Appendix 8A. World nuclear forces, 2008

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I. Introduction

While world attention in 2007 focused on the nuclear test by the Democratic People's Republic of Korea (DPRK, or North Korea) and Iran's uranium enrichment programme, eight nuclear weapon states possess almost 10 200 operational nuclear weapons (see table 8A.1). Several thousand of these nuclear weapons are kept on high alert, ready to be launched within minutes. If all nuclear warheads are counted—operational warheads, spares, those in both active and inactive storage, and intact warheads scheduled for later dismantlement—the United States, Russia, the United Kingdom, France, China, India, Pakistan and Israel together possess a total of more than 25 000 warheads.

All of the five legally recognized nuclear weapon states, as defined by the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT),[1] appear determined to remain nuclear powers for the foreseeable future and are in the midst or on the verge of modernizing their nuclear forces. At the same time, Russia and the USA are in the process of reducing their operational nuclear forces from cold war levels as a result of two bilateral treaties—the 1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I Treaty) and the 2002 Strategic Offensive Reductions Treaty (SORT).[2] Sections II and III of this appendix discuss the composition of the deployed nuclear forces of the USA and Russia, respectively. The nuclear arsenals of the UK, France and China are considerably smaller than those of the USA and Russia, but those three lesser nuclear powers are either deploying new nuclear weapons or have announced their intention to do so in the future. Data on their delivery vehicles and warhead stockpiles are presented in sections IV–VI.

Reliable information about the operational status of the nuclear arsenals of the three states that are not parties to the NPT—India, Pakistan and Israel—is difficult to find. In the absence of official declarations, the information that is available is often contradictory or incorrect. India and Pakistan are expanding their nuclear strike capabilities, while Israel appears to be waiting to see how the situation in Iran develops. Sections VII–IX provide information about the status of the Indian, Pakistani and Israeli nuclear arsenals. North Korea's military nuclear capabilities are discussed in section X.

The figures presented here are estimates based on public information and contain some uncertainties, as reflected in the notes to the tables.

[1] According to the NPT, only states that manufactured and exploded a nuclear device prior to 1 Jan. 1967 are recognized as nuclear weapon states. By this definition, China, France, Russia, the UK and the USA are the nuclear weapon states parties to the NPT. For a summary of the NPT see annex A in this volume.

[2] For summaries of the START I and SORT treaties see annex A in this volume.

Table 8A.1. World nuclear forces, January 2008

All figures are approximate.

Country[a]	Strategic warheads	Non-strategic warheads	Total number of warheads
USA	3 575	500	4 075[b]
Russia	3 113	2 076	5 189[c]
UK	185[d]	–	185
France	348	–	348
China	161	15	176
India	–	–	60–70[e]
Pakistan	–	–	60[e]
Israel	–	–	80[e]
Total			**10 183**

[a] North Korea claimed in 2005 that it had developed nuclear weapons and conducted a nuclear test in 2006, but there is no public information to verify that North Korea has weaponized its nuclear capability.

[b] The total US stockpile, including reserves, contains *c*. 5300 warheads. Another 5100 warheads are scheduled to be dismantled between now and 2023.

[c] The total Russian stockpile contains *c*. 14 000 warheads, of which *c*. 8800 are in reserve or awaiting dismantlement.

[d] Some warheads on British strategic submarines have sub-strategic missions previously covered by tactical nuclear weapons.

[e] The stockpiles of India, Pakistan and Israel are thought to be only partly deployed.

II. US nuclear forces

As of January 2008, the USA maintained an estimated arsenal of approximately 4075 operational nuclear warheads, consisting of roughly 3575 strategic and 500 non-strategic warheads (see table 8A.2).[3] In addition to this operational arsenal, approximately 1260 warheads are held in reserve, for a total stockpile of approximately 5300 warheads. Over 5100 other warheads were removed from the US Department of Defense (DOD) stockpile at the end of 2007, destined to be dismantled by 2023.

This force level is a significant change compared with the estimate presented in *SIPRI Yearbook 2006*, and is precipitated by the announcement by the administration of President George W. Bush on 18 December 2007 that it would meet the goal of the 2004 Nuclear Weapons Stockpile Plan of reducing the total stockpile 'by nearly 50 percent from the 2001 level' five years early, in 2007 instead of 2012.[4] The

[3] According to the US Department of State, 'the number of U.S. operationally deployed strategic nuclear warheads was 3,696 as of December 31, 2006'. US Department of State, Bureau of Verification, Compliance, and Implementation, '2007 Annual report on implementation of the Moscow Treaty', 12 July 2007, <http://www.state.gov/t/vci/rls/rpt/88187.htm>, p. 1.

[4] See The White House, 'President Bush approves significant reduction in nuclear weapons stockpile', Press release, 18 Dec. 2007, <http://www.whitehouse.gov/news/releases/2007/12/20071218-3.html>; US Department of Energy, National Nuclear Security Administration, 'NNSA releases draft plan to transform nuclear weapons complex', 18 Dec. 2007, <http://nnsa.energy.gov/news/print/1463.htm>; and Agence France-Presse, 'US accelerates nuclear stockpile cuts: White House', GlobalSecurity.org, 18 Dec. 2007, <http://www.globalsecurity.org/org/news/2007/071218-stockpile-cuts.htm>. The classified Nuclear Weapons Stockpile Plan was submitted to the US Congress on 3 June 2004. US Department of Energy,

Table 8A.2. US nuclear forces, January 2008

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warhead loading	No. of warheads
Strategic forces						**3 575**
Bombers[b]		*104/72*				*1 083*
B-52H	Stratofortress	94/56	1961	16 000	ALCM 5–150 kt	528[c]
B-2	Spirit	20/16	1994	11 000	B61-7, -11, B83-1 bombs	555[d]
ICBMs[e]		*488*				*764*
LGM-30G	Minuteman III					
	Mk-12	138	1970	13 000	1–3 x 170 kt	214
	Mk-12A	250	1979	13 000	1–3 x 335 kt	450
	Mk-21 SERV	100	2006	13 000	1 x 300 kt	100
SSBNs/SLBMs[f]		*228*				*1 728*
UGM-133A	Trident II (D-5)					
	Mk-4	. .	1992	>7 400	6 x 100 kt	1 344
	Mk-5	. .	1990	>7 400	6 x 475 kt	384
Non-strategic forces						**500**
B61-3, -4 bombs		. .	1979	. .	0.3–170 kt	400[g]
Tomahawk SLCM		320	1984	2 500	1 x 5–150 kt	100[h]
Total						**4 075**[i]

. . = not applicable; ALCM = air-launched cruise missile; ICBM = intercontinental ballistic missile; kt = kiloton; SERV = security-enhanced re-entry vehicle; SLBM = submarine-launched ballistic missile; SLCM = sea-launched cruise missile; SSBN = nuclear-powered ballistic missile submarine.

[a] Aircraft range is given for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

[b] The first figure in the *No. deployed* column is the total number of B-52Hs in the inventory, including those for training, test and reserve. The second figure is for primary mission inventory aircraft, i.e. the number of operational aircraft assigned for nuclear and conventional wartime missions.

[c] Approximately 860 ALCMs may have been withdrawn in 2007 due to early implementation of the 2004 Nuclear Weapons Stockpile Plan. All advanced cruise missiles have also been retired.

[d] These warheads are available for both the B-52H and the B-2A, but the B-2A is thought to be the main bomb delivery vehicle.

[e] The 2006 Quadrennial Defense Review decided to reduce the ICBM force to 450 missiles by 2008. The download of most Minuteman ICBMs to 1 warhead to meet the warhead ceiling mandated by the 2002 Strategic Offensive Reductions Treaty (SORT) is under way, but *c*. 25 missiles will continue to carry 3 warheads each.

[f] Although D-5 missiles are counted under the 1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I Treaty) as carrying 8 warheads each, the US Navy completed a preliminary download in 2005 (to an average of 6 warheads per missile) and will conduct an additional download to an average of 4 warheads per missile to meet the SORT-mandated warhead ceiling by 2012.

[g] Approximately 350 B61 bombs are deployed in Europe at 7 airbases in 6 NATO countries.

[h] Another 190 W80-0s are in inactive storage. The Tomahawk cruise missile (TLAM/N, from Tomahawk land attack missile, nuclear) is no longer deployed at sea but is stored on land.

[j] Approximately 1260 additional warheads are in reserve, for a total stockpile of *c.* 5300 warheads. Nearly 5100 warheads are awaiting dismantlement. In addition, *c.* 15 000 plutonium pits are stored at the Pantex Plant in Texas.

Sources: US Department of Defense, various budget reports and press releases; US Department of Energy, various budget reports and plans; US Department of State, START I Treaty Memoranda of Understanding, 1990–Jan. 2008; US Department of Defense, various documents obtained under the Freedom of Information Act; US Air Force, US Navy and US Department of Energy, personal communication; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; US Naval Institute, *Proceedings*, various issues; and Authors' estimates.

stockpile reduction has so far occurred largely on paper, because it consists of transferring ownership of the warheads from the DOD to the Department of Energy (DOE). In practical terms, the weapons will mostly remain at their bases for several years because the DOE does not have capacity to store them.

The stockpile announcement accompanied the National Nuclear Security Administration's publication of the *Draft Complex Transformation Supplemental Programmatic Environmental Impact Statement* (SPEIS) for modernizing the US nuclear weapon complex.[5] Complex Transformation, a scaled-down version of the 2006 plan known as Complex 2030,[6] evaluates how the nuclear weapon complex should be structured to meet nuclear weapon production and maintenance requirements at force levels below those imposed by SORT. The plan proposes consolidating the complex and increasing the capacity to produce plutonium 'pits' (cores) from the current 10 annually to up to 200.

The Bush Administration's proposal to begin production, in 2014, of the first of a series of Reliable Replacement Warheads (RRWs) ran into opposition in the US Congress, which rejected the administration's funding request for 2008. Instead, the Congress delayed a decision on RRW funding until after the completion of a new assessment of future US strategic nuclear deterrence requirements.

In an effort to 'ensure that stockpile and infrastructure transformation is not misperceived by other nations as "restarting the arms race"', the Bush Administration announced in 2007 that dismantlement of retired warheads had increased by 146 per cent.[7] Although the percentage increase looks impressive, the actual number of warheads dismantled appears to be modest compared with the rate of dismantlement during the 1990s. On the basis of previously declassified or released dismantlement information, it is possible to estimate that the 146 per cent increase means roughly 260 warheads. For comparison, the average number of warheads dismantled per year

National Nuclear Security Administration, 'Administration plans significant reduction in nuclear weapons stockpile', News release, Washington, DC, 3 June 2004, <http://www.nnsa.doe.gov/news releases.htm>.

[5] US Department of Energy (DOE), National Nuclear Security Administration, *Draft Complex Transformation Supplemental Programmatic Environmental Impact Statement* (DOE: Washington, DC, Dec. 2007), <http://www.complextransformationspeis.com/>.

[6] US Department of Energy (DOE), National Nuclear Security Administration, *Complex 2030: An Infrastructure Planning Scenario for a Nuclear Weapons Complex Able to Meet the Threat of the 21st Century*, DOE/NA-0013 (DOE: Washington, DC, Oct. 2006).

[7] US Department of Energy, National Nuclear Security Administration (NNSA), 'Nuclear weapons dismantlements up 146 percent', *NNSA Monthly News*, Nov./Dec. 2007, p. 1.

during the 1990s was nearly 1200. Dismantlement is not currently a priority at the Pantex Plant in Texas, where the focus is on life extension of the warheads that are slated to remain in the enduring stockpile. As a result, dismantling the current backlog of retired warheads will not be completed until 2023.[8]

In parallel with reducing the nuclear arsenal, the DOD has upgraded its nuclear strike plans to reflect new presidential guidance and a transition in war planning from the Single Integrated Operational Plan (SIOP) of the cold war to a set of smaller and more flexible strike plans designed to defeat today's adversaries. In March 2003 a new series of executable scenario-based strike options against regional states armed with weapons of mass destruction (WMD) was added to the strategic war plan, which is now known as OPLAN (Operations Plan) 8044. This was refined in October 2004 and resulted in an updated war plan known as OPLAN 8044 Revision 05. In February 2005 General Richard B. Meyers, chairman of the Joint Chiefs of Staff, described some of the characteristics of the plan: '[US Strategic Command] has revised our strategic deterrence and response plan that became effective in the fall of 2004. This revised, detailed plan provides more flexible options to assure allies, and dissuade, deter, and if necessary, defeat adversaries in a wider range of contingencies'.[9]

In mid-2004 a controversial plan for striking regional adversaries pre-emptively with conventional and nuclear weapons, called CONPLAN (Concept Plan) 8022, entered into effect as the combat employment part of a new Global Strike mission. The plan was withdrawn in the fall of 2004, however, and the strike options incorporated into OPLAN 8044.

Land-based ballistic missiles

The US intercontinental ballistic missile (ICBM) force is undergoing significant change as part of the USA's implementation of SORT. Approximately 764 warheads were deployed on 488 ICBMs as of January 2008, a reduction of 136 warheads compared with 2007 due to offloading of W62 warheads and downloading of W78 warheads. The last W62 is scheduled to be offloaded in 2009, and additional downloading of W78s will reduce the total loading to 500 warheads in 2011. As the 170-kiloton W62 is removed from the missiles, the modern 300-kt Mk-21/W87 security-enhanced re-entry vehicle (SERV) is being installed. The increased power of the W87 will broaden the range of targets of the Minuteman force. A previous plan to convert the ICBM force to single-warhead configuration has been modified: 25 missiles will continue to carry three warheads. Several hundred additional warheads will be kept in storage for upload to increase the warheads on the ICBM force if necessary in the future. Work is continuing on designing a new ICBM to begin replacing the Minuteman III missile from 2018.

Only one Minuteman III missile flight test was launched in 2007, compared to four in 2006. That missile was launched from Vandenberg Air Force Base (AFB) in California on 7 February and delivered a single, unarmed warhead approximately 6760 kilometres, with impact on a water target east of Kwajalein in the Marshall Islands.

[8] US Department of Energy (note 6), p. 8.

[9] Myers, R. B., General, US Air Force, Chairman of the Joint Chiefs of Staff, Posture statement before the Senate Armed Services Committee, 17 Feb. 2005, <http://www.senate.gov/~armed_services/statemnt/2005/February/Myers%2002-17-05.pdf>, p. 32.

Ballistic missile submarines

The conversion of Pacific-based nuclear-powered ballistic missile submarines (SSBNs, from 'ship submersible ballistic nuclear') from Trident I C-4 missiles to the longer-range and more accurate Trident II D-5 missile is nearing completion with the USS *Alabama* scheduled to complete conversion in 2008. Twelve operational Ohio Class SSBNs carry a total of 228 D-5 submarine-launched ballistic missiles (SLBMs), each of which is estimated to be armed with an average of six warheads. Two additional SSBNs are undergoing overhaul at any given time, and their 48 missiles and 288 warheads are not included in the total. In the future, eight SSBNs will be based in the Pacific and six in the Atlantic, focusing the US sea-based deterrent against targets in China and elsewhere in the Pacific region.

In 2008 the US Navy will begin production of a modified D-5 missile. A total of 108 missiles are planned by 2011, at a cost of more than $4 billion, with initial deployment scheduled for 2013. The modified D-5 SLBM will arm the Ohio Class SSBNs for the rest of their service lives, which have been extended from 30 to 44 years. The oldest submarine is scheduled to retire in 2029, at which point a new SSBN class is planned to become operational. Development studies for the new class, known as SSBN(X), have begun.

Three Trident II D-5 missiles were test-launched during 2007 in two events. The USS *Tennessee* launched two missiles from the eastern test range off the Florida coast on 15 May. The missiles were the first to carry the new Lockheed low-cost test missile kit, which converts an operational missile into test configuration and contains range safety devices and flight telemetry instrumentation. On 29 November the USS *Henry M. Jackson* test-launched a single missile from the western test range in an operation to certify the submarine for deployment after a lengthy retrofit from C-4 to D-5 SLBMs.

The deployment of the W76-1/Mk4A warhead, a modernized version of the existing W76/Mk4, was scheduled to begin in March 2008, but owing to a technical production problem the programme has been delayed. The programme involves production of approximately 2000 W76-1 warheads up to 2021.[10] The W76-1/Mk4 is equipped with a new fuse that will give military planners more flexibility in setting the height of burst to 'enable W76 to take advantage of [the] higher accuracy of the D-5 missile'[11] and hold at risk a wider range of targets including hard targets. The increased lethality of the W76-1 warhead may also permit a reduction of the explosive yield.

Another potential upgrade, proposed by the US Strategic Command (STRATCOM), involves the 'accuracy adjunct', a manoeuvring attachment that was developed for the Mk4 re-entry vehicle to give the weapon 'GPS-life accuracy'. The US Congress has refused to approve the upgrade, which would enable STRATCOM to deploy conventional warheads on the D-5 SLBM.[12]

[10] Kristensen, H. M., 'Administration increases submarine nuclear warhead production plan', FAS Strategic Security Blog, 30 Aug. 2007, <http://www.fas.org/blog/ssp/2007/08/us_triples_submarine_warhead.php>.

[11] US Department of Energy (DOE), Office of Defense Programs, *Stockpile Stewardship and Management Plan: First Annual Update, October 1997* (DOE: Washington, DC, Oct. 2006), pp. 1–14. This document was partially declassified and released under the Freedom of Information Act.

[12] The 2006 Quadrennial Defense Review directed STRATCOM to replace nuclear warheads on 24 Trident II (D-5) missiles with 96 conventional warheads for deployment in 2008. The Congress has

The first of a series of RRWs is designed to replace a portion of the W76 warheads currently deployed on the D-5 missiles. The Nuclear Weapons Council has approved a preliminary RRW-1 design, which is based on the two-stage thermonuclear SKUA-9 design developed by Lawrence Livermore National Laboratory. The high-yield design was tested several times during the early 1970s, prior to the 1974 Threshold Test-Ban Treaty (TTBT).[13] If funded by the Congress, the warhead would be incorporated into the Mk5 re-entry body originally designed for the W88 warhead.

Long-range bombers

A B-2 bomber crashed on Guam on 23 February 2008, the first loss of the $1.2 billion stealth bomber. Of the remaining 20 B-2s, 16 have nuclear missions. Both the bomber fleet and their nuclear weapons continued to be upgraded. Approximately 1000 nuclear warheads are earmarked for delivery by B-52H and B-2 bombers, including W80-1 warheads on air-launched cruise missiles and B61-7, B61-11, and B83-1 gravity bombs. The US Air Force is studying options for a new long-range strike aircraft to begin replacing the current bomber force from 2018.

The advanced cruise missile (ACM) was retired in 2007, and approximately half of the air-launched cruise missiles (ALCMs) were withdrawn from the stockpile as part of a plan to reduce by nearly 50 per cent the size of the stockpile by the end of 2007. The life extension of the W80-1 warhead has been put on hold and the Air Force is designing a next-generation nuclear-armed cruise missile known as the enhanced cruise missile.

Non-strategic nuclear weapons[14]

As of January 2008, the USA retained approximately 500 active non-strategic nuclear warheads. These consisted of 400 B61 gravity bombs and 100 W80-0 warheads for Tomahawk cruise missiles (TLAM/Ns, from Tomahawk land attack missiles, nuclear). Another 800 non-strategic warheads are in inactive storage. Approximately 350 B61 bombs are deployed in Europe at seven airbases in six North Atlantic Treaty Organization (NATO) member states (Belgium, Germany, Italy, the Netherlands, Turkey and the UK). The bombs were apparently withdrawn from Ramstein Air Base, Germany, in 2005.[15] The aircraft of non-nuclear weapon NATO countries that are assigned nuclear strike missions with US nuclear weapons include Belgian and Dutch F-16 and German and Italian Tornado combat aircraft.[16] The US arsenal in Europe may include inactive bombs. A portion of the new Joint Strike Fighter force will be nuclear-capable.

been unwilling to fund the programme and has expressed concern about the implications for crisis stability of mixing nuclear- and conventionally armed ballistic missiles.

[13] For a summary of the Treaty on the Limitation of Underground Nuclear Weapon Tests see annex A in this volume.

[14] Neither START nor SORT place limits on Russian and US inventories of non-strategic nuclear weapons. The US Nuclear Posture Review also did not address this category of weapons.

[15] On the history and status of US nuclear weapons in Europe see Kristensen, H. M., 'United States removes nuclear weapons from German Base, documents indicate', FAS Strategic Security Blog, 9 July 2007, <http://www.fas.org/blog/ssp/2007/07/united_states_removes_nuclear.php>.

[16] See Kristensen, H. M., *US Nuclear Weapons in Europe* (Natural Resources Defense Council: Washington, DC, 2005), <http://www.nrdc.org/nuclear/euro.contents.asp>.

Only 100 W80-0 warheads for the TLAM/N are active; another 200 are in inactive storage. TLAM/Ns are earmarked for deployment on selected Los Angeles, Improved Los Angeles and Virginia Class nuclear-powered attack submarines (SSNs, from ship submersible nuclear). TLAM/Ns are not deployed at sea under normal circumstances but can be redeployed within 30 days of a decision to do so. All are stored at strategic weapon facilities at Bangor, Washington, and Kings Bay, Georgia. The W80-0 may be retired in the near future.

Nuclear warhead stockpile management and modernization

The total US stockpile of roughly 5300 warheads is organized in two categories: active and inactive warheads. The active category includes intact warheads with all components that are either deployed on operational delivery systems, are part of the 'responsive force' of reserve warheads that can be deployed on operational delivery systems in a relatively short time, or are spare warheads. The inactive category includes warheads that are held in long-term storage as a reserve with their limited life components (tritium) removed. In addition to these warheads, more than 5100 other warheads are awaiting dismantling.

The USA keeps nearly 5000 plutonium pits in storage at the Pantex Plant in Texas as a strategic reserve. Another 10 000 pits at Pantex make up most of the 43 tonnes of weapon-grade plutonium previously declared in excess of military needs by the administrations of President Bill Clinton and President George W. Bush. All of these nearly 15 000 pits come from retired warheads. Approximately 5000 canned assemblies (thermonuclear secondaries) are kept at the Oak Ridge Y-12 Plant in Tennessee.

III. Russian nuclear forces

As of January 2008, Russia had an estimated 5189 nuclear warheads (see table 8A.3). In 2007 Russia continued to reduce its strategic nuclear forces in accordance with its commitments under SORT and as part of a doctrinal shift away from a 'substantially redundant' (*suschestvenno izbytochnyi*) and towards a 'minimally sufficient' (*garantirovanno dostatochnyi*) deterrence posture. According to a senior Russian military planner, Russia's strategic nuclear forces can still guarantee 'minimally sufficient' deterrence until 2015–20 within the force ceilings imposed by SORT, even if the USA develops a ballistic missile defence (BMD) system.[17] However, he said that the strategic forces would need qualitative improvements to enhance their survivability and ability to penetrate missile defences in the futute. Russia has prioritized the procurement of the land-based SS-27 (RS12-M2/1 Topol-M) ICBMs and the development of sea-launched SS-NX-30 Bulava missile systems, while continuing to extend the service lives of older missiles as an interim measure. In 2007 Russia began flight tests of a new road-mobile missile with multiple independently targetable re-entry vehicles (MIRVs) and missile defence penetration aids, continued to upgrade its sea-based strategic force and resumed regular long-range patrols of strategic aviation.

[17] Umnov, S., 'SYaS Rossii: naraschivaniye vozmozhnostey po preodoleniyu protivoraketnoy oborony' [Russia's SNF: building up ballistic missile defence penetration capacities], *Voenno-Promyshlennyi Kur'er*, 8–14 Mar. 2006. On US BMD programmes see appendix 8C.

Table 8A.3. Russian nuclear forces, January 2008

Type and Russian designation (NATO designation)	No. deployed	Year first deployed	Range (km)[a]	Warhead loading	No. of warheads
Strategic offensive forces	**685**				**3 113**
Bombers	*79*				*884*
Tu-95MS6 (Bear-H6)	32	1981	6 500–10 500	6 x AS-15A ALCMs, bombs	192
Tu-95MS16 (Bear-H16)	32	1981	6 500–10 500	16 x AS-15A ALCMs, bombs	512
Tu-160 (Blackjack)	15	1987	10 500–13 200	12 x AS-15B ALCMs or AS-16 SRAMs, bombs	180
ICBMs[b]	*430*				*1 605*
RS-20 B/V (SS-18 Satan)	75	1979	11 000–15 000	10 x 500–750 kt	750
RS-18 (SS-19 Stiletto)	100	1980	10 000	6 x 500–750 kt	600
RS-12M (SS-25 Sickle)	201	1985	10 500	1 x 550 kt	201
RS-12M2 Topol-M (SS-27)	48	1997	10 500	1 x 550 kt	48
RS-12M1 Topol-M (SS-27)	6	2006	10 500	1 x 550 kt	6
SLBMs	*176*				*624*
RSM-50 (SS-N-18 M1 Stingray)	80	1978	6 500	3 x 200 kt	240
RSM-54 (SS-N-23 Skiff/Sineva)	96	1986	9 000	4 x 100 kt	384
Strategic defensive forces	**2 000**				**733**
Anti-ballistic missiles[b]					
51T6 (SH-11 Gorgon)	32	1989		1 x 1000 kt	32
53T6 (SH-08 Gazelle)	68	1986		1 x 10 kt	68
S-300 (SA-10/20 Grumble)	1 900	1980		low kt	633
Non-strategic forces					**1 343**
Land-based non-strategic bombers	*524*				*524*[c]
Tu-22M Backfire	124	1974		2 x AS-4 ASM, bombs	124[c]
Su-24 Fencer	400	1974		2 x bombs	400[c]
Naval non-strategic attack aircraft	*179*				*295*
Tu-22M Backfire	58	1974		2 x AS-4 ASM, bombs	116
Su-24 Fencer	58	1974		2 x bombs	116
Be-12 Mail/Il-38 May	63	1967/68		1 x depth bomb	63
Sea-launched cruise missiles SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22					*276*
Anti-submarine warfare and surface-to-air missile weapons SS-N-15/16, SA-N-1/3/6, depth bombs, torpedoes[c]					*248*
Total strategic defensive and non-strategic forces					**2 076**
Total					**5 189**[d]

ALCM = air-launched cruise missile; ASM = air-to-surface missile; kt = kiloton; ICBM = intercontinental ballistic missile; NATO = North Atlantic Treaty Organization; SLBM = Submarine-launched ballistic missile; SRAM = short-range attack missile.

[a] Aircraft range is given for illustrative purposes only; actual mission range will vary.

[b] The SH-11 Gorgon may not be operational. The SA-10 Grumble, SA-12A Gladiator, SA-12B Giant and S-400 Triumf may have some capability against some ballistic missiles. Only a third of 1900 deployed SA-10s are counted as having nuclear capability.

[c] These figures assume that only half of land-based strike aircraft have a nuclear mission. Surface ships are not estimated to be assigned nuclear torpedoes.

[d] An additional *c*. 8800 warheads are estimated to be in reserve or awaiting dismantlement for a total stockpile of *c*. 14 000 warheads.

Sources: US Department of State, START I Treaty Memoranda of Understanding, 1990–Jan. 2008; US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, Ohio, Mar. 2006), <http://www.nukestrat.com/us/afn/NASIC2006.pdf>; US Central Intelligence Agency, National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001 <http://www.fas.org/spp/starwars/CIA-NIE.htm>; US Department of Defense, 'Proliferation: threat and response', Washington, DC, Jan. 2001, <http://www.fas.org/irp/threat/prolif00.pdf>; World News Connection, National Technical Information Service (NTIS), US Department of Commerce, various issues; Russianforces.org; International Institute for Strategic Studies, *The Military Balance 2007* (Routledge: London, 2007); Cochran, T. B. et al., *Nuclear Weapons Databook Volume IV: Soviet Nuclear* Weapons (Harper & Row: New York, 1989); *Proceedings*, US Naval Institute, various issues; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

Land-based ballistic missiles

The Russian Strategic Rocket Forces (SRF) consist of three missile armies: the 27th Guards Missile Army (Vladimir, five divisions), the 31st Missile Army (Orenburg, three divisions) and the 33rd Guards Missile Army (Omsk, five divisions).[18]

As of January 2008, Russia had on combat duty 75 SS-18 Satan (R-36M) heavy ICBMs in two versions: the R-36MUTTKh (RS-20B) and the R-36M2 Voevoda (RS-20V), deployed in Dombarovsky (41 missiles) and Uzhur (34 missiles).[19] The RS-20B was first deployed in 1979–83 and the RS-20V in 1988–92. Both are silo-based, two-stage, liquid-propellant ICBMs designed and produced in Ukraine.[20]

Russia intends to keep RS-20V missiles in service until 2016–18, but the RS-20B missiles are being gradually retired from service.[21] Instead of dismantlement, the SRF sometimes refurbishes them as Dnepr space launch vehicles (SLVs). In 2007 Russia conducted three successful launches of Dnepr SLVs: on 17 April and 15 June from Baikonur, Kazakhstan, and on 28 June from Yasnyi launch site in Orenburg region.[22]

As of January 2008, Russia had a total of 100 SS-19 Stiletto (RS-18) missiles deployed at Kozelsk (50 missiles) and Tatischevo (50 missiles).[23] The SS-19 is a silo-

[18] US Department of State, START I Memorandum of Understanding, Jan, 2008. On Russian missile deployments see also 'Russian strategic nuclear forces', <http://russianforces.org/missiles/>.

[19] US Department of State (note 18), pp. 13, 17.

[20] Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group: Coulsdon, July 2006), pp. 128–30.

[21] Russian Strategic Rocket Forces, Information and Public Relations Service, 'Pusk mezhkontinental'noy ballisticheskoy rakety RS-20V ("Voevoda")' [Launch of the intercontinental ballistic missile RS-20V ('Voevoda')], 21 Dec. 2006, <http://www.mil.ru/848/1045/1275/rvsn/19220/index.shtml?id=19753>.

[22] Russian Strategic Rocket Forces, Information and Public Relations Service, 'Pusk rakety RS-20B' [Lauch of an RS-20B missile], 15 June 2007, <http://www.mil.ru/848/1045/1275/rvsn/19220/index.shtml?id=25678>; and 'Russia launches SS-18 "Satan" ICBM with U.S. satellite', RIA Novosti, 28 June 2007, <http://en.rian.ru/world/20070628/68007073.html>.

[23] US Department of State (note 18), pp. 20, 24.

based, two-stage, liquid-propellant ICBM capable of carrying up to six warheads, which entered into service in 1980.[24] On 29 October 2007 the SS-19 missile was successfully test-launched from Baikonur to its target at the Kura test range. As a result of the test, the SS-19's service life was extended to 31 years.[25]

Russia has 201 SS-25 Sickle (RS-12M Topol) ICBMs deployed in eight missile divisions across the country.[26] The SS-25 is a road-mobile, three-stage solid-propellant ICBM that carries a single warhead. It was first deployed in 1985.[27] According to Russian press reports, the SS-25 is expected to be in service until 2015.[28] On 18 October and 8 December 2007 the SRF successfully launched SS-25 missiles from the Plesetsk and the Kapustin Yar test site launch sites, respectively. The service life of the weapon was reported to have been extended to 21 years.[29]

The SS-27 Topol-M missile is a three-stage solid-propellant ICBM that has been developed in both road-mobile (RS-12M1) and silo-based (RS-12M2) versions, which the missile's designers say use standardized and interoperable components. Russia plans to deploy 40 RS-12M1 and 114 RS-12M2 missiles by 2015.[30] As of January 2008 Russia had 48 RS-12M2 missiles at the 60th Missile Division in Tatischevo, Saratov oblast, and 6 RS-12M1 missiles at the 54th Missile Division in Teikovo, Ivanovo region.[31] Deployment of the silo-based RS-12M2 will be completed in 2010.[32]

On 7 May 2007 the SRF Commander, Nikolai Solovtsov, announced that Russia will start to install MIRVs on SS-27 Topol-M missiles 'in two or three years', probably referring to the expiry of START I in December 2009.[33] The treaty prohibits the installation of MIRVs on existing missiles but does not restrict the development of new ones.[34]

On 29 May 2007 a MIRVed missile, designated the 'RS-24', was test-fired for the first time. It was launched from a specially modified transporter-erector-launcher (TEL) vehicle at the Plesetsk launch site and successfully hit its target at the Kura test range.[35] On 25 December 2007 the second launch of the RS-24 was conducted at

[24] ed. Lennox (note 20), pp. 130–32.

[25] 'Russia launches RS-18 ICBM from Baikonur in Kazakhstan-1', RIA Novosti, 29 Oct. 2007, <http://en.rian.ru/russia/20071029/85783408.html>.

[26] US Department of State (note 18).

[27] ed. Lennnox (note 20), pp. 136–39.

[28] 'Russia fires intercontinental ballistic missile', ITAR-TASS, 18 Oct. 2007.

[29] Russian Strategic Rocket Forces, Information and Public Relations Service, 'Pusk rakety RS-12M "Topol"' [The launch of the missile RS-12M 'Topol'], 18 Oct. 2007, <http://www.mil.ru/848/1045/1275/rvsn/19220/index.shtml?id=32232>; and 'Russia test-fires RS-12M ballistic missile', RIA Novosti, 8 Dec. 2007, <http://en.rian.ru/russia/20071208/91500297.html>.

[30] Nikol'skii, A., 'Mutatsiya "Topolya"' [Topol's mutation], *Vedomosti*, 8 May 2007; and Isachenkov, V., 'Russia plans new ICBMs, nuclear subs', *Washington Post*, 7 Feb. 2007.

[31] Russian Ministry of Defence, '"Topol-M" missile system is on duty', 10 Jan. 2008, <http://www.mil.ru/eng/1866/12078/details/index.shtml?id=35978>.

[32] 'Russia to deploy fixed-site Topol-M ICBMs by 2010-SMF cmdr', RIA Novosti, 8 May 2007, <http://en.rian.ru/russia/20070508/65086382.html>.

[33] Nikol'skii, A. (note 30).

[34] On legal issues concerning MIRVs see Sokov, N., 'Russia tests a new ground-launched cruise missile and a new strategic missile on the same day', Monterey Institute of International Studies, James Martin Center for Nonproliferation Studies, 1 June 2007, <http://cns.miis.edu/pubs/week/070601.htm>.

[35] 'Pervyi start' [First start], *Krasnaya Zvezda*, 30 May 2007; and Richardson, D., 'Russia tests a new ICBM', *Jane's Missiles and Rockets*, vol. 11, no. 7 (July 2007), pp. 1–2.

Plesetsk, with three test warheads successfully reaching the Kura range.[36] Russian officials stated that the RS-24 is not an entirely new missile but a 'new version' of the SS-27 Topol-M, with the MIRVs as the main difference from the SS-27 Topol-M.[37] In order to declare the missile as a new type under START I, Russia will have to make other treaty-specified modifications, such as altering the diameter or length of the missile's first stage or changing the launch weight. Alternatively, the missile could be maintained as a 'prototype' (not accountable under START I) until the treaty's expiry date.[38]

After the first launch Solovtsov announced that the RS-24 test programme would require no more than five additional launches, and the missile could be placed in service by 2010. He also stated that advanced missile defence penetration capability would be added to the RS-24 and probably to the single-warhead SS-27 Topol-Ms as well.[39] In February 2008, however, Solovtsov declared that the RS-24 would enter service in 2009 and that two flight tests were planned in 2008.[40]

Ballistic missile submarines and sea-launched ballistic missiles

The Russian Navy operates 14 SSBNs in its Northern and Pacific fleets. Of these, six are Delta III Class (Project 667BDR Kalmar) submarines. The *Petropavlovsk-Kamchatskii*, the *Svyatoi Georgii Pobedonosets*, the *Zelenograd* and the *Podol'sk* are deployed with the Pacific Fleet, and the *Ryazan'* and the *Borisoglebsk* with the Northern Fleet. On 21 September 2007 the *Ryazan'* completed a two-year overhaul at the Zvezdochka shipyard in Severodvinsk, and it began sea trials in December 2007.[41]

The Russian Navy also operates six Delta IV Class (Project 667BDRM Delfin) submarines, all part of the Northern Fleet. Four of them—the *Bryansk*, the *Tula*, the *Verkhotur'e* and the *Yekaterinburg*—are currently in service after returning from an overhaul.[42] In November 2006 two Delta IV submarines—the *Kareliya* and the *Novo-*

[36] 'Putin: puski raket—eto prazdnichnyi feierverk' [Putin: missile launches are festive fireworks], Rosbalt News Agency, 26 Dec. 2007, <http://www.rosbalt.ru/2007/12/26/443915.html>.

[37] Richardson (note 35), p. 1; and Gertsev, O., 'Rabota po "Bulave" idet po planu' [Development of 'Bulava' is proceeding according to plan], *Voenno-Promyshlennyi Kurier*, 5–11 Sep. 2007.

[38] For more discussion see Sokov (note 34).

[39] Isby, D., 'RS-24s set to receive penetration aids, MIRVs', *Jane's Missiles and Rockets*, vol. 11, no. 11 (Nov. 2007), p. 4.

[40] 'Russia's RS-24 ICBM to enter service in 2009—SMF commander', RIA Novosti, 27 Feb. 2008, <http://en.rian.ru/russia/20080227/100186909.html>.

[41] 'V Severodvinske spushchena na vodu posle planovogo remonta strategicheskaya atomnaya podlodka Severnogo flota "Ryazan"' [Northern Fleet's SSBN 'Ryazan' was launched in Severodvinsk after a planned overhaul], ARMS-TASS, 21 Sep. 2007, <http://armstass.su/?page=article&aid=45389&cid=25>; and 'PLARB Severnogo flota "Ryazan" vyshla na hodovye ispytaniya posle remonta v Severodvinske' [Northern Fleet's SSBN 'Ryazan' has started sea trials after an overhaul in Severodvinsk], ARMS-TASS, 13 Dec. 2007, <http://www.armstass.su/?page=article&aid=49071& cid=25>.

[42] 'PLARB Severnogo flota "Bryansk" ushla na bazu v Zapolyar'e posle modernizatsii v Severodvinske' [Northern Fleet's PLARB 'Bryansk' sailed to its base beyond the Arctic Circle after an overhaul in Severodvinsk], ARMS-TASS, 23 Jan. 2008, <http://www.armstass.su/?page=article&aid=50377&cid=25>; and Kile, S. N., Fedchenko, V. and Kristensen, H. M., 'World nuclear forces, 2007', *SIPRI Yearbook 2007: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2007), p. 528.

moskovsk—started service life-extension overhauls.[43] The Delta IV submarines are scheduled to remain in service for 10 years after these overhauls.[44]

The Soviet Union built six Typhoon Class (Project 941 Akula) SSBNs in 1976–89. Russia decommissioned three of them in 1996. One of them, renamed the *Dmitrii Donskoi,* was relaunched in June 2002 after an overhaul and is used as a test platform for the new SS-NX-30 Bulava (RSM-56) missile, which is under development. Russian military officials have indicated that in future the *Dmitrii Donskoi* may be equipped with the full complement of Bulava missiles. The two remaining submarines—the *Arkhangel'sk* and the *Severstal'*—were withdrawn from service in 2004 for financial reasons, and a decision on their future was not taken in 2007.[45]

Russia is building three SSBNs of a new class, the Project 955 Borei. The first in the class, the *Yurii Dolgorukii*, was launched on 15 April 2007 and is expected to enter service in 2008.[46] The second and third submarines, the *Aleksandr Nevskii* (to enter service in 2009) and the *Vladimir Monomakh* (to enter service in 2011) were laid down at the Sevmash shipyard in March 2004 and March 2006, respectively.[47] Each Borei SSBN is equipped with 16 RSM-56 missiles.[48] The Russian Government plans to have eight Borei SSBNs by 2015.[49] In July 2007 the Russian Navy announced plans to build a new submarine base for Borei Class submarines at Viluchinsk on the Kamchatka peninsula.[50]

Russia's SLBM force currently consists of two types of missile—the SS-N-18 M1 Stingray (RSM-50) and the SS-N-23 Skiff (RSM-54). The SS-N-18 M1 first entered service in 1978 and is deployed on Delta III Class submarines. It has two liquid-fuelled stages and carries three warheads.[51] On 7 August 2007 a Delta III Class SSBN, the *Petropavlovsk-Kamchatskii*, launched an SS-N-18 M1 SLBM from the Pacific that successfully hit the target at the Chizha test range.[52]

The SS-N-23 Skiff SLBM, a successor to the SS-N-18, was first test-launched in 1983 and is deployed on Delta IV Class submarines.[53] It has since been modified twice. In 1996–2002 an improved re-entry vehicle was added,[54] and in 2002–2005, the missile was modernized to extend its service life and a new satellite guidance

[43] 'SSBN Kareliya enters Zvezdochka yard for medium repair', Interfax-AVN, 2 Nov. 2006; and Popov, A., ' "Begemot" ego proslavil' ['Begemot' made him famous], *Severnyi Rabochii*, 30 Nov. 2006, <http://www.nworker.ru/article.phtml?id=4616>.

[44] ARMS-TASS (note 42).

[45] '"Taifuny" ne budut pereoborudovat'sya pod "Bulavu-M"' ['Typhoons' will not be re-equipped with 'Bulava-Ms'], Vesti.Ru, 5 Aug. 2007, <http://www.vesti.ru/doc.html?id=133340>.

[46] Nikol'skii, A., 'Podlodka na polveka' [Submarine for 50 years], *Vedomosti*, 16 Apr. 2007; and Richardson, D., 'Bulava SLBM makes successful flight', *Jane's Missiles and Rockets*, vol. 11, no. 8 (Aug. 2006), p. 3.

[47] 'Iz-pod vody dostali' [Reached from under water], *Kommersant Business Guide*, 4 July 2006.

[48] US Department of State (note 18), p. 55.

[49] Isachenkov, V., 'Russia plans new ICBMs, nuclear subs', *Washington Post*, 7 Feb. 2007.

[50] 'Rossiya postroit novuyu bazu atomnykh podlodok' [Russia will build a new nuclear submarine base], BBC News, 9 July 2007, <http://news.bbc.co.uk/hi/russian/russia/newsid_6283000/6283024.stm>.

[51] ed. Lennox (note 20), pp. 149–50.

[52] 'Russia test launches sea-based ballistic missile in Pacific-1', RIA Novosti, 7 Aug. 2007, <http://en.rian.ru/russia/20070807/70528653.html>.

[53] ed. Lennox (note 20), pp. 155–56.

[54] Kontareva, E., 'Gosudarstvo vysoko otsenilo vklad yuzhnoural'tsev v modernizatsiyu odnogo iz luchshikh strategicheskikh kompleksov Voenno-Morskogo Flota Rossii' [The state highly appreciated the contribution of the people of the South Urals to modernization of one of the best strategic missile complexes of the Russian Navy], Ural-Press-Inform News Agency, 23 Sep. 2005, <http://uralpress.ru/show_article.php?id=82055>.

system was added.[55] The upgraded version of the missile is called the Sineva ('the Blue') in Russian. According to the US Air Force, the Sineva has the same range as the SS-N-23 Skiff but can carry up to 10 warheads.[56] However, the START I information exchange memorandum does not make a distinction between the two versions.[57]

On 9 July 2007 President Vladimir Putin signed a decree accepting the Sineva SLBM into service.[58] Serial production of the missile is under way.[59] Four Sineva SLBMs were delivered in 2006 and another 12 were procured in 2007.[60] On 25 December 2007 a Delta IV SSBN, the *Tula*, test launched a Sineva from an underwater position in the Barents Sea that hit a simulated target at the Kura test range.[61] Russia also continues to test the SS-N-23 Skiff. On 17 December the *Tula* launched an 18-year-old SS-N-23 missile, whose service life certification was set to expire shortly thereafter, from a submerged position in the Barents Sea.[62]

Russia is giving high priority to the development of the SS-NX-30 Bulava, a new three-stage, solid-propellant SLBM. President Putin has declared that Borei Class SSBNs, equipped with the new Bulava SLBM, will form the backbone of Russia's strategic deterrent force together with the Topol-M ICBM.[63] The missile will reportedly have a maximum range of 8300 km.[64] Russia has declared that the Bulava will be attributed under START I counting rules as carrying six warheads,[65] although some of the capacity may instead be used for carrying missile-defence penetration aids or for other purposes.

As of December 2007 six Bulava test launches had been conducted. Two tests in 2005 were successful, but the three in 2006 ended in failure.[66] On 28 June 2007 the *Dmitrii Donskoi* SSBN fired a Bulava missile from a location in the White Sea, and

[55] 'Atomnyi podvodnyi raketnyi kreiser "Tula" Severnogo flota osushchestvil uchebno-boevoi pusk mezhkontinentalnoy ballisticheskoy raketi' [SSBN 'Tula' has launched an intercontinental ballistic missile], ARMS-TASS, 17 Dec. 2007, <http://armstass.su/?page=article&aid=49154 &cid=25>.

[56] US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, Ohio, Mar. 2006), <http://www.nukestrat.com/us/afn/NASIC2006.pdf>.

[57] US Department of State (note 18), p. 1.

[58] Makeyev Design Bureau, 'President RF V. V. Putin podpisal ukaz o prinyatii na vooruzheniye VMF raketnogo kompleksa "Sineva"' [Russian President V. V. Putin has signed a decree accepting the missile complex 'Sineva' into the Navy's arsenal], News release, 16 July 2007, <http://www.makeyev.ru/news.php?extend.27>.

[59] Richardson, D., 'Russian SLBMs should see out 2030', *Jane's Missiles and Rockets*, vol. 11, no. 5 (May 2007), p. 10.

[60] Barabanov, M., 'I tselogo flota malo' [The fleet is not enough], Rosbalt News Agency, 18 Sep. 2007, <http://www.rosbalt.ru/2007/09/17/413702.html>. On the Russian fleet see <http://www.kommersant.com/p856120/russian_naval_fleet_directory/>.

[61] Makeyev Design Bureau, 'Soobscheniye o puske RSM-54 "Sineva"' [Report on the launch of the RSM-54 'Sineva'], 26 Dec. 2007, <http://www.makeyev.ru/comment.php?comment.news.47>.

[62] Makeyev Design Bureau, 'Uspeshnyi pusk ballisticheskoy rakety RSM-54' [Successful launch of the ballistic missile RSM-54], 26 Dec. 2007, <http://www.makeyev.ru/comment.php?comment.news.44>.

[63] Putin, V., President of the Russian Federation, Annual Address to the Federal Assembly of the Russian Federation, 10 May 2006, <http://www.kremlin.ru/eng/speeches/2006/05/10/1823_type70029type82912_105566.shtml>.

[64] ed. Lennox (note 20), p. 166.

[65] US Department of State (note 18), p. 1.

[66] Kile, Fedchenko and Kristensen (note 42), p. 529; and Kile, S. N., Fedchenko, V. and Kristensen, H. M., 'World nuclear forces, 2006', *SIPRI Yearbook 2006: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2006), p. 652.

the simulated warhead hit the target at the Kura test range.[67] Shortly after the test Russian military officials announced plans to start large-scale production of Bulava components and to complete missile testing in 2008 after conducting launches to determine the maximum range of the missile.[68]

In November and December 2007 the Russian press reported that another test launch of Bulava had been conducted on 10 November. The missile reportedly failed immediately after launch.[69]

Strategic aviation

Russia's strategic aviation units are grouped under the 37th Air Army of the Supreme High Command (Strategic) of the Russian Air Force. They include the 22nd Guards Heavy Bomber Division based in Engels and Ryazan, with 14 Blackjack (Tu-160), 17 Bear-H16 (Tu-95MS16) and 7 Bear-H6 (Tu-95MS6) aircraft; and the 326th Heavy Bomber Division based in Ukrainka, Khabarovsk kray, with 15 Tu-95MS16 and 25 Tu-95MS6 aircraft.[70] The 37th Air Army also comprises four divisions of Backfire C (Tu-22M3) bombers.[71] The Russian Minister of Defence, Sergei Ivanov, announced in February 2007 that Russia plans to have a total of 50 Tu-160 and Tu-95MS bombers in service by 2015.[72] This would probably be accomplished by retiring some Tu-95MSs and completing the production of a limited number of Tu-160s. In 2007 the Kazan Aviation Plant completed the production of a new Tu-160 bomber, which began flight testing on 28 December 2007 and is expected to enter service in 2008.[73]

In 2007 Russia's decision to resume regular long-range strategic bomber patrols resulted in several encounters with British, Norwegian and US fighter aircraft.[74]

Non-strategic nuclear weapons

There is considerable uncertainty in estimates of Russia's inventory of non-strategic nuclear weapons, which continues to be characterized by a high degree of secrecy and a lack of transparency. Since the end of the cold war, Russia has significantly reduced this inventory pursuant to President Boris Yeltsin's 1992 unilateral initiative on non-strategic nuclear weapons.[75] In 2007 the top Ministry of Defence official responsible

[67] 'Russia test launches sea-based ballistic missile—Navy-1', RIA Novosti, 28 June 2007, <http://en.rian.ru/russia/20070628/68009320.html>.

[68] Isby, D., 'Bulava-M SLBM looks set to enter production', *Jane's Missiles and Rockets*, vol. 11, no. 10 (Oct. 2007), p. 3.

[69] Lantratov, K. and Gritskova, A., 'Den'gi est', oruzhiya net' [There is money, but no weapon], *Kommersant*, 21 Nov. 2007.

[70] US Department of State (note 18), pp. 62–63.

[71] Khudoleev, V., '37-ya derzhit kurs' [37th Army is following the course], *Krasnaya Zvezda*, 23 Dec. 2005.

[72] Russian State Duma, Transcript of the Plenary Session, 7 Feb. 2007, <http://wbase.duma.gov.ru/steno/nph-sdb.exe>.

[73] 'New serial Tu-160 Blackjack bomber undergoes flight test', RIA Novosti, 10 Jan. 2008, <http://en.rian.ru/russia/20080110/96102740.html>.

[74] Putin, V., President of the Russian Federation, Press Statement and Responses to Media Questions following the Peace Mission 2007 Counterterrorism Exercises and the Shanghai Cooperation Organisation Summit, General Forces Training Ground 225, Chebarkul, Chelyabinsk Region, 17 Aug. 2007, <http://president.kremlin.ru/eng/speeches/2007/08/17/2033_type82915_141812.shtml>.

[75] As part of a series of reciprocal unilateral presidential initiatives on nuclear weapons between the Soviet Union or Russia and the USA, Yeltsin announced on 29 Jan. 1992 that the production of nuclear

for nuclear weapon custody, Colonel General Vladimir Verkhovtsev, reported on the progress made in reducing this inventory but did not give specific numbers of warheads.[76] On the basis of the number of available delivery platforms, it can be estimated that Russia has approximately 2100 warheads that are operational for delivery by anti-ballistic missiles, air-defence missiles, tactical aircraft and naval cruise missiles, depth bombs and torpedoes.[77] In addition, Russia is believed to have up to several thousand non-strategic warheads held in reserve or awaiting dismantlement.

IV. British nuclear forces

The United Kingdom's nuclear deterrent consists of a sea-based component only, namely, Vanguard Class Trident SSBNs, Trident II (D-5) SLBMs and associated warheads (see table 8A.4). The UK possesses an operational stockpile of about 185 nuclear warheads available for use by a fleet of four Vanguard Class Trident SSBNs. All British nuclear warheads are designed and manufactured at the Atomic Weapons Establishment, Aldermaston, Berkshire. The UK leases 58 Trident II (D-5) SLBMs, including spares, from the US Navy. Under a system of 'mingled asset ownership' Trident II (D-5) missiles to be loaded onto British submarines are randomly selected from the stockpile at the US Navy's Trident facility in Kings Bay, Georgia. The submarines then go to the Royal Naval Armaments Depot at Coulport, Argyll and Bute, where the missiles are fitted with warheads that are designed and manufactured at the Atomic Weapons Establishment.

Each SSBN is equipped with 16 Trident II (D-5) missiles carrying up to 48 warheads. The warhead is similar to the US W76 warhead and has an explosive yield of about 100 kt. As part of a reduced force-loading option, it is believed that a number of the Trident II (D-5) missiles are deployed with only one warhead instead of three; this warhead may also have a greatly reduced explosive yield, possibly produced by the detonation of only the fission primary.[78]

The British Ministry of Defence's 1998 Strategic Defence Review added a 'substrategic' role to the Trident fleet. The review states that 'the credibility of deterrence also depends on retaining an option for a limited strike that would not automatically lead to a full scale nuclear exchange' as a means of demonstrating resolve or conveying a political message.[79] A 2002 addendum to the Strategic Defence Review

warheads for land-based tactical missiles, artillery shells and landmines had ceased and that Russia had begun eliminating one-third of its naval non-strategic warheads and one-half of its nuclear surface-to-air missile warheads. He stated that tactical air force weapons would be reduced by one-half and proposed placing the remaining weapons in centralized storage bases on a reciprocal basis with the USA. Excerpts from the text of Yeltsin's statement are reproduced in *SIPRI Yearbook 1992: World Armaments and Disarmament* (Oxford University Press: Oxford, 1992), pp. 89–92.

[76] Volgin, V., 'Strategicheskii monitoring' [Strategic monitoring], *Rossiiskaya Gazeta*, 31 Oct. 2007. According to Verkhovtsev, in 2007 Russia had eliminated the following percentages of its non-strategic nuclear warheads compared with 1992: 100% of the ground forces' warheads, 60% of surface-to air missile warheads, 50% of the Air Force's warheads, 30% of the Navy's warheads.

[77] Warheads for ships and submarines are stored on land in depots and can be deployed if necessary.

[78] Quinlan, M., 'The future of United Kingdom nuclear weapons: shaping the debate', *International Affairs*, vol. 82, no. 4 (July 2006).

[79] British Ministry of Defence (MOD), *The Strategic Defence Review: Modern Forces for the Modern World*, Cm 3999 (MOD: London, July 1998), p. 63.

Table 8A.4. British nuclear forces, January 2008

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warhead loading	No. of warheads
Submarine-launched ballistic missiles						
D-5	Trident II	48	1994	>7 400	1–3 x 100 kt	185[b]

kt = kiloton.

[a] Range is given for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

[b] Fewer than 160 warheads are operationally available, *c.* 144 to arm 48 missiles on 3 of 4 nuclear-powered ballistic missile submarines. The operational stockpile may consist of *c.* 185 warheads, with additional warheads in reserve. Only 1 boat is on patrol at any time, with up to 48 warheads.

Sources: British Ministry of Defence (MOD), White Papers, press releases and the MOD web-site, <http://www.mod.uk/>; British House of Commons, *Parliamentary Debates* (*Hansard*); Norris, R. S. et al., *Nuclear Weapons Databook*, vol. 5, *British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 9; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimate.

extendes the role of nuclear weapons to include deterring 'leaders of states of concern and terrorist organizations'.[80]

In a posture known as continuous at sea deterrence (CASD), one British SSBN is on patrol at all times. The second and third SSBNs can be put to sea fairly rapidly, but there are not enough missiles in the British inventory to arm the fourth submarine. Since the end of the cold war, the SSBN on patrol has been kept at a level of reduced readiness with a 'notice to fire' measured in days and its missiles de-targeted. Some patrol coordination may take place with France. The 300th British deterrent patrol was completed in 2007.

The four Vanguard Class SSBNs were each designed to reach the end of their nominal service lives from the early 2020s. The British Government concluded in its December 2006 White Paper, after 'an exhaustive review of possible future threats and deterrent options' that 'renewing the Trident system, by replacing the existing submarines and extending the life of the Trident missiles, is the best and most cost effective way to maintain our ability to deter future threats to the UK'.[81] It also proposed starting, in the near future, the design and construction work on a successor SSBN to the Vanguard Class that would enter service in the 2020s. On 14 March 2007 the British House of Commons approved the government's plan to replace the Vanguard SSBNs with a fleet of new Trident submarines.[82]

The 2006 White Paper also proposed that the new SSBN might be equipped with the modified Trident II D5LE SLBMs that the USA is building, thereby keeping the Trident II (D-5) missile in service until the early 2040s.[83] To assuage concerns that

[80] British Ministry of Defence, *The Strategic Defence Review: A New Chapter*, Cm 5566, vol. 1 (Stationery Office: London, July 2002), p. 12.

[81] British Ministry of Defence and British Foreign and Commonwealth Office, *The Future of the United Kingdom's Nuclear Deterrent*, Cm 6994 (Stationery Office: London, Dec. 2006).

[82] 'Trident plan wins Commons support', BBC News, 15 Mar. 2007, <http://news.bbc.co.uk/2/6448173.stm>.

[83] British Ministry of Defence and British Foreign and Commonwealth Office (note 81).

the UK was not complying with its commitment under Article VI of the NPT to work in good faith towards nuclear disarmament, the government proposed a small reduction in the British nuclear stockpile. It deferred a decision until the next parliament (due to be elected by 2010) on whether to refurbish or replace the current warheads. On 15 November 2007 in a written answer to a parliamentary question, the Secretary of State for Defence, Des Browne, confirmed that the UK's inventory of 'operationally available warheads' had been reduced 'from fewer than 200 to fewer than 160'.[84] A small inventory of non-operational reserve warheads presumably also exists.

According to the 2006 White Paper, the procurement costs of the new submarines and associated infrastructure would be about £15–20 billion ($28.5–38 billion), at 2006 prices, for a four-boat fleet. Most of this cost (*c*. £1 billion, or $1.9 billion, per annum) would be incurred during the period 2012–27.[85]

V. French nuclear forces

There has been a gradual evolution in France's nuclear doctrine since the end of the cold war. French officials have emphasized the need for greater flexibility in meeting a widening range of plausible deterrence scenarios. In 2006 President Jacques Chirac stated that France's nuclear deterrent remained the fundamental guarantor of its security, including against the dangers of regional instability growing extremism and the proliferation of WMD. Chirac threatened to retaliate with nuclear weapons against any state found to be supporting terrorism against France or considering the use of WMD and revealed that French nuclear forces had already been reconfigured accordingly (see table 8A.5). This involved reducing the number of nuclear warheads on SLBMs to allow more precisely targeted strikes.[86]

France's sea-based strategic force consists of a fleet of four operational SSBNs, of which three are of the new Triomphant Class and one is of the L'Inflexible Class. The remaining L'Inflexible Class SSBN will be retired when the fourth and final vessel of the Triomphant Class, *Le Terrible*, enters service in 2010. Laid down in 2002, *Le Terrible* is due to be launched in 2008, beginning sea trials in 2009.[87]

All French SSBNs are armed with 16 Aérospatiale M45 missiles, which carry up to six TN-75 warheads.[88] In 2010–15, beginning with the *Le Terrible*, the Triomphant Class SSBNs will be retrofitted with the longer-range M51.1 SLBM, which is a three-stage solid-propellant missile armed with up to six TN-75 warheads. It is estimated to have a maximum range of 6000–8000 km.[89]

[84] British House of Commons, 'Trident missiles', *Hansard*, 15 Nov. 2007, C363W <http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm071115/text/71115w0007.htm#07111542000024>.

[85] British Ministry of Defence and British Foreign and Commonwealth Office (note 81).

[86] Chirac, J., 'Speech by Jacques Chirac, President of the French Republic, during his visit to the Strategic Air and Maritime Forces at Landivisiau/L'Ile Longue', 19 Jan. 2006, <http://www.elysee.fr/elysee/elysee.fr/anglais/speeches_and_documents/2006/speech_by_jacques_chirac_president_of_the_french_republic_during_his_visit_to_the_stategic_forces.38447.html>.

[87] Richardson, D., 'M51 ballistic missile proves itself in a full-range test flight', *Jane's Missiles & Rockets*, vol. 11, no. 1 (Jan. 2007), pp. 1–2.

[88] Norris, R. S. and Kristensen, H. M., 'French nuclear forces, 2005', *Bulletin of the Atomic Scientists*, vol. 61, no. 4 (July/Aug. 2005), pp. 73–75.

[89] Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group: Coulsdon, July 2007), pp. 44–45; and 'France's nuclear-powered Le Vigilant prepares for patrol', *Jane's Missiles & Rockets*, vol. 9, no. 2 (Feb. 2005), p. 5.

Table 8A.5. French nuclear forces, January 2008

Type	No. deployed	Year first deployed	Range (km)[a]	Warhead loading	No. of warheads
Land-based aircraft					
Mirage 2000N	60	1988	2 750	1 x 300 kt ASMP	50
Carrier-based aircraft					
Super Étendard	24	1978	650	1 x 300 kt ASMP	10
Submarine-launched ballistic missiles					
M45	48	1996	6 000[b]	6 x 100 kt	288
Total					**348**[c]

ASMP = Air–Sol Moyenne Portée; kt = kiloton.

[a] Aircraft range is given for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

[b] The range of the M45 submarine-launched ballistic missile is listed as only 4000 km in a 2001 report from the National Defence Commission of the French National Assembly.

[c] France may also have a small inventory of reserve warheads.

Sources: French Ministry of Defense website, <http://www.defense.gouv.fr/>, various policy papers, press releases and force profiles; French National Assembly, various defence bills; Norris, R. S. et al., *Nuclear Weapons Databook*, vol. 5, *British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 10; *Air Actualités*, various issues; *Aviation Week & Space Technology*, various issues; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

As of January 2008 the M51.1 missile had been flight-tested twice, on 9 November 2006 and 21 June 2007. Both times an unarmed M51.1 missile was launched from the Landes Missile Launch Test Centre at Biscarosse, Aquitaine.[90] Simulated underwater launches are due to start in late 2008 at Toulon, Provence-Alpes-Côte d'Azur. The first underwater launch from a submarine is planned for 2010. A total of 10 test launches are planned.[91] A follow-on version of the missile, the M51.2, may be under development for possible deployment in 2015–17.

The air component of the French nuclear force consists of two types of aircraft: approximately 60 Mirage 2000N aircraft, equipping three Air Force squadrons with nuclear strike roles; and about 24 Super Étendard aircraft deployed on the aircraft carrier *Charles de Gaulle*. Both types of aircraft carry the Air–Sol Moyenne Portée (ASMP) cruise missile. A total of 90 ASMP missiles were produced, along with 80 TN81 300-kt warheads for them. France may have about 60 operational ASMP missiles with nuclear warheads deployed, with additional missiles in storage.[92]

[90] Richardson (note 87); 'France tests strategic missile', Global Security Newswire, 10 Nov. 2006, <http://www.nti.org/d_newswire/issues/2006_11_10.html >; Agence France-Presse, 'France tests ballistic missile for nuclear deployment', Spacewar.com, 9 Nov. 2006, <http://www.spacewar.com/reports/France_Tests_Ballistic_Missile_For_Nuclear_Deployment_999.html>; and 'Second M51 SLBM flight test hits target', *Jane's Missiles & Rockets*, vol. 12, no. 8 (Aug. 2008), p. 8.

[91] Isby, D., 'M51 tests set to begin on schedule', *Jane's Missiles & Rockets*, vol. 10, no. 12 (Dec. 2006), p. 10.

[92] Fiszer, M., 'French MoD to develop nuclear missile', *Journal of Electronic Defense*, vol. 26, no. 12 (Dec. 2003), p. 21.

A follow-on cruise missile, the ASMP-A (Air–Sol Moyenne Portée Améliorée), is planned to gradually replace the ASMP.[93] The ASMP-A is expected to enter service in 2008. The nuclear-capable missile will initially equip one Mirage 2000N squadron, and then a second squadron in September 2010. An Air Force Rafale F3 squadron is reportedly scheduled to receive the ASMP-A in December 2009, and the Navy's Rafale F3 combat aircraft will receive the missile in 2010.[94]

VI. Chinese nuclear forces

According to its 2006 Defence White Paper, China 'upholds the principles of counter-attack in self-defence and limited development of nuclear weapons, and aims at building a lean and effective nuclear force'. Chinese nuclear forces are stated to have the purpose of deterring 'other countries from using or threatening to use nuclear weapons against China'.[95] The 2006 White Paper reiterates commitment to 'the policy of no first use of nuclear weapons at any time and under any circumstances'.

China is estimated to have an arsenal of approximately 176 operational nuclear weapons for delivery mainly by ballistic missiles and aircraft (see table 8A.6). Additional warheads may be in reserve, giving a total stockpile of about 240 warheads.[96] The Chinese Foreign Ministry stated in 2004 that China possessed 'the smallest nuclear arsenal' among the nuclear weapon states.[97] China has a long-term nuclear force modernization programme under way. It is still unclear whether China intends to significantly expand its ballistic missile force or to deploy newer, more survivable missiles in approximately the same numbers as today.[98]

As of early 2008, China had four types of deployed ICBMs: the solid-fuel mobile DF-31 and DF-31A; the silo-based, liquid fuel DF-5A (CSS-4); and the smaller liquid-fuel DF-4 (CSS-3).[99] A 2007 US DOD report suggested that the DF-31 achieved 'initial threat availability' in 2006 and probably had achieved 'operational

[93] Norris, R. S., and Kristensen, H. M., 'Nuclear notebook: nuclear cruise missiles', *Bulletin of the Atomic Scientists*, vol. 63, no. 6 (Nov./Dec. 2007), p. 61.

[94] Isby (note 91).

[95] Chinese State Council, *China's National Defense in 2006* (Information Office of the State Council of the People's Republic of China: Beijing, Dec. 2006), <http://www.china.org.cn/english/features/book/194421.htm>.

[96] In 2006 the US Defense Intelligence Agency repeated an estimate that China has over 100 nuclear warheads deployed on ballistic missiles and some additional warheads in storage. Maples, M. D., Director, US Defense Intelligence Agency, 'Current and projected national security threats to the United States', Statement for the record, US Senate Armed Services Committee, 28 Feb. 2006, <http://www.dia.mil/publicaffairs/Testimonies/statement24.html>. The 2008 DOD report on China's military forces lists approximately 138 nuclear ballistic missiles. US Department of Defense, *Military Power of the People's Republic of China 2008* (DOD: Washington, DC, 3 Mar. 2008), <http://www.defenselink.mil/pubs/china.html>, p. 56. In 2005 a US non-governmental analyst calculated that China's operational arsenal might be as small as 80 warheads. Lewis, J., 'The ambiguous arsenal', *Bulletin of the Atomic Scientists*, vol. 61, no. 3 (May/June 2005), pp. 52–59.

[97] Chinese Ministry of Foreign Affairs, 'Fact sheet: China: nuclear disarmament and reduction of [sic]', Beijing, 27 Apr. 2004, <http://www.fmprc.gov.cn/eng/wjb/zzjg/jks/cjjk/2622/t93539.htm>.

[98] Kristensen, H. M., Norris, R. S. and McKinzie, M. G., *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Federation of American Scientists and Natural Resources Defense Council: Washington, DC, Nov. 2006), p. 43, <http://www.fas.org/nuke/guide/china/Book2006.pdf>.

[99] US Department of Defense (note 96), pp. 3, 5, 23, 24–27, 30, 56.

Table 8A.6. Chinese nuclear forces, January 2008

Type and Chinese designation (US designation)	No. deployed	Year first deployed	Range (km)[a]	Warhead loading	No. of warheads
Strategic weapons					**~161**
Land-based missiles[b]	*~121*				*~121*
DF-3A (CSS-2)	17	1971	3 100[c]	1 x 3.3 Mt	17
DF-4 (CSS-3)	17	1980	5 500	1 x 3.3 Mt	17
DF-5A (CSS-4)	20	1981	13 000	1 x 4–5 Mt	20
DF-21 (CSS-5)	~55	1991	2 100[c]	1 x 200–300 kt	~55
DF-31 (CSS-X-10)	<10	2007	>7 200	1 x . .	<10
DF-31A (?)	<10	(2008–10)	>11 200	1 x . .	<10
SLBMs	*0*				*0*
JL-1 (CSS-N-3)	(12)	1986	>1 770	1 x 200–300 kt	(12)
JL-2 (CSS-NX-5)	(24)	(2008–10)	>7 200	1 x ?	(24)
Aircraft[d]	*>20*				*~40*
H-6 (B-6)	20	1965	3 100	1 x bomb	~20
Attack (Qian-5, others?)	. .	1972–?	. .	1 x bomb	~20
Non-strategic weapons[e]					
Cruise missiles (DH-10)	50–250	2007	>2000	1 x . .	~15[f]
Short-range ballistic missiles (DF-15 and DF-11)					. .
Total					**~176**[g]

( ) = not fully operational; kt = kiloton; Mt = megaton; SLBM = submarine-launched ballistic missile; . . = unknown.

[a] Aircraft range is given for illustrative purposes only; actual mission range will vary.

[b] China defines missile ranges as short-range <1000 km; medium-range 1000–3000 km; long-range 3000–8000 km; and intercontinental range >8000 km.

[c] The range of the DF-3A and the DF-21A may be longer than is normally reported.

[d] The figures for aircraft are for nuclear-configured versions only.

[e] Other than the DH-10, the existence of tactical warheads is uncertain but possible.

[f] Can be delivered from H-6 bomber and ground-based launcher.

[g] Additional warheads are thought to be in storage. The total stockpile is believed to comprise *c*. 240 warheads.

Sources: US Department of Defense (DOD), Office of the Secretary of Defense, *Military Power of the People's Republic of Chin*a, Annual Report to Congress, various years (DOD: Washington, DC), <http://www.defenselink.mil/pubs/china.html>; US Air Force, National Air and Space Intelligence Center (NASIC), various documents; US Central Intelligence Agency, various documents; US DOD, Office of the Secretary of Defense, 'Proliferation: threat and response', Washington, DC, Jan. 2001, <http://www.defenselink.mil/pubs/archive.html>; Kristensen, H. M., Norris, R. S. and McKinzie, M. G., *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Federation of American Scientists and Natural Resources Defense Council: Washington, DC, Nov. 2006), <http://www.fas.org/nuke/guide/china/Book2006.pdf>; Norris, R. S. et al., *Nuclear Weapons Databook*, vol. 5, *British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994); 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; Google Earth; and Authors' estimates.

status' by May 2007.[100] China deploys one type of medium-range ballistic missile (MRBM)[101]—the solid-fuel, road-mobile DF-21 (CSS-5)—and one type of intermediate-range ballistic missile (IRBM)—the liquid-fuel DF-3A (CSS-2). The DF-3A and the DF-4 are expected to be completely replaced by the DF-21 and DF-31.

China operates a single Type 092 (Xia Class) SSBN armed with 12 intermediate-range solid-fuel, single-warhead JL-1 (CSS-N-3) SLBMs. The submarine has never conducted a deterrent patrol and is not thought to be fully operational.[102] The 2006 White Paper states that the Chinese Navy 'aims at . . . enhancing its capabilities in integrated maritime operations and nuclear counterattacks'.[103] To this end, China is developing the Type 094 (Jin Class) SSBN. It will carry the intercontinental-range JL-2 SLBM with a range of more than 7200 km. The US DOD estimates that the JL-2 will reach an 'initial operational capability' in 2009–2010.[104]

Commercial satellite imagery analysed by the Federation of American Scientists in 2007 showed the existence of at least two Type 094 submarines and confirms that each has 12 launch tubes for JL-2 SLBMs.[105] The US Office of Naval Intelligence projected in December 2006 that 'a fleet of probably five TYPE 094 SSBNs will be built in order to provide more redundancy and capacity for a near-continuous at-sea SSBN presence'.[106] This projection was somewhat confirmed by the DOD in 2008, which stated that 'by 2010, China's nuclear forces will likely comprise . . . up to five Jin-class SSBNs'.[107] The first Jin (Type 094) Class SSBN was launched in 2004 and is currently being fitted out. A second vessel was launched in 2006,[108] and a third vessel may be under construction.

It is thought that China has a small stockpile of nuclear bombs earmarked for delivery by aircraft as a contingency mission. The most likely aircraft to have a nuclear role today are the H-6 bombers. China has also started deploying the DH-10 land-attack cruise missile, which exists in a nuclear and conventional version for delivery by the H-6 and ground forces.

VII. Indian nuclear forces

Most published estimates of the size of the Indian nuclear stockpile are based on calculations of the total amount of weapon-grade plutonium that India has produced. There is considerable uncertainty in these calculations. There have also been numer-

[100] US Department of Defense (note 96), p. 56; and US Department of Defense (DOD), *Military Power of the People's Republic of China 2007* (DOD: Washington, DC, 25 May 2007), <http://www.defenselink.mil/pubs/china.html>, p. 42.

[101] Although China has its own system for defining missile ranges, the US DOD definitions are used here: short-range = <1100 km; medium-range = 1100–2750 km; intermediate-range = 2750–5500 km; and intercontinental range = >5500 km. See Kristensen, Norris and McKinzie (note 98), p. 218.

[102] Kristensen, Norris and McKinzie (note 98), pp. 77–80.

[103] Chinese State Council (note 95).

[104] US Department of Defense (note 96), p. 3.

[105] Kristensen, H. M., 'A closer look at China's new SSBNs', FAS Strategic Security Blog, 15 Oct. 2007, <http://www.fas.org/blog/ssp/2007/10/post_4.php>; and Kristensen, H. M., 'Two more Chinese SSBNs spotted', FAS Strategic Security Blog, 4 Oct. 2007, <http://www.fas.org/blog/ssp/2007/10/two_more_chinese_ssbns_spotted.php>.

[106] US Navy, Office of Naval Intelligence, Answers to questions obtained by Hans M. Kristensen under the Freedom of Information Act, 20 Dec. 2006, <http://www.fas.org/nuke/guide/china/ONI2006.pdf>.

[107] US Department of Defense (note 96), p. 25.

[108] Saunders, S. (ed.), *Jane's Fighting Ships 2006–2007* (Jane's Information Group: Coulsdon, 2006), p. 120.

Table 8A.7. Indian nuclear forces, January 2008

Type	Range (km)[a]	Payload (kg)	Status
Land-based ballistic missiles			
Prithvi I (P-I)	150	800	Entered service in 1994; widely believed to have a nuclear delivery role; fewer than 50 launchers have been deployed; most recent flight test on 9 May 2007
Agni I[b]	>700	1 000	Test-launched on 5 Oct and 24 Oct. 2007[c]
Agni II	>2 000	1 000	Last test-launched on 29 Oct. 2004[c]
Agni III	>3 500	1 500	Under development; test-launched on 12 Apr. 2007
Sea-based ballistic missiles			
Danush	400	1 000	Last test-launched on 30 Mar. 2007; induction under way
K-15	700	. .	Launched from a submerged pontoon on 26 Feb. 2008
Aircraft[d]			
Mirage 2000H Vajra	1 850	6 300	Has reportedly been certified for delivery of nuclear gravity bomb
Jaguar IS Shamsher	1 400	4 760	Some of 4 squadrons may have a nuclear delivery role

[a] Missile payloads may have to be reduced in order to achieve maximum range. Aircraft range is given for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

[b] The original Agni I, now known as the Agni, was a technology demonstrator programme that ended in 1996.

[c] Media reports in late 2007 and early 2008 indicated that the Agni I and the Agni II had achieved operational status.

[d] Other aircraft in the Indian Air Force's inventory that are potentially suitable for a nuclear role are the MiG-27 (Bahadur) and the Su-30MKI. The Su-30MKI can be refuelled in-flight by the IL-78 aerial tanker.

Sources: Indian Ministry of Defence, annual reports and press releases; International Institute for Strategic Studies (IISS), *The Military Balance 2005–2006* (Routledge: Abingdon, 2006); US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, Ohio, Mar. 2006), <http://www.nukestrat.com/us/afn/threat.htm>; US Central Intelligence Agency, 'Unclassified report to Congress on the acquisition of technology relating to weapons of mass destruction and advanced conventional munitions, 1 January through 30 June 2002', Apr. 2003, <http://www.nti.org/e_research/official_docs/cia/cia.html>; US Central Intelligence Agency, National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, <http://www.dni.gov/nic/PDF_GIF_otherprod/missilethreat2001.pdf>; Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group: Coulsdon, 2004); Bharat Rakshak, Consortium of Indian military websites <http://www.bharat-rakshak.com>; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

ous media and government reports suggesting that India has not manufactured as many nuclear weapons as it otherwise could owing to material constraints. On the basis of an upper bound estimate of its inventory of weapon-grade plutonium—650 kg as of December 2006—India would have the material capacity to build an arsenal exceeding 100 nuclear weapons.[109] The conservative estimate presented here is that the Indian arsenal holds about 60–70 nuclear weapons. The figure is based on the lower range of a widely-cited estimate of India's military plutonium inventory as well as on unclassified assessments made by the US intelligence community.[110] It is not publicly known whether India has produced high enriched uranium (HEU) for weapon purposes, in particular for thermonuclear devices.

India's nuclear doctrine, which was published as a draft document in 1999, is 'based on the principle of a minimum credible deterrent and no-first-use'.[111] However, additional guidelines published in January 2003 stated that India would use nuclear weapons to deter or retaliate against the use of chemical or biological weapons.[112] There have been no official statements specifying the size of the arsenal required for 'minimum credible deterrence' but, according to the Indian Ministry of Defence, it involves 'a mix of land-based, maritime and air capabilities'.[113]

Strike aircraft

At present, aircraft are the core of India's nuclear strike capabilities (see table 8A.7). The Indian Air Force (IAF) has reportedly certified the Mirage 2000H Vajra ('Divine Thunder') multi-role aircraft for delivery of nuclear gravity bombs. The IAF deploys two squadrons of Mirage 2000H aircraft at the Gwalior Air Force Station in north-central India. In addition to the Mirage 2000H, some of the IAF's four squadrons of Jaguar IS Shamsher ('Sword') fighter-bombers may have a nuclear delivery role.[114] Other aircraft which are suitable for a nuclear role are the MiG-27 and the Su-30MKI.

Land-based ballistic missiles

The Prithvi ('Earth') was India's sole operational ballistic missile for many years. A number of Prithvi I missiles are widely believed to have been modified to deliver nuclear warheads, although this has not been officially confirmed. The Prithvi I (SS-150) is a single-stage, road-mobile ballistic missile capable of delivering a 1000-kg warhead to a maximum range of 150 km. The missile was first flight-tested in 1988 and entered service with the Indian Army in 1994. It is currently deployed

[109] See appendix 8B, table 8B.2.

[110] Albright, D., 'India's military plutonium inventory, end of 2004', *Global Stocks of Nuclear Explosive Materials*, Institute for Science and International Security <http://www.isis-online.org/global_stocks/end2003/india_military_plutonium.pdf>. The estimate assumes that each warhead would require at least 5 kg of plutonium.

[111] Indian Ministry of External Affairs, 'Draft report of National Security Advisory Board on Indian Nuclear Doctrine', 17 Aug. 1999, <http://meaindia.nic.in/disarmament/dm17Aug99.htm>.

[112] Indian Ministry of External Affairs, 'The Cabinet Committee on Security reviews operationalization of India's nuclear doctrine', Press release, 4 Jan. 2003, <http://meaindia.nic.in/pressrelease/2003/01/04pr01.htm>.

[113] Indian Ministry of Defence (MOD), *Annual Report 2004–05* (MOD: New Delhi, 2005), <http://mod.nic.in/reports/report05.htm>, p. 14.

[114] Norris, R. and Kristensen, H., 'India's nuclear forces', *Bulletin of the Atomic Scientists*, vol. 61, no. 5 (Sep./Oct. 2005), pp. 73–75.

with the Army's 333, 444 and 555 missile groups. On 9 May 2007 a Prithvi I missile was successfully test-launched at the Integrated Test Range (ITR) at Chandipur-on-Sea, Orissa, on the Bay of Bengal. Officials at India's Defence Research and Development Organisation (DRDO) described the test as a 'user trial' for production quality control involving a missile selected at random from the Army's inventory.[115]

There are two newer versions of the Prithvi missile—the Prithvi II (SS-250), which has entered into service with the Air Force, and the Prithvi III (SS-350)—with improved range, accuracy and handling characteristics. Both are capable of carrying nuclear warheads but are not believed to be assigned a nuclear delivery role.

Indian defence sources indicate that the family of longer-range Agni ('Fire') ballistic missiles, which are designed to provide a short reaction time nuclear capability, has largely taken over the Prithvi's nuclear role.[116] The short-range Agni I is a single-stage solid-fuel missile that can deliver a 1000-kg warhead to a maximum range of 700–800 km. The two-stage Agni II can deliver a similar payload to a range of up to 2000–2500 km. The missiles are road and rail mobile, and both can carry nuclear as well as conventional warheads. In April 2007 the Indian Defence Minister, A. K. Antony, indicated that the Agni I and the Agni II missiles had yet to be inducted into the armed forces but stated that this would be done in a 'reasonable time' and without 'unnecessary delay'.[117] On 4 February 2008, however, three days after Pakistan launched an IRBM, the Indian Government reportedly announced that the Agni I and the Agni II were operationally deployed with India's Strategic Forces Command's 334th and 335th rocket regiments.[118]

On 5 October 2007, army personnel from the Strategic Forces Command successfully test-launched an Agni I missile at the Chandipur-on-Sea facility. The test was described as a 'training trial' for the Indian Army.[119] It was followed, on 24 October, by the test launch of an Agni I missile equipped with improved re-entry technology.[120] The Agni II has not been test-launched since October 2004.

On 12 April 2007 the DRDO conducted the second test flight of the intermediate-range Agni III. The missile was launched from a fixed platform at the ITR on Wheelers Islands in the Bay of Bengal.[121] The first flight test, in July 2006, failed after the missile crashed into the sea reportedly due to problems with its heat shield.[122] The missile is expected to be able to deliver a 1500-kg payload to a range of up to 3500 km. This would put large areas of China within range of launch points in eastern India, although Indian defence officials have denied that the missile was

[115] 'Prithvi missile to test-fired again', Rediff News,5 May 2007, <http://www.rediff.com/news/2007/may/05prithvi.htm>; and 'India tests nuclear-capable surface missile', Agence France-Presse, 9 May 2007, <http://www.spacewar.com/reports/India_Tests_Nuclear_Capable_Surface_Missile_999.html>.

[116] 'Prithvi SRBM', Bharat Rakshak: consortium of Indian military websites, 28 Dec. 2005, <http://www.bharat-rakshak.com/MISSILES/Prithvi.html>.

[117] 'Agni-III missile tests will continue: Antony', Rediff News, 14 Apr. 2007, <http://www.rediff.com/news/2007/apr/14agni.htm>.

[118] Bermudez, J. S., Jr., 'Pakistan carries our successful Ghauri launch', *Jane's Defence Weekly*, 13 Feb. 2008, p. 18.

[119] Pubby, M., 'Nuclear-capable Agni-I missile is all set for army's first training trial', *India Express*, 2 Oct. 2007.

[120] 'India test-fires nuclear capable missile', Agence France-Presse, 24 Oct. 2007, <http://www.spacewar.com/reports/India_test_fires_nuclear-capable_missile_999.html>.

[121] 'India successfully test fires Agni III test ballistic missile', *The Hindu*, 12 Apr. 2007; and Srivastava, S., 'India has China in its range', *Asia Times*, 14 Apr. 2007.

[122] 'India demonstrates Agni 3 with "textbook precision"', *Jane's Missiles & Rockets*, vol. 11, no. 6 (June 2007), p. 2.

designed with China in mind. The DRDO is developing a longer-range version of the Agni III missile, sometimes referred to as Agni III* (Agni Three Star), which may begin flight tests in 2009.[123]

In June 2007 there were unconfirmed media reports that the Indian Government had decided not to proceed with the development of an ICBM with a range exceeding 5000 km.[124] The decision to impose a 5000-km range limit, or 'cap', on strategic missiles was reportedly intended as a 'goodwill gesture' aimed at facilitating implementation of the Indian–US Civil Nuclear Cooperation Initiative (CNCI) as well as an effort to forestall additional sanctions on exports of critical material for India's missile programme.[125] However, in December 2007 DRDO officials stated that design work was under way on a three-stage, nuclear-capable Agni missile with a range of up to 6000 km.[126]

There has been speculation in recent years that India is developing a 10 000 km-range ICBM, known as the Surya ('Sun'), based on India's Polar Space-Launch Vehicle (PSLV).[127]. In 2007 there were no authoritative statements indicating that India is actively pursuing such a programme.

Sea-launched ballistic missiles

India continues efforts to develop the naval component of its planned 'triad' of nuclear forces. The converted Prithvi II missile, the Dhanush ('Bow'), was test-launched on 30 March 2007 from the Indian Navy ship *Rajput*. This was the fourth flight test of the Dhanush, which the Indian Ministry of Defence (MOD) has stated will be capable of carrying both conventional and nuclear warheads.[128] The MOD stated in 2006 that the 'process of weaponisation of INS *Suvarna* and *Subhadra* with the Dhanush missile is under progress'.[129]

India's first test launch of an SLBM occurred on 26 February 2008, when the K-15 was launched from a submerged pontoon near Visakhapatnam on India's east coast. An MOD spokesperson said that the test 'was successful', and the media reported that the missile has a range of 700 km, similar to that of the Agni I.[130] MOD officials disclosed in 2007 that the DRDO had tested components of an underwater missile

[123] Joseph, J., 'Missile programmes disappoint scientists', *Daily News & Analysis* (Mumbai), 14 Apr. 2007; and 'India to test Agni III+ ballistic missile in 2009', *Express India*, 7 Jan. 2008.

[124] Thapar, V., 'Missile capped: govt under fire', CNN-IBN News, 19 June 2007, <http://www.ibnlive.com/news/india-softens-missile-power-for-us/43179-11.html>; and 'Thinking cap', *Daily News & Analysis* (Mumbai), 18 June 2007.

[125] See Joshi, S., 'India and Pakistan missile race surges on', *WMD Insights*, Oct. 2007. After the flight test of the Agni III in Apr. 2007, the USA and a number of other exporters suspended the sale to India of polyacrylonitrile (PAN) carbon fibre, which is used to make missile engine casings. On the CNCI see chapter 8, section IV.

[126] 'India building 6,000 km nuclear-capable missile', Agence France-Presse, 12 Dec. 2007, <http://www.spacewar.com/reports/India_building_6000km_nuclear-capable_missile_999.html>; and Dikshit, S., 'Range of ballistic missiles to be improved', *The Hindu*, 13 Dec. 2007.

[127] 'Indian press reports potential for ICBM development', *Jane's Missiles & Rockets*, vol. 9, no. 10 (Oct. 2005), pp. 10–11.

[128] Indian Ministry of Defence, 'Dhanush successfully test fired', Press release, New Delhi, 8 Nov. 2004, <http://mod.nic.in/pressreleases/content.asp?id=853>.

[129] Indian Ministry of Defence (MOD), *Annual Report 2006* (MOD: New Delhi, 2006), <http://mod.nic.in/reports/ebody.htm>, p. 88.

[130] 'India successfully tests submarine-based missile', Reuters, 26 Feb. 2008; and 'India test-fires sea-based nuclear-capable missile: ministry', Agence France-Presse, 26 Feb. 2008.

launch system and was developing a two-stage ballistic missile, designated the K-15, to be launched from a submerged submarine using a gas booster.[131] The K-15 is expected to be deployed on an indigenous nuclear-powered submarine, the Advanced Technology Vessel (ATV), which has been under development since the 1970s. Government officials have stated the ATV is scheduled to be launched in the spring of 2009 and to begin sea trials.[132] There has been considerable speculation that India was developing an SLBM known as the Sagarika ('Oceanic'), and some reports of the K-15 launch also called it the Sagarika. However, the Indian MOD stated in 2006 that 'There is no missile project by the name "Sagarika"'.[133]

VIII. Pakistani nuclear forces

The estimate presented here—that Pakistan possesses approximately 60 nuclear weapons—is conservative. On the basis of recent estimates of the size of Pakistan's military inventory of HEU and separated plutonium, the country could theoretically produce 70–100 nuclear weapons.[134] However, Pakistan is believed to have used only part of this inventory to manufacture warheads, and thus the actual number of warheads is likely to be lower than this. Pakistani officials claim that the country has already produced more warheads than needed to satisfy its current 'minimum deterrence requirement' but note that this requirement is subject to review 'according to situation'.[135] Pakistan's Prime Minister, Shaukat Aziz, asserted in January 2007 that since the Indian–US CNCI could result in more fissile material becoming available for India's military stockpile, and since India has expressed interest in acquiring missile defences, Pakistan 'would need to take measures to ensure the credibility of our deterrence'.[136]

Pakistan's current nuclear arsenal is based primarily on HEU, which is produced by a gas centrifuge uranium enrichment facility at the Kahuta Research Laboratories (also called the A. Q. Khan Research Laboratories). There is evidence that Pakistan is moving towards a plutonium-based arsenal.[137] Pakistan is currently operating the 50-megawatt thermal (MW(t)) Khushab I reactor, completed in 1998, which is cap-

[131] Associated Press, 'India developing submarine launched ballistic missiles', *International Herald Tribune*, 11 Sep. 2007; and Unnithan, S., 'The secret undersea weapon', *India Today*, 28 Jan. 2008.

[132] Raghuvanshi, R., 'India working on sea-based nuclear missiles', *Defense News*, 15 Oct. 2007; and Joseph, J., 'Sea trials of nuke submarine in 2 yrs', *Daily News & Analysis* (Mumbai), 4 Dec. 2007.

[133] Indian Ministry of Defence, 'Development and trials-missiles', Press release, New Delhi, 2 Aug. 2006, <http://pib.nic.in/release/rel_print_page1.asp?relid=19395>.

[134] Pakistan possessed an estimated 1.4 ± 0.3 tonnes of HEU and about 80 kg of separated plutonium as of 2007. See also appendix 8B. It is assumed that Pakistan's HEU weapons are of solid core, implosion-type designs requiring 15–20 kg of HEU each, and its plutonium weapons require at the very least *c*. 4–5 kg of plutonium.

[135] Interview with Gen. Ehsanul Haq, Chairman of Joint Chiefs of Staff Committee, Today with Kamran Khan, Karachi Geo News TV, 24 Nov. 2006, Translation from Urdu, World News Connection, National Technical Information Service (NTIS), US Department of Commerce.

[136] Press Trust India, 'Pak apprehensive about Indo-US nuclear deal: Aziz', *Economic Times* (Mumbai), 31 Jan. 2007.

[137] Plutonium-based nuclear warheads would normally be lighter and more compact than those using HEU to achieve the same yield. Such warheads could either be fitted onto smaller missiles, possibly including cruise missiles, or give already deployed ballistic missiles longer ranges.

able of producing about 10–12 kg of weapon-grade plutonium annually.[138] It is building a second heavy-water reactor at the Khushab nuclear complex, Punjab. According to one estimate by non-governmental experts, the new reactor is likely to be in the '40 to 100 MWt range'.[139] In 2007 commercial satellite images indicated that Pakistan had begun construction of a new reactor, identical to the second, at Khushab.[140] This would enable Pakistan to significantly increase its plutonium production capability, provided that the country has sufficient spent fuel-reprocessing capacity. Plutonium separation takes place at the pilot-scale New Labs reprocessing plant at Rawalpindi, Punjab. A new chemical separation facility appears to be nearing completion at Chashma, Punjab.[141]

Strike aircraft

The aircraft of the Pakistani Air Force that is most likely to be used in the nuclear weapon delivery role is the F-16 (see table 8A.8). Other aircraft, such as the Mirage V or the Chinese-produced A-5, could also be used. Pakistan currently maintains 32 F-16 aircraft in service, deployed in three squadrons. In September 2006 Pakistan signed a deal with the USA, worth $5.1 billion, to buy 18 Block 52 F-16C/D aircraft, with an option for 18 more. Pakistan will also receive 24 used USAF F-16s at a later date.[142] As part of the agreement, the 32 F-16A/Bs already in Pakistani service are to receive a midlife update.[143] The USA delivered the first two F-16s in July 2007.[144]

Ballistic missiles

Pakistan has begun deployment of two types of short-range ballistic missiles (SRBMs) which are believed to have nuclear delivery roles. The Ghaznavi (Hatf-3) is a single-stage, solid-propellant, road-mobile SRBM which was formally inducted into service in 2004. It is believed to be a domestically produced copy of the M-11 missile that was acquired from China in the 1990s. The Pakistani Army test-launched a Ghaznavi missile on 13 February 2008.[145] The other short-range ballistic missile, the

[138] Mian, Z. et al., International Panel on Fissile Materials (IPFM), *Fissile Materials in South Asia: The Implications of the U.S.–India Nuclear Deal*, IPFM Research Report no. 1 (IPFM: Princeton, N.J., Sep. 2006), <http://www.fissilematerials.org/ipfm/site_down/ipfmresearchreport01.pdf>.

[139] Cochran, T. B., Natural Resources Defense Council, 'What is the size of Khushab II?', 8 Sep. 2006, <http://docs.nrdc.org/nuclear/nuc_06090801A.pdf>.

[140] Albright, D. and Brannan, P., 'Pakistan appears to be building a third putonium production reactor at Khushab nuclear site', Institute for Science and International Security Report, 21 June 2007, <http://www.isis-online.org/publications/southasia/ThirdKhushabReactor.pdf>.

[141] Albright, D. and Brannan, P., 'Chashma nuclear site in Pakistan with possible reprocessing plant', Institute for Science and International Security Report, 18 Jan. 2007, <http://www.isis-online.org/publications/southasia/chashma.pdf>.

[142] Schanz, M., 'US and Pakistan hammer out new F-16 deal', *Air Force Magazine*, vol. 90, no. 12 (Dec. 2006), p. 12; and 'Pakistan agrees deal with US for F-16s', *Jane's Defense Weekly*, 11 Oct. 2006, p. 16. The agreement stipulated that Pakistan would not equip the F-16s with systems to penetrate air defences and would seek in advance US approval for any F-16 flights out of Pakistani airspace.

[143] Schanz (note 142).

[144] US Embassy in Pakistan, 'U.S. delivers two F-16 fighters to Pakistan Air Force', Press release, Islamabad, 11 July 2007, <http://islamabad.usembassy.gov/pakistan/h07071101.html>.

[145] 'Ghaznavi missile launched', *Dawn*, 14 Feb. 2008. See also President of the Islamic Republic of Pakistan, Office of the Press Secretary, 'Pakistan successfully test fires short range ballistic missile',

Table 8A.8. Pakistani nuclear forces, January 2008

Type	Range (km)[a]	Payload (kg)	Status
Aircraft			
F-16A/B	1 600	4 500	32 aircraft, deployed in 3 squadrons; most likely aircraft to have a nuclear delivery role
Ballistic missiles			
Ghaznavi (Hatf-3)	~400	500	Entered service with the Pakistani Army in 2004; fewer than 50 launchers have been deployed; last test-launched on 13 Feb. 2008
Shaheen I (Hatf-4)	>450[b]	750–1 000	Entered service with the Pakistani Army in 2003; fewer than 50 launchers deployed; last test-launched on 25 Jan. 2008
Shaheen II (Hatf-6)	>2 000	~1 000	Under development; fourth test launch on 23 Feb. 2007
Ghauri I (Hatf-5)	>1 200	700–1 000	Entered service with the Pakistani Army in 2003; fewer than 50 launchers deployed; test-launched on 1 Feb. 2008
Ghauri II	2 300	. .	Under development; status uncertain
Cruise missiles			
Babur (Haft 7)	700[c]	. .	Under development; ground-launched version tested 3 times in 2007 (Mar., June and Dec.); sea- and air-launched versions also under development

[a] Missile payloads may have to be reduced in order to achieve maximum range. Aircraft range is given for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

[b] Some unofficial sources claim a range of 600–1500 km.

[c] Since 2006 the range of flight tests have been increased from 500 to 700 km.

Sources: US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, Ohio, Aug. 2003), <http://www.nukestrat.com/us/afn/NAIC2003rev.pdf>; US Central Intelligence Agency, Unclassified report to Congress on the acquisition of technology relating to weapons of mass destruction and advanced conventional munitions, 1 January through 30 June 2002', Apr. 2003, <http://www.nti.org/e_research/official_docs/cia/cia.html>; US Central Intelligence Agency, National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, <http://www.dni.gov/nic/PDF_GIF_otherprod/missilethreat2001.pdf>; International Institute for Strategic Studies, *The Military Balance 2005–2006* (Routledge: London, 2004); 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

Shaheen I (Hatf-4), entered into service with the Pakistani Army in 2003. It was most recently test-launched on 25 January 2008 during a troop training exercise.[146] There are rumors that the short-range Abdali may also be nuclear-capable. After a test launch in March 2007, the president's office stated in a press release that the missile 'can carry all types of warheads'.

Pakistan's only MRBM currently in service is the Ghauri I (Hatf-5), which is a road-mobile, liquid-propellant, single-warhead missile. Pakistani defence officials have declared it to have a nuclear delivery role. In addition to the Ghauri MRBM, Pakistan continues to develop the two-stage road-mobile solid-propellant Shaheen II (Hatf-6) MRBM. On 23 February 2007 the Pakistani military announced that an upgraded Shaheen II missile had been successfully test-launched to a range of 2000 km.[147] The launch, which was described as being 'part of a continuous process of validation and technical improvement',[148] was the fourth test of the Shaheen II, which may soon become operational. The Shaheen II's range of 2000–2500 km means that it can reach targets across India. Pakistani military officials have denied that the country was seeking to develop long-range ballistic missiles that could strike targets outside the region.[149]

Pakistan is continuing to develop its arsenal of cruise missiles. On 11 December 2007, Pakistan test-fired a nuclear-capable cruise missile, designated the Babur (Hatf-7), from a ground launcher This marked the missile's fourth ground-launched test flight since 2005. According to a statement issued by the military, the range of the low-flying, subsonic cruise missile had been increased from 500 to 700 km, and efforts are under way to increase the range further to 1000 km.[150] Pakistan is developing an air-launched version of the Babur, which will reportedly be carried by F-16 and JF-17 aircraft.[151] It is also developing a sea-launched version, to be deployed on the Agosta Class attack submarine, that is intended to give Pakistan a second-strike capability.[152] Pakistani officials have insisted that the Babur is an entirely indigenous programme. However, some non-governmental analysts have noted that the missile appears to be similar to the new Chinese DH-10 air-launched cruise missile, which is suspected to be a reverse-engineered US Tomahawk cruise missile.[153]

Press release, 31 Mar. 2007, <http://www.presidentofpakistan.gov.pk/NewsEventsDetail.aspx?NewsEventID=3617>.

[146] 'Pakistan tests ballistic missile', BBC News, 25 Jan. 2008, <http://news.bbc.co.uk/2/7208416.stm>; and President of the Islamic Republic of Pakistan, Office of the Press Secretary, 'Pakistan successfully launches Shaheen-1 missile', Press release, 29 Nov. 2006, <http://www.presidentofpakistan.gov.pk/NewsEventsDetail.aspx?NewsEventID=3411>.

[147] 'Pakistan test-fires long-range missile', *PakTribune*, 23 Feb. 2007.

[148] Iqbal, T., 'Pakistan tests upgraded Shaheen II', Pakistan Defence, 22 Feb. 2007, <http://www.defence.pk/news/publish/article73.php>.

[149] Interview with Gen. Ehsanul Haq (note 135).

[150] President of the Islamic Republic of Pakistan, Office of the Press Secretary, 'Government has prepared comprehensive plan to equip armed forces: Musharraf', Press release, 30 May 2007, <http://www.presidentofpakistan.gov.pk/NewsEventsDetail.aspx?NewsEventID=3713>.

[151] 'Pakistan successfully test-fires Hataf-VII missile', *PakTribune*, 26 July 2007.

[152] Hali, S., 'Second strike capability', *The Nation* (Islamabad), 16 Aug. 2006.

[153] Norris, R. S. and Kristensen, H. M., 'Pakistan's nuclear forces, 2007', *Bulletin of the Atomic Scientists*, vol. 63, no. 3 (May/June 2007).

Table 8A.9. Israeli nuclear forces, January 2008

Type	Range (km)[a]	Payload (kg)	Status
Aircraft[b]			
F-16A/B/C/D/I Falcon	1 600	5 400	205 aircraft in the inventory; some are believed to be certified for nuclear weapon delivery
Ballistic missiles[c]			
Jericho II	1 500–1 800	750–1 000	*c.* 50 missiles; first deployed in 1990; test-launched on 27 June 2001
Jericho III	>4 800	. .	Test launched on 17 Jan. 2008
Submarines			
Dolphin			Rumoured to be equipped with nuclear-capable cruise missiles; denied by Israel

[a] Missile payloads may have to be reduced in order to achieve maximum range. Aircraft range is given for illustrative purposes only; actual mission range will vary.

[b] Some of Israel's 25 F-15I aircraft may also have a long-range nuclear delivery role.

[c] The Shavit space launch vehicle, if converted to a ballistic missile, could deliver a 775-kg payload a distance of 4000 km. The Jericho I, first deployed in 1973, is no longer operational.

Sources: Cohen, A. and Burr, W., 'Israel crosses the threshold', *Bulletin of the Atomic Scientists*, May/June 2006, pp. 22–30; Cohen, A., *Israel and the Bomb* (Columbia University Press: New York, 1998); Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997); Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group, Ltd: Coulsdon, 2003); Fetter, S., 'Israeli ballistic missile capabilities', *Physics and Society,* vol. 19, no. 3 (July 1990), pp. 3–4 (see unpublished 'Ballistic missile primer' for an updated analysis, <http://www.puaf.umd.edu/Fetter/1990-MissilePrimer.pdf>); 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

IX. Israeli nuclear forces

Israel continues to maintain its long-standing policy of nuclear ambiguity, neither officially confirming nor denying that it possesses nuclear weapons. However, in December 2006 the Israeli Prime Minister, Ehud Olmert, made a statement that was widely interpreted as tacitly acknowledging that Israel possessed a nuclear arsenal. Speaking to German television, Olmert included Israel in a list of countries that possess nuclear weapons.[154] Olmert and other Israeli officials quickly disavowed the remark and reiterated that Israel 'will not be the first country that introduces nuclear weapons to the Middle East'.[155]

The size of the Israeli nuclear weapon stockpile is unknown but is widely believed to consist of roughly 100 plutonium warheads. According to one estimate, Israel possessed 340–560 kg of military plutonium as of December 2006, or the equivalent

[154] 'Was Olmert über Atomwaffen sagte' [What Olmert said about nuclear weapons], N24 television channel, 12 Dec. 2006.

[155] Boudreaux, R., 'Fallout rains on Israel's Olmert after nuclear remark', *Los Angeles Times*, 13 Dec. 2006.

of up to 110 warheads, assuming that each contains 5 kg of plutonium.[156] Only part of this plutonium may have been used to produce warheads. It is estimated here that Israel may have approximately 80 intact warheads, of which 50 are re-entry vehicles for delivery by ballistic missiles and the rest bombs for delivery by aircraft (see table 8A.9). Many analysts believe that Israel has a recessed nuclear arsenal (i.e. one that is stored but not fully armed, requiring some preparation before use). There has been speculation that Israel may have produced non-strategic nuclear weapons, including artillery shells and atomic demolition munitions, but this has never been confirmed.

On 17 January 2008 Israel conducted a test launch reportedly of a long-range ballistic missile from the Palmahim AFB. The Israeli Ministry of Defence did not provide details of the type or purpose of the missile but stated that the experiment tested the missile's rocket propulsion system and was successful.[157] Israeli radio speculated that the missile was a Jericho III IRBM.[158] The Jericho III is believed to be a three-stage solid-propellant missile, with a probable maximum range of 4800–6500 km and an estimated payload of 1000–1300 kg. It is reported to be in development, with an estimated in-service date in 2008.[159]

X. North Korea's military nuclear capabilities

North Korea demonstrated a nuclear weapon capability in October 2006 by carrying out an underground nuclear test explosion.[160] However, the unexpectedly low explosion yield led many experts to believe that it had been a 'fizzle' (an inefficient detonation releasing less explosive energy than expected). This has raised doubts about whether North Korea has mastered the design and engineering skills needed to manufacture an operational nuclear weapon.[161] On 28 March 2007 the US Central Intelligence Agency Director, Michael Hayden, stated that the North Korean nuclear test was a 'failure'.[162]

North Korea is believed to have produced and separated enough plutonium from the spent fuel of its 5-megawatt-electric graphite-moderated research reactor at Yongbyon to be able to build a small number of nuclear warheads. In December 2007, as part of its 'complete and correct' declaration of past and present nuclear activities, North Korea reportedly informed the United States that it had a separated a total of 30 kg of plutonium; of this, it had used 6 kg for its nuclear test in October 2006.[163] The declared amount was at the lower end of estimates by US Government experts of how much plutonium North Korea could have separated and has raised

[156] See appendix 8B, table 8B.2.

[157] Katz, Y., 'Israel test-fires long-range ballistic missile', *Jerusalem Post*, 17 Jan. 2008.

[158] 'Israel says carries out missile launching test', Reuters, 17 Jan. 2008, <http://www.reuters.com/article/worldNews/idUSL175785020080117>.

[159] ed. Lennox (note 20), pp. 81–83.

[160] Fedchenko, V. and Ferm Hellgren, R., 'Nuclear explosions, 1945–2006', *SIPRI Yearbook 2007* (note 42), pp. 552–57.

[161] Sanger, D. E. and Broad, W. J., 'Small blast, or "big deal"? U.S. experts look for clues', *New York Times*, 11 Oct. 2006.

[162] 'CIA says North Korea nuclear test a failure: report', Reuters, 28 Mar. 2007, <http://www.reuters.com/article/topNews/idUSSEO15521620070328>.

[163] 'North Korea produced 30 kg of plutonium–newspaper', Reuters, 21 Apr. 2008, <http://in.reuters.com/article/worldNews/idINIndia-33143320080421>; and Kessler, G., 'N. Korea agrees to blow up its tower at its nuclear facility', *Washington Post*, 2 May 2008, p. A13.

doubts about the correctness of North Korea's declaration. These estimates are based on calculations of how long the Yongbyon reactor operated to build up plutonium in the fuel rods and how much plutonium was chemically extracted from the spent fuel at the adjacent reprocessing plant. Two US non-governmental experts estimated that, as of February 2007, North Korea had a total plutonium stock of 46–64 kg of plutonium, of which about 28–50 kg was in separated form and usable in nuclear weapons.[164] This would be sufficient to produce 6–10 nuclear weapons, assuming that each weapon used 4.5–5.0 kg of weapon-grade plutonium

North Korea deploys approximately 500–600 road-mobile SRBMs of three types—Hwasong-5 (Scud B), Hwasong-6 (Scud Mod-C) and Hwasong-7 (Scud Mod-D)—and 50–200 road-mobile Nodong MRBMs.[165] It is also developing the longer-range Taepodong-1 and Taepodong-2 missiles. On 25 April 2007 North Korea held a large military parade in Pyongyang featuring ballistic missiles, reportedly including the Hwasong-6 (Scud C), Hwasong-7 (Scud D) and a new short-range KN-02, a North Korean version of the Russian 9K79 Tochka (SS-21 'Scarab') surface-to-surface missile.[166] Most analysts consider it unlikely that North Korea has developed a nuclear warhead that is light and compact enough to fit onto a ballistic missile.[167]

[164] Albright, D. and Brannan, P., 'The North Korean plutonium stock, February 2007', Institute for Science and International Security (ISIS), 20 Feb. 2007, <http://www.isis-online.org/publications/dprk/DPRKplutoniumFEB.pdf>.

[165] US Air Force (note 56); ed. Lennox (note 20), pp. 90–96; and Nuclear Threat Initiative, 'North Korea Profile: missile capabilities', Dec. 2006, <http://www.nti.org/e_research/profiles/NK/Missile/62.html>.

[166] Isby, D. C., 'N Korea parades latest missiles', *Jane's Missiles and Rockets*, June 2007, p. 2; and Bermudez, J. S., 'North Korea takes wraps off the KN-02', *Jane's Defence Weekly*, 9 May 2007, p. 25.

[167] See e.g. Hecker, S., 'Report on North Korean nuclear program', Nautilus Institute, Policy Forum Online, 06-97A, 15 Nov. 2006, <http://www.nautilus.org/fora/security/0697Hecker.html>.