Mobile Tactical High Energy Laser (MTHEL)

Outlook

- With formal program funding stopped several years ago, Northrop Grumman continues to use technology from early MTHEL development as a testbed and demonstrator for such programs as the U.S. Army's High Energy Laser Technology Demonstrator (HEL TD)
- U.S. Army in early 2010 selects Northrop Grumman's 100kW Solid-State Laser for field tests, joining other speed-of-light weapons demonstrators for field tests at High Energy Laser System Test Facility (HELSTF)

Orientation

Description. Developing point defense weapon system for destruction of short-range artillery rockets.

Sponsor

U.S. Army Space and Missile Defense Command
Weapons Directorate
PO Box 1500
Huntsville, AL 35807-3801
USA

Status. Program exists only in drastically truncated form for R&D.

Total Produced. One demonstrator unit.

Platform. The system was envisioned to initially deploy in up to eight semi-mobile trailers. Future systems might be deployed on a 5-ton truck, the chassis of an M2 Bradley infantry fighting vehicle, or other similar platforms.

Application. Ground mobile defense of small areas against close-in, small point targets that have already penetrated other defenses.

Price Range. Based entirely on early budget estimates, MTHEL (or any similar version derived from MTEHL) may cost approximately $300 million to produce.

Contractors

Prime

Northrop Grumman Space Technology	http://www.as.northropgrumman.com, 1 Space Park, Redondo Beach, CA 90278 United States, Tel: + 1 (310) 812-4321, Fax: + 1 (310) 813-7548, Prime

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Mobile Tactical High Energy Laser (MTHEL)

Technical Data

Design Features. The Tactical High Energy Laser (THEL) prototype uses a megawatt class continuous-wave deuterium fluoride chemical laser. The infrared optics on the beam director also serve as a high-resolution imaging system that can record data on missile tests conducted at the White Sands Missile Range. The system will also feature a compact carbon-dioxide laser generator, sensors, fire control elements, and command and control units.

Operational Characteristics. As envisioned, the THEL system could be transported via a C-130 Hercules aircraft and would be ready to operate upon arrival. It is being designed for use against incoming rockets and similar munitions that may penetrate other defenses. A point defense weapon system with a short (approximately 30-second) flight time, it will have the ability to destroy short-range artillery rockets and targets difficult to pinpoint because of their small size. It could also be used against ballistic missiles in their re-entry phase, cruise missiles, unmanned aerial vehicles, helicopters, anti-radiation missiles, and, potentially, combat aircraft.

The system would be able to autonomously detect, categorize, and track the incoming threat and then aim and maintain the laser beam on the target until it is destroyed or rendered ineffective. The time between detection and firing is expected to be about seven seconds. The rapid reaction capability of the system would be used to provide an automatic re-targeting capability to counter multiple threats.

Space and Strategic Defense Command briefing charts have placed the THEL's range for hard kills at 1 kilometer and its range for sensor kills at 10 kilometers. The laser's engagement rate was placed at 10 kills per minute.

The engagement timeline associated with terminal point defense, whether it is land- or ship-based, is extremely short when all phases of the encounter are considered, which include target acquisition, verification, tracking/aiming, and weapon delivery. The technical requirements resulting from this short timeline are highly demanding. From a system design standpoint, it is important to note that the ability to accomplish one or more of the above primary encounter functions in the shortest possible time serves to relax the requirements placed on the remaining functions, and reduce the overall technical risk of the system implementation.

Laser weapons, with their literal speed-of-light weapon delivery characteristic, afford the ability to reduce the final phase of the encounter to the theoretical minimum limit. While this characteristic has long been recognized, the required technology has not matured to a level sufficient to accomplish a practical implementation. Among the key issues to be resolved are the incident energy levels required to kill specific targets and the ability to maintain the required energy flux on a moving target for a sufficient time to inflict damage (i.e., laser-beam pointing accuracy and jitter).

The program seeks to develop the database to answer these questions through a combination of ground and flight tests. Laser optical power output levels of several hundred kilowatts have been tentatively identified as necessary to defeat the smaller incoming weapons associated with a tactical encounter. The verification and further quantification of these levels are being established based on the initial ground-based phase of the test program.

Program Review

Background. The Tactical High Energy Laser (THEL) program (originally called Nautilus) began as a two-year program planned by the U.S. Army Space and Strategic Defense Command (SSDC) to determine the feasibility of using high-energy lasers to defeat small rockets in a tactical endgame encounter. It initially focused on the performance of lethality tests to determine whether a laser can apply sufficient energy to kill or disable a specific target in a dynamic environment; the power, time, and distance required to accomplish the kill; and the rapidity with which the system could then engage another target.

Early Days of Program Filled with Strong Government, Industry Support

In the mid-1990s, the program enjoyed a hopeful measure of support. There was a flurry of planning/proposal activities and publicity for airborne and space-based laser weapon demonstrations with indicated costs in the hundreds of millions of dollars. Congress increased the High Energy Laser Range System Test Facility's (HELSTF) FY96 $3 million request to maintain skeleton operations. The surprisingly large $21.8 million addition brought the

total to $24.8 million to keep the MIRACL (Mid-Infrared Advanced Chemical Laser) in business and to test-fire the laser against a space target in FY96. The augmentation clearly showed Congress' level of interest in reassessing the feasibility of laser weapons.

In February 1996, a test was conducted using the MIRACL, during which the U.S. Army destroyed a short-range missile in flight. According to an SSDC release, this marked the first time a laser had engaged and destroyed such a missile in flight, as well as the first time a warhead was exploded in flight by any developmental or operational weapon system.

THEL was established as a joint program with the government of Israel. Because of Israel's location, political environment, and experiences during Operation Desert Shield/Desert Storm, Israelis have had a strong interest in developing an effective point defense system. In April 1996, this interest took on urgency when Lebanese Hezbollah forces attacked northern Israeli settlements using Katyusha short-range missiles. Following these attacks, the U.S. and Israel agreed to intensify their THEL efforts so that a prototype could be ready for testing in Israel by the end of 1997.

A Memorandum of Agreement, which accelerated THEL development, was signed by the U.S. and Israel in July 1996. The U.S. began paying 70 percent of the proposed THEL cost, and Israel picked up the remainder.

The program's forward surge continued in August 1996, when TRW was awarded a $22.1 million contract for the procurement of one THEL Advanced Concept Technology Demonstrator (ACTD) to meet joint U.S. and Israeli requirements. The contract was an increment to an $89 million cumulative total cost-plus-award/fee competition letter and completed in 2002.

Initial Israeli Participation Appears to Support Full Development, Deployment

In early 1997, the Israeli Defense Forces (IDF) stated that after the final ACTD demonstrations they wished to deploy up to 13 operational THEL systems. While it was unknown what the U.S. Army would do with THEL, a draft Mission Needs Statement was authored by the Air Defense Artillery School.

The statement sought to replace vehicle-mounted Stinger ADA systems with a Combined Arms Directed Energy Weapon System (CADEWS) that would be used not only on aircraft but also on cruise missiles, UAVs, HARMs, and inbound artillery. The U.S. Army's tentative time scale put the first prototype CADEWS-equipped vehicle as being ready between 2003 and 2005, if funding could be made available.

Funding issues became a major obstacle in the late 1990s. The main problem regarding funding for THEL could be traced to the rapid start of this international program, in which initial R&D to test unit took approximately three years. The program failed to adequately address the post-R&D/ACTD portion during this time: specifically, how to pay for testing and fielding the system. To compound the problem, Israeli officials had projected that only an additional $10 million was needed to complete testing; therefore, they were skeptical when the U.S. stated that an additional $50 million was necessary.

Dark Clouds Appear on Horizon as Major Stumbling Blocks for Funding Appear

A tug of war was initiated within Congress in 1997 over the FY98 funding for THEL. Eventually, a back-and-forth funding fight ended with the authorization of $49.4 million to complete testing, and an additional $9.6 million appropriated to the HELSTF facility for the sole purpose of supporting the THEL test.

TRW completed demonstrator testing in 1998, and system integration and field-testing began at HELSTF. The Boeing Co successfully completed proof-of-concept testing for the chemical oxygen-iodine laser (COIL) in April 1999. Also in April, the U.S. Army Space and Missile Defense Command began to study the potential use of the laser weapons for the defense of South Korea. Despite this action, the U.S. Army still maintained that it had no official requirement for the THEL system, but had interest in the development of the technology for possible use in future air defense weapons.

The future of the project was cast into doubt in the summer of 1999, when negotiations began to determine whether the contractor or the U.S. government was responsible for development delays and cost overruns that amounted to $30 million. Talks between the U.S. Army, Israeli Ministry of Defense, and TRW had become quite heated by that time, until the two countries agreed to pay for at least half of the cost overruns.

In June 1999, the program took a significant step forward when THEL achieved "first light" during testing at HELSTF, which demonstrated the end-to-end capability of the system. The test apparently proved that the high-energy beam could be generated and controlled.

While successful testing of THEL continued in summer 2000, the U.S. Army and the Israelis made it known that they were moving ahead with plans to develop the

mobile version of the system. It was hoped that the newer version would provide some much-needed operational flexibility. In October 2000, it was announced by U.S. Army officials that the original THEL would be too fragile for operational use and that all future emphasis should be placed on the mobile version. The need for mobility had also been strongly underscored by the fact that the sources of potential missile attacks on Israel had shifted geographically over the previous months.

Although RDT&E funding for THEL remained robust, if not strongly fought for over the years, a change seemed to be in the works in early 2001. When the much-delayed defense budget submitted to Congress in May 2001 turned out to be significantly smaller than the DoD had anticipated, additional funding for THEL for FY02 and beyond appeared to be less than hoped for or needed.

In June 2001, TRW was awarded a $5.6 million modification to a previously awarded contract with the U.S. Army Space and Missile Defense Command (SMDC). The modification would entail a six-month System Engineering Trade Study (SETS) for the MTHEL. At the time, the program's developers were also seeking $30 million in congressional funding for FY02 just to keep THEL moving. By early September 2001, the House Armed Services Committee had formally allocated $10 million for FY02 THEL development.

Israeli Support Starts to Falter

THEL took another heavy hit by the end of summer 2001 when Israel's Ministry of Defense indicated that it was having even stronger reservations about the validity of the system, in view of the fact that there had been a drastic change in the threat environment. Facing an enemy perceived to be growing in strength, the Israelis had begun to worry if there could ever be enough of the laser systems to cover all the possible weak spots in their defense network.

The notion of THEL's usefulness changed dramatically with the 9/11 terrorist attacks on the U.S. Within a week of the event, the SMDC made it known that it could provide THEL for the new homeland defense effort. The threat scenario had transformed overnight from potential attack on Israel to a very real vulnerability in the U.S. as well. Suddenly, the consideration of protection against terrorists had become the principal purview of a new office of the U.S. government.

THEL's viability had been so restored that by December 2001, Israel had rejoined the effort to determine the best size and shape for a practical and deployable system. The Middle Eastern state once again noted its preference for a THEL that could be driven about on flatbed trucks, while the U.S. pressed for a system that could fit on a C-130 Hercules for faster fighting capability. Thus, the creation of the MTHEL now seemed even more likely. The U.S. Army subsequently let it be known that it would seek up to $175 million through 2007 for the rejuvenated development effort.

However, as 2001 ended, it was not immediately apparent that the U.S. Senate appropriators would fall in line with the Army's desires. By that time, U.S. military actions in Afghanistan were already putting a strain on the defense budget.

A postponement of an SMDC hardware development contract for MTHEL was instituted in January 2002. For FY02, $13 million was budgeted for MTHEL, and it was hoped that Israel would add $12 million. Even with this allocation, however, only enough funding to maintain a reasonable program pace would be available. The hardware development program would have to be sacrificed until the budget was brought back to acceptable levels.

Post 9/11, New Funding and Program Changes Appear to Boost MTHEL

In March 2002, SMDC finalized a $118 million out-year budget plan for MTHEL, with the intention of finishing a demonstrator by 2007. Testing of MTHEL resumed in April 2002.

In early 2002, MTHEL was transitioned from SMDC to the U.S. Army's Program Executive Office for Air and Missile Defense. This would indicate that the program had reached such a level of maturity that the acquisition phase might be moving closer. In March, the service also finalized a long-term $118 million budget plan for MTHEL.

By the end of 2002, Northrop Grumman had acquired TRW and, consequently, became prime contractor of the system.

In a test at the White Sands Missile Range in November 2002, MTHEL reportedly shot down a 152mm artillery shell in mid-flight. The test was actually conducted from the system's current, static testbed.

The FY04/FY05 budget for MTHEL under the U.S. Army's Missile Defense Systems Integration program was released in early 2003. Contained within the budget was probably the largest infusion of funding for the program since its inception. Starting in FY04 with $39 million, the amount would rise to approximately $255 million by FY09. The budget also stated the service's intention to have low-rate initial production (LRIP) begin by FY10.

Later in FY03, MTHEL would receive significant funding boosts. Israel would provide $19.4 million as part of its expected contribution. The U.S. Congress would add $15 million to the FY03 MTHEL effort.

In July 2003, Northrop Grumman announced that it was looking into the feasibility of applying MTHEL to the defense of air base operations for both military and civilian aircraft.

An announcement was made in September 2003 that would seem to indicate that MTHEL had formally been chosen as the preferred short-range missile interceptor for the U.S. Army and Israel's Ministry of Defense.

In 2004, Congress added $17 million to the MTHEL R&D budget for FY04, raising the annual total, under related programs, to approximately $69.1 million.

It was reported, in May 2004, that THEL had successfully destroyed a larger caliber rocket than it had in any previous tests. This occurred during testing at the White Sands Missile Range. Later tests around this time would also demonstrate that the system could destroy multiple mortar rounds in a single salvo.

Time, Strained Defense Budget Catch Up with MTHEL

In August 2004, the U.S. Army announced that MTHEL was being restructured and delayed due to budget constraints. In light of this, Army personnel overseeing the program made it known that they would be investigating options for development of a smaller, less powerful, and presumably cheaper version of MTHEL.

Northrop Grumman, in late 2004, announced that it was offering the U.S. Army yet another system, which appeared to draw on the MTHEL. Named the High Energy Laser for Rocket, Artillery and Mortar (HELRAM), the system, according to the company, could be available within 18 months of a contract award. The system was further described as being a moveable, three-part device that could be transported via C-130 and further deployed, in parts, on separate trucks.

In March 2005, the U.S. Army announced that it was dropping any further plans to develop MTHEL. Despite this, the Army made it known that it was still interested in investigating the use of chemical lasers and that testing and evaluation of the original THEL system would likely continue in a drastically truncated form.

As fighting between Israel and Hezbollah broke out in the summer of 2006 and missiles were flying into population centers, interest in MTHEL was renewed. Northrop Grumman officials were quick to point out that the system was ready to be deployed. "Development of the MTHEL laser and pointing mechanism has been largely completed," said Loren Thompson, defense analyst for the Lexington Institute.

Perhaps Giving It a New Name Will Help

Northrop Grumman, in August 2006, introduced a new laser-based anti-missile system predicated on MTHEL. The new system was called Skyguard. While there was no direct U.S. government funding for its development, Northrop Grumman claimed that it would support future spiral developments.

The summer 2006 war between Israel and Hezbollah led the Israeli public to demand that the government revisit its decision to exit the MTHEL program. Upon review, the MoD eventually reaffirmed its rejection of the program. Officials have stated their desire to purchase the Rafael-produced Iron Dome system.

At the start of 2009, Israel continued to look for a defense against missile attack, with some Israeli military officials and analysts favoring the Northrop Grumman Skyguard missile defense system. Supporters claimed it was less expensive and could deploy more quickly than alternatives such as the Iron Dome. Iron Dome uses a short-range rocket to counter missile threats. Israeli Defense Ministry officials countered that Skyguard is not a viable alternative to Iron Dome.

Mobile Tactical High Energy Laser (MTHEL)

Artist's impression of MTHEL in action.

Source: Northrop Grumman

Related News

U.S. Army Selects Northrop Grumman's 100kW Solid-State Laser for Field Tests – The solid-state laser system from Northrop Grumman Corp, which produced the most powerful beam ever from a continuous wave, electric laser in 2009, is joining other pioneering speed-of-light weapons demonstrators for field tests at the Army's High Energy Laser System Test Facility (HELSTF) located in New Mexico. In cooperation with the U.S. Army's Space and Missile Defense Command/Army Forces Strategic Command, which operates the test range at White Sands Missile Range in southeastern New Mexico, BAE Systems has contracted with Northrop Grumman to relocate the Joint High Power Solid State Laser (JHPSSL) Phase 3 system from the company's laser factory in Redondo Beach to HELSTF. Field testing is expected to begin this year. This laser will be integrated with the beam control and command and control systems from another Northrop Grumman-built system, the Tactical High Energy Laser (THEL), to provide the Army with the world's first high-power Solid State Laser Testbed Experiment (SSLTE), according to the company. (Northrop Grumman, 2/10)

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Funding

Major funding for MTHEL R&D was canceled in 2005.

Contracts/Orders & Options

Contractor	Award ($ millions)	Date/Description
TRW	21.3	Jan 1998 – An increment of a $42.5 million modification to a $131.5 million CPAF completion contract to add field testing at the HELSTF facility for the THEL ACTD. Contracting authority is the U.S. Army Space & Missile Defense Command (SMCD), Huntsville, AL. (DASG60-96-C-0155)
TRW	5.6	Jun 2001 – Modification to cost-plus-fixed-fee contract (DASG60-96-C-0155) for MTHEL System Engineering Trade Study (SETS). Work completed Dec 1, 2001. U.S. Army Space & Missile Defense Command (SMCD), Huntsville, AL, is the contracting agency.

Contractor	Award ($ millions)	Date/Description
Northrop Grumman	14.9	Dec 2003 – Modification to a contract for Direct Productive Person Hours for MTHEL operations and technology developments. Work was completed by Jun 2004.
Northrop Grumman	22.4	Aug 2004 – Contract increment as part of a $333.8 million contract for work on MTHEL concept and technology development. Work completed Jun 2005. U.S. Army Space & Missile Defense Command (SMCD), Huntsville, AL, is the contracting agency. (DASG60-96-C-0155)

Timetable

Month	Year	Major Development
FY	1995	Nautilus ground tests begun
Feb	1996	Successful in-flight testing of Nautilus conducted at White Sands Missile Range
Jul	1996	Memorandum of Agreement to accelerate joint U.S./Israeli development of THEL
Jul	1996	Contract awarded to TRW to build THEL prototype
Mar	1998	THEL demonstrator testing completed at TRW
Jul	1999	First functional prototype scheduled for completion
Jun/Aug	2000	Successful test firing against Katyusha rockets completed
	2001	U.S. Army/Israel decided to focus solely on MTHEL development
Jun	2001	TRW awarded $5.6 contract modification for MTHEL study
Sep	2001	Award of $10 million appropriated for THEL development for FY02
	2002	Hardware development contract postponed
Apr	2002	MTHEL testing resumed, successful shootdown of rocket
	2002	TRW acquired by Northrop Grumman
	2003	Program officially transitioned from SMDC to U.S. Army's Program Executive Office for Air and Missile Defense
	2003	Israel contributes $19.4 million to MTHEL program
Aug	2004	Northrop Grumman awarded $22.4 contract increment to continue work on MTHEL
Mar	2005	U.S. Army announces it is dropping MTHEL
	2007	Northrop Grumman awarded Phase I contract for HEL TD
Mar	2008	Israeli MoD announces support for Rafael Iron Dome system

Worldwide Distribution/Inventories

MTHEL is now a truncated **U.S. Army** research program.

Forecast Rationale

What is left of the system once known as Mobile Tactical High Energy Laser (MTHEL) still serves as a foundation for testing and demonstration of at least one offshoot system that stands some chance of production in the future. Although formal funding for development of MTHEL stopped some years ago, the technology that very nearly brought it to fruition continues to be exploited as much as possible.

MTHEL was once a highly active and promising joint U.S./Israeli program that promised to bring missile defense to the Middle Eastern nation's borders. Serious interest in MTHEL technology has been revived on and off since its retirement, especially whenever fighting between Israel and Hezbollah flares up.

Northrop Grumman has introduced an offshoot of the system, called Skyguard, which is claimed to be less costly and more easily transportable than the original system. However, without any direct Pentagon funding for its development, Skyguard is likely to suffer the same fate as MTHEL.

Mobile Tactical High Energy Laser (MTHEL)

The U.S. Army in early 2010 selected Northrop Grumman's 100kW Solid-State Laser for field tests, joining other speed-of-light weapons demonstrators such as MTHEL for field tests at the High Energy Laser System Test Facility (HELSTF).

While corporate-funded research related to MTHEL is apparently ongoing, along with myriad other laser-related projects under the DoD's High Energy Laser Test Facility program, long-term funding for specific work on the system remains terminated.

Ten-Year Outlook

Long-term funding for the MTHEL program has been terminated.

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