules for a miniaturized satellite threat warning and attack reporting system.
– (U)	\$2,855	Fabricate and test integrated MMIC assembly and multi-chip modules for the miniaturized satellite threat warning and attack reporting system.
– (U)	\$476	Investigate composite materials and advanced packaging concepts for a miniaturized satellite threat warning and attack reporting system.
– (U)	\$5,310	Total
(U) <u>FY 1999 (\$ in Thousands):</u>		
– (U)	\$43	Continue susceptibility/vulnerability assessments of critical space-based subsystems to ambient/enhanced space environments and directed energy weapon threats.
– (U)		– (U) Assess hostile/stressing environment impact on subsystem performance parameters using multithreat sensor modeling tool.
– (U)	\$490	Perform radio frequency (RF) threat warning space-based sensor design, fabrication, and test.
– (U)		– (U) Complete fabrication and test of RF payload for space experiment
– (U)	\$293	Select, for evaluation, laser weapon detector technologies for satellites in hostile environments.
– (U)		– (U) Complete fabrication and test of laser detector brassboard.
– (U)	\$826	Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4400
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(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total</u> <u>Cost</u>
(U) Previous President's Budget (FY 1998 PB)	5,778	592	582	Cont
(U) Current Budget Submit/FY 1999 PB	5,734	5,310	826	Cont

(U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4599
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COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4599 Reusable Launch Vehicle Technology	9,579	11,715	0	0	0	0	0	TBD	TBD

(U) A. Mission Description and Budget Item Justification: This project funds development of technologies for advanced and innovative low-cost launch vehicles and orbit transfer vehicles. This Air Force Reusable Launch Vehicle (RLV) technology project directly complements and leverages off of the National Aeronautics and Space Administration (NASA)-led RLV program. The spending plan has also been coordinated and approved by NASA Headquarters. The tasks identified in this project summary represent the DoD stake in RLV technology development as recommended by the Space Launch Modernization Plan (SLMP) study. In FY 1998, Congress added \$5M for low-cost launch vehicle technology development and \$7.5M for the Solar Thermionic Orbit Transfer Vehicle (SOTV) to this project.

(U) FY 1997 (\$ in Thousands):

- (U) \$6,705 Applied advanced military unique technologies to reusable launch vehicles.
 - (U) Began development of an integrated technology testbed to coordinate technology development.
- (U) \$958 Performed technology development for upperstages as they apply to reusable launch vehicles.
 - (U) Continued development of concepts and military unique technologies for use in an upperstage.
- (U) \$1,916 Executed and coordinated the Department of Defense reusable launch vehicle program including coordination with NASA's X-33 program and analysis of military applications.
- (U) \$9,579 Total

(U) FY 1998(\$ in Thousands):

- (U) \$1,406 Develop low-cost, reliable, launch vehicle technologies.
 - (U) Continue systems engineering effort for the SR-2 testbed vehicle.
 - (U) Build and conduct ground demonstration of Hydroxyl Amine Nitrate - Tri-Ethanol Amine Nitrate (HAN TEAN) flight weight gas generator.
 - (U) Build and conduct ground demonstration of POD separation devices.
 - (U) Design, fabricate, and test five foot linerless poly Dicyclopentadiene (DCPD) resin liquid oxygen tank
- (U) \$3,280 Conduct suborbital flight tests of low-cost launch technologies.
 - (U) Perform series of flight tests and evaluate performance of the SR-1 low-cost launch technology testbed vehicle.
 - (U) Reengineer SR-1 testbed vehicle, incorporating "lessons learned" from initial flight test experience.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	4599
<p>– (U) \$7,029 Develop technologies for upperstages that can operate as orbit transfer vehicles.</p> <ul style="list-style-type: none">– (U) Continue development of radiation hardened thermionic energy conversion device.– (U) Continue development of rigid deployable solar concentrator technology.– (U) Continue development of lightweight cryogenic propellant storage tank.– (U) Continue development of high-power electric energy generation subsystem.– (U) Continue development of high specific impulse orbit transfer propulsion system. <p>– (U) \$11,715 Total</p> <p>(U) <u>FY 1999</u>: Not Applicable.</p>		
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 4599
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(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total Cost</u>
(U) Previous President's Budget (FY 1998 PB)	9,579	0	0	TBD
(U) Current Budget Submit/FY 1999 PB	9,579	11,715	0	TBD

(U) Change Summary Explanation:

Funding: Congress added \$10 million in FY 1997 for Reusable Launch Vehicle technology. In FY 1998, Congress added \$5 million for low-cost launch vehicle technology and \$7.5 million for the Solar Thermionic Orbit Transfer Vehicle.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602269F, Hypersonic Technology Program.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) UPN 242, National Aeronautics and Space Administration (NASA) Reusable Launch Vehicle Program.
- (U) This project has been coordinated through the Reliance process and with NASA to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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BUDGET ACTIVITY 3 - Advanced Technology Development				PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology				PROJECT 682J		
COST (\$ In Thousands)										
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
682J	Space Power and Thermal Management Technology	4,555	3,778	4,768	5,961	7,700	7,366	7,524	Continuing	Continuing
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This project develops and demonstrates compact, low-cost, spacecraft and ballistic missile power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation work focuses on lightweight, low-cost, low volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydride (NiH₂) and sodium sulfur (NaS) spacecraft batteries and flywheel energy storage systems for extended (five-ten year) satellite missions. Power distribution efforts focus on producing lightweight, high efficiency, standardized power busses for use on future Air Force space programs. This project also funds the development and demonstration of the non-nuclear technologies associated with space nuclear power systems such as power conversion, conditioning, and power system thermal management. In addition, investigations into alternative technologies to increase space vehicle power subsystem performance, lifetime, survivability, and safety while reducing costs/risks. In FY 1995, the Air Force assumed responsibility for the Ballistic Missile Defense Organization's (BMDO's) goal to develop spacecraft thermal management technologies. Examples of this are cryogenic coolers necessary to maintain passive (e.g., infrared focal plane array) sensors in low-light backgrounds through this project.</p>										
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 682J
<u>(U) FY 1997 (\$ in Thousands):</u>		
– (U) \$2,850	Developed space conventional power technologies such as advanced solar cells and arrays.	
	– (U) Demonstrated high voltage (45-130V) space-qualified 90% efficient power converters and 99% efficient solid state switches for power management and distribution system applications.	
	– (U) Continued development of 25% efficient alkali metal thermal to electric converter (AMTEC) cells.	
	– (U) Conducted life cycle testing of AMTEC cells.	
	– (U) Demonstrated more manufacturable 25% efficient space-qualified three-junction solar cell.	
	– (U) Designed and fabricated thermionic testbed power system components for evaluation.	
	– (U) Initiated multi-junction solar cell flight test program.	
– (U) \$1,330	Developed space vehicle conventional power technologies such as compact volume/weight batteries.	
	– (U) Continued NiH ₂ low earth orbit life testing.	
	– (U) Completed fabrication of Sodium Sulfur Battery Cell Flight Experiment for manifest on shuttle flight Space Transportation System 87 (STS-87) mission to be flown in November 1997.	
– (U) \$375	Developed space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.	
	– (U) Quantified single stage reverse Brayton cryocooler performance parameters and generated requirements for a 10K cryogenic cooler.	
– (U) \$4,555	Total	
 <u>(U) FY 1998 (\$ in Thousands):</u>		
– (U) \$2,494	Develop space conventional power technologies such as advanced solar cells and arrays.	
	– (U) Continue development of 25% efficient alkali metal thermal to electric converter (AMTEC) cells.	
	– (U) Complete technology transition of more manufacturable efficient space-qualified three-junction solar cell program.	
	– (U) Continue multi-junction solar cell flight test program.	
	– (U) Continue electrical characterization of three- and four-junction solar cells.	
– (U) \$331	Develop space vehicle conventional power technologies such as compact volume/weight batteries.	
	– (U) Continue Nickel Hydride battery low earth orbit life testing.	
	– (U) Complete demonstration of Sodium Sulfur Battery Cell with flight experiment on Space Transportation System 87 (STS-87).	
– (U) \$953	Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.	
	– (U) Initiate preliminary design, critical design, and development of a prototype 10K cryogenic cooler for space application.	
– (U) \$3,778	Total	
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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 682J
<p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li> – (U) \$2,827 Develop space conventional power technologies such as advanced solar cells and arrays. <ul style="list-style-type: none"> – (U) Initiate advanced lightweight, high efficiency, radiation resistant concentrator solar array program. – (U) Initiate alkali metal thermal to electric converter (AMTEC) cell flight demonstration program. – (U) Continue multi-junction solar cell flight test program. – (U) Continue electrical characterization of three- and four-junction solar cells. <li> – (U) \$814 Develop space vehicle conventional power technologies such as compact volume/weight batteries. <ul style="list-style-type: none"> – (U) Complete ten year NiH₂ low earth orbit life testing. – (U) Continue development of lightweight flywheel integrated power and attitude control systems (IPACS); initiate cooperative IPACS experiment on International Space Station scheduled for deployment in FY 2001. <li> – (U) \$1,127 Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays. <ul style="list-style-type: none"> – (U) Fabricate and begin characterization of 10K cryogenic cooler for very long wavelength infrared space applications. <li> – (U) \$4,768 Total 		
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