

# ARCHIVED REPORT

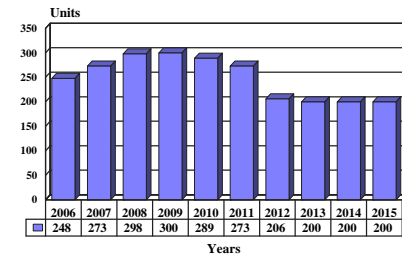
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## STAR-1 - Archived 10/07

### Outlook

- Development proceeding, with some missiles in production
- A new anti-radiation missile (ARM) could be fielded by Israel in the near future; this missile may be based on the Delilah strike weapon
- China is expanding its missile inventory, which may now include an ARM

10 Year Unit Production Forecast  
2006 - 2015



### Orientation

**Description.** Anti-radiation missile system.

**Sponsor.** Israel Ministry of Defense.

**Status.** STAR-1, also called Light Defender, was said to have entered its final development phase in 1992. However, financial problems at IMI slowed development and delayed the program. Production of this missile has yet to commence.

**Total Produced.** The STAR-1 has yet to enter full-scale production. A small number of Light Defenders, a missile based on the STAR-1, were purchased by the U.S. Navy for testing.

Production of the Keres has been completed, with close to 300 units manufactured.

**Application.** Loitering anti-radiation missile capable of suppressing enemy air defense systems such as radar-controlled, surface-to-air missile (SAM) and anti-aircraft artillery (AAA) batteries.

**Price Range.** No specifics are available on per-unit prices. Estimates place the unit cost of the STAR-1 between \$387,000 and \$490,000. The Keres is believed to have cost roughly \$131,000 each.

### Contractors

#### Prime

<b>China Precision Machinery Import &amp; Export Corp (CPMIEC)</b>	<a href="http://www.cpmiec.com.cn">http://www.cpmiec.com.cn</a> , 30 Haidian Nanlu, Beijing, 100080 China, People's Republic of, Tel: + 86 10 68 74 88 77, Fax: + 86 10 68 74 88 44, Prime
<b>Israel Military Industries Ltd (IMI)</b>	<a href="http://www.imi-israel.com">http://www.imi-israel.com</a> , PO Box 1044, Bialik St 64, Ramat Hasharon, 47100 Israel, Tel: + 972 3 548 5617, Fax: + 972 3 548 6125, Email: <a href="mailto:imimrktg@imi-israel.com">imimrktg@imi-israel.com</a> , Prime

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## STAR-1

## Technical Data

	<u>Metric</u>	<u>U.S.</u>
<b>Dimensions</b>		
Missile length	2.7 m	106 in
Missile weight	180 kg	400 lb
Wingspan	1.15 m	4.92 ft
<b>Performance</b>		
Speed	Mach 0.8	Mach 0.8
Altitude	150-9,000 m	500-30,000 ft
Range	400 km	249 mi

**Propulsion.** The STAR-1 is equipped with a turbojet propulsion system.

**Control & Guidance.** The STAR-1 is capable of being configured for anti-radar and standoff strike missions. When used against air-defense radar sites, the STAR-1 uses a standard passive radio-frequency guidance system. For precision strike missions, the missile is believed to be equipped with an inertial guidance system for the cruise phase of flight and an active radar seeker for terminal homing.

As a decoy, this system is equipped with a Luneburg lens or radio-frequency repeaters to increase its radar cross section and apparent size on radars.

**Launcher Mode.** Fired from underwing-mounted pylons.

**Warhead.** The STAR-1 is equipped with a high explosive blast/fragmentation type warhead, but the Delilah decoy has no warhead.



ITALD

Source: IMI

## Variants/Upgrades

Only the production version of the Keres is known to have been manufactured. The Delilah decoy system provides the basis for the STAR-1/Light Defender missile systems. This system could also be the basis for a new cruise missile that Israel is rumored to be developing.

Israel also developed the Kilshon, an M4 Sherman tank fitted to launch an AGM-45 Shrike anti radiation missile. Later, this system was fitted with AGM-78 Standard ARMs and then the Keres. This system is no longer in service.

## Program Review

**Background.** Israel, faced with a significant air-defense threat from Syria in particular, has developed various anti-radiation weapon systems to fulfill its suppression of enemy air defense (SEAD) requirements. Among the country's products are the Keres and STAR-1 anti-radiation missiles.

**Keres.** The information available on Keres is limited and contradictory. Developed during the 1970s, the Keres is a surface-to-surface anti-radiation missile that came into service with the Israeli Defense Force after the 1973 Yom Kippur War. Israeli sources have said that the Keres was a modified program based on the General Dynamics-built AGM-78 anti-radiation missile. This missile was part of the Kilshon system.

The Israeli Air Force adapted the air-launched missile for surface-to-surface use under the new designation RGM-66D/2, supposedly with help from General Dynamics. However, General Dynamics denied any knowledge of the program and speculated that the system was actually developed by MBT, a subsidiary of Israel Aircraft Industries (IAI). However, IAI could find no information that attested to its involvement in Keres, and Israeli sources continue to insist that General Dynamics was involved in its development.

### *New Warhead for Standard ARM*

Another report supposedly involving the AGM-78 centered on the development of a more effective warhead. Whether this is the same as Keres is not known. Operational experience had shown that the AGM-78's original warhead was not effective enough against the Syrian radar installations. Therefore, Israel Military Industries (IMI) was contracted to develop a new warhead with controlled fragmentation to meet the Israeli Air Force's request. This new warhead was said to have been used during Israeli operations over Lebanon in 1982.

The Keres is described as having a range of several dozen kilometers and was used during the 1982 Israeli invasion of Lebanon against Syrian SA-2, SA-3, and SA-6 air-defense missile batteries. Some sources had indicated that the Keres was similar to the IAI Harpy ground-launched anti-radiation drone, but this has been dismissed by Israeli military sources who stated that Keres is nothing like the Harpy. It's possible that only 300 Keres were produced.

**STAR-1.** This classified program entered its final development phase in 1992; Israel Military Industries (IMI) is the prime contractor. Few details are available on the STAR-1, although the missile's design is based

on a modified version of the Delilah unmanned aerial decoy system. The Delilah, which is in service with the Israeli Defense Force, simulates attack aircraft profiles to draw hostile air-defense fire to help in clearing flight paths for manned strike platforms. However, the STAR-1 is larger than the Delilah, and is turbojet powered.

### *Loitering Anti-Radar Weapon*

Israeli officials claim that the STAR-1 missile is comparable in performance to the U.S.-designed AGM-136A Tacit Rainbow, which was canceled prior to production start. The Israeli missile is said to carry a significantly smaller per-unit price tag than its canceled American counterpart. When in operation, the STAR-1 uses a preprogrammed flight path and an autonomous search mode. The STAR-1 also covers a wide range of radar frequencies. The missile range is believed to be 400 kilometers with a maximum speed of Mach 0.8.

Talks between IMI and Boeing concerning the joint development of the STAR-1 broke down in 1999. According to reports, IMI is now talking to another unidentified U.S. firm about this joint missile development effort. In the U.S., the STAR-1 was called the Light Defender. In mid-2000, the U.S. Navy purchased a small number of Light Defenders for testing. The service was attempting to determine the feasibility of integrating this missile with its SH-60B Seahawk helicopter fleet. In 2001, the U.S. Navy mentioned an interest in conducting additional tests of this weapon. The Light Defender would complement the Seahawk's existing Penguin anti-ship missile armament and would be used against softer targets.

Israel is accused of transferring STAR-1 technology to the People's Republic of China and using this missile as the basis for the development of a cruise missile. The STAR-1 project may be related to Delilah (see Delilah).

**Delilah.** In 2004, Israel said it had developed a new ground-launched cruise missile based on IMI's Delilah aerial decoy system. The Delilah-GL (Ground-Launched) cruise missile has a range of 300 kilometers. This missile may have been deployed before the end of 2004.

### *Land-Based and Shipborne Versions of Delilah May be Available*

It has long been rumored that Israel has developed a new cruise missile on its own. Tel Aviv tried to purchase the Raytheon BGM-109 Tomahawk cruise missile, but the U.S. government would not approve the

## STAR-1

sale. Prior to the unveiling of the Delilah-GL, Israel may have developed a similar missile for shipborne or submarine use called the Delilah-SL (Surface-Launched or Sea-Launched).

In the late 1990s, Israel was said to have developed a cruise missile for use on its new German-built Dolphin diesel-electric submarines. The new weapon was based on either the Rafael Popeye strike missile or the Israel Military Industries (IMI) Delilah, and equipped with a turbofan or turbojet engine (another report said IAI had developed this missile). The missile was said to have mid-body, pop-out swept wings, a reconfigured tail, and a lower read-body engine intake.

Israel is believed to have had a new cruise missile in production (at least at a low rate), possibly since 2002. Whether this submarine-launched missile is based on the Popeye or Delilah is unknown. There may be a version of this missile configured for use against air defense radars.

The Delilah-SL may have been developed specifically to arm Israeli naval surface combatants, not submarines.

**Chinese ARM.** A rumored Israeli cruise missile program could be related to two or more Chinese projects. These Chinese projects include an undesignated missile with a range of 400 kilometers, as well as the YJ-12A and YJ-62.

### *China Slowly Expanding Missile Inventory, Adding ARMs*

The YJ-12A, a medium-range supersonic missile, is a follow-on to China's current inventory of supersonic missiles, such as the C301, and may be largely based on these existing systems. Meanwhile, the YJ-62 development program is believed to be focused on providing a long-range anti-ship missile, with only a subsonic top speed.

At the Zhuhai Air Show 2000, China displayed a new supersonic air-to-surface missile. Designated FBC-1, this ramjet-powered missile may be intended to perform anti-shiping or anti-radar missions. Chinese officials declined to comment on the FBC-1. Later, it was discovered that this designation referred to a fighter/bomber version of the JH-7.

The designation for this new anti-radiation missile may be either YJ-9 or YJ-91 (Ying Ji-91). One source said this missile was intended to be carried by the J-10 fighter, which could be based on Israel's Lavi combat aircraft design. The YJ-91 may actually be based on the Russian Kh-31P anti-radiation missile, while the YJ-9 may be a version of C802. In 2000, reports said the missile on display at the air show was similar in size to the C802 subsonic anti-ship missile.

The Chinese People's Liberation Army Air Force (PLAAF) has a very limited standoff attack and air-defense suppression capabilities.

## Funding

No specific funding information has been released by the Israeli government or IMI. Money for this program may be provided by the People's Republic of China.

## Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1970s	Keres in development
	1982	Keres used against Syrian SAMs in Lebanon
	1992	STAR-1 unveiled
Early	1990s <sup>(a)</sup>	Production delayed
May	2000	Israel tested cruise missile off Sri Lankan coast
Mid	2000	U.S. Navy purchased small number of STAR-1 missiles
Jun	2000	Israel denied cruise missile test off Sri Lanka
	2004 <sup>(a)</sup>	Delilah-GL deployed by Israel
	2004-2005 <sup>(a)</sup>	YJ-91 enters production in China

<sup>(a)</sup> Estimate

## Worldwide Distribution / Inventories

**User Country.** The **Israel Defense Force** is the only known operator of the Keres and the Delilah systems.

## Forecast Rationale

Israel and China are among the few nations outside the major power blocs that are acquiring anti-radiation missiles. Few countries have a real need for a suppression of enemy air defenses (SEAD) capability, but these two appear to be exceptions.

### *Market for ARMs Remains Small*

Israel has long employed anti-radiation missiles in its wars with Arab neighbors. Starting with the 1967 Six Days War, Israel has made extensive use of anti-radar weapons against the air defense systems of its opponents. During the Yom Kippur War (1973) and Operation Peace for Galilee (1982), Israel undertook SEAD missions on a massive scale. In the latter, 19 Syrian air defense sites were destroyed in a single day, enabling Israeli aircraft to operate with impunity over much of Lebanon.

To meet its need, Israel has acquired anti-radiation missiles from both domestic and foreign sources. The United States has provided the AGM-45 SHRIKE, AGM-78 Standard ARM, and the AGM-88 HARM, while the Keres was a locally produced missile. Now, Israel may have developed an all-new loitering anti-radar weapon. This new missile, possibly based on the Delilah-GL (Ground-Launched) long-range strike weapon, is tentatively called STAR-1. Other sources have called this missile the Delilah-AR. It is doubtful that the STAR-1 will make it into production, partly due to financial constraints within the Israeli defense budget.

Meanwhile, China needs anti-radiation missiles as part of its plan to seize Taiwan by military force, if necessary. Beijing has pressured Taiwan to move ahead more quickly with reunification talks. Taipei is worried

it will suffer a fate similar to Hong Kong if it rejoins the mainland. There has been a steady assault by Beijing on the freedoms of the former British colony. Also, Taiwan may fear that its economic position may be threatened by reunification. Hong Kong's position as an economic hub for China has diminished since reunification in favor of Shanghai.

### *China Wants ARMs to Support Operations Against Taiwan*

To take Taiwan by force, China will need the capability to destroy, disable, and disrupt a large segment of Taipei's defenses. If this invasion should fail, Beijing would not be able to launch a similar operation for another decade or more. Anti-radiation missiles may not play a prominent role in any Chinese invasion of Taiwan, but they could help to increase the chances of such an operation being successful.

China may be receiving help from Israel in the development and manufacture of anti-radiation missiles. Whether this effort has produced an operational missile is unclear. China may have also turned to Russia to meet this need. The new YJ-91 could be a Chinese version of the Russian Kh-31P anti-radiation missile. There is a possibility that China has two anti-radiation missiles in production: one based on Israeli technology and another derived from a Russian design.

Anti-radiation missiles do not generate the kind of sales common with many of their counterparts. Worldwide, only a handful of countries possess anti-radiation missiles in any great number, and the leading suppliers remain located in the U.S. and Europe.

## Ten-Year Outlook

### ESTIMATED CALENDAR YEAR PRODUCTION

Missile	(Engine)	thru 05	High Confidence Level				Good Confidence Level				Speculative		Total 06-15
			06	07	08	09	10	11	12	13	14	15	
CHINESE STATE ARSENALS													
YJ-91	UNSPECIFIED	313	217	201	208	209	203	202	206	200	200	200	2046
Subtotal - CHINESE STATE ARSENALS		313	217	201	208	209	203	202	206	200	200	200	2046
ISRAEL MILITARY INDUSTRIES													
KERES	UNSPECIFIED	300	0	0	0	0	0	0	0	0	0	0	0
STAR-1	UNSPECIFIED	0	31	72	90	91	86	71	0	0	0	0	441
Subtotal - ISRAEL MILITARY INDUSTRIES		300	31	72	90	91	86	71	0	0	0	0	441
Total Production		613	248	273	298	300	289	273	206	200	200	200	2487