

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development
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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
Total Program Element (PE) Cost	113,000	125,585	115,313	110,811	116,109	131,858	144,557	149,674	Continuing	Continuing
1010 Geophysics and Weather Technology	19,848	23,885	8,120	9,133	7,960	8,641	15,437	17,028	Continuing	Continuing
1011 Rocket Propulsion Technology	28,199	34,824	31,835	20,817	24,820	36,105	41,916	40,541	Continuing	Continuing
3326 Lasers and Imaging Technology	16,873	18,662	17,193	17,211	16,177	19,161	19,600	19,561	Continuing	Continuing
5797 Advanced Weapons and Survivability Technology	13,602	14,239	16,183	16,752	17,304	17,723	17,375	17,870	Continuing	Continuing
8809 Space and Missile Technology	34,478	33,975	41,982	46,898	49,848	50,228	50,229	54,674	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2000, spectral sensing (intelligent satellite systems and hyperspectral technology) efforts currently in Project 3326 move into Project 8809.

(U) A. Mission Statement: This is the Applied Research program for space technology, rocket propulsion, and directed energy for the Air Force Research Laboratory. In geophysics, this PE develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. In rocket propulsion, this PE develops technologies to demonstrate the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) goals for boost and orbit transfer, satellite maneuvering, and tactical/ballistic missile rocket propulsion. In lasers, this PE examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques. Advanced weapons examines high power microwave and other unconventional weapon concepts using innovative technologies such as compact toroids. This also provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In space and missiles, this PE develops the following technologies: spacecraft platform (e.g., structures, controls, power, and thermal management); space-based payload (e.g., sensors, satellite communications, and survivable electronics); satellite control (e.g., spacecraft software); ballistic missile/launch vehicle-specific (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle

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<p>merging). Note: In FY 1999, Congress added \$9.0 million for the High-frequency Active Auroral Research Program and \$4.0 million for the Terabit fiber optic technology program.</p> <p>(U) B. Budget Activity Justification: This program in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.</p> <p>(U) C. Program Change Summary (\$ in Thousands):</p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: right;"><u>FY 1998</u></th> <th style="text-align: right;"><u>FY 1999</u></th> <th style="text-align: right;"><u>FY 2000</u></th> <th style="text-align: right;"><u>FY 2001</u></th> <th style="text-align: right;"><u>Total</u></th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget/FY 1999 PB</td> <td style="text-align: right;">118,266</td> <td style="text-align: right;">116,139</td> <td style="text-align: right;">131,078</td> <td style="text-align: right;">138,457</td> <td style="text-align: right;">Cost</td> </tr> <tr> <td>(U) Appropriated Value</td> <td style="text-align: right;">127,259</td> <td style="text-align: right;">129,139</td> <td></td> <td></td> <td style="text-align: right;">Cont</td> </tr> <tr> <td>(U) Adjustments to Appropriated Value</td> <td></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: right;">-7,390</td> <td style="text-align: right;">-3,554</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">b. SBIR</td> <td style="text-align: right;">-1,765</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">c. Omnibus/Other Above Threshold Reprogrammings</td> <td style="text-align: right;">-3,811</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">d. Below Threshold Reprogrammings</td> <td style="text-align: right;">-1,293</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Budget Year Since FY 1999 PB</td> <td></td> <td></td> <td style="text-align: right;">-15,765</td> <td style="text-align: right;">-27,646</td> <td></td> </tr> <tr> <td>(U) Current Budget Submit/FY 2000 PB</td> <td style="text-align: right;">113,000</td> <td style="text-align: right;">125,585</td> <td style="text-align: right;">115,313</td> <td style="text-align: right;">110,811</td> <td style="text-align: right;">Cont</td> </tr> </tbody> </table> <p>(U) Significant Program Changes: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>FY 1999: \$2,632 identified for a source for SBIR.</p>							<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total</u>	(U) Previous President's Budget/FY 1999 PB	118,266	116,139	131,078	138,457	Cost	(U) Appropriated Value	127,259	129,139			Cont	(U) Adjustments to Appropriated Value						a. Congressional/General Reductions	-7,390	-3,554				b. SBIR	-1,765					c. Omnibus/Other Above Threshold Reprogrammings	-3,811					d. Below Threshold Reprogrammings	-1,293					(U) Adjustments to Budget Year Since FY 1999 PB			-15,765	-27,646		(U) Current Budget Submit/FY 2000 PB	113,000	125,585	115,313	110,811	Cont
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development					PROJECT 1010	
<i>COST (\$ 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
1010 Geophysics and Weather Technology	19,848	23,885	8,120	9,133	7,960	8,641	15,437	17,028	Continuing	Continuing
<p>(U) A. Mission Statement: This project develops the technologies to exploit the aerospace environment to the warfighter's benefit. The project focuses on characterizing the battlespace environment for realistic space system design, modeling, and simulation. It includes technologies to specify and forecast the environment " mud to sun" for planning operations and ensuring uninterrupted system performance. Finally, it includes technologies that allow the opportunity to mitigate or exploit the aerospace environment for both offensive and defensive operations.</p> <p>(U) FY 1998 (\$ in Thousands):</p> <ul style="list-style-type: none"> - (U) \$3,863 Developed hardware, software, and decision aids to specify the impact of space radiation on the design and operation of DoD space systems. Fabricated a space experiment to track solar eruptions, which disrupt communications and cause satellite anomalies and tracking errors. - (U) \$5,600 Developed infrared background clutter codes and missile and aircraft target identification codes to improve the detection of theater ballistic missiles and other targets from space. Conducted atmospheric turbulence measurements and performance analysis required by operational laser systems. - (U) \$10,385 Developed techniques and systems, both ground-based and space-based, to measure, specify, and predict the effects of ionospheric disturbances on the operation of communications, surveillance, navigation, and other space systems. Increased the capability of the High-frequency Active Auroral Research Program (HAARP) facility in Alaska and initiated development of techniques for imaging underground structures. - (U) \$19,848 Total <p>(U) FY 1999 (\$ in Thousands):</p> <ul style="list-style-type: none"> - (U) \$4,099 Complete and validate hardware, software, and decision aids, including the Improved Solar Optical Observation Network (ISOON) system, and transition to Air Force Space Command and other users for improved specification of space environmental hazards. - (U) \$4,939 Develop techniques for detecting and tracking low-signature ballistic and cruise missiles and optimizing new surveillance sensor design, including hyperspectral sensors. Develop instruments and techniques to detect theater ballistic missiles through clouds, haze, smoke, and dust and to optimize the performance of operational laser weapon systems. - (U) \$5,557 Develop systems such as the space-based Communications/Navigation Outage Forecasting System (C/NOFS), sensors, and decision aids to measure, specify, and predict the effects of ionospheric disturbances on the operation of DoD space systems. 										
Project 1010			Page 3 of 18 Pages				Exhibit R-2A (PE 0602601F)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1010
<ul style="list-style-type: none"> - (U) \$8,791 Expand the infrastructure at the High Frequency Active Auroral Research Program's (HAARP) Alaska facility through construction of a control center and installation of radio and optical diagnostic instruments. Use the HAARP facility to assess new concepts for imaging underground structures. - (U) \$499 Identified as a source for SBIR. - (U) \$23,885 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$2,960 Develop techniques and systems to monitor and predict environmental conditions hazardous to DoD operational space systems. Complete analysis and initial design of a space experiment to demonstrate control of radiation belt particle levels. - (U) \$2,515 Design real-time predictive background clutter code and develop data-based models to support design and operation of global surveillance systems. Validate atmospheric turbulence effects on operational laser systems and conduct experiment to detect theater ballistic missiles at earliest boost phase to enhance counterforce operations and force protection. - (U) \$2,645 Fabricate and test instrumentation for the Communications/Navigation Outage Forecasting System (C/NOFS). - (U) \$8,120 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,672 Develop systems to predict space environmental hazards, including solar disturbances and the earth's radiation belts, and the resultant disruptions of operational space systems. - (U) \$2,772 Develop real-time infrared background clutter code, target detection techniques, and decision aids for application to space surveillance, laser weapons, and countermeasures systems, including detection of low-observable targets. Confirm utility of hyperspectral imaging sensors for earliest boost-phase detection of theater ballistic missiles. - (U) \$2,689 Develop artificial intelligence techniques, forecasting tools, and sensors for improved ionospheric specification and forecasting support, including communications/navigation outage forecasting and space-based radar demonstrations. - (U) \$9,133 Total 		
Project 1010	Page 4 of 18 Pages	Exhibit R-2A (PE 0602601F)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	February 1999
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0305160F, Defense Meteorological Satellite Program.- (U) PE 0601102F, Defense Research Sciences.- (U) PE 0602204F, Aerospace Sensors.- (U) PE 0603410F, Space Systems Environmental Interactions Technology.- (U) PE 0305111F, Weather Systems- (U) PE 0603707F, Weather Systems Advanced Development.- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development					PROJECT 1011	
<i>COST (\$ 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
1011 Rocket Propulsion Technology	28,199	34,824	31,835	20,817	24,820	36,105	41,916	40,541	Continuing	Continuing
<p>(U) A. <u>Mission Statement:</u> The technologies developed in this project are boost and orbit transfer, satellite maneuvering, and tactical and ballistic missile rocket propulsion. This project develops technologies and provides technology options for rocket propulsion advanced demonstrations, components, or subsystems. Technologies of interest are those which will improve reliability, operability, survivability, affordability, environmental compatibility, and performance of future space and missile launch sub-systems while reducing material, manufacturing, and support costs. Technology will be developed to reduce the weight and cost of components using new materials, improved designs, and improved manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology (IHRPT) initiative; a joint Department of Defense, National Aeronautics and Space Administration (NASA), and industry effort to focus rocket propulsion technology on national needs.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$3,442 Developed propellants with a high-energy density for increased payload capability and lower cost space launch systems. – (U) \$13,790 Developed propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. – (U) \$3,601 Developed advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal. – (U) \$6,000 Initiated technologies for long-term sustainment of strategic systems which also apply to the development of the next generation booster. – (U) \$1,366 Developed solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations. – (U) \$28,199 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$3,756 Develop propellants with a high-energy density for increased payload capability and lower cost space launch systems. Develop advanced chemical propellant formulation and perform propellant testing. This propellant will be used in heavylift vehicles. – (U) \$2,928 Develop advanced combustion technology for improved performance and reliability of engines used in heavylift vehicles. – (U) \$3,629 Develop advanced material technology for lightweight components and material property enhancement. – (U) \$13,509 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. Develop solid and hybrid rocket propulsion technologies for upperstage and air launched missiles, part of international agreements. – (U) \$7,000 Develop technologies for long-term sustainment of strategic systems which also apply to the development of the next generation booster. 										
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1011
<ul style="list-style-type: none"> - (U) \$3,278 Develop solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations. - (U) \$724 Identified as a source for SBIR. - (U) \$34,824 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$4,269 Develop propellants with a high-energy density for increased payload capability and lower cost space launch systems. Develop advanced chemical propellant formulation and perform propellant testing. - (U) \$14,347 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. - (U) \$3,260 Develop advanced combustion technology for improved performance and reliability of liquid engines used in heavylift vehicles. - (U) \$4,114 Develop advanced material technology for lightweight components and material property enhancement. - (U) \$2,000 Complete development of insulation and case materials for high combustion temperature propellants, plus complete analytical tools for prediction of propellant life. - (U) \$3,845 Develop solar electric and solar thermal propulsion technologies for stationkeeping, repositioning, and orbit transfer appropriate for large communication satellites and satellite constellations. - (U) \$31,835 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,926 Develop propellants with a high-energy density for increased payload capability and lower cost space launch systems. - (U) \$14,001 Develop propulsion component technology for reliable, safe, and low-cost boost and orbit transfer systems. - (U) \$1,093 Continue to develop advanced combustion technology for improved performance and reliability. - (U) \$1,797 Develop advanced ablative components using hybrid polymers for use in current and future launch systems. - (U) \$20,817 Total 		
Project 1011	Page 7 of 18 Pages	Exhibit R-2A (PE 0602601F)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	February 1999 PROJECT 1011
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.- (U) PE 0602303A, Missile Technology.- (U) PE 0603302F, Space and Missile Launch Technology.- (U) PE 0603311F, Ballistic Missile Technology.- (U) PE 0603401F, Advanced Spacecraft Technology.- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
Project 1011	Page 8 of 18 Pages	Exhibit R-2A (PE 0602601F)

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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development					PROJECT 3326	
<i>COST (\$ 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
3326 Lasers and Imaging Technology	16,873	18,662	17,193	17,211	16,177	19,161	19,600	19,561	Continuing	Continuing
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This project examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include advanced, short-wavelength laser devices for application as illuminators and imaging sources as well as advanced optical imagers for target identification and assessment. Laser technologies will be studied for their utility in aimpoint selection, target maintenance, and damage assessment. Additionally, high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques are developed.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$898 Developed generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions. - (U) \$1,666 Developed long-range optical imaging and non-imaging technologies for increased resolution and data fusion to support missions such as space object identification. - (U) \$1,485 Investigated and developed advanced laser radar for space surveillance and remote sensing using transceiver systems, and advanced data collection and processing algorithms for laser radar (LADAR) remote sensing of atmospheric properties, chemical agents, and target effluents, and intelligence preparation of the battlefield. - (U) \$4,600 Developed laser source and targeted coupling technology for next generation high-payoff applications such as damage/destroy countermeasures against infrared imaging seekers. - (U) \$1,610 Investigated and developed nonlinear optics (NLO) technologies to support imaging and other applications. - (U) \$3,801 Developed high power semiconductor lasers/arrays at alternate wavelengths for applications such as forward looking infrared (FLIR) systems and infrared (IR) missile jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules, and disrupt/jam countermeasures against near-term threats. - (U) \$2,813 Developed coherent laser diode arrays for improved performance/higher power in applications requiring high power levels. - (U) \$16,873 Total 										
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	PROJECT 3326
<p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$1,025 Develop generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions. - (U) \$3,606 Develop long-range optical technologies for increased resolution, characterization, and data fusion to support missions such as space object identification and ground target identification from space. - (U) \$1,486 Investigate and develop advanced laser transceiver systems, and advanced data collection and processing algorithms for light detection and ranging (LIDAR) remote sensing of atmospheric properties, chemical agents, and target effluents, and intelligence preparation of the battlefield. - (U) \$2,854 Develop laser source and target coupling technology for next-generation high-payoff applications such as damage/destroy countermeasures against infrared imaging seekers. - (U) \$588 Investigate and develop nonlinear optics (NLO) technologies to support imaging and beam projection technologies. - (U) \$4,558 Develop high power semiconductor lasers/arrays at alternate wavelengths for applications such as forward looking infrared (FLIR) systems and infrared (IR) missile jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules, and disrupt/jam countermeasures against near-term threats. - (U) \$4,150 Develop spatially coherent lasers for tactical/unmanned air vehicle and space applications such as designation/illumination and remote sensing which require higher power sources. - (U) \$395 Identified as a source for SBIR. - (U) \$18,662 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$1,892 Develop long-range optical technologies (e.g., speckle holography) for increased resolution, characterization, and data fusion for applications such as space object identification and status. - (U) \$645 Continue development of NLO technologies to support imaging and beam projection applications. NLO allows non-mechanical beam clean-up and modification for decreased complexity. - (U) \$3,514 Develop high power chemical gas/solid state laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications such as infrared countermeasures. - (U) \$1,806 Develop laser source beam control and target coupling technology for next generation high payoff applications such as damage/destroy countermeasures against surface-to-air missiles (SAM) and air-to-air missiles (AAM) threats. - (U) \$2,614 Develop high power semiconductor lasers at alternate (e.g., longer) wavelengths for applications such as forward looking infrared (FLIR) systems and IR missile warning/sensor jamming, chemical agent detection, and illuminators. - (U) \$6,722 Develop higher power, more efficient monolithic, solid state/semiconductor lasers for tactical/unmanned air vehicle and space applications such as jamming near-term infrared guided missile threats. 		
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2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	3326
<p>– (U) \$17,193 Total</p> <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$1,925 Continue development of long-range imaging and non-imaging optical technologies for increased resolution, characterization, and data fusion for identifying satellites. – (U) \$645 Continue development and begin large-scale field test of nonlinear optics (NLO) technologies to support beam projection and imaging applications associated with large aperture lightweight optics. – (U) \$3,655 Develop high power chemical gas/solid-state laser technologies for applications such as directed energy weapons, illuminators, and wavelength specific applications such as infrared countermeasures. – (U) \$1,893 Develop laser source beam control and target coupling technology for next generation high payoff applications such as damage/destroy countermeasures against surface-to-air missiles (SAM) and air-to-air missiles (AAM) threats. – (U) \$2,286 Develop high power semiconductor lasers at alternate (e.g., higher) wavelengths for applications such as forward looking infrared (FLIR) systems and infrared (IR) missile warning/sensor jamming, chemical agent detection, and illuminators. – (U) \$6,807 Develop higher power, more efficient monolithic, solid state/semiconductor lasers for tactical/unmanned air vehicle and space applications such as jamming near-term infrared guided missile threats. – (U) \$17,211 Total <p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (U) PE 0602101N, Directed Energy Weapons. - (U) PE 0602307A, Laser Weapon Technology. - (U) PE 0603314A, High Energy Laser and Directed Energy Components. - (U) PE 0603319F, Airborne Laser Demonstrator. - (U) PE 0603605F, Advanced Weapons Technology. - (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p>		
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	
(U) E. <u>Schedule Profile:</u> Not Applicable.		

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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development				PROJECT 5797		
<i>COST (\$ 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
5797 Advanced Weapons and Survivability Technology	13,602	14,239	16,183	16,752	17,304	17,723	17,375	17,870	Continuing	Continuing
<p>(U) A. <u>Mission Statement:</u> High power microwave (HPM) and other unconventional weapon concepts using innovative technologies are explored in this project. Technologies that support a wide range of Air Force missions such as suppression of enemy air defenses, command and control warfare, and vehicle self-protection are developed. This project provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In addition to directed energy weapon threats, this project conducts assessments of specific space environmental (natural and man-made) effects on space systems and develops hardening technologies and methodologies.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$4,723 Developed generic advanced weapon technologies that support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses. – (U) \$1,884 Assessed effects/lethality of directed energy weapon technologies against representative air and ground military systems. – (U) \$978 Developed HPM technologies that will support applications such as command and control warfare. – (U) \$2,217 Developed HPM technologies that will support applications such as suppression of enemy air defenses and aircraft self-protection. – (U) \$1,909 Developed HPM technologies, including susceptibility and effects experiments and modeling and database development, to support space control applications. – (U) \$1,891 Assessed the vulnerability of various space assets to threats such as solar radiation and directed energy weapons. – (U) \$13,602 Total 										
Project 5797			Page 12 of 18 Pages				Exhibit R-2A (PE 0602601F)			

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	PROJECT 5797
(U) <u>FY 1999 (\$ in Thousands):</u>		
– (U) \$5,799	Developed generic advanced weapon technologies that support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.	
– (U) \$3,439	Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.	
– (U) \$1,397	Develop high power microwave (HPM) technologies that will support applications such as command and control warfare.	
– (U) \$1,583	Develop HPM technologies that will support applications such as suppression of enemy air defenses.	
– (U) \$1,723	Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons.	
– (U) \$298	Identified as a source for SBIR.	
– (U) \$14,239	Total	
(U) <u>FY 2000 (\$ in Thousands):</u>		
– (U) \$1,498	Investigate technologies for developing innovative HPM sources to support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.	
– (U) \$1,977	Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.	
– (U) \$1,787	Develop HPM technologies that will support applications such as command and control warfare.	
– (U) \$2,646	Investigate HPM technologies best suited to support applications such as suppression of enemy air defenses.	
– (U) \$5,727	Investigate HPM technologies best suited to support offensive and defensive advanced tactical applications made possible based on increased power available on future aircraft.	
– (U) \$571	Investigate best means for Active Denial Technology to support Agile Combat Support applications.	
– (U) \$1,977	Assess the vulnerability of various space assets to radiation threats such as solar radiation and directed energy weapons.	
– (U) \$16,183	Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	5797
<p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none">- (U) \$1,574 Investigate technologies for developing innovative high power microwave (HPM) sources to support multiple Air Force applications such as command and control warfare and suppression of enemy air defenses.- (U) \$1,868 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.- (U) \$1,957 Develop HPM technologies that will support applications such as command and control warfare.- (U) \$2,899 Investigate HPM technologies best suited to support applications such as suppression of enemy air defenses.- (U) \$6,498 Investigate HPM technologies best suited to support offensive and defensive advanced tactical applications made possible based on increased power available on future aircraft.- (U) \$1,956 Assess the vulnerability of various space assets to radiation threats such as solar radiation and directed energy weapons.- (U) \$16,752 Total <p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.- (U) PE 0602202F, Human Systems Technology.- (U) PE 0603605F, Advanced Weapons Technology.- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development					PROJECT 8809	
<i>COST (\$ 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
8809 Space and Missile Technology	34,478	33,975	41,982	46,898	49,848	50,228	50,229	54,674	Continuing	Continuing
<p>(U) A. <u>Mission Statement:</u> This project focuses on seven major space and missile technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); space-based payload (e.g., sensors and survivable electronics); satellite control (e.g., software for satellite control and autonomous operations); modeling and simulation of space-based systems; satellite protection technologies (e.g., space environment effects, debris prediction, and threat warning/attack reporting); microsatellite technologies; and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging).</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$4,656 Developed technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts. - (U) \$3,522 Developed technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures. - (U) \$2,155 Developed technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-based Radar. - (U) \$3,808 Developed technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, micro-electo-mechanical systems (MEMS) devices, and advanced electronics packaging. - (U) \$2,719 Developed technologies for satellite control, autonomous satellite operations, astrodynamics, and modeling and simulation for space-based surveillance systems. - (U) \$10,726 Developed ground and small satellite integration technologies for space and near-space experiments such as MightySat and the Integrated Ground Demonstration Program. - (U) \$1,113 Developed technologies such as guidance, navigation, and control avionics to support launch vehicles and ballistic missile flights. - (U) \$5,779 Conducted Phase III of the Terabit fiber optic technology program. - (U) \$34,478 Total 										
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	PROJECT 8809
(U) FY 1999 (\$ in Thousands):		
– (U) \$4,669	Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts.	
– (U) \$4,589	Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures.	
– (U) \$1,889	Develop technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-based Radar.	
– (U) \$3,661	Develop technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, micro-electo-mechanical systems (MEMS) devices, and advanced electronics packaging.	
– (U) \$1,831	Develop technologies for satellite control, autonomous satellite operations, and modeling and simulation for space-based surveillance systems.	
– (U) \$1,402	Develop satellite protection technologies such as space environmental effects mitigation and space debris prediction.	
– (U) \$9,548	Develop ground and small satellite integration technologies for space and near-space experiments.	
– (U) \$1,763	Develop microsatellite technologies and integrated microsatellite technology concepts for applications such as near-earth object inspection and collaborative microsatellite constellations.	
– (U) \$3,907	Conduct Phase III of the Terabit fiber optic technology program.	
– (U) \$716	Identified as a source for SBIR.	
– (U) \$33,975	Total	
(U) FY 2000 (\$ in Thousands):		
– (U) \$5,581	Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts.	
– (U) \$5,787	Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures.	
– (U) \$2,395	Develop technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-Based Radar.	
– (U) \$1,904	Develop hyperspectral imaging data exploitation methodologies for military remote sensing applications.	
– (U) \$4,426	Develop technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, MEMS devices, and advanced electronics packaging.	
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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	8809
<ul style="list-style-type: none"> - (U) \$1,831 Develop technologies for satellite control, autonomous satellite operations, and modeling and simulation for space-based surveillance systems. - (U) \$3,275 Develop satellite protection technologies such as space debris prediction and threat warning/attack reporting. - (U) \$12,961 Develop ground and small satellite integration technologies for space and near-space experiments. - (U) \$3,822 Develop microsatellite technologies and integrated microsatellite technology concepts for applications such as near-earth object inspection and collaborative microsatellite constellations. - (U) \$41,982 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$5,919 Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact, high efficiency solar power cells, lightweight batteries, and innovative power generation and storage concepts. - (U) \$5,562 Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression, multifunctional structures, and lightweight composite satellite and launch vehicle structures. - (U) \$3,434 Develop technologies for space-based payload subsystems such as advanced infrared sensors, advanced hardened focal plane detector arrays, and antenna architectures for Space-Based Radar. - (U) \$1,938 Develop hyperspectral imaging data exploitation methodologies for military remote sensing applications. - (U) \$5,815 Develop technologies for space-based payload components such as low power, high performance, radiation hardened electronic devices, micro-electro-mechanical systems (MEMS) devices, and advanced electronics packaging. - (U) \$1,713 Develop technologies for satellite control, autonomous satellite operations, and modeling and simulation for space-based surveillance systems. - (U) \$2,331 Develop satellite protection technologies such as threat warning/attack reporting. - (U) \$10,218 Develop ground and small satellite integration technologies for space and near-space experiments. - (U) \$9,968 Develop microsatellite technologies and integrated microsatellite technology concepts for applications such as near-earth object inspection and collaborative microsatellite constellations. - (U) \$46,898 Total 		
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A EXHIBIT)		DATE
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development	February 1999 PROJECT 8809
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0602203F, Aerospace Propulsion.- (U) PE 0602102F, Materials.- (U) PE 0603302F, Space and Missile Rocket Propulsion.- (U) PE 0603311F, Ballistic Missile Technology.- (U) PE 0603401F, Advanced Spacecraft Technology.- (U) PE 0603410F, Space Systems Environmental Interactions.- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
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