RAAF F-111G ‘Wild Weasel’ concept

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One of the most interesting recent proposals for an F-111 upgrade is the EADS bid to convert the RAAF’s fleet of 14 General Dynamics F-111G aircraft into ‘Wild Weasels’, equipped to perform electronic reconnaissance and Suppression of Enemy Air Defences (SEAD). EADS have proposed the integration of the Tornado ECR lethal Electronic Attack package in the F-111G.

The term Wild Weasel first appeared during the Vietnam conflict, when the US Air Force equipped a small number of N.A. F-100F Super Sabres as dedicated radar killers, equipped with homing receivers and tasked with locating NVA Soviet supplied acquisition and engagement radars such as the P-12 Spoon Rest, P-15/P-15M Flat Face/Squat Eye and the ubiquitous Fan Song associated with the V-75/SA-2 Dvina/Guideline SAM. The F-100F lacked the performance and endurance to perform well on missions deep inside North Vietnam and was soon supplanted by modified F-105D ‘Thuds’, which eventually led to the first custom designed ‘Wild Weasel’, the F-105G.

By the early 1970s the F-105 was earmarked for retirement, and the US Air Force developed the F-4G Wild Weasel to replace it, using the production F-4E Phantom II airframe. The F-4G was a potent weapon system, carrying the capable IBM APR-38 Radar Warning And Homing System (RHAW) and armed with the AGM-45 Shrike and AGM-78 Standard anti-radiation missiles. The APR-38 employed precision direction finding interferometer antennas – three in the modified nose canoe and one in the tail – in addition to a veritable farm of low band antennas.

The APR-38 was unique in its ability to perform precision direction finding of hostile radars through a 360-degree azimuth, and by digital computation integrate successive measures to localise the emitter. In modern terms it was an ‘Emitter Locating System’. The F-4G carried a specialist Electronic Warfare Officer (EWO) or ‘Bear’ in a heavily missionised back seat.

The F-4G was built only in modest numbers and underwent a series of upgrades before its retirement in the early 1990s. By that stage the APR-38 had evolved into the APR-45, and the Shrike and Standard anti-radiation missiles were replaced by the newer, faster and more capable Texas Instruments (now Raytheon) AGM-88A HARM (High speed Anti Radiation Missile) – refer http://F-111.net/CarloKopp/AGM-88.htm.

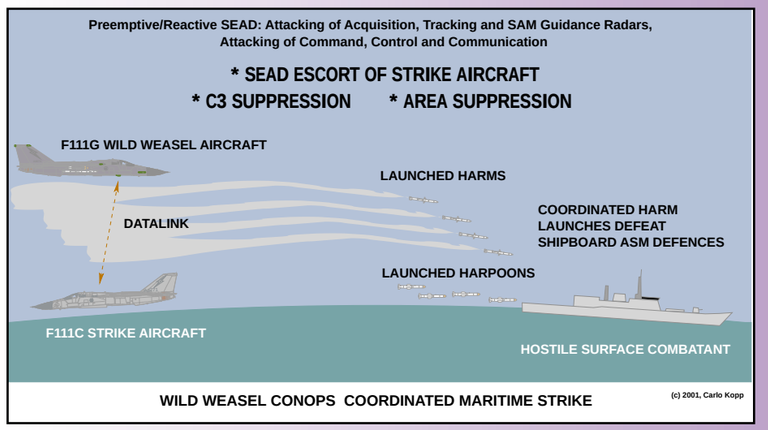
The F-4G Wild Weasels distinguished themselves during the opening hours of the Desert Storm campaign when they broke the back of the Iraqi Integrated Air Defence System (IADS) with a deluge of HARMs. Indeed, so effective were the F-4G Weasels operating in concert with US Air Force EF-111A Raven and US Navy EA-6B Prowler support jammers, that the Iraqis scored only a small number of kills using radar guided SAMs.

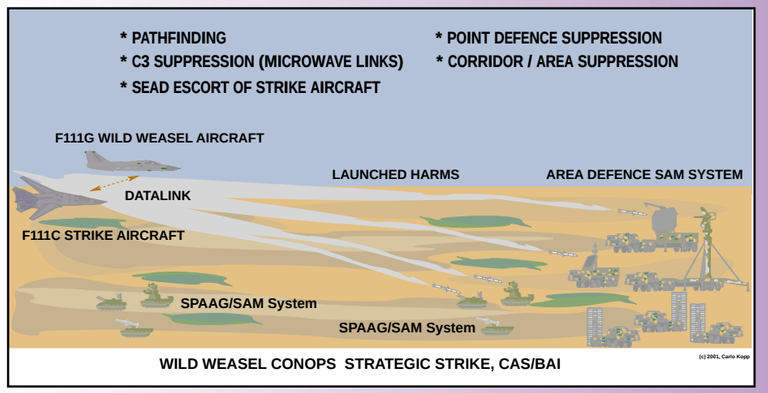
As the US Air Force retired its Phantoms, replacing them with the F-15 and F-16, the F-4G faded into history. The replacement for the F-4G in USAF service is the AN/ASQ-213 HARM Targeting System (HTS) equipped single seat F-16CJ.

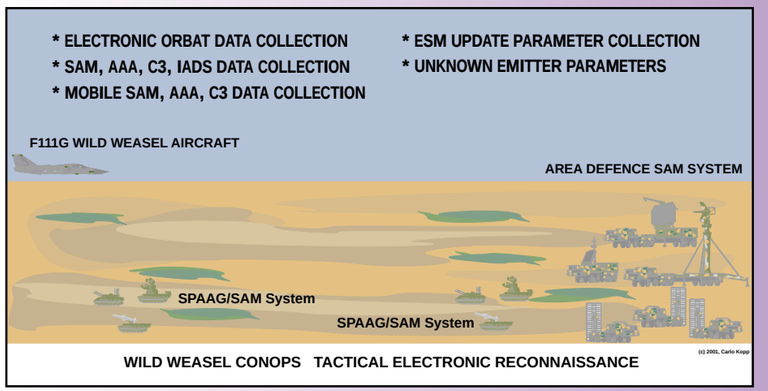
The podded HTS system, carried on an inlet pylon, provides forward sector coverage for the F-16C, which is an important distinction from the original F-4G Weasel, capable of searching 360 degrees for offending radar emitters. Many purists in the electronic combat community do not regard the F-16C/HTS to be a robust replacement for the F-4G/APR-38/45, despite the better frequency coverage and sensitivity of the newer HTS system - single sector coverage is a tactical disadvantage against the all-azimuth APR-38/45 system.

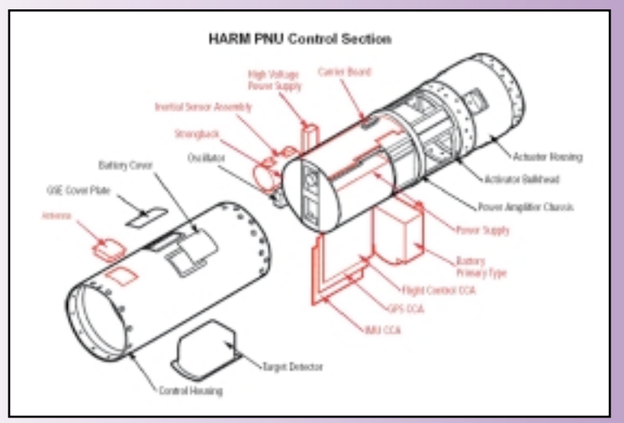
The F-16C/HTS combo achieves its combat effect by exploiting digital datalink targeting information provided by the RC-135 Rivet Joint electronic surveillance aircraft, and more recently the ESM equipped E-3C AWACS. In effect the F-16C/HTS is ‘vectored’ against an emitter tracked and identified by ‘offboard’ sources. Without these ‘offboard’ supporting surveillance systems the F-16C/HTS loses much of its potency.

In Europe, Germany’s Luftwaffe and Italy’s Air Force both carefully observed US developments. In the latter period of the Cold War, the Soviets deployed the highest density of air defence radars ever encountered historically along the West German borders with East Germany and Czechoslovakia. Clearly, the US Air Forces’ F-4G equipped 52nd Tactical Fighter Wing (TFW) stationed at Spangdahlem AFB in Germany would be hard pressed to cope even if reinforced by CONUS-based F-4Gs of the 37th TFW (later to convert to the F-117A).





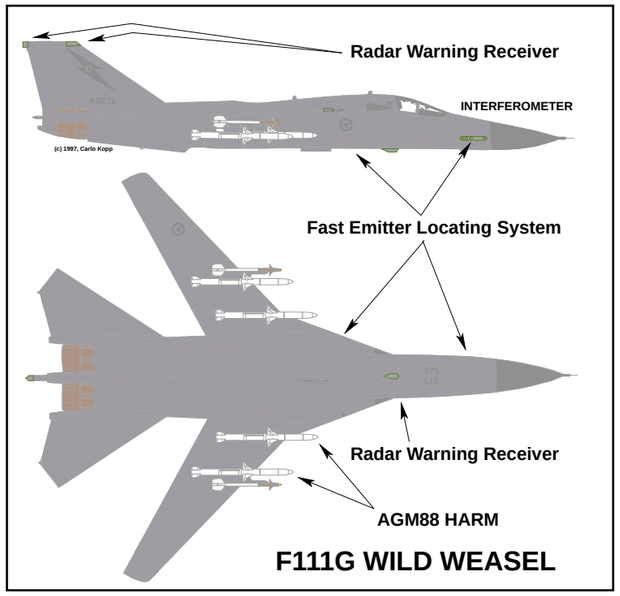




The escalating tension between the Reagan administration and Soviet leaders preceding Gorbachev created a strategic 'pressure cooker' environment in central Europe during the early 1980s. The Soviets' massive arms race was peaking during this period. To achieve and maintain air superiority over the Soviets' Voyska-Protivo Vozdushnoy Oboroni Strany (PVO-S) and Voyska Voyskovoi Protivovozdushnoy Oboroni (V-PVO) demanded Wild Weasel numbers well in excess of US Air Force capabilities.

During this period, Germany and Italy were in the latter phases of the Panavia Tornado manufacturing program, and they identified the Tornado as a viable platform for the role. A fast low level penetrator like the F-111, the Tornado was a survivable high performance strike aircraft. Both Germany and Italy had broader needs than the USAF, as the former had to maintain control of maritime lines of communications in the Baltic and North Sea, and the latter the Mediterranean. Germany's BundesMarine maintained its own fleet of land based Tornado IDS bombers, armed with the Kormoran ASM (a teutonic Exocet) to perform a sea control role nearly identical to the RAAF's Harpoon firing F-111Cs. Thus was born the Tornado ECR (Electronic Combat Reconnaissance). The Tornado ECR is a 'true Wild Weasel' in the mould of the F-4G, with full 360 degree RHAW/ELS coverage and thus designed from the outset for autonomous operations inside hostile airspace without the support of an RC-135 or similar remote surveillance platform.

The Tornado ECR first flew in 1988, and was first delivered in May 1990. The aircraft was equipped with a Texas Instruments Emitter Locating System (ELS), a Honeywell/Sondertechnik Infrared Line Scanner (IRLS), a Zeiss thermal imager (FLIR), missionised cockpits, and a storage and datalink package to support the aircraft's reconnaissance roles. The aircraft was equipped with the 10.4 HARM/STARM interface to fire the Texas Instruments AGM-88 HARM. Two HARMs can be carried on fuselage stations, and two on wing pivot pylons. With a genuine Emitter Locating System, the Tornado ECR can fire the HARM in Pre-Brief, Pre-Emptive or Position-Known (PB/PE/POS) mode where the seeker locks on well after launch, for maximum standoff range.



The Luftwaffe ordered 35 Tornado ECRs and first equipped 2/JagdBomberGeschwader 38 and 3/JagdBomberGeschwader 32. The Tornado ECR first saw action during the Serbian air war, flying as part of the NATO coalition force.

The Tornado ECR fleet has undergone progressive upgrades to maintain commonality with the IDS strike variants and to maintain potency in the electronic combat suite.

Germany is co-developing with the US Navy the HARM Precision Navigation Upgrade Program (PNU), which will see the baseline AGM-88 guidance package enhanced by the addition of GPS receiver and inertial measurement unit.

The limitation of the baseline HARM is that the loss of hostile emitter transmissions denies the missile an accurate aim point. With a GPS/IMU package the HARM can be provided with reasonably accurate target coordinates produced by the ELS in the Tornado ECR prior to launch, and thus use its homing seeker to fine tune the target aim point. Should the hostile emitter go quiet, the missile will still fly close enough to do some damage. Other benefits accrue from a GPS/IMU package, as the missile can fly a much more accurate trajectory and manage its energy better, providing a slight range improvement. Raytheon in the US, Bodenseewerk Geratetechnik (BGT) in Germany, and Alenia Marconi Systems in Italy are jointly developing the HARM PNU.

The evolving Tornado ECR avionic suite includes elements from Tornado IDS upgrades as well as unique components. The design incorporates the Pilot's Head Down Display (PHDD), Navigator's Head Down Displays, Moving Map Displays, Threat Awareness Displays, Defensive Aids Computer and Radar Warning Receivers common to the latest block upgrades on the IDS. Unique to operational Luftwaffe Tornado ECRs are the Litton Ring Laser Gyro/Inertial reference, the second generation Display Video Recorder System, and cartridge based digital Mission Data Transfer System.

The latest phase of the ongoing block upgrades could be the addition of a Fast Emitter Locating System (FELS) with a dual baseline interferometer, a digital receiver, and a digital Tactical Data Link. EADS have not disclosed whether the FELS uses Differential Doppler, Differential Time Of Arrival or Phase Rate of Change emitter location techniques, or some hybrid of these techniques. These components will be flight tested in 2004.

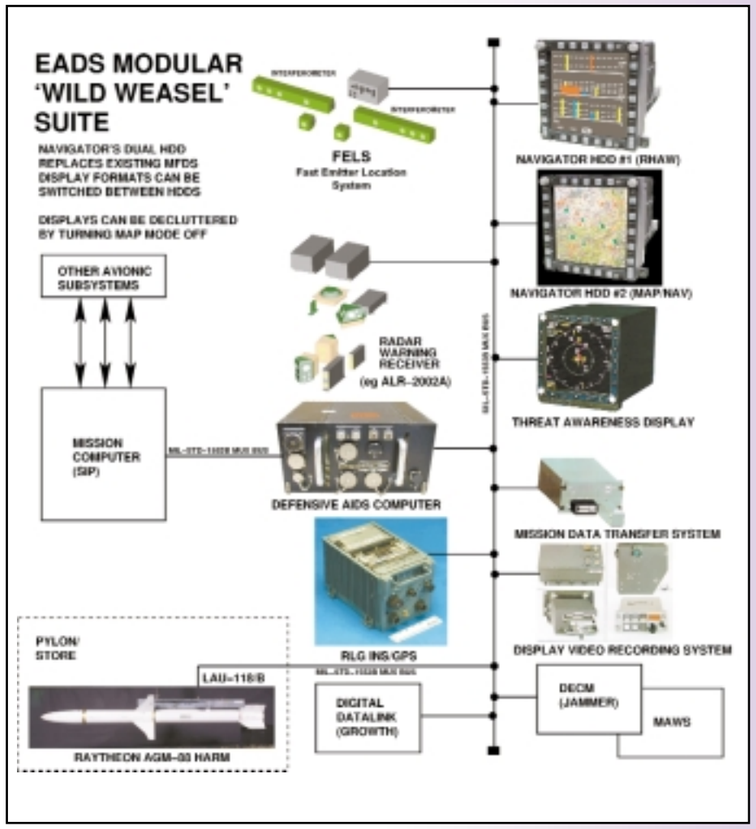
The EADS F-111G Wild Weasel proposal

The Keating government purchased fifteen former US Air Force F-111G aircraft during the early 1990s. These aircraft were formerly nuclear-armed Strategic Air Command (SAC) FB-111As, which were 'de-nuclearised' and used in their latter years as trainers by the USAF.

The origins of the F-111Gs have been a mixed blessing. While the aircraft spent much of their life subjected to a more benign fatigue environment than tactical F-111s they have also never been equipped with a weapon system capable of delivering precision munitions (refer http://F-111.net/CarloKopp/F-111G).

US Air Force F-111Fs and RAAF F-111Cs were fitted with the potent AVQ-26 thermal imager and laser designator pod positioned on a bomb bay cradle and wired to carry the GBU-15 electro-optical precision glide bomb. The F-111G was limited to dumb bombs aimed by radar.

The RAAF explored the 'weaponisation' of the F-111G during the early phases of the AIR 5404 project. However, delays and funding problems precluded the retrofit of the very capable F-111C Avionic Update Program (AUP) weapon system and installing the Pave Tack into the F-111G. Arguably most of the difficulties experienced in the early life of the RAAF F-111G were attributable to inadequate funding.



At this time the F-111G is used primarily for training, although it has from time to time been used for battlefield interdiction and close air support – dropping laser guided bombs against targets laser illuminated by ground Forward Air Controllers. In principle, the aircraft could be flown as a 'bomb truck' paired with an F-111C to illuminate the target.

A range of options exist for 'weaponisation' of the F-111G with the advent of the Mil-Std-1760 based Block C-4 system on the F-111C - the latter could be grafted on to the F-111G's existing systems to provide a limited precision strike capability using the GBU-31/38 JDAM GPS/inertial bomb. The changes could be as modest as adding the new VMEbus computer, and manipulating wiring and software alone.

EADS recognised that the F-111 is operated in roles not unlike those performed by Luftwaffe and BundesMarine Tornadoes: strategic strike, battlefield interdiction, close air support and maritime strike are all roles common to the RAAF's F-111C.

Where the Luftwaffe/BundesMarine and RAAF diverge is in the area of Electronic Combat / Electronic Attack capabilities. The Luftwaffe/BundesMarine have formidable capabilities, the RAAF sadly has none. While the ADF is in the early stages of a tri-Service program – DEF 224 Bunyip intended to address these capability gaps – there are few if any off-the-shelf packages adaptable to ADF operated platforms.

At this time the EADS Tornado ECR system is one of only two fully integrated lethal Electronic Attack and Reconnaissance packages in the market. The US Navy's Litton ASQ-218 (formerly LR-700) ICAP III package is more capable in many respects, but is also intended to address broader needs such as supporting the high power ALQ-99 Tactical Jamming System (TJS) on the EA-6B and EF-18F (formerly F/A-18G Growler).

The EADS proposal to integrate the Tornado ECR lethal Electronic Attack package in the F-111G aims to convert these aircraft into fully autonomous Wild Weasel aircraft capable of performing lethal Suppression of Enemy Air Defences (SEAD) against land and maritime threat emitters.

The F-111G Wild Weasel would perform electronic reconnaissance in times of tension or shooting conflict, while supporting the F-111C and F/A-18A with a SEAD capability as required when penetrating to defended targets.

The strength of the EADS proposal lies in the fully autonomous 360-degree coverage of an improved Tornado ECR system - superior to the in-service Tornado ECR package. The aircraft can perform reconnaissance and SEAD independent of standoff electronic surveillance platforms, providing a fully self-contained package.

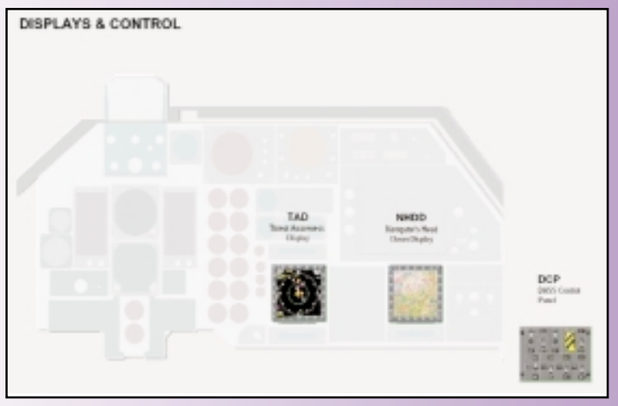
The advent of ‘double digit’ Russian mobile SAM systems such as the S-300PM/PMU/PMU-1 through PMU-2 (SA-10), S-300V (SA-12) and S-400 (SA-20), and the proliferation of third party and Russian digital upgrades to legacy S-75/SA-2, S-125/SA-3 and ZRK-Kub/9M9/SA-6 SAMs has important longer term implications. Such SAMs are more mobile that older generations of SAM technology, they are often harder to jam than their predecessors, they are better at rejecting low altitude clutter, and importantly their kinematic envelopes are often much larger than older generation SAMs. Replacing a primitive analogue vacuum tube command link guidance computer on an S-125/SA-3 with a modern ruggedised Pentium 4 guidance processor can transform the original weapon: smarter energy management can squeeze every bit of feasible range from the original missile airframe.

The result of this is that many regional and worldwide users of legacy Soviet-era SAMs will see major improvements in their IADS capabilities - especially area coverage.

While Australia’s near term regional concerns might be focused on North Korea, and long term concerns about China, the reality is that coalition operations with the US as part of the War on Terror could see RAAF combat aircraft flying against opponents in various parts of Asia and the Middle East.

The US does not have an abundance of Electronic Attack assets. Their EA-6B Prowlers are stretched very thin and are burning out airframe hours at a frightening rate, while the Rivet Joints and F-16C Weasels are also in relatively short supply. Any opponent with a robust IADS will present a respectable challenge even for the USAF, if a ‘loss free’ and politically acceptable campaign is sought.

What this means in practical terms is simple: a good case can be made for Australia to field an Electronic Attack capability to meet the needs of a range of regional ‘Defence of Australia’ scenarios, yet the very same assets would be a uniquely valuable niche contribution to any distant overseas coalition campaign led by the US. Niche capabilities yield a bigger political payoff for Australia in coalition campaigns since these are capabilities the US often over-commits operationally, producing spares shortages, crew rotation problems and unavailability during combat operations.



EADS envisage the use of the F-111G Wild Weasel across the whole spectrum of land and maritime strike roles. In maritime strike, an Electronic Attack / SEAD capability can be especially potent, since HARM launches can be timed to synchronise weapon arrival on target with incoming subsonic Harpoons. The defending warship gets hit with HARMs stripping off its radar cover if it attempts to light up its radars to defend against the inbound Harpoons. In the endgame, the warship faces a dual threat that overwhelms its defensive systems.

In land strike roles, the F-111G Wild Weasel could operate as an independent ‘hunter-killer’ platform, sniffing out mobile SAMs for HARM, LGB or JDAM attack, or it could operate as an escort to a package of F-111C bombers. With an electronic recce capability it could supplement imaging reconnaissance performed by the RF-111C with electronic intelligence gathering. The aircraft retains its capability to deliver MK.82/84 bombs.

The EADS proposal is based upon a Mil-Std-1553B/Mil-Std-1760 architecture, therefore the F-111G Wild Weasel would be built to support the HARM via a pylon adaptor. Any Mil-Std-1760 ‘J-series’ weapon could be carried on the F-111C. In practice, this yields a dual-role capability, as the aircraft could be ‘swung’ into the basic bomber role should circumstances require it.

Current thinking in the EADS camp is that the package could be integrated in parallel with existing EW systems on the F-111G, adding cockpit displays and pylon wiring as required, or it could replace the existing EW suite. As the system is architected around the Mil-Std-1553B/Mil-Std-1760 busses, a range of possible configurations could be produced to best accommodate RAAF needs.

In summary, the EADS proposal has considerable technical merit: it would plug a major and long standing gap in ADF capabilities, and yield a niche asset which would be actively sought by the US for coalition air campaigns.