

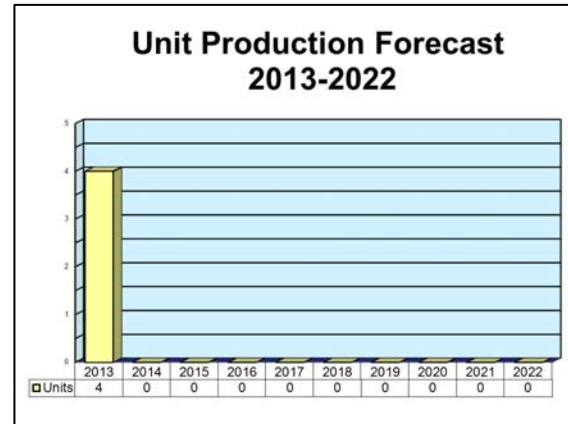
ARCHIVED REPORT

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PS-05/A

Outlook

- Thailand is the lone remaining customer
- Saab's Gripen C/D replacement, the Gripen NG, will feature the new ES-05 Raven AESA radar, effectively negating the PS-05's market
- Barring any unforeseen contracts, this report will be archived in 2014



Orientation

Description. I/J-band pulse-Doppler airborne radar for air-to-air and air-to-ground missiles.

Sponsor

Defence Materiel Administration
 Försvarets Materielverk (FMV)
 Banérgatan 62
 S-11588 Stockholm
 Sweden
 Tel: + 46 8 782 4000

Licenseses. No production licenses are known to have been granted.

Status. In production and service.

Application. The PS-05/A is a multirole airborne radar designed for fighter aircraft. Thus far, the PS-05/A has been fitted onto only the Swedish-built Gripen multirole fighter. It is used for air-to-air and air-to-ground functions, including long-range search, ground mapping, and missile fire control.

Price Range. As no contracts have been awarded specifically for the PS-05/A radar system, it is not possible to precisely determine the price of this system. A comparison with the known costs of equivalent systems indicates a cost of \$1.5 million to \$2.5 million.

Contractors

Prime

Saab Electronic Defense Systems	http://www.saabgroup.com , Solhusgatan 10, Kallebäck's Teknikpark, Göteborg, 412 89 Sweden, Tel: + 46 31 794 9000, Fax: + 46 31 794 9002, Prime
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PS-05/A

Technical Data

Specifications

Antenna

Diameter
Frequency
Pulse Type
Transmitter/Amplifier Type
Amplifier Peak
Power Consumption

LRUs

Weight

Cooling

Amplifier

Other

Interface

MTBF

Metric

Mechanically Scanned Planar Array
with IFF dipoles

60 cm

I/J-band

Monopulse

TWT

>10 kW

<7 kW

7

150 kg

Liquid

Forced air

MIL-STD-1553b databus,

Ethernet, Opto-link

250 hr

U.S.

23.6 in

X-band

330.7 lb



Swedish JAS 39C Gripen Arriving at Eielson AFB, Alaska – Platform for the PS-05/A Radar

Source: Erik Engstrom, SwAF

Design Features. An output power of approximately 1 kW gives the PS-05/A a range comparable to that of its predecessor, the Viggen radar, with at least three times as many functions. Because of the large-scale integration circuitry and the dense packaging techniques employed in the design, the radar occupies only about 60 percent of the volume of its forerunner.

The PS-05/A planar array antenna is fabricated from carbon-fiber composite material for lightweight and low inertia characteristics to provide quick response under high load factors. It features an integrated identification friend or foe (IFF) system. The central Gripen computer is a standardized 32-bit system (Ericsson SDS 80) and will operate the radar and its processing/display system. The system consists of the following six line-replaceable units:

- Flat-panel antenna
- Electromagnetically stabilized platform
- High-frequency power pack
- Transmitter using TWTs
- Receiver
- Signal and data processor

The cockpit has advanced electronic graphics using three programmable head-down raster displays, as well as one wide-field-of-view diffraction optics head-up display (HUD). All cater to multimode use and high development flexibility. The center display shows the relief contour in map form. The left unit acts as a replacement for traditional flight instruments, and the display on the right is dedicated to sensor-acquired information, including radar. The HUD displays all essential information for the pilot.

The system also employs a number of advanced technologies, including Doppler beam-sharpening processing, pulse compression, narrow Doppler filters, and pulse repetition frequency (PRF) switching. High clutter rejection is obtained through use of high transmitter spectral purity, wide receiver dynamic ranges, and low antenna side-lobe levels. Additionally, high electronic counter-countermeasure capabilities are accomplished with monopulse techniques, high power output, low side-lobe levels, wide radio frequency bandwidths, and frequency agility/special functions.

The PS-05/A also meets all requirements to datalink with NATO-approved radar guided missiles.

Operational Characteristics. The PS-05 radar is designed to be highly flexible and to have exceptionally high resistance to electronic countermeasures. Complex and flexible software-controlled waveforms, in conjunction with operation in the I/J-band, are used to optimize the FM pulse-compressed signal to the mission

requirement. In the air-to-air mode, the radar uses high- and medium-PRF waveforms that employ a variety of software-controlled antenna search patterns for long-range search and multiple track-while-scan, together with short-range wide-angle scanning and fire control. Air-to-surface, frequency-agile, low-PRF modes are applied for sea and ground target search, high-resolution ground mapping, and fire control.

Air-to-Air Modes:

- Automatic Waveform Selection
- BVR Missile Datalink
- Data Link Integrated Tracking
- Long & Medium Range Look-up Look-down Detection
- Multi-target Engagement (priority target tracking)
- Multi-target Track-while-search
- Short-range Auto Acquisition & Tracking

Air-to-Surface Modes:

- Air-to-Ground Ranging
- Ground Moving Target Indication/Tracking (GMTI)
- SAR Mapping – Real Beam & High Resolution
- Sea Surface Search & Track

The PS-05/A is compatible with the U.S. AMRAAM. Other missile systems expected to be operated aboard Gripen include the Sidewinder AIM-9L and the RBS73, for which a PS-05/A-compatible active homing head is being developed. (RBS73 is the Swedish version of the British Skyflash missile.) In the anti-ship role, Gripen will carry the RBS15 anti-ship missile. In the air-to-surface role, Gripen will carry the MBB anti-armor munitions dispenser.

Variants/Upgrades

Mk 3. Saab is currently selling the Mk 3 variant, also known as JURA (JAS Upgraded Radar), which has been available since 2005. Mk 3 operates Version E18 software and is equipped with a new signal/data processor based on Mercury processor technology.

According to the *Jane's International Defence Review*, Ericsson has plans to field an interim air-to-ground software as part of the new E19 software release. South African Gripens will be the first aircraft to be equipped with E19 software.

Mk 4. The next variant, the Mk 4, is being developed under a project known as GRETA (Gripen Reconnaissance and Enhanced Target Acquisition). GRETA is intended to produce a high-resolution synthetic aperture radar (SAR) capability and to offer enhanced ground moving target indication/tracking and automatic detection of stationary objects. Mk 4 will involve new software (Version E20) and hardware, primarily extra signal processing and high-frequency signal generation capacity. Saab is said to be in talks

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with the Swedish Defense Materiel Administration for full development of Mk 4; however, no contract signing has been announced. Reports indicate that a Version Mk 4 would be fielded on Swedish aircraft only.

Mk 5. Version Mk 4 will be upgraded to the Mk 5 standard by 2012. According to Ericsson, the PS-05/A Mk 5 will include an active electronically scanned array (AESA) antenna and new radar software. The radar's back end would remain the same.

NORA. The Not Only a Radar (NORA) technology demonstration program was designed to give the PS-05/A an AESA antenna with approximately 1,000 individual transmit/receive modules. The antenna was

to be mounted on a single axis platform to provide more than 200° of coverage in azimuth. Side panels were considered, to give the system the ability to provide rear radar coverage. Ericsson received the AESA antenna from Raytheon in 2004. It was reported that this program was halted due to restrictions on U.S. technology exports to certain third countries.

PS-05 AESA (ES-05 Raven). Saab announced in March 2009 that the Gripen Next Generation (NG) program will use an AESA radar under a cooperative development agreement reached between Saab and SELEX Galileo. This radar is now known as the ES-05 Raven.

Program Review

Background. This program originated from the Swedish Air Force requirement for a replacement for the Saab Viggen aircraft. In 1982, the Swedish government announced a plan covering development and procurement of the Gripen aircraft. Ericsson Radio Systems collaborated with Ferranti of the U.K. in the project definition stage of the radar requirement. The design philosophy of the PS-05/A is based on a combination of the PS-46 radar designed for Viggen and Ferranti's Blue Falcon radar project.

Development and Testing

The major subsystems of the PS-05/A were tested in 1984, and system development continued during 1985. Radar flight trials took place on a Viggen in 1987. The radar development program was completed in August 1992. At that time, two production batches of Gripen aircraft had been ordered, totaling 140 aircraft.

A New Focus – International Sales

Export orders for Gripen experienced a significant boost in 1999 when South Africa ordered 26 of the fighters. The initial South African Gripen was delivered in April 2008. All nine two-seater models had been delivered by mid-2009.

Additionally, because of marketing efforts, Hungary and the Czech Republic are leasing 14 PS-05/A-equipped fighters. The Czech Republic is leasing 12 single-seaters and two two-seaters for a period of 10 years (2005-2015). The last Czech aircraft was delivered in 2005. The Hungarian Parliament approved funding for the lease of 14 Gripen aircraft in 2003. The Hungarian Gripens are ex-Swedish JAS 39A/Bs remanufactured by Saab to a configuration similar to JAS 39C/D aircraft. The first Hungarian Gripen was delivered in March 2006 and deliveries ended in December 2007.

NORA

The Not Only a Radar technology demonstration program was designed to give the PS-05/A an AESA antenna with approximately 1,000 individual transmit/receive modules. Ericsson received the AESA antenna from Raytheon in 2004. NORA, designed for network-centric warfare, was to offer high modular flexibility, antenna beam agility, simultaneous operating modes, extended detection range and azimuth coverage, high-speed broadband sensor-to-sensor communications, reduced RF signature, and enhanced electronic counter-countermeasures. NORA was expected to be a complete electronic warfare system that included jamming capability and data communications systems. If successful, NORA would have been a very attractive system for other platforms. The AESA capability was expected to allow Gripen to fully exploit Meteor ramjet-powered air-to-air missiles, as the current PS-05/A's detection range is not far enough to take full advantage of the Meteor's capabilities. Knowledge gained from the NORA project was also expected to be applied to replace the PS-05/A back end with NORA hardware at a later date.

It was reported that the NORA program was halted due to restrictions on U.S. technology exports to certain third countries.

Older Versions Available for Sale

In October 2007, the Swedish government awarded Saab a SEK3.9 billion (\$600 million) contract to upgrade 31 older Gripens to the new JAS 39C/D standard and to launch a technology demonstrator program for the fighter. However, the fleet would be cut to 100 Gripens and the remaining 70 A/B aircraft would be sold on the export market "as is" or as converted C/D models. The upgrade effort was

scheduled to be completed in 2012, and unsold aircraft would be scrapped. These available aircraft have the potential to cut into new aircraft sales.

Thailand Joins the Gripen Family

In October 2007, the Thai government announced its plan to procure 12 Gripen aircraft in two lots, two Saab Erieye airborne early warning (AEW) aircraft, and associated items. However, in June 2009, the Royal Thai Air Force (RTAF) announced that it had postponed its plans for the second batch of six Gripens.

The initial RTAF Gripen, a JAS 39D, made its first flight in September 2009. All six were scheduled to be delivered by the end of 2011.

Saab Loses One to F-35

In November 2008, Norwegian Prime Minister Jens Stoltenberg formally recommended to his country's Parliament that the F-35 Lightning II be selected to fulfill Norway's future air-combat capability requirements. The F-35 won over the Saab Gripen NG.

Gripen to Get AESA

In April 2008, Saab unveiled its Gripen NG JAS 39 demonstrator in Sweden. The following month, Saab

revealed that the Gripen development platform would soon be equipped with a new radar that Saab was developing in collaboration with Thales. Aviation Week's *ShowNews* for Farnborough 2008 reported that the new radar would combine the Thales RBE2-AA active array with the existing signal data processor and exciter/receiver of the PS-05/A radar.

The Thales-Saab radar only served a demo function, however. The probable reason why the Thales-Saab radar was not included in the production Gripen NG version is that the Thales RBE2 radar-equipped Dassault Rafale competes with Gripen for market share.

Instead, in March 2009 Saab announced that it had entered into a cooperative agreement with SELEX Galileo to jointly develop the AESA radar for the Gripen NG program. According to Saab, the jointly developed radar will be based on the SELEX Galileo Vixen AESA radar using functionality from the Vixen, PS-05/A and other programs. Saab stated that the agreement was initially aimed at Brazil's fighter program. The radar is known as the Vixen 1000E / ES-05 Raven. SELEX Galileo reports that the Vixen / Raven advantage comes from the use of a swashplate mounting that enables the active array to be rotated by +/-100 degrees.

Contracts/Orders & Options

While no official contract data has been released, Saab can be assumed to have supplied all required radar systems for the Saab JAS 39 Gripen.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jun	1980	Project definition funding approved by FMV
Jan	1981	Ericsson announces development of JAS 39 radar
Apr	1982	Procurement program for aircraft agreed upon
2Q	1983	Overall program, including avionics, agreed upon
	1984	Major radar subsystems satisfactorily tested
4Q	1984	Manufacture and unit test of prototype radar
	1987	Prototype radar flown in JAS 39 airframe
Dec	1988	JAS 39 first flight
Jun	1992	Second production batch ordered
Jun	1993	First production deliveries
Jul	1997	Third production batch of JAS 39 Gripens ordered by Swedish Air Force
	1998	Gripen pushed on world market
Dec	1999	South Africa orders Gripen
Aug	2001	Hungary decides to lease 14 Gripen fighters
Jun	2004	Czech Republic signs agreement to lease 14 Gripen fighters
	2005	Czech Republic first international customer to receive export Gripens
Oct	2007	Thai government signs contract for 12 Gripen fighters Saab and Thales agree to codevelop new radar for Gripen
May	2008	Gripen demo platform flies for the first time
	2008	Gripen deliveries to South Africa begin
	2009	Gripen demo flies with new AESA radar

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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Early	2011	Gripen deliveries to Thailand to begin
	2011	End of South African Gripen deliveries
	2013	Scheduled end of Thai Gripen deliveries and anticipated end of PS-05/A production

Worldwide Distribution/Inventories

Czech Republic	Leasing 14 PS-05/A-equipped Gripen fighters
Hungary	Leasing 14 Gripens (ex-Swedish JAS 39A/B remanufactured to a C/D-like configuration)
South Africa	26 PS-05/A-equipped Gripens
Sweden	132 PS-05/A-equipped Gripens
Thailand	12 PS-05/A-equipped Gripens on order
United Kingdom	The Empire Test Pilots' School (ETPS) in the U.K. operates a Gripen as its advanced fast jet platform for test pilots worldwide

Forecast Rationale

The PS-05 radar's sole platform, the Saab Gripen A/B/C/D fighter jet, competes against several comparable aircraft. However, the Gripen is about to lose its market share to a rival that it is simply unable to compete with... itself.

The Gripen C/D generation will soon come to an end. Fighter jets of the next generation are arriving, and with them comes more advanced technology, with better flight performance, stealthier features, and more accurate electronics. To answer the need for a more contemporary aircraft, Saab has begun developing the Gripen NG (also known as the Gripen E/F).

In the coming years, the Gripen NG will fully supplant the Gripen C/D. Correspondingly, the Gripen NG's ES-05 Raven AESA radar will fully supplant the C/D's

PS-05. Even the potentially valuable aftermarket support and upgrade market will be eliminated, as current PS-05 users will likely retrofit with the more capable and cost-effective ES-05.

The rise of the Gripen NG will soon bring about the end of the PS-05. For now, however, one customer remains. Thailand is in the process of receiving 12 Gripen C/Ds. The final PS-05 for the requirement is set to be delivered in 2013, though, spelling the end of the program. Barring any unforeseen orders for the PS-05-equipped Gripen C/D, there will likely be no further production.

The PS-05 is expected to leave Saab's lineup in 2013. If no new orders are announced over the coming year, this report will be archived in 2014.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Saab Electronic Defense Systems												
PS-05 A <=> Thailand <=> Air Force <=> JAS 39 Export												
	11	4	0	0	0	0	0	0	0	0	0	4
Total	11	4	0	0	0	0	0	0	0	0	0	4