

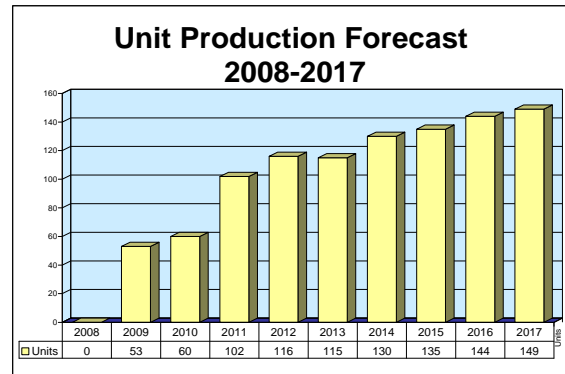
# ARCHIVED REPORT

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## ADAMS - Archived 4/2009

### Outlook

- Production under way
- Iron Dome and Magic Wand will defend Israel from rocket attacks
- Lebanese and Palestinian militant groups have fired thousands of rockets into Israeli territory
- ADAMS was not purchased by Israel Defense Force
- Israel offering SPYDER air defense system, which uses Derby and Python missiles



### Orientation

**Description.** ADAMS (Air Defense Anti-Missile System) is a land-based vertical launch point missile defense system.

**Sponsor.** Israel Ministry of Defense, Tel Aviv, Israel.

**Status.** In production. Venezuela is considered the launch customer for this system, but earlier reports said Chile had purchased a land-based version of Barak.

Rafael and Israel Aerospace Industries (IAI) are working on an enhanced version of the Barak, which could be capable of intercepting long-range ballistic missiles.

**Total Produced.** Approximately 227 ADAMS missiles had been manufactured or were being produced at the end of 2007.

**Application.** The ADAMS is an area air defense missile/gun system designed to attack and destroy airborne targets.

**Price Range.** Estimated per-unit price of the ADAMS missile is \$541,000. The entire system could be sold for approximately \$4.25 million (excluding transport vehicles and missiles).

### Contractors

#### Prime

|   |   |
|---|---|
| <b>IAI Systems Missiles &amp; Space - MBT Missile Systems</b> | <a href="http://www.iai.co.il">http://www.iai.co.il</a> , PO Box 75, Yahud Industrial Zone, Yahud, 56000 Israel, Prime  |
| <b>Rafael Advanced Defense Systems Ltd</b>                    | <a href="http://www.rafael.co.il">http://www.rafael.co.il</a> , PO Box 2250, Haifa, 31021 Israel, Tel: + 972 4 879 4444, Fax: + 972 4 879 4613, Email: <a href="mailto:intl-mkt@rafael.co.il">intl-mkt@rafael.co.il</a> , Prime |

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## ADAMS

## Technical Data

|                                 | <u>Metric</u> | <u>U.S.</u>  |
|---------------------------------|---------------|--------------|
| <b>Dimensions<sup>(a)</sup></b> |               |              |
| Length                          | 2.175 m       | 7.134 ft     |
| Diameter                        | 170 mm        | 6.70 in      |
| Weight <sup>(b)</sup>           | 50-90 kg      | 110-198 lb   |
| Wingspan                        | 680 mm        | 26.77 in     |
| <b>Performance</b>              |               |              |
| Speed                           | Mach 1.8-2.0  | Mach 1.8-2.0 |
| Range (max)                     | 12 km         | 7.45 mi      |

<sup>(a)</sup> Estimated

<sup>(b)</sup> A specific weight for the missile of 86 kilograms has been mentioned.

**Propulsion.** This missile uses an undesignated solid rocket motor, which employs a three-level thrust motor and a disposable thrust vector control system that controls it at low speeds and is then discarded. The missile is launched with a relatively low initial thrust from the motor, and is turned toward the target by the thrust vector control system.

**Control & Guidance.** Three guidance methods are available, depending on the target being engaged and other circumstances: semi-active radar, command-to-line-of-sight (which can use electro-optical and radar sensors), and a straight electro-optic system for visible target attack. When employed autonomously, the system can perform a full operational cycle ranging from threat detection to interception and kill assessment without external intervention.

The surveillance radar detects the target at a range of 20 kilometers and passes it to a tracking radar. Detection range is over 10 kilometers for helicopters and 10 to 12 kilometers for fixed-wing aircraft. Once the target (or targets) has been identified through IFF integration and designated to the fire control radar, the attack sequence is initiated in one of two alternative modes: full or semi-automatic. In the full automatic

mode, the computer selects the target to be engaged according to pre-defined priorities and selects the missile or gun response. In the semi-automatic mode, the operator manually selects the target and whether to respond with either the missile or the gun. Although ADAMS is an entirely different system from the Barak PDM (with different search and tracking radars and fire control systems), it uses the same basic missile.

**Launcher Mode.** This missile is vertically launched. The ADAMS/HVSD (Air Defense Anti-Missile System/High Value Site Defense) is expected to be offered with a variety of transport vehicle options. The current system is mounted on an 8x8 wheeled vehicle outfitted with 12 missiles in two rows of six. All 12 missiles are ready-to-fire at all times (no reloading is required). The current system is also air transportable by such aircraft as a C-130.

**Warhead.** The missile uses a 22-kilogram high explosive/fragmentation warhead with an adaptive (possibly a laser) proximity fuse. The warhead accounts for over 25 percent of the missile's total weight. This large quantity of explosives is mixed with heavy and light metal particles and splinters.

## Variants/Upgrades

There is currently only one version of the ADAMS missile, which is basically the Barak. However, the following additional system configurations are available:

**ADAMS/IAI** is a mobile configuration integrated with an IAI radar system and the Barak missile.

**ADAMS/HVSD** is a mobile configuration incorporating General Dynamics (now Hughes) High Value Site Defense (a 20mm cannon) and Barak missiles, thereby

creating a two-belt air defense system. This report focuses on the ADAMS/HVSD.

**HVSD/ADAMS** is an alternative configuration incorporating a towed ADAMS launcher controlled by a (then) General Dynamics radar system.

**ADAMS** is integrated with an IAI/Eagle Eye or other existing air defense gun system.

**Relampago (Lightning)** is the name for the export version of ADAMS.

## ADAMS

Rafael plans to offer a modified version of ADAMS, known as Defender, to NATO Alliance members and Eastern European nations.

In 2001, Rafael announced it was working on a so-called Super Barak, possibly also known as the B-8. Rafael and IAI are said to be working to increase the missile's range beyond "medium-range," and improve its capability against countermeasures. There were also reports of a next-generation defense missile being

developed, possibly as a follow-on to Barak. This new missile could have the capability to intercept long-range ballistic missiles during their reentry phase.

In early 2006, Rafael and Thales Nederland successfully tested the Defender short-range air defense system. This system uses the Barak missile. The Defender uses the Flycatcher Mk 2 surveillance radar. The system was developed to meet the requirements of Venezuela.



SPYDER Air Defense System

Source: Rafael

## Program Review

**Background.** Point defense against helicopters and aircraft has been of growing concern among the major world powers. Israel has developed a system – the ADAMS/HVSD (Air Defense Anti-Missile System/High Value Site Defense) – to address this short-range area air defense requirement. The ADAMS consists of two different and independent weapons systems: the ADAMS surface-to-air missile (a derivative of the Barak 1), developed by Rafael, and the Phalanx CIWS (close-in weapon system) by General Dynamics, consisting of a 20mm six-barrel Gatling gun and radar.

Each weapon retains its ability to operate independently and at different ranges. The ADAMS creates a two-level air defense system that can select the most appropriate weapon and operational mode, according to the characteristics of the threat and its range.

Through integrated use of its two weapon sub-systems, the ADAMS can create a defended area of approximately 200 kilometers square consisting of two partially overlapping belts. The external belt (from 12 kilometers down to 500 meters) is covered by the ADAMS missile, which is used to intercept aircraft and

## ADAMS

helicopters, as well as certain types of missiles and air-to-ground stand-off weapons. The internal belt (from 2,000 meters down to 100 meters) is covered by the M61 Vulcan gun, which provides a last-ditch defense against any threat that penetrates the external belt, as well as against pop-up targets. The gun also provides self-defense for the fire unit. The system can operate either as a completely autonomous unit or as an integral part of an existing air defense network of several ADAMS units or other anti-aircraft assets.

**SPYDER.** Rafael and IAI have also developed the SPYDER (Surface-to-Air Python and Derby) air defense system. Elta is also involved in this project. The initial system unveiled by Rafael has been reclassified SPYDER-SR after the SPYDER-MR was introduced.

The SPYDER-SR is equipped with the Python V and Derby air-to-air missiles. This system is a quick reaction, low-level missile system designed to counter attacks by aircraft, helicopters, UAVs, and PGMs.

The SPYDER launch vehicle (a 6x6 truck) has four ready-to-fire missiles: two Python Vs for point defense and two Derbys for long-range engagements. The Derby is equipped with a booster to extend its range to 40 kilometers. Elta Electronics provides a mast-mounted search radar carried on a separate vehicle.

### *New Air Defense Systems Combine Air-to-Air and Surface-to-Air Missiles*

The SPYDER system provides a 360-degree engagement capability day and night, under all weather conditions. The SPYDER can engage targets at distances of 1 to 15 kilometers flying at altitudes between 20 and 9,000 meters. The system can also engage multiple threats simultaneously.

A typical SPYDER system consists of a command and control unit, a radar sensor unit, six missile fire units, and a logistical support vehicle.

The SPYDER-MR is more capable than the SR version and features a new surveillance radar (the MF-STAR) incorporating enhanced counter-countermeasures and the ability to track multiple targets. The MF-STAR replaces the earlier EL/M 2106 ATAR 3-D radar that is used by the SPYDER-SR. The SPYDER-MR also has a higher missile capacity: four Python Vs and four Derbys. The missiles are equipped with boosters to expand its intercept envelope to 35+ kilometers. This version also provides 360-degree coverage.

In mid-2005, Rafael said it had signed a contract with an unidentified Asian nation (possibly India) for the procurement of three SPYDER squadrons. The

SPYDER-MR is being offered to Finland. By June 2006, India had announced that the SPYDER would meet its Low Level Quick Reaction Missile (LLQRM) need. The Indian military was still awaiting cabinet approval of this purchase the following September. Indian sources say four batteries are to be purchased as part of the deal, which could be worth \$240-\$325 million. Earlier, Rafael and IAI had said India may order an initial three systems with options to procure an additional 12 to 14 units.

Israel has yet to place an order for either system.

**SRBMD.** The United States is helping Israel to develop a more comprehensive missile defense shield in the wake of Hezbollah rocket attacks. During the July-August 2006 fighting between Israel and Hezbollah, the Lebanese terrorist group fired thousands of rockets into Israeli territory.

Israel had already been examining ways to strengthen its missile defense shield when its troops entered southern Lebanon. The current "system" includes the Arrow, Patriot, and HAWK air defense missiles.

The Short-Range Ballistic Missile Defense (SRBMD) program was initiated in March 2005 (an 18-month risk-reduction study was launched). The U.S. FY07 defense budget included funding (\$25 million) for the SRBMD initiative. The SRBMD requirement will be met by the Magic Wand system, which is called David's Sling (or David's Slingshot) in Israel. The name Stunner is used to describe the system's interceptor.

Rafael and Raytheon are working on this system. This team was selected over a proposal from IAI and Boeing (their bid centered on the Arrow). The proposed interceptor, once called Stunner, will use an ATK Tactical Systems booster motor. The projected cost is around \$450-\$500 million; each interceptor will cost \$300,000-\$400,000 apiece. Initial Operational Capability (IOC) will be achieved in 2011 or soon thereafter.

The Magic Wand will serve in the bottom layer of Israel's multi-tiered active defense network, intercepting rockets and missiles whose ranges of 40-200 kilometers (well below the class of Scud and Shahab threats, which the Arrow was designed to engage). The system may have a capability against slow-moving cruise missiles.

Rafael-Raytheon proposed the development of a "hit-to-kill" interceptor. The new interceptor will cost around \$200,000-\$300,000 apiece. Rafael will leverage work on previous air-to-air (Python and Derby) and surface-to-air (Barak) missile systems. The development portion of this contract could cost \$250-

\$300 million, with initial procurement adding another \$200 million.

**Iron Dome.** Israel will also add a system to defend against ultra-short-range threats (15 kilometers or less), such as the Qassem, a crude rocket used by Gaza-based Palestinian militants. During the Second Lebanon War, Palestinian militants fired over 1,000 rockets into southern Israel. This project is called the Ultra-Short-Range Ballistic Missile Defense (USRBMD) initiative.

A different solution is needed to protect Israeli border communities from short-range rocket attacks. Israel Military Industries (IMI) proposed the Magen Kassum (Magic Shield) based on its 160mm AccuLAR (Accurate Light Artillery Rocket). Other bids included: Northrop Grumman's Skyguard; Raytheon's Laser Area

Defense System (LADS); Lockheed Martin's Skyshield; and Rafael's Iron Dome (erroneously called David's Slingshot). The winning bid came from Rafael (this system is sometimes referred to as Iron Cap). The Barak missile can intercept rockets, but Israel saw no sense in downing a \$100 rocket with a \$300,000+ missile.

Iron Dome consists of an inexpensive kinetic interceptor based on Rafael missile technology, combined with an IAI targeting system. The interceptor will cost no more than \$40,000. Several million dollars was set aside in Israel's 2007 defense budget for this anti-rocket system, with the final cost placed at \$300 million.

Development began in 2007, with IOC to be achieved in 2009.

## Significant News

**Israel Moves Ahead with Short-Range Missile Defense Project** – In reaction to growing threats from militants in the Gaza Strip and southern Lebanon who routinely fire rockets into Israeli territory, the Israeli government has allocated \$207 million for the development of a new missile defense system. Plans are for this advanced system to counter short-range rocket fire.

Development of the system, called Iron Dome, will take some 30 months, according to Israeli Defense Minister Ehud Barak. The Iron Dome system will be developed by Rafael and is to be operational by the end of this period. The Iron Dome is part of a multi-layered defense system. Funding will support production for at least three years.

The first system will be deployed near Sderot, a southern Israeli town that comes under nearly daily rocket fire from the Gaza Strip. (AFP, 12/07)

**U.S. to Provide Funding for Israeli Missile Defense Program** – The U.S. will provide additional funding to help Israel tighten its missile defense shield. The U.S. House of Representatives and Senate appropriators approved a \$155 million package for Israel's missile defense program.

The U.S. will provide \$98 million for Israel's Arrow anti-tactical ballistic missile (ATBM) program. Israel's short-range interceptor program will receive \$37 million. This new system will provide Israel protection against rocket attacks from Hezbollah and Palestinian militants. Another \$20 million will go toward development of high altitude missile defense.

The total package is \$17 million more than was appropriated in 2007 and \$75 million more than President Bush requested. (JTA, 11/07)

**Israel to Deploy New Missile Defense System Soon** – Israel will enhance its rocket and missile defenses through the deployment of a new system. The new system, dubbed Iron Dome, is a short-range rocket-based missile interception system being developed by Rafael. Plans are for it to be operational in 18 months.

Israeli Defense Minister Ehud Barak said the operational deployment of Iron Dome is a prerequisite for an Israeli pullout from the West Bank. Palestinian militants in the Gaza Strip routinely fire rockets, such as the Qassam, at Israeli territory. The Iron Dome is designed to deal with rockets and short-range missiles and can launch an interceptor within one second of detecting an inbound target. A single Iron Dome launch costs from \$30,000 to \$40,000.

In addition, the Israeli government is considering resuming funding for the advanced laser-based Skyguard missile protection system (Nautilus). (Haaretz, 08/07)

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## ADAMS

## Funding

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U.S. President George W. Bush has signed a defense funding bill for FY08. This bill includes funding for the joint U.S.-Israeli Arrow anti-tactical ballistic missile (ATBM) system. The U.S. will provide \$155 million for Arrow and the development of a short-range missile defense system. The latter project will receive \$37 million.

The U.S. FY07 defense budget included funding for a Short-Range Ballistic Missile Defense (SRBMD) initiative. The U.S. and Israel studied the feasibility of developing a defense against short-range rockets. Raytheon and Rafael were involved in this study, and possibly IAI.

## Timetable

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| <u>Month</u> | <u>Year</u>         | <u>Major Development</u>                            |
|--------------|---------------------|---|
|              | 1985                | ADAMS announced by Rafael                           |
| May          | 1986                | Ground testing of the ADAMS begun                   |
| Jul          | 1987                | ADAMS left out from U.S. Army FAADS-LOS trials      |
|              | 1992                | ADATS program canceled                              |
|              | 1994                | Reports that ADAMS was purchased by Chilean Army    |
|              | 1999                | Venezuela, considered launch customer, buys ADAMS   |
|              | 2001                | Rafael and IAI work on enhanced Barak missile       |
|              | 2007                | Rafael working on Iron Dome system                  |
|              | 2009 <sup>(a)</sup> | New land-based air defense system enters production |

<sup>(a)</sup> Estimated

## Worldwide Distribution/Inventories

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The **Chilean Army** reportedly purchased a version of ADAMS in 1994 for its local area air defense requirements. A coproduction agreement is also on offer as part of this package. However, others have said that no such order was ever placed.

Israel is also working to integrate its Barak missile with Russian air defense radars. Tel Aviv sees a potential large market for this upgrade among users of the ZSU.23-4 gun and SA-8 Gecko SAM in Eastern Europe and Asia.

In 2005, **India** expressed an interest in the SPYDER Air Defense System. India has already purchased a small number of Derby missiles to arm its Harrier fighter aircraft. New Delhi is said to want up to 75 SPYDER systems. Initially, the SPYDER could meet India's need for 12 Low-Level Quick-Reaction Missile (LLQRM) systems.

Another long-time customer for Israeli defense equipment is **Turkey**. Ankara wants to acquire new surface-to-air missiles. Turkey has three requirements: the Turkish Low Altitude Air Defense Missile System (T-LALADMIS), the Turkish Medium Altitude Air Defense Missile System (T-MALADMIS), and the Turkish Long Range Air and Missile Defense System (T-LORAMIDS).

Companies that received the Request for Information (RFI) for the T-LALADMIS include Rafael, Saab Bofors Dynamics, Raytheon, China National Precision Machine, and Denel, among others.

The list of companies interested in T-MALADMIS include ASELSAN-Turkey, AYESAS-Turkey, CPMIEC-China, C-TECH-Turkey, Denel-South Africa, Diehl BGT Defence-Germany, FNSS-Turkey, Havelsan Teknoloji Radar-Turkey, IAI-Israel, Kongsberg-Norway, MILSOFT-Turkey, Rafael-Israel, Raytheon-USA, Roketsan-Turkey, Saab Bofors Dynamics-Sweden, and Thales-France. Some of the previously mentioned companies want to meet the T-LORAMIDS need, as well.

**User Countries.** The initial customer for the ADAMS was said to have been **Chile**. The system reportedly sold to the Chilean Army may have been the Relampago. **Venezuela** may have been the launch customer for the ADAMS.

## Forecast Rationale

A barrage of Hezbollah and Palestinian rockets has Israel moving quickly to enhance its missile defenses. Thousands of rockets have rained down on Israeli territory. Hezbollah, the Lebanese terrorist group, fired over 4,000 during 34 days of fighting in 2006.

Israel launched Operation Change of Direction (July-August 2006) to stop rocket attacks by Hezbollah on northern Israeli territory and retrieve two soldiers kidnapped by the terrorist group. In mid-August, Israel withdrew its forces from southern Lebanon.

### *Shield Against Rockets*

Israel's military operations in Lebanon did not eliminate the Hezbollah rocket threat. In fact, within months of the ceasefire, Hezbollah claimed to have rebuilt its rocket inventory and acquired even longer-range versions. The problem for Israel is that its defenses are designed to counter long-range threats, which are presented by Syrian and Iranian ballistic missiles. The Patriot and Arrow systems, however, are not suitable for intercepting short-range rockets. Israel, with U.S. assistance, is looking to fill this "capability gap."

Therefore, Israel launched the Ultra-Short-Range Ballistic Missile Defense (USRBMD) and Short-Range Ballistic Missile Defense (SRBMD) initiatives. These two systems will engage lower-tier threats (rockets with ranges of 200 kilometers or less). Rafael is currently developing systems to meet both needs: the USRBMD solution will be the Iron Dome system, and the SRBMD requirement will be met with the Magic Wand, which Rafael is designing in cooperation with Raytheon. The interceptor for Magic Wand is called Stunner.

Israel wants these systems fielded as soon as possible. As a result, the Iron Dome may be operational by next year (2009), with the Magic Wand following in 2011 or so. The purchase of these systems to defend Israel against short-range rockets will be sizable, considering the multiple threats Israel must defend against. Hezbollah is firing rockets from Lebanon, Syria is threatening to do the same, and the Palestinians launch these weapons from Gaza. Dozens of Iron Dome systems will be needed to defend hundreds of miles of border. There is a chance the U.S. could procure one or both of these systems.

As for more mundane manned threats, Israel is looking to design more capable land-based and shipborne surface-to-air missiles. The Barak 8 surface-to-air missile is intended to arm Israel's fleet of naval surface combatants. This system, once called Super Barak, is to be capable of engaging targets, both aircraft and missiles, out to a range of 100 kilometers.

In addition, Rafael and IAI have developed the SPYDER (Surface-to-Air Python and Derby) air defense weapon. As the name implies, the SPYDER uses the short-range Python V and medium-range Derby air-to-air missiles in an air defense role. This system is designed to engage fixed-wing aircraft, helicopters, missiles, and unmanned air vehicles (UAVs). This system could be among the competitors to fill a Turkish air defense requirement.

**Note:** *The follow-on Israeli Land-Based SAM forecast represents the possible purchase of a land-based Barak 8 or the SPYDER.*

## Ten-Year Outlook

| ESTIMATED CALENDAR YEAR UNIT PRODUCTION    |                 |      |      |      |      |                 |      |      |             |      |      |       |
|--|-----------------|------|------|------|------|-----------------|------|------|-------------|------|------|-------|
| Designation or Program                     | High Confidence |      |      |      |      | Good Confidence |      |      | Speculative |      |      | Total |
|  | Thru 2007       | 2008 | 2009 | 2010 | 2011 | 2012            | 2013 | 2014 | 2015        | 2016 | 2017 |       |
| <b>Rafael Advanced Defense Systems Ltd</b> |                 |      |      |      |      |                 |      |      |             |      |      |       |
| <b>Iron Dome</b>                           | 0               | 0    | 53   | 60   | 71   | 83              | 85   | 95   | 95          | 97   | 99   | 738   |
| <b>Stunner (Magic Wand)</b>                | 0               | 0    | 0    | 0    | 31   | 33              | 30   | 35   | 40          | 47   | 50   | 266   |
| <b>Subtotal</b>                            | 0               | 0    | 53   | 60   | 102  | 116             | 115  | 130  | 135         | 144  | 149  | 1004  |
| <b>Total</b>                               | 0               | 0    | 53   | 60   | 102  | 116             | 115  | 130  | 135         | 144  | 149  | 1,004 |