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

DATE: February 2000

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603174C Space Based Laser

PROJECT: 1360

COST (*In Thousands*)	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
1360 Directed Energy Program	0	0	74537	74475	74410	74325	74253	Continuing	Continuing

A. Mission Description and Budget Item Justification

BMDO has the charter to provide for defense against current and future missile threats. An effective ballistic missile defense against a wide variety of current and near-term projected threats will require boost phase intercept capability. The Space Based Laser (SBL) Project was created to provide the nation with a highly effective, continuous, global boost phase intercept option for both national and theater missile defense (NMD and TMD). While BMDO is pursuing numerous terminal and midcourse intercept concepts, this program element (0603174C, formerly part of PE 0603173C), project number 1360, and the companion AF program element (0603876F) fund technology development for the only boost phase intercept concept that can provide national missile defense and operate in all theaters, regardless of size, geometry, or weather conditions. This system may also provide many ancillary capabilities, including air defense, global surveillance, and target detection and designation for other systems. Unique features of an SBL missile defense system include global, 24-hour boost phase intercept capability and defense against surprise first strikes. An SBL system could destroy missiles whose range is greater than 75 miles, providing a robust first layer for missile defenses-in-depth. The SBL system does not require prior knowledge of enemy launch site locations. The footprint of one SBL platform can cover approximately 10% of the earth. A constellation of twenty SBL platforms could provide overlapping full-time coverage of missile threats from theaters anywhere. Each SBL platform would be capable of destroying approximately 100 missiles with the initial fuel load. Capability for on-orbit refueling would be provided. An SBL system could defend against missiles without putting the lives of US military personnel at risk. With its long range and speed-of-light engagement capability, it accomplishes boost phase intercept at the earliest possible moment, offering the highest probability that intercepted missile fragments (possibly containing active chemical/biological or nuclear materials) will fall within the attackers territory, not on defended assets.

The SBL project was structured to address the key critical technical issues: (1) Can a chemical laser be built powerful enough to destroy a missile at militarily useful ranges? (Alpha program); (2) Can mirrors and optics be built large enough and easily enough? (Large Advanced Mirror Program (LAMP) and Large Optical Segment (LOS)); (3) Can the high power beam be controlled adequately? (Large Optics Demonstration Experiment, LODE); (4) Can the high power components of a Space Based Laser be integrated on the ground and operated as a system? (Alpha LAMP Integration (ALI)); (5) Can missile targets be acquired and tracked from space and can a laser be pointed and fired accurately enough? (Acquisition, Tracking, Pointing, and Fire Control (ATP/FC)); (6) Can these key components be integrated into a functional unit suitable for space flight and remote operation? (Space Based Laser integrated ground demonstration known as the Integrated Test Unit (ITU)); (7) Can the fully integrated system operate adequately on-orbit? (SBL Integrated Flight Experiment (IFX)).

Progress To Date: The Project demonstrated the answer to questions 1 through 4 (and partially 5) is "yes," and has built devices to perform the respective functions. (1) The Alpha program high energy chemical laser achieved weapons-class power in 1991. (2) LAMP and LOS demonstrated the ability to build optics of the required dimensions with the successful fabrication of a 4-meter segmented mirror in 1989 and a key segment of an 11 meter mirror in 1993. (3) The Large Optics Demonstration Experiment (LODE) demonstrated the ability to control the projected (or outgoing) beam in low power laser experiments in 1987. (4) The Alpha LAMP Integration (ALI) experiment demonstrated integrated open loop and closed loop fast steering mirror (FSM) and deformable mirror (DM) system operation in 1997. (5) The basic technologies of acquiring and tracking missiles and pointing a high power laser beam from ground and space were demonstrated by a number of programs. The necessary ATP/FC technologies (sensors, optics, processors, etc.) were demonstrated at or near performance levels required for the SBL system. Stable low power laser beam pointing from a space platform was demonstrated at the precision level required for an operational SBL in 1991 during the flight of the Relay Mirror Experiment (RME).

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The high power components of an SBL payload were integrated at the Capistrano Test Site (CTS) and successfully achieved project objectives, thereby validating the SBL beam generation and control concepts. The ALI experiment successfully achieved all of its objectives: 1) the integration of the Alpha high power laser with a LODE-derived beam control system and a beam expander using the LAMP 4 meter mirror; 2) the use of uncooled optics in a high power beam train; and 3) the high power operation of the integrated hardware (LAMP with Holographic Optical Elements (HOEs), Outgoing Wavefront Sensor (OWS) behind the secondary mirror, and FSM and DM control optics).
On 20 Feb 97, the first integrated high power test of SBL technologies was successfully conducted at CTS. The second high power test was completed on 16 Jul 97, with the OWS controlling the steering of the high power beam through the 4 meter LAMP mirror. The third, and final, high power test of the ALI experiment was completed on 22 October 1997, with the OWS controlling the steering and wavefront error of the high power beam through the 4 meter LAMP mirror. The water-cooled deformable mirror was replaced by an uncooled deformable mirror, and it performed successfully during a high power test on 9 June 1998. Data from high power laser optimization tests on 10 and 19 August 1999 are being analyzed. These tests are meant to demonstrate alignment correctability and performance repeatability. The next major tests planned for CTS are low and high power laser and beam control system performance optimization experiments.

In the HABE ATP/FC program, passive and active laboratory testing was successfully accomplished. Laboratory testing of the gimbal control loops, the line of sight stabilization and passive tracking were completed in FY98. Laboratory testing of the active tracking system and integrated ground testing against scaled rockets was conducted. Future testing in the HABE ATP/FC effort is uncertain at this time, it may be continued with hardware replacements at some later date.
By previous guidance in PBD 224C (28 Dec 98) the BMDO and USAF SBL project is pursuing an integrated ground demonstration. It is known as the IPTD. Additional guidance was provided by the Undersecretary of Defense for Acquisition and Technology (USD(A&T)) memorandum to BMDO Director dated 25 Feb 99) to structure a project plan leading to an SBL IFX in FY12. Furthermore, the SBL project has been designated as a Pre-MDAP by the Undersecretary of Defense for Acquisition and Technology. A letter contract was awarded 8 February 1999 conveying total system authority (TSA) on an interim Joint Venture (JV) Team comprised of Lockheed Martin, TRW, and Boeing. Under TSA the government specifies broad objectives, and the JV is responsible for the content of the SBL IFX, including the ITU. The descriptions of certain activities beyond 1QFY00 will be contingent upon the baseline design and the Integrated Project Execution Plan (IPEP) developed by the JV.
Visits to candidate sites for a new performance test facility resulted in a site survey report in March 1998 and in an environmental assessment report in January 2000. It is anticipated the site selection will be made in time to support the project schedule provided by the contractor team in the IPEP.
Testing of a linear array of hypersonic low temperature (HYLTE) gain generator nozzles with the potential for more efficient laser operation was successful. Testing continues, and fabrication techniques for a cylindrical gain generator are being developed. The phase conjugation experiment will begin testing in the second quarter of FY00. Phase conjugation is being explored for application to an advanced, possibly upgraded, operational system.
In FY00, Congress provided additional project funding for the new performance test facility to permit site specific facility design, site geotechnical surveys, and other facility planning activities.

Current Status: The key technical challenge for the Project is to develop large, lightweight deployable optics. Other remaining tasks are: to demonstrate and develop additional components which may provide space platform weight and system cost reductions; to continue integration of components and high power beam control system testing; to field test ATP/FC hardware and software; to integrate the high power laser and the large optics beam director hardware with ATP/FC hardware and test; to integrate the system in a space qualified SBL experimental vehicle for ground and flight testing.
In FY99-00, a space high energy laser (HEL) affordability and architecture study (A&AS) is being conducted to determine if technically- or mission-derived constraints have changed sufficiently such that the SBL concept is no longer the most cost effective solution as determined by similar studies in the past. Also, the Joint Venture was formed and a contract was awarded to pursue the ground and flight demonstrations of flight configured hardware. The JV has been given TSA for the ground demonstration and flight experiment, if approved.

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FY01 will be the first year under the new PE 0603174C. FY98-00 funding and descriptions for the SBL project from BMDO PE 0603173C and from AF PE 0603876F are identified in Section C.

FY 1999 Accomplishments:

Total 0 See Section C for FY 1999 funding

FY 2000 Planned Project:

Total 0 See Section C for FY 2000 funding

FY 2001 Planned Project:

- 69500 SBL Integrated Flight Experiment – Conduct ITU/IFX SRR; Continue fabrication, risk reduction, and design validation efforts for the laser, beam control system, beam expander, and ATP/FC.
- 5037 Mission Definition and Requirements Analysis – Continue operational system concept definition and alternate technology development; Update the operational system baseline minimum technical data set; Continue operations concept and objectives development with AF Space Command; Continue lethality and system effectiveness assessments.

Total 74537

B. Project Change Summary	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 2000 PB)	0	0	N/A
Appropriated Value			
Adjustments to Appropriated Value			
a. Congressional General Reductions			
b. SBIR / STTR			
c. Omnibus or Other Above Threshold Reductions			
d. Below Threshold Reprogramming			
e. Rescissions			
Adjustments to Budget Years Since FY 2000 PB			+74537
Current Budget Submit (FY 2001 PB)	0	0	74537

Change Summary Explanation:

The SBL Project was conducted in Program Element 0603173C, titled "Support Tech – Adv Tech Dev" along with several other projects. This was based on previous guidance to maintain the SBL project as a technology development program to preserve a far-term ballistic missile defense option. New guidance to pursue an integrated ground demonstration in a project structure leading to an SBL integrated flight experiment in FY12 and the designation of the SBL project as a Pre-MDAP resulted in the

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segregation of the SBL Project from other "Advanced Technology Development" budget activities and the creation of a new Program Element (PE 0603174C). All SBL Project funds were transferred from PE 0603173C to PE 0603174C.

C. Other Program Funding Summary ($ in Thousands)

	FY 1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Cost to Complete	Total Cost
1360 Directed Energy, PE 0603173C	120975	73199	0	0	0	0	0	N/A	N/A
Space Based Laser, AF PE 0603876F	32792	63840	63779	63674	63565	64244	64938	Continuing	Continuing