

# ARCHIVED REPORT

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## HARD - Archived 7/2010

### Outlook

- Last known contract was awarded in 2002 and deliveries have been completed
- Rheinmetall Italia has completed design and development work on a new 3D air surveillance radar – X-Tar 3D, to be used with the ASRAD system
- Barring further activity, this report will be archived in July 2010

### Orientation

**Description.** The Helicopter and Airplane Radar Detection (HARD) system is an X-band, 3D, frequency-agile, pulse-Doppler search radar. It is also known as the Air Defense Search and Acquisition Radar.

#### Sponsor

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**Licensees.** No production licenses have been granted.

**Status.** In service.

**Application.** HARD is intended for mobile Short-Range Air Defense Missile Systems (SHORADMS) such as Stinger and Mistral.

The Swedish Army is using it as a local surveillance radar for the RBS90 missile, while Germany is using it for the Advanced Short-Range Air Defense (ASRAD) system.

**Platform.** The HARD is mounted on vehicles with self-propelled anti-aircraft gun or mobile SAM applications. The Swedish Army is deploying the HARD mounted on the BV-208 all-terrain vehicle by Hägglunds.

**Price Range.** Analysis of contract values suggests a unit cost of approximately \$1.25 million.

### Contractors

#### Prime

<b>Saab Microwave Systems</b>	<a href="http://www.saabgroup.com">http://www.saabgroup.com</a> , Solhusgatan, Göteborg, 412 89 Sweden, Tel: + 46 31 794 9000, Fax: + 46 31 794 9002, Prime
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## HARD

## Technical Data

<b>Specifications</b>	<u><b>Metric</b></u>	<u><b>U.S.</b></u>
Frequency	X-band	X-band
Peak power output	65 W	
Average power output	8 W	
Range/hovering helicopter	8-10 km	5-6 mi
Range/fixed-wing aircraft	16-20 km	10-12 mi
<b>Dimensions</b>		
Weight	110 kg	275 lb



Saab Microwave Systems' HARD Radar Mounted on a Hägglunds BV-208 All-Terrain Vehicle

Source: Swedish Ministry of Defense

**Design Features.** HARD is a 3D search radar optimized for helicopter detection and low-level air threat. Important features of the HARD radar are low peak output power, a high antenna gain coupled with low sidelobes, simultaneous moving-target indication (MTI), and frequency agility (pulse-to-pulse or pulse burst). The all-solid-state transmitter is based on pulse compression technology and has multi-frequency capability. The search-and-acquisition radar is essentially the same PS-91 sensor that is used on the Swedish RBS90 short-range air defense system, operational since 1993.

The radar's output power is significantly increased with the use of new transmitter modules. Saab states that pulse compression makes it impossible for false echoes to be inserted via electronic countermeasures. Threat evaluation and separation of helicopter, aircraft, and missile targets are carried out automatically. The radar also provides automatic simultaneous tracking of an unspecified number of targets. Target information in azimuth, range, and elevation is provided for associated weapons systems.

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Vector displays provide the operator with rapid threat assessment. The vertical scan pattern is optimized for the detection of low-level helicopters. The first whole antenna revolution is devoted to the helicopter threat. The rest of the envelope is scanned on the second revolution. Devoting the first sweep to helicopter detection allows the MTI to register rotor hub movement. This is likely to be the only visible moving part of a hovering helicopter. The target in this case is less than one-third a square meter, whereas an aircraft is usually about 3 square meters.

The radar is reportedly capable of sector scan and intermittent transmission. This further limits the effectiveness of electronic countermeasures (ECM). The HARD is lightweight and consists of two modules: the antenna and transceiver unit, which weighs 60 kilograms (132 lb); and the signal processing unit, which weighs 50 kilograms (110 lb).

**Operational Characteristics.** The HARD radar's power and range are minimized because high power is unnecessary in a short-range operation and is more likely to be detected by enemy sensors. Instrument range is only 20 kilometers, with target detection of 8 to 9 kilometers. This is adequate for the 5- to 6-kilometer range of the RBS70 missile. Higher powered versions are feasible should the requirement arise. HARD provides target velocity. Range is accurate to plus or

minus 50 meters, elevation to plus or minus 1 degree, and azimuth to plus or minus 0.5 degree. The planar array antenna turns mechanically at 40 rpm in azimuth, but scans electronically.

Saab states that the low peak power output of 65 W and a mean power output of 8 W, with a noise value of 6 dB, give HARD its excellent low probability of intercept. The "whispering radar" can be identified only at a range of 30 kilometers, provided the interceptor is located precisely inside the radar's main emitting beam. That, in turn, is a very narrow slot due to the electronic scanning in elevation with the slotted waveguide antenna. Outside the main beam, the radar cannot be intercepted at ranges exceeding a few hundred meters.

The HARD is also said to be almost totally immune to electronic jamming because of its pulse-to-pulse frequency agility, Doppler processing, and pulse compression. Sidelobes have been virtually eliminated, says Ericsson. Typical reaction times, measured from the time the target is first visible to the time the system supplies the target data to the command and control unit, are 3.2 seconds in normal mode and 1.7 seconds in pop-up mode. The very short reaction time after target detection stems partly from combining a search pattern for high-elevation coverage and a 3D function with intelligent beam control.

## Variants/Upgrades

**Improved HARD 3D – German Version.** This version was bought by STN Atlas Elektronik for delivery to the German Army in 1995-96. This improved configuration reportedly operates in X-band, has track-while-scan capability, and can simultaneously

track 20 targets and five jammers automatically. It has a detection range of 20 kilometers (compared with the original HARD's 12-km detection range).

**PS-91.** The Swedish Army designation for HARD.

## Program Review

**Background.** In 1978, Bofors began designing a self-propelled version of its RBS90 missile, known as ARMAD (Armored and Mechanized Air Defense), to meet the requirements of mechanized units. The prototype was mounted on an M-113A1 armored personnel carrier (APC), and featured a HARD radar mounted on the turret roof. Bofors stressed that this system was suitable for mounting on any tracked or wheeled APC. In theory, the radar could operate while traveling, with automatic compensation for vehicle movements. The prototype HARD radar entered trials in 1984 and was evaluated by the U.K. and the United States.

### *First Win Is at Home*

The Swedish Army issued a \$75 million contract for HARD 3D radar systems in 1989. This procurement was for use with Sweden's all-weather, night-capable, short-range air defense RBS90 SAM system. In RBS90 configuration, the HARD system was mounted on a BV-208 tracked all-terrain vehicle.

In 1992-93, Ericsson (now Saab) began development of a second-generation HARD system known as Improved HARD. This new variant has an alternating pulse-repetition frequency mode that eliminates second-time

## HARD

echoes; an improved antenna with lower sidelobe levels; a new adaptive moving target indicator (MTI) filter intended to improve the detection range by 20 percent; and an increase in power output per module to 14 W, from 6 W.

### *Joint Venture Brings New Customer*

In a joint venture between STN Atlas Elektronik of Germany and Ericsson Microwave Systems, the Improved HARD radar was incorporated into the LeFlaSys Light Mechanized SHORAD (Short-Range Air Defense) system, also known as ASRAD (Advanced Short-Range Air Defense). In 1995, Germany ordered 50 ASRAD firing platforms under the name Ozelot. Included in this order were 10 command vehicles equipped with the Improved HARD radar system. The German Army's Air Defense Service took formal delivery of the first platoon of the LeFlaSys air defense system in June 2001. Final deliveries were scheduled for 2003, and deliveries have been completed.

### *Greece's ASRAD Orders Might Not Include HARD*

In October 2000, Greece ordered 54 ASRAD systems. It was assumed that Greece would need the same number of command vehicles as Germany did for its 50 systems – 10 HARD 3D radar systems. However, Greece did not order any command vehicles at the time of the ASRAD order. No information is available on the radar system that is being used with these ASRAD systems. *Army Technology* reports that deliveries to Greece began in 2004 and were completed in 2006.

An interesting side note is that in May 2003, INTRACOM Defense Electronics of Greece signed a three-year export contract for the manufacture, industrialization, testing, and development of Ericsson's HARD products. INTRACOM is also involved in the marketing of this product. INTRACOM reports that the project's budget amounts to EUR2.6 million.

### *Latest Customer is Finland*

In September 2002, STN Atlas Elektronik ordered four HARD 3D systems for four ASRAD-T batteries in Finland. ASRAD-R is based on the Saab Bofors Bolide

missile and the HARD search radar. *Army Technology* reported that Finland placed an order for 16 ASRAD-R systems in four batteries, in August 2002 for \$121 million. Deliveries began in 2004 and were completed in 2006.

At the Eurosatory 2008 defense industry trade show, Rheinmetall Defence revealed that it had sold and deployed 16 ASRAD-R systems to Finland since 2006. The ASRAD-R features a HARD 3D radar, various EO sensors, and four Saab Bofors Defense Bolide SAMs. According to *Military Procurement International (MPI)*, the first four ASRAD-Rs were mounted on Sisu Nasus trucks and the remaining 12 on Mercedes Unimog 5000 chassis.

### *Current Orders Wrapped Up*

Apart from Finland, Germany is the only export country to have purchased the HARD 3D radar system. Germany purchased 10 HARD 3D radar-equipped command posts in 1995 for its ASRAD (aka Ozelot) firing platforms.

### *HARD Loses RNLA Competition*

In 2005, *MPI* announced that Turkey's Aselan had won the Royal Netherlands Army (RNLA) competition to supply 36 Raytheon Stinger Weapon Platforms (SWPs) for Krauss-Maffei Wegmann Fennek vehicles. One of the other firms that was invited to compete was Rheinmetall Defense Electronics, which included the HARD radar as part of its bid package.

### *Possible Future Platform*

In March 2007, *MPI* reported that Germany's Rheinmetall Defence Electronics and MBDA of France had entered a wide -ranging agreement to develop a new multipurpose combat vehicle (MPCV) capable of mounting short- range air defense or anti-tank missiles. Rheinmetall is responsible for designing, developing, and manufacturing the new MPCV's missile platform, based on the company's short-range ASRAD system. The new system will integrate MBDA's Mistral air defense and MILAN ER anti-tank missiles. It is not clear which radar will be used on the MPCV.

## Contracts/Orders & Options

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Ericsson Microwave Systems	N/A	Sep 2002 – STN Atlas Elektronik ordered HARD 3D surveillance radar systems for four ASRAD-R air defense batteries in Finland.

## Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1978	Start of HARD system development
	1984	HARD pre-production stage
	1988	HARD evaluated by Swedish Army
May	1989	HARD ordered by Swedish Army
	1992	Start of HARD deliveries to Sweden
Oct	1995	Order by STN Atlas Elektronik of Germany, constituting the first export deal
	1996	First HARD unit delivered to STN Atlas Elektronik
Dec	1998	\$30.6 million contract for 10 Improved HARD units awarded to Ericsson by STN Atlas Elektronik
	2000	First deliveries of Improved HARD systems to STN Atlas
Nov	2000	Greek Defense Ministry orders 54 ASRAD systems (unknown if HARD order attached to this procurement)
Late	2000	First batteries delivered to German Army
	2002	Deliveries to STN Atlas Elektronik scheduled for completion
Sep	2002	Finland orders HARD 3D systems
	2003	German HARD deliveries scheduled for completion
	2006	Finnish deliveries to be completed

## Worldwide Distribution/Inventories

<b>Germany</b>	STN Atlas Elektronik ordered 10 units for its ASRAD system.
<b>Finland</b>	Ordered 16 HARD systems for its new ASRAD-R air defense batteries.
<b>Sweden</b>	Large numbers of HARD units are believed to be in use by the Swedish Defense Forces.

## Forecast Rationale

### ***Rheinmetall Radar Replacement***

Rheinmetall Italia announced in April 2009 that it had completed design and development of a new 3D air surveillance radar – X-Tar 3D. The radar is now in the qualification phase. According to the company, X-Tar 3D can coordinate any type of SHORAD system and forms an integral part of the ASRAD missile air defense system. The new X-Tar 3D radar appears to have eliminated the need for Rheinmetall Defence to go to Saab for its HARD radar.

### ***Saab Continues to Offer HARD***

Saab continues to promote the Helicopter and Airplane Radar Detection (HARD) radar on its Web site, even

though a contract for the radar has not been awarded since 2002. There are several sources of competition, but Saab still believes that HARD's small size, low weight, low power requirements, easy integration with vehicles of all types, and ability to stand alone make it attractive for customers requiring rapid force deployment.

### ***Outlook***

Because the last known contract for HARD was placed in 2002, the outlook for this radar is not very promising. Saab continues to promote the system on its Web site, however, indicating that future sales are possible.

## Ten-Year Outlook

Market analysis indicates that the last HARD order was placed in 2002 and all deliveries have been completed. Therefore, this report contains no **Ten-Year Outlook** chart.

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