Arms Control Association (ACA)
British American Security Information Council (BASIC)
Institute for Peace Research and Security Policy at the University of Hamburg (IFSH)

Nuclear Policy Paper No. 14 July 2013

Edmond E. Seay III

COUNTDOWN TO CHAOS?

Timelines and Implications of Procurement Decisions for NATO's Dual-Capable Aircraft

Introduction

NATO's nuclear sharing program is in trouble. The United States has continuously maintained nuclear weapons in Europe since March 1954 (and NATO has agreed to this policy since December of that year).[1] Since 1991, the only U.S. nuclear weapons in NATO's arsenal have been B61 gravity bombs, designed for delivery to target by "dual-capable" fighter-bomber aircraft (DCA).[2] These aircraft are rapidly reaching the end of their normal service lives, however, and are the only means by which NATO shares the threat of nuclear attack on potential opponents in times of crisis among several Allied nations.

This arrangement is, according to NATO policy, necessary to reassure Allies that the pledge of mutual security under Article 5 of the North Atlantic Treaty has real meaning in the 21st century.[3] If this is so, the aging of the DCA fleet risks an unplanned end to those sharing arrangements: to do nothing will be to court what Professor Neil Cooper and others have called "disarmament by default".[4] At that point, NATO would be left to choose between two bad alternatives: reconstitute a theater nuclear force in Europe of some sort—further further antagonizing a Russian Federation already objecting to NATO's missile defense plans for Europe—or do nothing and appear weak and rudderless, throwing doubt upon the further utility (and existence) of the North Atlantic alliance.

This paper addresses the choices facing NATO in five sections: The first examines how much longer current DCA airframes can reasonably be expected to serve before being replaced; the second notes the three options available to NATO in dealing with its aging DCA assets as well as the status of the DCA debate in each of four current DCA host nations; the third points out the problems with the F-35, at the moment the only potential replacement for current-generation DCA; the fourth notes the limitations to, and potential costs of, exploring further life extension programs for NATO's current DCA; while the fifth and final section

The author is a senior consultant to BASIC, and a recently retired career U.S. diplomat. In his final posting he was arms control adviser to Amb. Ivo Daalder at the U.S. mission to NATO.

suggests a course of action for NATO to avoid the pitfalls noted above.

Aging Airframes

The two aircraft in current operation as NATO DCA are the Panavia *Tornado* IDS (Interdictor Strike) fighter-bomber, in use by Germany and Italy, and the General Dynamics/Lockheed Martin F-16 *Fighting Falcon* fighter-bomber, in service with the Belgian and Netherlands air forces. Turkey also hosts United States B61 nuclear gravity bombs, but non-government analysts believe its F-16C Block 50 aircraft are not currently certified for the nuclear role.[5]

NATO's problems in maintaining the nuclear sharing status quo stem from sheer age: The first production F-16 entered operational service in January 1979, and the first *Tornado* in July 1980.[6] All modern aircraft are rated for structural soundness over a certain number of hours of flying time. In reality, though, there is a high level of variation in the "wear and tear" these aircraft actually experience, leading to a great deal of uncertainty over safety in future planning for older aircraft (see next section). In the case of the *Tornado*, the IDS variant was originally certified for 4,000 hours of "safe life" flying time. However, a life extension program begun in 1995 doubled that figure to 8,000 hours, enabling both Germany and Italy to extend the life expectancy of their *Tornado*s considerably.[7]

Further upgrades and extension programs have followed. Both Germany and Italy have upgraded the software suites in their *Tornado* airframes to accommodate new weapons, electronic countermeasures and networked communications under the ASSTA (Avionics System Software Tornado Ada) rubric.[8] The Italian air force is currently on the third wave of mid-life upgrades (MLU) to its *Tornado* fleet, and anticipates operating some 58 modernized *Tornados* "until at least 2025".[9]

The F-16, on the other hand, began life with an expected 8,000 hours of flight time, but this has changed a number of times over the course of the aircraft's history:

> *The F-16 fleet consists of several different configurations that were acquired in a long and successful evolutionary program. The Air Force has invested millions over the years to upgrade capabilities, engines, and structural enhancements needed to achieve its original life expectancy of 8,000 hours. Significant unknowns exist about extending the life beyond 8,000 hours should that be necessary…As a system's cumulative operating time increases, the probability of its failure tends to increase, decreasing the system's potential reliability. Reliability also decreases when the conditions under which the system was designed to operate change. Many of these aircraft are at critical points in their life cycles…In the case of the F-16, operational usage had been more severe than design usage (eight times more), resulting in the acceleration of its airframe service life at a rate that may not let it reach its overall service life.*[10]

The same analysis then added:

> *By 2011 the US Air Force was considering a Service Life Extension Program (SLEP) to the newest Block 40/50 F-16s, with a 12,000-hour goal per airframe…In other inspections, maintainers found bulkhead cracks in approximately 67 percent (428 of 642) of Block 40/52 F-16 aircraft. As of early 2011 about 285 aircraft had been repaired and 83 aircraft had the bulkheads replaced. An additional 54 aircraft continued to fly with increased inspections to measure crack growth.*[11]

As we shall see below, both extreme flexibility in defining "safe" service lives, and fluctuating levels of concern over cracks and other signs of serious airframe fatigue, can and have been attributed to factors other than strict engineering criteria.

Unhappy options for the host states

The four NATO DCA host nations face hard decisions: Should they invest a significant portion of their defense budgets to replace their existing DCA aircraft at a time of continuing global recession? Should they take the lower-cost (but still very expensive) option of further extending the service lives of their DCA fleets, even though this may carry considerable risks? Or should they do nothing, and drop out of participation in NATO's nuclear sharing program "by default"?

As has been pointed out in the past, the four DCA hosts face different challenges and distinct timelines for their decisions.[12] Belgium has the longest time in which to make its decision, having opted for the F-16 MLU for its fleet of F-16A/B Block 10 and Block 15 airframes, keeping them viable through 2020 or so.[13] Over the years it has reduced its fleet of F-16s from 160 to 60,[14] but has not yet finalized plans to replace them. A 2011 WikiLeaks cable revealed that the Belgian government was interested in purchasing F-35s "off the shelf" in the 2020 timeframe.[15]

The Netherlands had planned to replace its fleet of 67 F-16s (all that remain from the original 213 purchased) by 2015, but must now wait to see if the F-35s it has agreed to purchase will be available by 2018 – and even this date may slip.[16] Some observers believe the current government has been using "trial balloon" leaks of its intentions to finalize an F-35 purchase to see if the opposition and news media are paying attention; when objections are made public, the decision is postponed. The firm plan is, however, to procure the F-35 as the replacement for the F-16.[17]

Italy's Chamber of Deputies voted on June 26, 2013 to approve the purchase of 90 F-35s, an action reinforced on July 3rd when the Supreme Defense Council announced that Parliament could not veto the purchase even if it chose to.[18] The question of replacing Italy's *Tornado* and/or Belgian and Dutch F-16 DCA may not have been solved yet, however; the next section outlines the problems surrounding the F-35 program.

Finally, Germany has made the choice to replace its *Tornado* IDS fighter-bombers, but with an aircraft unsuitable for nuclear missions. The Eurofighter *Typhoon* is not currently a DCA candidate since its builders are unwilling to submit their proprietary technology to U.S. government inspection in order to achieve nuclear certification.[19] Germany's remaining options would seem to be to maintain a small number of *Tornados* in the DCA role at a reduced level of readiness,[20] or to do nothing and allow itself to drop out of nuclear sharing participation.

There may, however, be a third way for Berlin. There have been persistent rumors that the U.S. government is working to eliminate most issues related to nuclear certification by making the B61-12 "platform-independent"; in other words, to ensure the B61-12 is capable of being deployed on any almost any aircraft that can handle the bomb's physical dimensions.[21] This would mean the Eurofighter *Typhoon* could replace Germany's aging *Tornados*, albeit at an estimated unit cost of €88.6 million.[22]

Option 1, replacement: but the F-35 is not out the woods yet

Lockheed Martin's fifth generation F-35 *Lightning II* Joint Strike Fighter (JSF) is, to say the least, a controversial aircraft dogged by spiraling costs and technical challenges. Scheduled for introduction to active service in 2010, it is still a work in progress.[23] The

current contractual arrangements between the U.S. Government and Lockheed Martin call for the production of some 2,450 F-35s at an acquisition cost of nearly US$400 billion, and an overall 30-year program cost of US$1 trillion, making the F-35 "the most expensive weapons system in history".[24]

Recent reports on the F-35 program have continued a trend of bad news:

- *The February 2013 grounding of the entire fleet after cracked engine blades were discovered;*[25]
- *The March 2013 resignation of the Lockheed Martin VP in charge of the F-35;*[26]
- *The April 2013 USAF request to Congress for FY 2014 funding for "continued development of the F-35 weapon system" (US$4.2 billion), and an additional US$1.3 billion to upgrade other fighter aircraft, largely because the F-35 is not expected to enter operational service before FY 2017.*[27]

There is widespread agreement that the problems with the F-35 stem from attempts to fit three widely different aircraft roles into one airframe:

> *"Mission Roles:*
>
> - *USAF: Multi-role (primary air-to-ground) fighter to replace the F-16, the A-10 and to complement the F/A-22;*
> - *USN: Multi-role strike fighter to complement the F/A-18E/F;*
> - *USMC: Multi-role, STOVL (Short Take-Off and Vertical Landing) strike fighter to replace the AV-8B and the F/A-18C/D."*[28]

The U.S. Air Force version, the F-35A, is designed for conventional take-off and landing (CTOL) from standard airfield runways. The U.S. Marine Corps variant, the F-35B, has been designed to "revolutionize expeditionary combat power in all threat environments by allowing operations from major bases, damaged airstrips, remote locations and a wide range of air-capable ships".[29] Finally, the U.S. Navy version, the F-35C, has a larger wing surface for greater low-speed stability when approaching aircraft carriers for landings, as well as a tail hook and other carrier take-off and landing equipment, significantly increasing the empty weight of the C variant – 5,500 pounds more than the F-35A.[30]

The various delays in the F-35 program have been accompanied by another factor which worries both prospective buyers and Congressional onlookers – rising prices. The figures given above in a March 2013 *Washington Times* story point to a program unit cost in excess of US$160 million, which in the current fiscal climate will guarantee that fewer units will be procured by the U.S. military, and likely by foreign governments as well.

One well-informed insider, a former United States military officer with an operations research analysis background who now works in the aerospace industry, believes the F-35 program's troubles began early on, with a lack of emphasis on appropriate acquisition requirements. To his mind, the Boeing design for the JSF competition was superior, since it was based on years of experience with combat aircraft in use with the USAF, USN and USMC, especially the STOVL AV-8B Harrier. Lockheed Martin's version, meanwhile, utilized "unproven technology that has given them fits."[31]

In response to the argument that Lockheed Martin had spread subcontracts among so many U.S. states and foreign countries that the F-35 program could never be cancelled,[32] he opined that involving multiple U.S. states and foreign countries to host sub-contracting

constructions was actually Lockheed Martin's attempt to bring down unit costs for the F-35. The real reason why the F-35 will not be allowed to fail is that the USMC "put all their eggs into the F-35 basket. The F-35 is supposed to replace the AV-8B Harrier, the F-18C/D Hornet, the A-6 Intruder and the EA-6B Prowler."[33]

In the end, this source believes that all three versions of the F-35 will enter service, albeit not as originally planned:

> *I believe that we will eventually get three operational versions of the F-35. None will meet their original specs (they already have not). They will still be excellent aircraft. Stealthy, with some wonderful capabilities. They won't be cheap, but what is these days? No way will they purchase them in the numbers they thought.*[34]

Option 2, extension: Frankenfighter, or The Modern Methuselah

What of the less expensive option to replacement, the sort of life extension programs touched on above for the *Tornado* and F-16? This option comes with its own costs, not all fiscal.

As previously noted, there appears to be more flexibility in the definition of aircraft service life than most civilian observers would anticipate. A natural assumption would be that such factors are determined solely by pure (physics) and applied (engineering) science. That assumption would be incorrect, however. The nature of the underlying problem was stated by the USAF's Air Combat Command director of requirements in a 2011 interview:

> *"We do have that struggle: Do you trade off capacity for capability?" he said. On the one hand, the Air Force must have enough aircraft to go around to meet field commander needs, which is capacity. On the other, the fighters must have technology relevant against adversaries with increasingly advanced aircraft—capability.*[35]

Quite simply, with American 4th generation strike fighters pushing hard against their original service life estimates, and the 5th generation F-35 both slow to achieve initial operational capability (IOC) and more expensive by the year, the Department of Defense has been left with a capacity-for-capability trade-off:

> *The exact impacts of sequestration on Air Force resources in FY14 and beyond depend on congressional action. We do know, however, that the national fiscal situation will require some reductions that may increase risk to our readiness, force structure, and our ability to modernize an aging aircraft inventory.*[36]

The evolving requirements for aircraft, such as survivability in areas defended by advanced surface-to-air missile systems, means that air forces are looking to acquire the fifth generation aircraft not yet available. There is a complex interplay in a continually-extended and expensive transitional period where the deployment of next generation aircraft is persistently delayed, and when they do arrive they are gradually introduced alongside enhanced legacy aircraft.[37]

However, this strategy has been placed under pressure by the continuing woes of the F-35 program. Many extended-life 4th generation fighters are reaching the new limits to their service lives, which required new thinking from their owners:

> *Following a monitoring program of the fleet, the Air Force concluded that the F-16s were flying 15-20% "less hard" than anticipated, not flying to maximum limits of such elements as speed or g-forces. In the decade after 9/11, the F-*

> *16s had been used to support ground forces or fly patrol in permissive airspace, missions that did not require the stressful maneuvers of dog fighting. This led the Air Force to calculate "equivalent flying hours" (EFH) to estimate the projected life, reflecting the lighter use of the fleet. This alone adds several years of life to each aircraft.*[38]

EFH is essentially a redefining of the allowable flying hours for aircraft, in recognition of the variation in wear and tear. However, it requires a good deal more:

> *Equivalent flight hours are the actual accounting of structural degradation that is determined from damage index data stored in the individual aircraft-tracking database, which is part of the aircraft structural integrity program.*[39]

This has enabled the operators of aircraft to be more flexible in their interpretations of life expectancy for aircraft and to delay fleet retirements:

> *The design service life for the [F-15] aircraft is 8,000 flight hours and the oldest aircraft in the fleet have flown more than 10,000 actual flight hours and counting, Boeing says. Boeing is now working on full-scale fatigue-test certifications to push F-15C/D models to 18,000 equivalent flight hours (EFHs) and F-15E models to 32,000 EFHs.*[40]

But this comes at a significant cost in the capabilities of the aging fleet and its safety and reliability. Later-model F15s have also suffered from extended use and significant aging:

> *Several have experienced in-flight catastrophic failures. In April 2002 an F-15C from the 46th Test Wing, flying a high-speed missile test mission out of Eglin AFB, FL., disintegrated over the Gulf of Mexico. Since then the F-15 has been saddled with speed restrictions to prevent a repeat of that type of accident.*
>
> *On December 3rd, 2007 the commander of Air Combat Command ordered the stand-down of all ACC F-15A/B/C/Ds until further notice. Cracks [in structural metal beams] had been discovered on some of the fleet and this may have been the cause of a fatal accident involving an F-15C in Missouri on November 2, 2007.*[41]

The comment about restrictions to flying conditions for legacy F-15s reveals an additional concern – enforced limitations on the permissible usage parameters under which aircraft may operate can severely limit their military utility, an issue for all legacy aircraft.[42] Flexibility in extending airframe service lives may therefore come at a future cost in the form of flight parameter restrictions and/or airframe failure, with a high probability of attendant loss of life.

Option 3, divestment: getting out of the business

Having examined the options of DCA replacement and life extension, the time has come to look at the third option: getting out of the DCA, and therefore the NATO nuclear sharing, business altogether. The question is when and how this is done in a manner that strengthens rather than weakens NATO cohesion and security.

If DCA host governments do nothing to replace or extend their current DCA aircraft, their participation in NATO's nuclear sharing arrangements will end - it is simply a question of time. While this is something a majority of citizens in each of these countries favor,[43] B61 removal through terminal DCA neglect will seriously affect NATO's credibility. For NATO, there is definitely a right way and a wrong way to end nuclear sharing.

If NATO loses its B61/DCA theater nuclear weapons system by default, its Article 5 guarantees will be seen as hollow and meaningless for the 21st century, not least by the Central and Eastern European allies, which most fear Russian revanchism.

In order to prevent this, NATO must opt to discuss realistic scenarios for dealing with its nuclear sharing problems in the very near future. Chief among these must be the agreed, deliberate removal of theater nuclear weapons from Europe and their return to American soil. Deterrence of possible future foes would be maintained, as NATO already acknowledges, by the U.S. strategic nuclear arsenal, as well as by its formidable conventional military capabilities.[44] Removal of all B61s to the U.S. by NATO consensus would also meet a longstanding Russian pre-condition for discussing changes to their own theater forces in Europe, and would do so in a way that demonstrated Alliance coherence and credibility.

The policy debate in NATO, which led to the Strategic Concept and the Deterrence and Defense Posture Review, has up until now been dominated by states blocking policy changes on the basis that such change would weaken the Alliance. Where we have ended up is a political compromise that fails to recognize the technical realities on the ground as outlined in this briefing. What is needed now is strong American political leadership of the kind promised by President Obama in his April 2009 speech in Prague, and reiterated by him in June 2013 in Berlin. In the 64 years of its existence, NATO has proven time and again that American leadership produces positive results for the Alliance, and that its absence spells trouble for NATO unity. Working in concert with the most affected states, the DCA hosts and those opposed to B61 removal, the Obama administration can and should lead the way to a responsible decision on the removal of theater nuclear weapons from NATO Europe in the national security interests of all Allies.

This paper is published under the joint ACA/BASIC/IFSH project on "Reducing the role of tactical nuclear weapons in Europe" funded by the William and Flora Hewlett Foundation. More information on the project can be found at http://basicint.org/issues/projects/natos-nuclear-posture#Joint

Endnotes

[1]George Mindling and Robert Bolton, *U.S. Air Force Tactical Missiles 1949-1969: The Pioneers*, (Morrisville, North Carolina: Lulu.com Publishing, 2011), p. 112. North Atlantic Treaty Organization, M.C. 48, 22 November 1954, accessed via http://www.nato.int/docu/stratdoc/eng/a541122a.pdf.
[2] Hans M. Kristensen, *U.S. Nuclear Weapons in Europe: A review of Post-Cold War Policy, Force Levels and War Planning*, (Washington, DC: Natural Resources Defense Council, 2005), p. 32.
[3]See, *inter alia*, NATO Chicago Summit declaration, accessed via http://www.nato.int/cps/en/natolive/official_texts_87593.htm?selectedLocale=en; and NATO Parliamentary Assembly, "VII. Presentation by Dr Bradley Roberts, Deputy Assistant Secretary of Defence for Nuclear and Missile Defence Policy, United States Department of Defence, on NATO's Deterrence and Defence Posture Review", *Saturday 8 and Sunday 9 October 2011 - Summary Of The Meeting Of The Defence And Security Committee*, accessed via http://www.nato-pa.int/Default.asp?SHORTCUT=2663.
[4]Neil Cooper, "Putting Disarmament Back in the Frame", *Review of International Studies* vol. 32, 2006, pp. 353-376; but see also Steven Pifer, "NATO, Nuclear Weapons and Arms Control", *Brookings Institution Arms Control Series Paper 7*, July 2011, p. 3.
[5]Aaron Stein, "Turkey and Tactical Nuclear Weapons: A Political Love Affair", EDAM Non-Proliferation Policy Briefs 2012/1, November 2012, p. 4. Accessed via http://edam.org.tr/disarmament/EN/documents/Turkey_TacticalNuclearWeaponsCleandraft.pdf.
[6]See ACA/BASIC/IFSH Nuclear Policy Paper No. 12, available at http://www.basicint.org/sites/default/files/npp12.pdf. For the F16, see http://www.bga-aeroweb.com/Defense/F-16-Fighting-Falcon.html. For the Tornado, see http://www.aerospaceweb.org/aircraft/bomber/tornado_ids/.
[7]G. Blech, "Aging Aircraft Subsystems Equipment Life Extension within the Tornado Program", NATO Research & Technology Organization RTO EN-14,AC/323(AVT)TP/32, 2000, pp. 61 – 67.
[8]See http://www.janes.com/article/13234/germany-receives-first-assta-3-upgraded-tornados-back-into-service.
[9]See http://www.ainonline.com/aviation-news/ain-defense-perspective/2013-03-15/italy-will-further-upgrade-tornados-weapons.
[10]"F-16 Fighting Falcon: Service Life", pp. 1-2, accessed 22 March 2013 via www.globalsecurity.org/military/systems/aircraft/f-16-life.htm.
[11] *Ibid.*, p. 4.
[12]Malcolm Chalmers and Simon Lunn, *NATO's Tactical Nuclear Dilemma*, (London, England: Royal United Services Institute, 2010), pp. 21-26.
[13]See *F-16.net: Belgium*, accessed via http://www.f-16.net/f-16_users_article2.html.
[14] *Ibid.*
[15]Stephen Trimble, "Leaked cable spills Belgium's plans to buy F-35s", *Flight International*, 12 September 2011, accessed via http://www.flightglobal.com/news/articles/leaked-cable-spills-belgiums-plans-to-buy-f-35s-361834/.
[16]Nick Ottens, "Netherlands Move Toward Final F-35 Fighter Jet Purchase", *Atlantic Sentinel*, 20 June 2013, accessed via http://www.atlanticsentinel.com/2013/06/netherlands-move-toward-final-f-35-fighter-jet-purchase/.
[17]E-mail exchange with anonymous Dutch activist, 02 July 2013.
[18]See http://www.gazzettadelsud.it/news/english/52691/Politicians-outraged-over-action-on-purchase-of-F-35-jets.html.
[19]Christopher A. Ford, "NATO, 'Nuclear Sharing', and the 'INF Analogy'", New Paradigms Forum 30 March 2011, accessed via http://www.newparadigmsforum.com/NPFtestsite/?p=793.
[20]Chalmers and Lunn *ibid.*, p. 23.

/

[21]European Leadership Network, *NATO Policy Brief No. 2*, April 2012, p. 6, accessed via http://www.europeanleadershipnetwork.org/medialibrary/2012/05/10/e074ba2d/ELN%20NATO%20Policy%20Brief%202%20-%20Escalation%20by%20Default.pdf.
[22]See http://beyonddefence.wordpress.com/tag/eurofighter/.
[23]Robert N. Charette, "F-35 Program Continues to Struggle with Software", *IEEE Spectrum*, 19 September 2012, accessed via http://spectrum.ieee.org/riskfactor/aerospace/military/f35-program-continues-to-struggle-with-software.
[24]Rowan Scarborough, "Prices soar, enthusiasm dives for F-35 Lightning", *Washington Times*, 6 March 2013, accessed via http://www.washingtontimes.com/news/2013/mar/6/prices-soar-enthusiasm-dives-for-f-35-lightning/?page=all.
[25]BBC News, "F-35 Fighter Jet Fleet Grounded by Pentagon", 22 February 2013, accessed via www.bbc.co.uk/news/world-us-canada-21554331.
[26]See www.dodbuzz.com/2013/03/20/lockheed-vp-retires-amidst-f-35-criticism/.
[27]"USAF Posture Statement 2013", April 12, 2013, pp. 15, accessed via http://www.posturestatement.af.mil/shared/media/document/AFD-130619-104.pdf.
[28]"F-35 Joint Strike Fighter", acquisition.navy.mil/media/files/programs/f_35_jsf.
[29]See http://www.lockheedmartin.com/us/products/f35/f-35b-stovl-variant.html.
[30]See http://www.lockheedmartin.com/us/products/f35/f-35c-carrier-variant.html.
[31]Interview with anonymous source employed by U.S. aerospace industry, April 2013.
[32]Chuck Spinney, "F-35: Out of Altitude, Airspeed, and Ideas — But Never Money", *Time*, 30 January 2012, accessed via http://nation.time.com/2012/01/30/f-35-out-of-altitude-airspeed-and-ideas-but-never-money/#ixzz2TbeNihaE.
[33]Anonymous interview, *ibid.*
[34]*Ibid.*
[35]John A. Tirpak, "New Life For Old Fighters", *Air Force Magazine*, February 2011, p. 32, accessed via http://www.airforcemag.com/MagazineArchive/Pages/2011/February%202011/0211fighters.aspx.
[36]"USAF Posture Statement 2013" *ibid.*, p. 4.
[37]Col. Gordon P. Greaney, "The Air Force's Combat Aircraft: A Future Holding onto the Past", U.S. Army Command and General Staff College Master's Thesis, July 2010, pp. 4-5; accessed via http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA522950.
[38]"F-16 Fighting Falcon: Service Life", p. 4, accessed 22 March 2013 via www.globalsecurity.org/military/systems/aircraft/f-16-life.htm.
[39]*Ibid.*, pp. 2-3.
[40]Michael Fabey, "US Air Force F-15 Funding Flying High", *Aviation Week's DTI*, 9 January 2013, accessed via http://www.aviationweek.com/Article.aspx?id=/article-xml/asd_01_09_2013_p03-01-534636.xml.
[41]See http://www.amarcexperience.com/ui/index.php?option=com_content&view=article&id=142&catid=8.
[42]Richard Shimooka, "Super Hornet: Analyzing the pros and cons of the Boeing Super Hornet as Canada's next generation fighter", *Canadian Aviation News*, 18 March 2013, accessed via http://skiesmag.com/news/articles/18498-super-hornet.html.
[43]Strategic Communications, *Nuclear Weapons in Europe: Survey Results in Six European Countries*, 25 May 2006, p. 6, accessed via http://www.greenpeace.org/international/Global/international/planet-2/report/2006/6/nuclear-weapons-in-europe-survey.pdf.
[44]"The supreme guarantee of the security of the Allies is provided by the strategic nuclear forces of the Alliance, particularly those of the United States"; *Deterrence and Defense Posture Review*, Section II Paragraph 9, 20 May 2012, accessed via http://www.nato.int/cps/en/natolive/official_texts_87597.htm.