Appendix 13A. World nuclear forces, 2006

SHANNON N. KILE, VITALY FEDCHENKO and
HANS M. KRISTENSEN

I. Introduction

While world attention is focused on the nuclear programmes of Iran and North Korea, eight states possess about 12 100 operational nuclear weapons (see table 13A.1).[1] Several thousand nuclear weapons are kept on high alert, ready to be launched within minutes. If all nuclear warheads are counted—operational warheads, spares, and those in both active and inactive storage—the United States, Russia, the United Kingdom, France, China, India, Pakistan and Israel together possess a total of more than 27 000 warheads.

None of the five legally recognized nuclear weapon states, as defined by the 1968 Non-Proliferation Treaty (NPT), appears to be planning to disarm its nuclear arsenal in the foreseeable future.[2] Russia and the USA are in the process of reducing their operational nuclear forces as a result of two bilateral treaties—the 1991 Strategic Arms Reduction Treaty (START I Treaty) and the 2002 Strategic Offensive Reductions Treaty (SORT).[3] In the USA, implementation of the 2001 Nuclear Posture Review (NPR)[4] has begun on all aspects of the nuclear postures. This includes a reduction by 'almost half' of the total stockpile by 2012 and the development of new ballistic missiles, strategic submarines, long-range bombers, new or modified nuclear weapons, nuclear weapon production facilities, nuclear command and control systems, and modified nuclear war plans. Similarly, Russia has announced its plan to reduce mainly land-based strategic missiles but also to retain for another decade, rather than dismantling, intercontinental ballistic missiles (ICBMs) equipped with multiple, independently targetable re-entry vehicles (MIRVs). A new ICBM, a new class of strategic submarines and a new cruise missile are being introduced. Tables 13A.2 and 13A.3 show the composition of the deployed nuclear forces of the USA and Russia, respectively.

[1] On developments in world nuclear forces see Kile, S. N. and Kristensen, H. M., 'World nuclear forces, 2005', *SIPRI Yearbook 2005: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2005), pp. 578–602, and previous editions of the SIPRI Yearbook. For a discussion of the national governance of nuclear weapons in these 8 states see chapter 5 in this volume.

[2] 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.

[3] The Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I Treaty) was signed in 1991 by the USA and the USSR; it entered into force on 5 Dec. 1994 for Russia and the USA (under the 1992 Lisbon Protocol, which entered into force on 5 Dec. 1994, Belarus, Kazakhstan and Ukraine also assumed the obligations of the former USSR under the treaty). For the treaty see URL <http://www.state.gov/www/global/arms/starthtm/start/toc.html>. SORT was signed by Russia and the USA in 2002; it entered into force on 1 June 2003 and is available at URL <http://www.state.gov/t/ac/trt/18016.htm>. On the implications of SORT see 'Special Section', *Arms Control Today*, vol. 32, no. 5 (June 2002), pp. 3–23.

[4] See 'Nuclear Posture Review [excerpts], submitted to Congress on 31 December 2001', 8 Jan. 2002, URL <http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm>.

Table 13A.1. World nuclear forces, by number of deployed warheads, January 2006

Country[a]	Strategic warheads	Non-strategic warheads	Total number of warheads
USA	5 021	500	**5 521**[b]
Russia	3 352	2 330	**5 682**[c]
UK	185[d]	–	**185**
France	348	–	**348**
China	~130	?[e]	**~130**
India	–	–	**~50**[f]
Pakistan	–	–	**~60**[f]
Israel	–	–	**100–200**[f]
Total			**~12 100**

[a] North Korea claimed in 2005 that it had developed nuclear weapons, although there is no public information to verify this claim.

[b] The total US stockpile, including reserves, contains *c.* 10 000 warheads. In addition, 5000 plutonium cores (pits) are in storage as a strategic reserve, while another 7000 pits make up most of 34 tons of weapon-grade plutonium declared in excess of military needs.

[c] The total Russian stockpile contains roughly 16 000 warheads, of which *c.* 10 100 are in storage and/or awaiting dismantlement.

[d] Some warheads on British strategic submarines have sub-strategic missions.

[e] The existence of operational Chinese non-strategic warheads is uncertain.

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

The nuclear arsenals of China, the UK and France are considerably smaller than those of the USA and Russia. Data on their delivery vehicles and nuclear warhead stockpiles are presented in tables 13A.4–13A.6. China is about to deploy a new generation of strategic missiles, but it remains unclear whether it intends to deploy a significantly larger strategic nuclear force or a more modern force of relatively the same size. France is currently engaged in developing and deploying a new generation of nuclear-powered ballistic-missile submarines (SSBNs), submarine-launched ballistic missiles (SLBMs) and air-launched nuclear weapons, although the number of operational warheads may decrease somewhat with the introduction of the new SLBM around 2010. Unlike any of the other nuclear weapon states, France continues to deploy nuclear weapons on its surface fleet in peacetime. The British nuclear weapon stockpile has levelled out at about 200 warheads: the UK is the only one of the five nuclear weapon states that is not known to have new nuclear weapon systems under development. Yet, the UK appears to have begun a multi-year programme to extend the service life of the warhead on the Trident II (D-5) SLBM, and it will soon face a decision about the future of its nuclear deterrent after the Trident system reaches the end of its scheduled service life.

It is particularly difficult to obtain public information about the nuclear arsenals of the three states that are not parties to the NPT—India, Pakistan and Israel. The information that is available is limited and often contradictory. India and Pakistan are both expanding their operational nuclear strike capabilities, while Israel appears to be waiting to see how the situation in Iran develops. Tables 13A.7–13A.9 provide information about the status of the Indian, Pakistani and Israeli nuclear arsenals.

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

II. US nuclear forces

As of January 2006, the USA maintained an estimated stockpile of approximately 5500 active or operational nuclear warheads,[5] consisting of more than 5000 strategic and 500 non-strategic warheads. Another 215 warheads are spares. More than 4200 inactive warheads are in reserve, for a total stockpile of about 10 000 warheads.

Of the current US stockpile, more than 4000 warheads are expected to be retired for dismantlement by 2012 as a result of the 2004 Nuclear Weapons Stockpile Plan. Most of these warheads will come from the large reserve of inactive warheads, while a smaller number will come from warheads removed from operational status as a result of SORT implementation. This will leave a stockpile of nearly 6000 warheads.

Because SORT does not include verification measures, and because the START I Treaty expires in 2009, monitoring the development of Russian and US strategic nuclear forces will be increasingly difficult. Much like during the cold war, satellite surveillance and human intelligence will once again be the primary means with which the world's two largest nuclear weapon powers monitor—and potentially misunderstand—each other's nuclear force developments.

In parallel with adjusting the nuclear forces, the US Department of Defense (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. The new central strategic war plan is known as OPLAN (Operations Plan) 8044. Former chairman of the Joint Chiefs of Staff General Richard B. Meyers described some of the planning changes in congressional testimony in February 2005: '[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'.[6]

One example of this adjustment is CONPLAN (Concept Plan) 8022, a plan for the quick use of nuclear, conventional, or information warfare capabilities to destroy—pre-emptively, if necessary—'time-urgent targets' anywhere in the world. Defense Secretary Donald Rumsfeld issued an Alert Order in early 2004 that directed the military to put CONPLAN 8022 into effect. As a result, the pre-emption policy of the administration of President George W. Bush is now operational for long-range bombers, strategic submarines and presumably ICBMs.

Land-based ballistic missiles

On the basis of the estimate for January 2006, the US ICBM force was reduced in 2005 by 10 missiles with the retirement of the Peacekeeper (MX) ICBM. The 500 W87 warheads from the 50 retired Peacekeeper missiles will be modified to replace W62 warheads on Minuteman ICBMs beginning in financial year (FY) 2006. With a yield of 310 kt, the W87 is nearly twice as powerful as the W62, which will

[5] This estimate for operational warheads is 600 warheads above the estimate for 2005 owing to new information about the composition of the active and inactive stockpiles. See Kile and Kristensen (note 1), p. 580.

[6] 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, URL <http://www.senate.gov/~armed_services/statemnt/2005/February/Myers%2002-17-05.pdf>, p. 32.

broaden the range of hardened targets that can be held at risk with the Minuteman force. The W62 will be retired by 2009. During 2005 work continued on modernizing the guidance and propulsion systems of the Minuteman ICBM force.

The USA abandoned the START II Treaty in 2002 and now plans to retain a multiple warhead capability for its ICBM force. The number of warheads deployed on ICBMs will be reduced to 500 to comply with the SORT ceiling of no more than 2200 operationally deployed strategic warheads by 2012. However, hundreds of additional ICBM warheads will be retained in the 'responsive force' reserve for potential uploading onto Minuteman missiles.

Four Minuteman IIIs were test-launched in 2005 from Vandenberg Air Force Base (AFB) in California; three with a single re-entry vehicle and one with three re-entry vehicles. One of the missiles with a single re-entry vehicle (from Malmstrom AFB) was a demonstration test for adapting the W87 warhead from the retired MX/Peacekeeper for deployment on the Minuteman III.[7]

Work is continuing on designing a new ICBM to begin replacing Minuteman III missiles from 2018. The Mission Need Statement (MNS) for the new ICBM states that nuclear weapons will 'continue to play a unique and indispensable role in US security policy' and that a credible and effective land-based nuclear deterrent force 'beyond 2020' will 'prepare the US for an uncertain future by maintaining US qualitative superiority in nuclear war-fighting capabilities in the 2020–2040 time frame'.[8]

Ballistic missile submarines

The Trident I (C-4) SLBM was retired in October 2005 after 26 years of service when the USS *Alabama* offloaded the last 24 operational C-4 missiles. The *Alabama*, along with three other former C-4-equipped SSBNs, will be converted to carry the longer-range and more accurate D-5 SLBM. The USS *Alaska* and USS *Nevada* have already been converted, while USS *Henry M. Jackson* and USS *Alabama* will be converted in 2006 and 2007, respectively.

The build-up of the SSBN force in the Pacific continued in 2005 with the transfer of two more boats from Kings Bay in Georgia to Bangor in Washington. The USS *Louisiana* arrived in its new homeport at Bangor in October, followed by the USS *Maine* in November. The transfers boost the Pacific SSBN fleet to nine boats, leaving only five SSBNs in the Atlantic, the lowest number there since ballistic missile-equipped submarines were first deployed to sea, in 1961. The SSBNs are being transferred to increase targeting of China, although SSBNs in the Pacific also target Russia and North Korea.

The US Navy purchased five more D-5 SLBMs in the FY 2006 budget, and production of the missile has been extended through 2013 for a total of 561 missiles. The development of a Life Extension (LE) programme for 108 older D-5s will allow them to match the service life of the Trident SSBN force, which has been extended through 2042.

[7] The 2006 Quadrennial Defense Review decided to reduce the ICBM force by 50 missiles, to 450 missiles, beginning in FY 2007. US Department of Defense, Office of the Secretary of Defense, *Quadrennial Defense Review*, 6 Feb. 2006, URL <http://www.defenselink.mil/qdr/report/Report20060203.pdf>.

[8] US Department of the Air Force, HQ, Air Force Space Command/Data Records Management, 'Final Mission Need Statement (MNS), AFSPC 001-00: Land-Based Strategic Nuclear Deterrent', Acquisition Category One (ACAT I), 18 Jan. 2002, p. 2.

Five D-5 missiles were flight-tested in 2005, four from two US SSBNs and one from a British SSBN. The first test, carried out from the USS *Tennessee* (SSBN-734) off Florida in March, involved the launch of a missile in the shortest trajectory ever flown by a US SLBM: 1200 nautical miles (2222 km). The re-entry vehicle was equipped with an 'accuracy adjunct', using a three-axis flap system developed by Lockheed Martin, which enabled manoeuvring of the re-entry vehicle to 'GPS-like accuracy' (within 10 metres). Both nuclear and conventional warhead strikes were simulated.

The modernization of the W76 warhead continues with three specific efforts under way. One involves an LE programme that *inter alia* replaces the arming, firing and fuzing (AF&F) system on the W76/Mk4 re-entry vehicle to add a ground-burst capability that will significantly enhance the lethality of the weapon against harder targets. The modified warhead, which will be called the W76-1, may permit a reduction of the explosive yield. A second effort involves adding the 'accuracy adjunct' to the Mk4 re-entry vehicle to enhance the effectiveness of the W76-1/Mk4 and to enable deployment of conventional warheads on the Trident II (D-5) SLBM. The third effort involves a design incorporating the W76-1 on the larger Mk5 re-entry vehicle normally used for the W88 warhead in order to relax the design constraints required when using the smaller Mk4 re-entry vehicle.[9]

Long-range bombers

The size of the US bomber force remained unchanged in 2005, but the aircraft and their nuclear weapons continued to be upgraded.

The US Air Force is replacing its bombers' ultra-high frequency (UHF) and very-high frequency (VHF) radios and satellite communications (SATCOM) with a new communications system to receive beyond-line-of-sight (BLOS) voice and data. This will allow crews to review full mission plans en route to their targets. An Extremely High Frequency (EHF) satellite communication will also be added to ensure that the bombers have secure BLOS communications in its nuclear mission.

The installation of the Avionics Midlife Improvement (AMI) on the B-52H, which is the only carrier of the air-launched cruise missile (ALCM) and the advanced cruise missile (ACM), began in 2005 to improve the aircraft's navigation and nuclear weapon delivery capabilities. The installation work is expected to be completed in September 2008. The existing Air Force satellite communications (AFSATCOM) radio will also be replaced by EHF radio to improve communications in nuclear strike scenarios.

The US Air Force is studying options for a new long-range strike aircraft to eventually replace the current bomber force. It is also studying options for a next-generation nuclear cruise missile. One possibility is a multi-service enhanced cruise missile (ECM) with a nuclear payload and longer range to support global strike missions against 'targets deep within future high threat anti-access environments', according to Air Force documents. Delivery is envisioned from bombers or from various ground- or sea-based platforms.

[9] The 2006 Quadrennial Defense Review decided to replace nuclear warheads on 24 Trident II (D-5) missiles with conventional warheads for deployment in 2008. The intention is to mix conventional and nuclear missiles throughout the SSBN fleet—a plan which, if approved by Congress, could have a significant impact on crisis stability if the launch of a conventionally armed D-5 SLBM were misinterpreted by a nuclear adversary as a pre-emptive nuclear strike. US Department of Defense (note 7).

Table 13A.2. US nuclear forces, January 2006

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads
Strategic forces						
Bombers[b]						
B-52H	Stratofortress	85/56	1961	16 000	ALCM 5–150 kt	1 000[c]
					ACM 5–150 kt	400
B-2	Spirit	21/16	1994	11 000	Bombs	555[d]
Subtotal		*106/72*				*1 955*
ICBMs[e]						
LGM-30G	Minuteman III					
	Mk-12	50	1970	13 000	3 x 170 kt	150
		150			1 x 170 kt[f]	150
	Mk-12A	300	1979	13 000	2–3 x 335 kt	750
Subtotal		*500*				*1 050*
SSBNs/SLBMs[g]						
UGM-133A	Trident II (D-5)					
	Mk-4	n.a.	1992	>7 400	6 x 100 kt	1 632
	Mk-5	n.a.	1990	>7 400	6 x 475 kt	384
Subtotal		*336*				*2 016*
Strategic subtotal						*5 021*
Non-strategic forces						
B61-3, -4, -10 bombs		n.a.	1979	n.a.	0.3–170 kt	400[h]
Tomahawk SLCM		320	1984	2 500	1 x 5–150 kt	100[i]
Non-strategic subtotal						*500*
Total						**5 521**[j]

[a] Aircraft range is 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 PMI (primary mission inventory) aircraft, i.e., the number of operational aircraft assigned for nuclear and conventional wartime missions.

[c] Another 360 ALCM warheads are in reserve.

[d] Available for both the B-52H and the B-2A.

[e] The Peacekeeper ICBM was retired in Sep. 2005. The planned downloading of all Minuteman ICBMs to a single warhead to meet the SORT-mandated force ceiling may already have taken place. The W62 (Mk-12) will be retired by 2009.

[f] Each of the 150 Minuteman III missiles of the 90th Space Wing at F.E. Warren AFB was downloaded from 3 to 1 W62 warhead in 2001.

[g] Two of 14 SSBNs are undergoing conversion from the C-4 missile, which was retired in Oct. 2005, to the D-5. Although D-5 missiles are counted under START I 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 later to meet the SORT-mandated force ceiling in 2012.

[h] Approximately 440 bombs (including inactive weapons) are deployed in Europe.

[i] Another 200 W80-0s are in inactive storage. The TLAM/N is no longer deployed at sea but is stored on land.

[j] Another 215 warheads are spares and more than 4220 warheads are kept in the inactive stockpile for a total stockpile of approximately 10 000 warheads. In addition, more than 12 000 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; US Department of State, START I Treaty MOUs, 1990 through July 2005; US Department of Defense, various documents obtained under the Freedom of Information Act; US Navy, personal communication; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; US Naval Institute, *Proceedings*, various issues; and Authors' estimates.

Non-strategic nuclear weapons

As of January 2006, the USA retained approximately 500 active non-strategic nuclear warheads. These consisted of 400 B61 gravity bombs and 100 W80-0 warheads for Tomahawk Land-Attack Cruise Missiles (TLAM/Ns). Another 790 non-strategic warheads are in inactive storage. Despite the significant number of warheads, neither the 2001 NPR nor SORT addresses non-strategic nuclear weapons.

The most significant change in 2005 was that all of the B61-10 bombs are now considered part of the inactive stockpile. Some of these weapons are still deployed in Europe together with B61-3/4 bombs. A total of 440 B61 non-strategic nuclear bombs are forward-deployed at eight airbases in six European NATO member states (Belgium, Germany, Italy, the Netherlands, Turkey and the UK). 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.[10]

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). The weapon is not deployed at sea under normal circumstances, but it can be redeployed within 30 days of a decision to do so.

Nuclear warhead stockpile management and modernization

The total US stockpile of roughly 10 000 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 or are part of the 'responsive force' of reserve warheads that can be deployed on operational delivery systems in a relatively short time. The inactive category includes warheads that are held in long-term storage as a reserve with their limited life components (tritium) removed. As SORT and the 2004 Nuclear Weapons Stockpile Plan are implemented over the next six years, the 'responsive force' will contain roughly three times as many warheads as there are operationally deployed warheads. In addition to the 10 000 active and inactive warheads, the USA keeps about 5000 plutonium cores (pits) in storage at the Pantex Plant in Texas as a strategic reserve. Approximately the same number of canned assemblies (thermonuclear secondaries) are kept at the Oak Ridge Y-12 Plant in Tennessee. Another 7000 pits held at Pantex make up most of

[10] On the history and status of US nuclear weapons in Europe see Kristensen, H. M., 'US nuclear weapons in Europe,' Natural Resources Defense Council, Washington, DC, 2005, URL <http://www.nrdc.org/nuclear/euro.contents.asp>.

the 34 tonnes of weapon-grade plutonium previously declared in excess of military needs by the administration of President Bill Clinton. All of these 12 000 pits come from retired warheads.

III. Russian nuclear forces

Land-based ballistic missiles

The ICBMs assigned to the Strategic Rocket Forces (SRF) have traditionally made up the largest element of the Soviet/Russian strategic nuclear forces. As of January 2006, the SRF consisted of three missile armies, with a total 13 missile divisions: the 27th Guards Missile Army (headquarters in Vladimir, five divisions), the 31st Missile Army (Orenburg, three divisions) and the 33rd Guards Missile Army (Omsk, five divisions).[11] In 2005, the SRF eliminated two missile divisions and decommissioned 36 SS-18s, 14 SS-19s, 36 SS-25s and all 15 remaining SS-24 missiles.[12] According to the long-term plan for Russia's strategic forces, made public at the end of 2004, the SRF will eventually deploy only the SS-27 Topol-M missile, while all other ICBMs will be gradually decommissioned.[13]

The SS-27 Topol-M missile is a solid-propellant three-stage ICBM and has been developed in both road-mobile (RS-12M1) and silo-based (RS-12M2) versions. The latter began to be deployed in 1997 with the 60th Missile Division in Tatischevo, Saratov oblast, as a replacement for the SS-19 missiles based there. As of early 2005, this division had four regiments armed with 10 RS-12M2 missiles each. Two more Topol-Ms were added in December 2005.[14] Russia will have to deploy on average four or five missiles per year to fulfil its plan to have 64 RS-12M2 missiles on duty by 2010.[15]

According to the 2006 State Defence Order, Russia will procure six Topol-M missiles in 2006, compared with four in 2005.[16] Three of these will be road-mobile RS-12M1 missiles scheduled for deployment with the 54th Missile Division in Teikovo, Ivanovo region, by December 2006.[17] Russia plans to have 15 such missiles by 2010.[18]

On 1 November 2005 the SRF successfully launched an RS-12M1 Topol-M missile from the Kapustin Yar test range in Astrakhan' region to the Balkhash test range in Kazakhstan. The launch reportedly tested a new hypersonic re-entry vehicle (RV) that

[11] 'Strategic Rocket Forces', Russian Nuclear Forces Project, 17 Dec. 2005, URL <http://www.russianforces.org/eng/missiles/>.

[12] Kile and Kristensen (note 1), pp. 586–87.

[13] Poroskov, N., '"V god budem sokrachshyat' po odnoy-dve raketnye divizii"' ['We will be decommissioning one or two missile divisions a year'], *Vremya Novostey*, 6 May 2005, URL <http://www.vremya.ru/2005/78/4/124290.html>.

[14] Dolinin, A., 'Khraniteli derzhavy' [The guardians of the state], *Krasnaya Zvezda*, 31 Jan. 2006, URL <http://www.redstar.ru/2006/01/31_01/1_01.html>.

[15] Safronov, I., 'Russian missiles will die of old age', *Kommersant*, 1 Apr. 2005, URL <http://www.kommersant.com/page.asp?id=559554>.

[16] 'Fradkov distributes defense order', *Kommersant*, 1 Dec. 2005, URL <http://www.kommersant.com/doc.asp?idr=527&id=631438>; and Kile and Kristensen (note 1), p. 587.

[17] Safronov, I., 'Moskva ispytala assimetrichnyi otvet' [Moscow has tested an asymmetrical response], *Kommersant*, 2 Nov. 2005.

[18] Safronov (note 15).

is capable of manoeuvring in flight in order to penetrate missile defence systems.[19] President Vladimir Putin has stated on several occasions that Russia was developing a new nuclear missile system 'which had no counterpart elsewhere in the world' and would be able to defeat any strategic missile defence system. Many observers believe that Putin was referring to the manoeuvrable RV for the Topol-M. The commander of the SRF, Colonel-General Nikolai Solovtsov, has stated that the new RV will be deployed on Topol-M missiles beginning in 2006 and later on a new SLBM, the SS-NX-30 'Bulava' (R-30).[20] He also indicated that the Topol-M could be equipped with multiple warheads, if a decision to do so were to be made by the political leadership.[21]

The SRF plans to continue to deploy the SS-18 'Satan' (R-36M) heavy ICBM for another 10–15 years, and possibly longer. Under the terms of the abandoned START II Treaty, Russia was committed to scrapping all of its SS-18s, which can carry up to 10 warheads each. As of January 2006, Russia had on combat duty 74 SS-18s, in two versions: the R-36MUTTKh and the R-36M2 Voevoda.[22] The former was first deployed in 1979–83 and the latter in 1988–92. They are silo-based, two-stage liquid-propellant ICBMs produced by the Yuzhnoe Machine-Building Plant in Dnepropetrovsk, Ukraine.[23]

In December 2004 Russia successfully test-launched an R-36M2 missile, which had been on combat alert for 16 years, as part of a programme to extend the service life of the R-36M2. In the summer of 2005 the SRF performed additional maintenance operations, which extended the service lives of its approximately 40 R-36M2 missiles until at least 2016.[24] On 26 December 2005 Solovtsov announced that Russia and Ukraine would sign an agreement on joint work to refurbish a number of R-36M2 missiles.[25]

In the summer of 2005 the service life of the R-36MUTTKh was extended until 2007–2009, after which time the remaining missiles will be decommissioned. The decomissioning process is under way. In early 2005 the warheads were removed from the missiles of the 59th Missile Division in Kartaly, Chelyabinsk region, and moved to the storage facilities of the 12th Main Directorate of the Ministry of Defence (MOD). The missiles were sent to Surovatikha, Nizhnii Novgorod region, for dismantlement.[26] In October 2005 the disbandment of the division at Kartaly was reported to have been completed.[27]

At the beginning of 2006 the SRF had 126 SS-19 Stiletto (UR-100NUTTH) missiles deployed at Kozelsk and Tatishchevo. The SS-19 is a silo-based, two-stage, liquid-propellant ICBM, capable of carrying up to six warheads. The currently deployed version of the missile entered service in 1980. On 20 October 2005 the SRF

[19] Richardson, D., 'Russia conducts further flight test of maneuvering warhead', *Jane's Missiles & Rockets*, vol. 10, no. 1 (Jan. 2006), p. 11.

[20] Safronov (note 15). On the Bulava SLBM see also the sub-section 'Ballistic missile submarines' below.

[21] Dolinin, A., 'Strazh bezopasnosti derzhavy' [The state security guard], *Krasnaya Zvezda*, 16 Dec. 2005, URL <http://www.redstar.ru/2005/12/16_12/1_01.html>.

[22] Dolinin (note 14).

[23] Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group Limited: Coulsdon, 2005), pp. 127–28.

[24] Poroskov (note 13).

[25] 'Russian commander pins hopes on missile cooperation with Ukraine', Interfax, 26 Dec. 2005.

[26] Safronov (note 15).

[27] ITAR-TASS, 'Russia disbands strategic missile division, redeploys troops', 19 Oct. 2005.

test-launched an SS-19 as part of a programme to extend the missile's service life by an additional 20 years. The dummy warhead successfully hit the target at the Kura test range at Kamchatka peninsula.[28] Of the 150 test-launches of the SS-19 carried out to date, only three are reported to have failed.[29] The Rokot satellite launch vehicle, a derivative of the SS-19, has been launched seven times since 2000, of which six launches were successful.[30] A launch failure occurred on 8 October 2005, when Rokot failed to put a European satellite, Cryosat, into orbit.[31]

The SRF deployed 270 SS-25 'Sickle' ICBMs as of January 2006. The SS-25 is a road-mobile, three-stage solid-propellant ICBM that carries a single warhead. The missile was first deployed in 1985 and production ceased in 1994.[32] According to Russian sources, 144 SS-25s are expected to be in service in 2010.[33] The missile's original 10-year service life has reportedly been extended to 19 years.[34] On 29 November the SRF successfully test-launched an SS-25 that had entered service in 1985. On the basis of the results of the test, the SRF stated that the service lives of such missiles could be extended up to 23 years, in which case they may remain operational until 2016–18.[35]

Ballistic missile submarines

In 2005 the Russian Navy deployed 13 SSBNs with the Northern and Pacific fleets. Of these, six were Delta III (Project 667BDR Kalmar) submarines.[36] Some experts suggest that the submarines of this class, which first entered service in 1982, may be retired during the next few years.[37] The Navy continues to operate seven Delta IV Class (Project 667BDRM Delfin) submarines. One SSBN has been paid off and is currently being refitted as a special-purpose submarine. The six remaining SSBNs—*Verkhotur'e*, *Yekaterinburg*, *Novomoskovsk*, *Tula*, *Bryansk* and *Kareliya*—are based in the Northern Fleet. As of January 2006, *Bryansk* and *Kareliya* were undergoing service life-extension overhauls and refitting with newly produced SS-N-23 Skiff

[28] 'Zapusk "Stileta" vnov' podtverdil nadezhnost' odnoy iz samykh sovershennykh MBR Rossii' [The launch of 'Stiletto' has once again confirmed the reliability of the one of Russia's most refined ICBMs'], *Izvestia*, 20 Oct. 2005, URL <http://news.izvestia.ru/community/news99862>.

[29] 'Russia to test launch ICBM on 20 Oct', ITAR-TASS, 17 Oct. 2005.

[30] 'Zapusk "Stileta"…' (note 28).

[31] 'Russia apologizes to ESA over the loss of Cryosat space probe', *Pravda*, 10 Oct. 2005, URL <http://english.pravda.ru/main/18/88/354/16280_Cryosat.html >.

[32] Lennox (note 23), p. 138.

[33] Safronov (note 15).

[34] 'S kosmodroma Plesetsk zapustili 20-letnyuyu raketu' [20-year-old missile was launched from Plesetsk cosmodrome], Strana.ru, 29 Nov. 2005, URL <http://www.strana.ru/news/266308.html>.

[35] 'Topol missile life could be extended', RIA Novosti, 29 Nov. 2005, URL <http://en.rian.ru/russia/20051129/42252655.html >.

[36] The *Petropavlovsk-Kamchatskii*, *Svyatoi Georgii Pobedonosets*, *Zelenograd* and *Podol'sk* are deployed with the Pacific Fleet, and the *Ryazan'* and *Borisoglebsk* are with the Northern Fleet. The Navy uses a seventh non-operational Delta III as a test platform.

[37] Norris, R. and Kristensen, H., 'Russian nuclear forces, 2005', *Bulletin of the Atomic Scientists*, vol. 61, no. 2 (Mar./Apr. 2005), pp. 70–72, URL <http://www.thebulletin.org/article_nn.php?art_ofn=ma05norris>; and Barabanov, M., 'Perspektivy atomnogo podvodnogo sudostroeniya v XXI veke' [Perspectives of nuclear submarines shipbuilding in XXI century], *Yadernyi Kontrol'*, vol. 10, no. 2 (summer 2004), pp. 133–54, URL <http://www.pircenter.org/data/publications/yk2-2004.pdf>.

missiles, which the others had recently completed.[38] The six Delta IVs may remain in service until 2015–20.

In addition to these submarines, the Russian Navy operates one Typhoon Class submarine, renamed the *Dmitrii Donskoi* following its overhaul and relaunching in June 2002, as a test platform for new SS-NX-30 Bulava missile.[39] The sea trials of *Dmitrii Donskoi* were successfully completed on 6 December 2004.[40] Russian military officials indicated in 2005 that *Dmitrii Donskoi* and the two remaining Typhoon Class submarines—*Arkhangel'sk* and *Severstal'*, which were laid up in 2004 for financial reasons—are to be upgraded by replacing their obsolete SS-N-20 Sturgeon SLBMs with the new SS-NX-30 Bulava.[41]

Russia is building a new class of SSBN, the Project 955 Borei, which so far does not have a NATO designation. Three submarines of this class are scheduled to be commissioned by 2010, with three more to follow. The first ship in the class, *Yurii Dolgorukii*, was laid down in November 1996 at the Severnoye Mashinostroitel'noye Predpriyatiye (Sevmash) shipyard in Severodvinsk in northern Russia.[42] The commissioning of this submarine was postponed several times because of financial problems and the decision to arm it with the SS-NX-30 Bulava SLBM instead of the previously planned SS-NX-28 Bark.[43] In November 2005, the Commander-in-Chief of the Russian Navy, Admiral Vladimir Masorin, stated that *Yurii Dolgorukii* will be commissioned in 2007.[44] The second ship in the class, *Aleksandr Nevskii*, was laid down at Sevmash on 19 March 2004. The construction of the third ship, tentatively named *Vladimir Monomakh*, is scheduled to begin in March 2006.[45] Each of these submarines will be armed with 12 SS-NX-30 Bulava missiles.[46]

Russia's SLBM force consists of two types of missile. The SS-N-18 Stingray missile (RSM-50), which first entered service in 1977, is deployed on Delta III Class submarines. The SS-N-18 M1 has two liquid-fuelled stages and carries three war-

[38] Norris and Kristensen (note 37); and Saunders, S. (ed.), *Jane's Fighting Ships 2005-2006* (Jane's Information Group Limited: Coulsdon, UK, 2005), p. 602); and Bondarenko, A., and Emel'yanenkov, A., 'Prishla "Tula" s novym "samovarom"' ['Tula' came with the new 'samovar'], *Rossiiskaya Gazeta*, 12 Jan. 2006.

[39] The Soviet Union built a total of six Typhoon Class (Project 941 Akula) SSBNs in 1976–89. Russia decommissioned three of the Typhoons in 1996.

[40] 'APL "Dmitrii Donskoi" zavershila hodovye ispytaniya' [SSBN 'Dmitry Donskoy' has finished sea trials], ITAR-TASS, 6 Dec. 2004, URL <http://www.a-submarine.ru/news/main/viewPrintVersion?id=10113&idChannel=418>.

[41] Tul'ev, M., 'V interesah triady' [In the interest of the triad], *Voenno-Promyshlennyi Kur'ier*, 11 May 2005; 'Russian defense minister on plans to equip new submarines with Bulava missiles', Agentstvo Voennykh Novostei, 28 Sep. 2005.

[42] Plugatarev, I., '"Topol-M" vytesnyaet "Molodtsa" i "Voevodu"'["Topol-M" replaces "Molodets" and "Voevoda"], *Nezavisimoe Voennoe Obozrenie*, 28 Jan. 2005, URL <http://nvo.ng.ru/printed/forces/2005-01-28/1_topol.html>.

[43] Kile and Kristensen (note 1), pp. 587–88; and Litovkin, V., '"Bulava" idet maketom' [The model of 'Bulava'], *Moskovskie Novosti*, 15 Oct. 2004, URL <http://www.mn.ru/issue.php?2004-39-16>.

[44] Ustinov, E. and Fomishenko, R., 'Novye kalibry "Astrakhani"' [New calibers of "Astrakhan'"], *Krasnaya Zvezda*, 17 Nov. 2005, URL <http://www.redstar.ru/2005/11/17_11/1_02.html>.

[45] 'V Rossii postroyat novuyu submarinu' [New submarine will be built in Russia], *Kommersant*, 25 Jan. 2006, URL <http://www.kommersant.ru/index-news-y.html?id=93941>.

[46] Safronov, I., '"Alexandr Nevskii" strategicheskogo naznacheniya' ['Alexander Nevsky' of strategic purpose], *Kommersant*, 19 Mar. 2004.

Table 13A.3. Russian nuclear forces, January 2006

Type	NATO designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads
Strategic offensive forces						
Bombers						
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	14	1987	10 500–13 200	12 x AS-15B ALCMs or AS-16 SRAMs, bombs	168
Subtotal		*78*				*872*
ICBMs[b]						
SS-18	Satan	74	1979	11 000–15 000	10 x 500–750 kt	740
SS-19	Stiletto	126	1980	10 000	6 x 500–750 kt	756
SS-25	Sickle	270	1985	10 500	1 x 550 kt	270
SS-27	(Topol-M)	42	1997	10 500	1 x 550 kt	42
Subtotal		*512*				*1 808*
SLBMs[b]						
SS-N-18 M1	Stingray	96	1978	6 500	3 x 200 kt (MIRV)	288
SS-N-23	Skiff	96	1986	9 000	4 x 100 kt (MIRV)	384
Subtotal		*192*				*672*
Total strategic offensive forces		**782**				**3 352**
Strategic defensive forces						
ABMs						
SH-11/ SH-08	Gorgon/ Gazelle	100	1989/1986		1 x 1000/10 kt	100
SA-10	Grumble[c]	1900	1980		1 x low kt	600[c]
Non-strategic forces						
Land-based non-strategic						
Bombers						
Tu-22M Backfire		116	1974		2 x AS-4 ASM, bombs	
Su-24 Fencer		371	1974		2 x bombs	
Subtotal		*487*				*974*[d]
Naval non-strategic						
Attack aircraft						
Tu-22M Backfire		58	1974		2 x AS-4 ASM, bombs	
Su-24 Fencer		58	1974		2 x bombs	
Subtotal		*116*				*232*[d]
SLCMs						
SS-N-12, SS-N-19, SS-N-21, SS-N-22						266
ASW and SAM weapons						
SS-N-15/16, torpedoes, SA-N-3/6						158
Total defensive and non-strategic						**2 330**
Total						**5 682**

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

[b] US designations are used in this column for Russian ICBMs and SLBMs.

[c] The SA-10 Grumble may have some capability against some ballistic missiles. Only a third of 1900 deployed SA-10s are counted as nuclear.

[d] Figure includes warheads for all the land-based and naval aircraft, respectively.

Sources: US Department of State, START I Treaty Memoranda of Understanding (MOU), 1990 through January 2006; US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, August 2003), URL <http://www.nukestrat.com/us/afn/NAIC2003rev.pdf>); US Central Intelligence Agency, National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballisticmissilefinal.pdf>; US Department of Defense, *Proliferation: Threat and Response,* Jan. 2001; US Foreign Broadcast Information Service (FBIS), various issues; 'Russia: General Nuclear Weapons Developments', Nuclear Threat Initiative/Monterey Institute's Center for Nonproliferation Studies, URL <http://www.nti.org/db/nisprofs/russia/weapons/gendevs.htm>; Russianforces.org; International Institute for Strategic Studies, *The Military Balance 2004–2005* (Routledge: London, 2004); Cochran, T. B. et al., *Nuclear Weapons Databook Volume IV: Soviet Nuclear* Weapons (Harper & Row: New York, N.Y., 1989); *Proceedings*, US Naval Institute, various issues; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

heads.[47] Apart from commercial launches, in 2005 the Russian Navy conducted two launches of this missile. On 30 September the *Svyatoi Georgii Pobedonosets* launched an SS-N-18 from a submerged position in the Okhotsk Sea. All three dummy warheads successfully hit the target at the Chizha test range in north-western Russia. On 8 October an SS-N-18 was successfully launched in the Barents Sea from the *Borisoglebsk* Delta III submarine.[48] This submarine had experienced a widely reported launch failure during a strategic forces exercise in 2004 observed by President Putin.

The three-stage SS-N-23 Skiff (RSM-54) missile is a successor to the SS-N-18 and was first test-launched in 1983. The current version of the missile, which carries four warheads, is deployed on Delta IV SSBNs.[49] As reported in September 2005, the missile underwent a modernization programme in 1996–2002, which included the development of an improved warhead.[50] There were three successful test-launches of modernized SS-N-23s from a Delta IV submarine, *Yekaterinburg,* in the Barents Sea on 29 June 2004, 8 September 2004 and 17 August 2005. In all of the tests the warheads reportedly hit their targets at the Kura test range on the Kamchatka peninsula.[51]

[47] Lennox (note 23), p. 147.

[48] Safronov, I., '"Svyatoi Georgii Pobedonosets" reabilitiroval "Volnu"' ['Svyatoi Georgii Pobedonosets' rehabilitated 'Volna'], *Kommersant*, 1 Oct. 2005; and 'Volna SLBM hits target in Kamchatka', RIA Novosti, 8 Oct. 2005.

[49] Lennox (note 23), p. 153; and US Department of State, START I Treaty Memorandum of Understanding (MOU), July 2005.

[50] Kontareva, E., 'Ofitsial'no. Gosudarstvo vysoko otsenilo vklad yuzhnoural'tsev v modernizatsiyu odnogo iz luchshikh strategicheskikh kompleksov Voenno-Morskogo Flota Rossii' [Officially. The state highly appreciated the contribution of the people of South Urals to modernization of the one of the best strategic missile complexes of the Russian Navy], Ural-Press-Inform News Agency, 23 Sep. 2005, URL <http://uralpress.ru/show_article_print.php?id=82055>.

[51] 'Ballistic missile successfully fired from a nuclear-powered submarine of the Russian Northern Fleet', ITAR-TASS, 29 June 2004; 'Russian submarines launch ballistic missiles', RIA Novosti, 8 Sep.

As noted above, Russia is developing a new three-stage, solid-propellant SLBM, the SS-NX-30 Bulava (R-30). The missile reportedly will have a maximum range of 8300 km. Russia has declared that the Baluva will be counted under START I rules as carrying six warheads.[52] The first tests of the Bulava—unpowered 'pop-up' launches—were conducted from the *Dmitrii Donskoi* Typhoon Class submarine in December 2003 and September 2004.[53] In 2005 the Russian Navy conducted two flight-tests of the Bulava. On 27 September the *Dmitrii Donskoi* launched a Bulava from a submerged position in the White Sea.[54] The missile carried a single warhead that hit a designated target at the Kura range in Kamchatka.[55] On 21 December the *Dmitrii Donskoi* successfully launched another Bulava while the submarine was moving under water. Following this, Defence Minister Sergey Ivanov stated that Bulava tests would continue in 2006 and the missile would be deployed by 2008.[56]

Strategic aviation

Russian strategic aviation units form the 37th Air Army of the Supreme High Command (Strategic) of the Russian Air Force, which includes two heavy bomber divisions of Tu-160 and Tu-95MS aircraft. The 22nd Guards Heavy Bomber Division is based in Engels, Saratov oblast, and the 326th Heavy Bomber Division is based in Ukrainka, Khabarovsk kray. The 37th Air Army also includes four divisions of Tu-22M3 Backfire C bombers.[57] The Russian Ministry of Defence announced in November 2004 that it planned to have a total of 75 Tu-160 Blackjack and Tu-95MS Bear bombers in service by 2010.[58]

The composition of the Russian strategic bomber fleet did not change in 2005, despite declared plans to deliver two Tu-160 Blackjack long-range bombers during the year.[59] On 30 December 2005 the Air Force accepted delivery of the 15th Tu-160 bomber, which was returning to active service after modernization.[60] The aircraft will be deployed by March 2006.[61] The other 14 deployed Tu-160 bombers will undergo

2004; and Gordeeva, E., 'Dostizheniye tselei' [Achievement of goals], *Vremya Novostey*, 18 Aug. 2005, URL <http://www.vremya.ru/2005/150/4/132369.html>.

[52] US Department of State, START I Treaty Memorandum of Understanding (MOU), Jan. 2006.

[53] 'First test launch of Bulava missile to be held late this year', ITAR-TASS, 28 Mar. 2005.

[54] 'Defense minister praises Bulava missile system tests', RIA Novosti, 28 Sep. 2005, URL <http://en.rian.ru/russia/20050928/41538033.html>.

[55] 'Update: Strategic ballistic missile launched in White Sea—defense ministry', RIA Novosti, 27 Sep. 2005, URL <http://en.rian.ru/russia/20050927/41525719.html>.

[56] 'Bulava missile launch successful—defense minister', RIA Novosti, 21 Dec. 2005, URL <http://en.rian.ru/russia/20051221/42609288.html>.

[57] 'Strategic Aviation', Russian Nuclear Forces Project, 2 Nov. 2005, URL <http://www.russianforces.org/eng/aviation/>; and Khudoleev, V., '37-ya derzhit kurs' [37th Army is following the course], *Krasnaya Zvezda*, 23 Dec. 2005, URL <http://www.redstar.ru/2005/12/23_12/1_02.html>.

[58] 'Mnogoletnie plany Minoborony' [Long-term plans of the defence ministry], *Kommersant*, 18 Nov. 2004, p. 3.

[59] Kristensen and Kile (note 1), pp. 586, 588.

[60] Khudoleev (note 57).

[61] 'Modernizirovannyi strategicheskii bombardirovshchik Tu-160 v kontse dekabrya byl prinyat na vooruzheniye VVS RF' [Modernized strategic bomber Tu-160 was added to the arsenal of the Russian Air Force in the end of December], ARMS-TASS, 17 Jan. 2006, URL <http://armstass.su/?page=article&aid=22369&cid=25>; and 'Dva samoleta v tri goda' [Two airplanes in three years], *Izvestia*, 17 Jan. 2006, URL <http://izvestia.ru/armia2/article3054737>.

similar modernization in the future.[62] The 2006 State Defence Order allocates funds to pay for one new Tu-160.[63] According to the Commander of the 37th Air Army, Major General Igor Khvorov, this will be a modernized bomber with new weapon systems and 'radio-electronic equipment'. It is scheduled to enter active service by the end of 2006.

In 2005 Russian strategic aviation units participated in a number of military exercises. These included manoeuvres with eight countries of the Commonwealth of Independent States in April, manoeuvres with China ('Peace Mission 2005') in August and a live-fire exercise of Tu-160 Blackjack bombers, also in August.[64] In the last exercise, four ALCMs were test-fired in the presence of President Putin and hit their targets at the Pemboy firing range near Vorkuta, in northern Russia. The type of the missiles that were fired was not disclosed, but they are believed to have been the nuclear-capable AS-15B Kent-B and the Raduga Kh-555 long-range conventional cruise missile.[65] Russia is planning to test-fire at least 10 ALCMs in 2006.[66]

IV. British nuclear forces

The UK possesses an arsenal of about 185 warheads for use by a fleet of four Vanguard Class Trident SSBNs. It leases a total of 58 Trident II (D-5) SLBMs, including spares, from the US Navy. Under normal circumstances one British SSBN will be on patrol, carrying up to 48 warheads on 16 D-5 missiles. The second and third SSBNs can be put to sea fairly rapidly, with similar loadings, while the fourth would take longer because of its cycle of extensive overhaul and maintenance. With the end of the cold war, the SSBN on patrol is maintained at a level of reduced readiness with a 'notice to fire' measured in days, and its missiles are de-targeted. There are reports that some patrol coordination takes place between the UK and France.

The first British Trident submarine, HMS *Vanguard*, entered service in 1994. In December 2004 it emerged from the Devonport Naval Base after undergoing a three-year Long Overhaul Period (Refuel). On 10 October 2005 *Vanguard* successfully launched a D-5 SLBM in the final phase of its Demonstration and Shakedown Operations (DSAO).[67] The Ministry of Defence did not specify when the vessel would resume operational patrols. In January 2005, HMS *Victorious* arrived at the Devonport Naval Base for a major refit, including a refuelling of its nuclear reactor. This meant that for most of 2005 only two SSBNs in the fleet—*Vigilant* and *Vengeance*—were available for operational deployment.

[62] Pulin, G., 'Nam otvoditsya osnovnaya rol' v politike uprezhdeniya' [We are assigned to play a major role in the policy of pre-emption], *Voenno-Promyshlennyi Kur'ier*, 15 Feb. 2006, URL <http://www.vpk-news.ru/article.asp?pr_sign=archive.2006.122.articles.names_01>.

[63] 'Fradkov distributes defense order', *Kommersant*, 1 Dec. 2005, URL <http://www.kommersant.com/doc.asp?idr=527&id=631438>.

[64] 'CIS air defense practiced on Russia's missile carriers', *Kommersant*, 6 Apr. 2005, URL <http://www.kommersant.com/doc.asp?id=560866>; 'First China–Russia war games begin', *The Guardian*, 18 Aug. 2005, URL <http://www.guardian.co.uk/russia/article/0,,1551833,00.html>; and 'Putin takes to the skies "like in a dream"', RIA Novosti, 17 Aug. 2005, URL <http://en.rian.ru/russia/20050817/41169637.html>.

[65] 'President Putin flies a cruise-missile sortie', *Jane's Missiles & Rockets*, vol. 9, no. 10 (Oct. 2005), p. 11.

[66] Khudoleev (note 57).

[67] 'Vanguard prepares to rejoin UK Royal Navy Trident fleet', *Jane's Missiles & Rockets*, vol. 9, no. 12 (Dec. 2005), pp. 1–2.

Table 13A.4. British nuclear forces, January 2006

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
SLBMs						
D-5	Trident II	48	1994	>7 400	1–3 x 100 kt	185[b]

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

[b] Fewer than 200 warheads are operationally available, *c.* 144 to arm 48 missiles on 3 of 4 SSBNs. The operational stockpile may consist of 185 warheads. Only 1 boat is on patrol at any time, with no more than 48 warheads.

Sources: British Ministry of Defence (MOD), Press releases and the MOD website, URL <http://www.mod.uk/issues/sdr/index.htm>; British MOD, *Strategic Defence Review* (MOD: London, July 1998); British House of Commons, *Parliamentary Debates (Hansard)*; Ormond, D., 'Nuclear deterrence in a changing world: the view from a UK perspective', *RUSI Journal*, June 1996, pp. 15–22; Norris, R. S. et al., *Nuclear Weapons Databook, vol. 5: British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 9; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimate.

The four Vanguard Class SSBNs will operate for almost two decades before their nominal retirement date. However, owing to the lengthy procurement process required for complex weapon systems (15 years in the case of the Trident system), Secretary of State for Defence John Reid told the House of Commons in July 2005 that 'decisions on any replacement of the United Kingdom's are likely to be necessary in the lifetime of the current Parliament, which will of course last some years'.[68] Reid later told the Commons Defence Committee that the government intended to retain 'Britain's minimum nuclear deterrent' for an unspecified period, pointing out that the UK 'has always maintained that as long as some other nuclear state which is a potential threat has nuclear weapons we will retain ours'.[69] Critics of the government, including some Labour Party parliamentarians, alleged that the decision had already been made to replace the Trident with a new generation of nuclear weapons—at an estimated cost of up to £20 billion ($35 billion)—without a public debate on whether the UK still needed a nuclear deterrent.[70]

The Ministry of Defence has confirmed that it is considering a range of options for replacing the Trident. These include options involving land- and air-based delivery systems as well as submarines.[71] In July 2005 the MOD announced a new, three-year,

[68] Reid, J., Secretary of State for Defence, Oral answers, 4 July 2005, House of Commons, *Hansard* C5, URL <http://www.publications.parliament.uk/pa/cm200506/cmhansrd/cm050704/debtext/50704-02.htm#50704-02_sbhd0>.

[69] Reid, J., Secretary of State for Defence, Oral evidence before the Select Committee on Defence, 1 Nov. 2005; as reproduced in House of Commons Paper 556-i (Session 2005-06), 17 Jan. 2006, URL <http://www.publications.parliament.uk/pa/cm200506/cmselect/cmdfence/556/5110101.htm>.

[70] McSmith, A., 'Revealed: Blair's nuclear bombshell', *The Independent* (Internet edn), 18 Oct. 2005, URL <http://news.independent.co.uk/uk/politics/article320124.ece>; and 'Labour MPs debate Trident scheme', BBC News Online, 31 Oct. 2005, URL <http://news.bbc.co.uk/1/4392050.stm>.

[71] Kirkup, J., 'UK nuclear defence up in the air', *The Scotsman* (Internet edn), 29 Oct. 2005, URL <http://news.scotsman.com/uk.cfm?id=2164822005>. For an overview of the options for a future nuclear deterrent see Willet, L., 'Questions for the debate on the future of the UK strategic deterrent', *RUSI Journal*, vol. 150, no. 6 (Dec. 2005), pp. 50–57.

£1.05 billion (€1.5 billion) investment to upgrade the Trident missile warhead facilities at the Atomic Weapons Establishment (AWE) at Aldermaston and Burghfield. The purpose of the investment is to ensure that the 'existing Trident warhead stockpile is reliable and safe' and can be 'maintained throughout its intended in-service life'.[72] MOD officials have denied reports that the facilities might be used to develop new nuclear weapons.

V. French nuclear forces

France continues to modernize and upgrade its nuclear forces. It maintains an operational arsenal of an estimated 348 nuclear warheads for delivery by SLBMs, carrier-based strike aircraft and land-based aircraft. In 2005 France allocated approximately €3 billion, or 7 per cent of its overall defence budget, to the nuclear forces.

The backbone of France's nuclear deterrent is the Force Océanique Stratégique, which consists of a fleet of four operational SSBNs of two classes: three of the new Triomphant Class SSBNs; and one L'Inflexible Class (formerly Redoubtable Class) SSBN. 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. The French Navy's four operational SSBNs are each armed with 16 Aérospatiale M45 missiles carrying up to 6 TN-75 warheads. In 2010–15, beginning with the *Le Terrible*, three Triomphant Class SSBNs will be retrofitted with the M51.1 SLBM. The new missile will have a payload of six warheads and a maximum range of 8000 km.[73] Its increased range compared to the M45 will permit French SSBNs to significantly expand their patrol zones. The French Navy plans to take delivery of the improved M51.2 missile, armed with the new Tête Nucléaire Océanique (TNO) warhead, from 2015.

The air component of the French nuclear force consist of two types of aircraft: approximately 60 Mirage 2000Ns, which equip the three Air Force squadrons currently 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. It is estimated that France has about 60 operational ASMPs, but additional missiles may be in inactive storage. A new follow-on cruise missile, designated the ASMP-A, is under development and will replace the ASMP on Mirage 2000N aircraft in 2007. Beginning in 2008, the missile will also be integrated with an unspecified number of Rafale aircraft in the Air Force and the Navy.

There has been a gradual evolution in France's nuclear doctrine since the end of the cold war. Although French officials continue to reject a no-first-use posture, they have emphasized the need for greater flexibility in meeting a widening range of plausible deterrence scenarios. Several reports in 2003 suggested that President Jacques Chirac had approved changes in the country's nuclear doctrine, similar to those in the USA, to permit the targeting of 'rogue states' armed with nuclear, biolog-

[72] Reid, J., Secretary of State for Defence, Oral answers, 19 July 2005, House of Commons, *Hansard* C60WS, URL <http://www.publications.parliament.uk/pa/cm200506/cmhansrd/cm050719/wmstext/50719m03.htm>.

[73] 'France's nuclear-powered *Le Vigilant* prepares for patrol', *Jane's Missiles & Rockets*, vol. 9, no. 2 (Feb. 2005), p. 5.

Table 13A.5. French nuclear forces, January 2006

Type	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
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
SLBMs[b]					
M45	48	1996	6 000[c]	6 x 100 kt	288
Total					**348**

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

[b] The fourth and final Triomphant Class SSBN, *Le Terrible*, will replace *L'Inflexible*, in 2010 with the M51 SLBM.

[c] The range of M45 is listed as only 4000 km in a 2001 report from the National Defence Commission of the National Assembly.

Sources: French National Assembly, 'Bill of Law for the 2003–2008 Military Programme', 2002; French Ministry of Defence, 'Nuclear disarmament and non-proliferation', *Arms Control, Disarmament and Non-Proliferation: French Policy* (La Documentation française: Paris, 2000), chapter 3, pp. 36–56; 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; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

ical or chemical weapons and which threatened France's vital interests.[74] However, Chirac denied at the time that that there had been any changes in nuclear doctrine.

On 19 January 2006 Chirac delivered a speech at L'Ile-Longue nuclear submarine base setting out a new rationale for France's *force de frappe* (nuclear deterrent force).[75] In the speech Chirac cited the dangers of regional instability, growing extremism and the proliferation of weapons of mass destruction and said that the country's nuclear deterrent remained the fundamental guarantor of its security. He threatened to retaliate with nuclear weapons against any state found to be supporting terrorism against France or considering the use of weapons of mass destruction. Chirac revealed that French nuclear forces had already been reconfigured to enable them to destroy the 'power centres' of any state which sponsored a terrorist attack against France.[76] This involved *inter alia* reducing the number of nuclear warheads of SLBMs to allow more precisely targeted strikes. He did not say whether France was prepared to resort to pre-emptive nuclear strikes against a country it saw as a threat.

The doctrinal change announced by Chirac was similar to one already undertaken by the UK. In 2002, an addendum to the UK's 1998 Strategic Defence Review (SDR)

[74] Tertrais, B., 'Nuclear policy: France stands alone', *Bulletin of the Atomic Scientists*, vol. 60, no. 4 (July/Aug. 2004), pp. 48–55.

[75] '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, URL <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>.

[76] 'Speech by Jacques Chirac' (note 75).

extended the role of nuclear weapons to include deterring 'leaders of states of concern and terrorist organizations'.[77]

VI. Chinese nuclear forces

In July 2005, the annual report of the US Department of Defense on Chinese military power included an overview of the composition of China's ballistic missile force.[78] This overview and other recent information—most significantly a declaration by the Chinese Foreign Ministry in 2004 that 'China . . . possesses the smallest nuclear arsenal of all the nuclear weapon states[79]—necessitates a reduction in the estimate of the size of China's nuclear forces. It is estimated here that China deploys approximately 130 nuclear warheads for delivery by land-based missiles, sea-based missiles and bombers.[80] Additional warheads are thought to be in storage.

Notwithstanding the change in the estimate for China's nuclear forces, the size of the Chinese warhead stockpile is thought not to have changed significantly for many years. However, the delivery systems for those warheads have changed, with the gradual withdrawal of the old DF-3A (CSS-2) and conversion of some of the newer DF-21s to conventional missions. Moreover, according to US Government assessments, China will soon begin replacing its small force of medium- and intermediate-range ballistic missiles with newer, more survivable, long-range missiles.[81] This includes the DF-31 (Dong Feng, or East Wind), a new solid-propellant, road-mobile ICBM that the US DOD for a number of years has predicted was about to enter service but which the 2005 report stated is still in development. Two modifications of the DF-31, the longer-range DF-31A and the submarine-based Julang-2, are also under development. The deployment of these longer-range, mobile systems is expected to enhance the survivability of the Chinese missile force by enabling the weapons to operate over a larger area. While the DOD is concerned that the new missiles will increase the number of warheads that can reach the USA, the Chinese Government insists that the development is consistent with China's long-standing commitment to a policy of no-first use of nuclear weapons.[82]

The July 2005 DOD report predicted that the future Chinese land-based missile force will eventually consist of modernized, silo-based DF-5A (CSS-4 Mod 2) and road-moble DF-31 and DF-31A ICBMs. In addition, China will maintain a number of nuclear-armed DF-21A MRBMs 'for regional contingencies'.[83] The US intelligence

[77] British Ministry of Defence, *The Strategic Defence Review: A New Chapter*, CM 5566, vol. 1, July 2002, p. 12, URL <http://www.mod.uk/linked_files/SDR_New_Chapter.pdf>.

[78] US Department of Defense, *Annual Report to Congress: The Military Power of the People's Republic of China 2005*, 19 July 2005, URL <http://www.defenselink.mil/news/Jul2005/d20050719china.pdf>, p. 45.

[79] Ministry of Foreign Affairs of the People's Republic of China, 'Fact Sheet: China: nuclear disarmament and reduction of [sic]', Beijing, 27 Apr. 2004, p. 1, URL <http://www.fmprc.gov.cn/eng/wjb/zzjg/jks/cjjk/2622/t93539.htm>.

[80] Some analysts have argued that only the land-based missile force is operationally deployed, in which case China's operational nuclear arsenal would be as low as *c.* 80 warheads. Lewis, J., 'The ambiguous arsenal', *Bulletin of the Atomic Scientists*, vol. 61, no. 3 (May/June 2005), pp. 52–59.

[81] US Department of Defense (note 78).

[82] Information Office of the State Council of the People's Republic of China, 'China's endeavors for arms control, disarmament and non-proliferation', Beijing, Sep. 2005, URL <http://www.china.com.cn/english/features/book/140320.htm>.

[83] US Department of Defense (note 78), p. 28.

Table 13A.6. Chinese nuclear forces, January 2006

Type	US or NATO designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
Land-based missiles[b]						
DF-3A	CSS-2	16	1971	3 100[c]	1 x 3.3 Mt	16
DF-4	CSS-3	22	1980	>5 500	1 x 3.3 Mt	22
DF-5A	CSS-4	20	1981	13 000	1 x 4–5 Mt	20
DF-21A	CSS-5	21	1991	2 100[c]	1 x 200–300 kt	21
DF-31	CSS-X-10	0	(2006)	~8 000	1 x ?	0
DF-31A	?	0	(2007–09)	~12 000	1 x ?	0
SLBMs						
Julang 1[c]	CSS-NX-3	12	1986	>1 000	1 x 200–300 kt	12
Julang 2	?	0	(2008–10)	~8 000	1 x ?	0
Aircraft[d]						
Hong-6	B-6	20	1965	3 100	1 x bomb	~20
Attack	(Qian-5, Others?)	?	1972–?	?	1 x bomb	~20
Strategic weapons						*~130*
Non-strategic weapons[e]						
Short-range ballistic missiles (DF-15 and DF-11)						?
Total						**~130**[f]

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

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

[c] The JL-1 has never been fully operational and the single Xia Class SSBN has never conducted a deterrent patrol.

[d] A small stockpile of bombs with yields between 10 kt and 3 Mt is thought to exist for delivery by aircraft. Chinese aircraft are not believed to have nuclear weapons delivery as a primary role but as a contingency mission. Figures for aircraft are for nuclear-configured versions only. The table assumes no more than 40 bombs for aircraft.

[e] The existence of tactical warheads is highly uncertain, but several low-yield nuclear tests in 1970s and US Government statements in the 1980s and 1990s suggest that some tactical warheads may have been developed.

[f] Additional warheads may be in storage.

Sources: US Department of Defense (DOD), Office of the Secretary of Defense, 'The Military Power of the People's Republic of China,' July 2005; US Air Force, National Air and Space Intelligence Center (NASIC), various documents; US Central Intelligence Agency, 'Foreign Missile Developments and the Ballistic Missile Threat Through 2015' (unclassified summary), Dec. 2001, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballistic missilefinal.pdf>; US DOD, Office of the Secretary of Defense, 'Proliferation: threat and response', Washington, DC, Jan. 2001, URL <http://www.defenselink.mil/pubs/ptr20010110.pdf>; Norris, R. S. et al., *Nuclear Weapons Databook, Vol. 5: British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994); 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

community has stated that China might deploy multiple warheads on its DF-5A (CSS-4) missiles to ensure the effectiveness of its deterrent against missile defence systems, but neither the DF-31 nor its two modifications are thought to be designed to carry multiple warheads.[84]

China has had great difficulty in developing a sea-based nuclear deterrent. The single Type 092 (Xia Class) SSBN, armed with the JL-1 SLBM, is not believed to have achieved full operational capability and, according to US Naval Intelligence, has never conducted a deterrent patrol. A new SSBN, the Type 094, is under construction. Press reports that the submarine had been launched in July 2004 appear to have been premature;[85] the submarine was probably the first unit of the Type 093, a replacement for the Han Class nuclear-powered attack submarine. The Type 094 is not expected to enter into service before the end of this decade at the earliest.

The missile intended for the Type 094 Class SSBN, a modified DF-31 known as the Julang-2 (JL-2), was successfully test-launched on 16 June 2005 from a submerged submarine in the Pacific Ocean near the Shandong Peninsula.[86] The submarine is believed to have been a modified Golf Class submarine. A previous test in mid-2004 failed. The DOD estimates that JL-2 will have an intercontinental range of about 7500–8000 km and that it will carry a single warhead.[87]

It is thought that China has a small stockpile of nuclear bombs for delivery by aircraft. Between 1965 and 1976, Chinese Hong-5, Hong-6 and Qian-5 aircraft dropped a total of 11 nuclear bombs in nuclear tests at the Lop Nur Test Site. The bombs detonated with yields of 8–4000 kt in four distinct ranges. The US Defense Intelligence Agency estimated in 1984 that 'a small number of the nuclear-capable aircraft probably have nuclear bombs, even though we are unable to identify airfield storage sites',[88] and in 1993 the National Security Council told Congress that China has a 'small stockpile of nuclear bombs'. Although the Chinese Air Force was not believed to have units whose primary purpose was to deliver the bombs, the NSC estimated that 'some units may be tasked for nuclear delivery as a contingency mission'.[89] The candidates for nuclear contingency missions today include the H-6 bomber, and perhaps also a fighter-bomber. China is also developing land-attack cruise missiles that may be for delivery by the H-6. The 2005 DOD report states that, once developed, there 'are no technological bars to placing on these systems a nuclear payload'.[90]

[84] A multiple re-entry vehicle system releases 2 or more RVs along the missile's linear flight path to a single target, which land in a relatively confined area at about the same time. The more sophisticated and flexible MIRV system can manoeuvre multiple RVs to several different release points to provide targeting flexibility against several independent targets over a much wider area and longer period of time.

[85] See, e.g., Gertz, B., 'China tests ballistic missile submarine', *Washington Times* (Internet edn), 3 Dec. 2004, URL <http://www.washingtontimes.com/functions/print.php?StoryID=20041202-115302-2338r>.

[86] 'China test-fires new submarine-launched missile', *Daily Yomiuri* (Internet edn), 18 June 2005, URL <http://www.yomiuri.co.jp/newse/20050618wo42.htm>; and 'China test fires long-range missile from submarine', *Jane's Missiles and Rockets*, vol. 9, no. 8 (Aug. 2005), p. 4.

[87] Norris, R. and Kristensen, H., 'Chinese nuclear forces 2003', *Bulletin of the Atomic Scientists*, vol. 59, no. 6 (Nov./Dec. 2003), URL <http://www.thebulletin.org/print.php?art_ofn=nd03norris>, pp. 77–80,

[88] US Defense Intelligence Agency, 'Nuclear weapons systems in China', DEB-49-84, 24 Apr. 1984, pp. 3–4, partially declassified and released under the US Freedom of Information Act.

[89] US National Security Council, 'Report to Congress on status of China, India and Pakistan nuclear and ballistic missile programs', n.d. [28 July 1993], p. 2, obtained under the US Freedom of Information Act by the Federation of American Scientists.

[90] US Department of Defense (note 78), p. 29.

VI. Indian nuclear forces

India is widely believed to be expanding the size of its nuclear arsenal, although little public information is available about the pace and scale of such an expansion. The conservative estimate presented here is that India possesses about 50 nuclear weapons. The figure is based on India's estimated inventory of 360–530 kg of military plutonium[91] and assessments made by the US intelligence community. The US Defense Intelligence Agency estimated in July 1999 that India possessed 10–15 nuclear weapons.[92]

There is considerable uncertainty in published estimates of the total amount of weapon-grade plutonium that India has produced and, hence, in estimates of the number of nuclear weapons that it could have built. A number of factors contribute to this. First, there are different assessments of the lifetime operating capacity (i.e., of the reliability and efficiency) of the 100-megawatt-thermal (MW(t)) Dhruva reactor and the ageing 40-MW(t) CIRUS reactor, which are dedicated to producing plutonium for military use.[93] Second, it is unclear whether India has used all of its available weapon-grade plutonium to build nuclear weapons, as some analysts have assumed. Finally, there are different views on how to take into account the losses and drawdowns of nuclear material that occur during production, processing and testing.

In addition to these factors, there continues to be a debate about whether non-weapon-grade plutonium (either in the form of reactor-grade plutonium or a mix of isotopes closer to weapon-grade plutonium) was used in one of the nuclear explosive tests carried out by India in May 1998.[94] If the test gave confidence that this material could be used for weapons, India may see the large quantity of plutonium contained in the spent fuel of its unsafeguarded power reactors as being a potential part of its military nuclear programme.

India may be working to increase its capability for producing weapon-grade plutonium.[95] Some critics of the July 2005 Civil Nuclear Cooperation Initiative (CNCI) between India and the United States have argued that, by allowing the sale of nuclear fuel for use in designated Indian civilian installations, the deal would free up India's limited domestic uranium supplies for military purposes.[96] Critics of the deal have also expressed concern about the unwillingness of India's Department of Atomic Energy to place its fast breeder reactor (FBR) programme under International Atomic

[91] Albright, D., 'India's military plutonium inventory, end of 2004', 7 May 2005, Institute for Science and International Security (ISIS), *Global Stocks of Nuclear Explosive Materials*, URL <http://www.isis-online.org/global_stocks/end2003/India:_military_plutonium.pdf>. The estimate of 50 warheads assumes that each warhead would require 5 kg of plutonium and that only 250 kg of the military plutonium produced by India has so far been used in assembled nuclear warheads.

[92] US Defense Intelligence Agency, 'A Primer on the Future Threat: The Decades Ahead: 1999–2020', July 1999, p. 38, reproduced in Scarborough, R., *Rumsfeld's War* (Regnery: Washington, DC, 2004), pp. 194–223.

[93] According to the World Nuclear Association, in the 1990s India's nuclear power reactors had some of the world's lowest operating capacity factors. World Nuclear Association, 'India and Pakistan', Information and Issues Brief, Nov. 2002, URL <http://www.world-nuclear.org/info/inf53.htm>.

[94] Perkovich, G., *India's Nuclear Bomb: the Impact on Global Proliferation* (University of California Press: Berkeley, Calif., 1999), pp. 428–31.

[95] Albright (note 91).

[96] Mian, Z. and Ramana, M., 'Feeding the nuclear fire', *Economic and Political Weekly* (Mumbai), 27 Aug. 2005, URL <http://www.geocities.com/m_v_ramana/nucleararticles/indo-us-deal.html>. For further detail on the Indo-US CNCI see appendix 13B in this volume.

Energy Agency safeguards, thereby raising doubt that the programme is for exclusively peaceful purposes.[97]

It is not publicly known whether India has produced highly enriched uranium (HEU) for weapon purposes. India operates two gas centrifuge facilities: a pilot scale plant at the Bhabha Atomic Research Centre (BARC) complex and a larger plant that has been reportedly operating since 1990 at Rattehalli, Karnataka. The primary purpose of the latter facility appears to be to produce HEU for an indigenous nuclear-powered submarine under development.

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'.[98] Additional guidelines, published in January 2003, state that India would use nuclear weapons to deter or retaliate against the use of chemical or biological weapons.[99] There have been no official statements specifying the size of the nuclear stockpile required for 'credible minimum deterrence'. However, according to the Indian MOD it involves 'a mix of land-based, maritime and air capabilities'.[100] Most observers believe that India maintains a recessed nuclear posture, in accordance with its no-first-use policy: that is, nuclear warheads are not mated to their delivery vehicles, and some nuclear warheads may be stored in unassembled form, with the plutonium core kept separately from the non-nuclear ignition components.

Strike aircraft

Aircraft currently constitute the core of India's nuclear strike capabilities. The Indian Air Force (IAF) has reportedly certified the Mirage 2000H Vajra ('Divine Thunder') combat 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 August 2005 India and Qatar suspended negotiations over India's purchase of 12 ex-Qatari Mirage 2000-5 aircraft, which could have augmented the IAF's nuclear strike capability. Some of the IAF's four squadrons of Jaguar IS Shamsher ('Sword') combat aircraft may have a nuclear delivery role.[101] Other aircraft that are potentially 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 and the first believed to have a nuclear capability. The Prithvi I (SS-150) is a single-stage, road-mobile ballistic missile capable of delivering a 1000-kg warhead to a maximum

[97] Albright, D. and Basu, S., 'Separating India's military and civilian nuclear facilities', Institute for Science and International Security (ISIS), *ISIS Report*, 16 Dec. 2005, URL <http://www.isis-online.org/publications/southasia/indiannuclearfacilities.pdf>; and 'Atomic Lethargy', *Indian Express* (Internet edn), 23 Jan. 2006, URL <http://www.indianexpress.com/full_story.php? content_id=86424>.

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

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

[100] Indian Ministry of Defence, *Annual Report 2004–05*, URL <http://mod.nic.in/reports/report 05.htm>, p. 14.

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

Table 13A.7. Indian nuclear forces, January 2006

Type	Range (km)[a]	Payload (kg)	Status
Ballistic missiles			
Prithvi I (P-I)	150	800	Entered service in 1994, widely believed to have a nuclear delivery role. Most recent flight-tests on 19 Mar. and 12 Dec. 2005
Agni I[b]	800	1 000	Inducted into Indian Army service in 2004
Agni II	2 000–2 500[c]	1 000	Inducted into Indian Army service in 2004
Aircraft[d]			
Mirage 2000H Vajra	1 850	6 300	Aircraft has reportedly been certified for delivery of nuclear gravity bomb
Jaguar IS Shamsher	1 400	4 760	Some of 4 squadrons may have nuclear delivery role

[a] Missile payloads may have to be reduced in order to achieve maximum range. Aircraft range is 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] An upgraded version (Agni III) currently under development may have a range of 3500 km, possibly with a reduced payload.

[d] Other aircraft in the Indian Air Force's inventory which are potentially suitable for a nuclear role are the MiG-27 (Bahadur) and the Su-30MKI. The Su-30MKI has an in-flight refuelling capability with the IL-78 aerial tanker.

Sources: Indian Ministry of Defence, annual reports and press releases; International Institute for Strategic Studies (IISS), *The Military Balance 2004–2005* (IISS: London, 2004); US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Aug. 2003), URL <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, URL <http://www.cia.gov/cia/publications/bian/bian_apr_2003.htm>; US National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballisticmissilefinal.pdf>; Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group, Ltd: Coulsdon, 2004); Bharat Rakshak, Consortium of Indian military websites URL <http://www.bharat-rakshak.com>; Vivek Raghuvanshi, *Defense News*, various articles; and Authors' estimates.

range of 150 km. The missile was first test flown in 1988 and entered into service with the Indian Army in 1994. It is currently deployed with the Army's 333, 444 and 555 Missile Groups. On 19 March and 12 May 2005, India conducted test-launches of Prithvi I missiles at its Integrated Test Range at Chandipur-on-Sea, in the Bay of Bengal, off the coast of the eastern state of Orissa. A number of Prithvi I missiles are widely believed to have been modified to deliver nuclear warheads, although this has never been officially confirmed.

There are two newer versions of the Prithvi missile featuring improved range, accuracy and handling characteristics. The Prithvi II (SS-250), which has entered into

service with the Indian Air Force, can carry a 500- to 700-kg warhead to a maximum range of 250 km. It is not believed to have a nuclear role. The Prithvi III (SS-350), which is in development, is a two-stage, solid-fuel missile designed to deliver a 1000-kg warhead to a range of up to 350 km. Its most recent flight-tests took place in January and October 2004.

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 delivery role.[102] The original Agni missile was a technology demonstrator that was test flown several times between 1989 and 1994, up to a range of 1500 km, but never operationally deployed. 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 2500 km. The missiles are road and rail mobile, and both can carry nuclear as well as conventional warheads. Following several successful flight-tests in 2004, the Agni I and Agni II were inducted into service with the Indian Army's 334 and 335 Missile Groups, respectively. In May 2005, the missiles were incorporated into India's tri-service Strategic Forces Command. The Defence Research & Development Organization (DRDO) is reportedly planning to upgrade the Agni II's engines and to install decoys along with the warhead to counter defensive systems.[103]

The DRDO is developing a longer-range Agni III intermediate-range ballistic missile with a maximum range of 3500 km. The Agni III continues to experience engineering and systems integration problems, and its maiden flight-test scheduled for 2003 was again postponed in 2005.[104] Indian media reports indicate that because of the ongoing technical problems, the DRDO has decided to increase the range of the Agni II missile, initially by 300 km, as an interim measure.[105]

In 2005 the Indian press reported that the MOD wanted to move beyond the Agni III and proceed with development of an ICBM. The proposed missile reportedly will be a three-stage design, with the first two stages using solid propellant and the third stage using liquid propellant, and will have a range of 9000–12 000 km. It may carry two or three nuclear warheads with yields of 15–20 kt.[106] It is not expected to enter service until after 2015. Western analysts have speculated for some time that India was developing an ICBM, known as the Surya, based on an indigenous space-launch vehicle.[107]

India continues to develop the naval leg of its planned 'triad' of nuclear forces. The Indian Navy is acquiring a rudimentary nuclear capability with the Dhanush ('Bow') ship-based launcher system. The system uses a modified version of the Prithvi II

[102] 'Prithvi SRBM', Bharat Rakshak: consortium of Indian military websites, updated 15 Apr. 2005, URL <http://www.bharat-rakshak.com/MISSILES/Prithvi.html>.

[103] 'DRDO plans to add decoys to Agni IRBM', *Jane's Missiles & Rockets*, vol. 9, no. 12 (Dec. 2005), p. 4.

[104] Pandit, R., 'Glitches delaying Agni III test', *Times of India* (Internet edn), 3 Mar. 2005, URL <http://timesofindia.indiatimes.com/articleshow/1038860.cms>; and 'Agni III to be test fired by end of year', *Hindu* (Internet edn), 30 Mar. 2005, URL <http://www.thehindu.com/2005/03/30/stories/2005033011851200.htm>.

[105] Dikshit, S., 'Step-up of Agni-II range planned', *The Hindu* (Internet edn), 13 Feb. 2005, URL <http://www.hindu.com/2005/02/13/stories/2005021303540900.htm>.

[106] Madhuprasad, 'India to "soon" develop intercontinental ballistic missile', *Deccan Herald* (Internet edn), 25 Aug. 2005, URL <http://www.deccanherald.com/deccanherald/aug252005/index2032552005824.asp>.

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

missile, which the MOD has stated will be capable carrying both conventional and nuclear warheads.[108] The DRDO successfully test-fired two missiles using the Dhanush launcher system mounted on a surface ship, INS *Rajput*, off the coast of Orissa on 16 April and 28 December 2005.

India appears to be developing a more advanced sea-based nuclear strike capability in the form of the Sagarika ('Oceanic') SLBM, which has sometimes been reported as being an sea-launched cruise missile (SLCM).[109] According to the US Defense Intelligence Agency, India flight-tested an SLBM for the first time in the spring of 2005.[110] Some press reports suggest that India may intend to deploy nuclear-armed missiles on the Advanced Technology Vessel, a much-delayed nuclear-powered submarine project that began in 1983.[111]

VII. Pakistani nuclear forces

The estimate presented here—that Pakistan possesses approximately 60 nuclear weapons—is a conservative one, based on the size of Pakistan's estimated military inventory of fissile material[112] and on assessments made by the US intelligence community. The US Defense Intelligence Agency estimated in July 1999 that Pakistan had up to 25 nuclear weapons.[113]

Pakistan is believed to be working to increase and diversify its nuclear forces, which are under the control of a National Command Authority that was established by the military government in 2000. In March 2005 President Pervez Musharraf pledged to upgrade the country's nuclear capability, which he said 'was here to stay' and would 'continue to receive the highest national priority'.[114] Pakistani officials have stated that the country 'subscribes to the principle of minimum credible deterrence and opposes nuclear proliferation and an arms race in the region'.[115] However, because of Pakistan's fears of being overrun by India's larger conventional forces in a military conflict, Pakistan has consistently rejected a no-first-use nuclear policy.

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

[109] Norris and Kristensen (note 101).

[110] Maples, M. D., Lieutenant General, US Army, Director, Defense Intelligence Agency, 'Current and projected national security threats to the United States', Statement for the Record to the Senate Armed Services Committee, 28 Feb. 2006, URL <http://www.senate.gov/~armed_services/statemnt/2006/February/Maples%2002-28-06.pdf>, p. 11.

[111] Pandit, R., 'Nuclear sub project gathers steam', *Times of India* (Internet edn), 20 July 2005, URL <http://timesofindia.indiatimes.com/articleshow/msid-1178241,prtpage-1.cms>.

[112] It is assumed that Pakistan's nuclear weapons are of solid core, implosion-type designs requiring 15–20 kg of HEU each, but it is likely that Pakistan has used only part of its inventory of military fissile material in assembled warheads. At the end of 2003 Pakistan's inventory of HEU for military programmes was estimated to be *c.* 1000–1250 kg. Albright, D., 'ISIS estimates of unirradiated fissile material produced in de facto nuclear weapon states, produced in nuclear weapon programs', revised 30 June 2005, Institute for Science and International Security (ISIS), *Global Stocks of Nuclear Explosive Material*, URL <http://www.isis-online.org/global_stocks/end2003/de_facto_nws.pdf >.

[113] US Defense Intelligence Agency (note 92).

[114] Gilani, M., 'Pakistan vows to strengthen nuclear program', Agence France-Presse, 21 Mar. 2005, URL <http://www.defensenews.com/story.php?F=735622&C=asiapac&P=true>.

[115] Shaukat Aziz, Prime Minister of Pakistan, quoted in 'PM warns of arms race in South Asia', *Dawn* (Internet edn), 25 Jan. 2006, URL <http://www.dawn.com/2006/01/25/top3.htm>.

Ballistic missiles

Pakistan will most likely remain dependent on external suppliers for its medium-range ballistic missile programmes in the short and medium terms.[116] The National Defence Complex (NDC), a subsidiary body of the National Engineering and Scientific Commission, and the Kahuta Research Laboratories have vigourous research and development and procurement programmes under way for MRBMs, based on imported missiles and production technology. Pakistan has received considerable technical assistance from China and North Korea in the past. Former Prime Minister Benazir Bhutto acknowledged in July 2004 that Pakistan had purchased missile technology from North Korea but denied that it aided the latter with nuclear technology.[117]

Pakistan has deployed three families of ballistic missiles that may have a nuclear delivery role, and it continues to develop more advanced versions. The Ghaznavi (Hatf-3) ballistic missile was formally inducted into service with the Pakistani Army in 2004. It can deliver a 500-kg payload to a maximum range of 290 km. Its single-stage, solid-propellant design, which can be transported by road on a modified Scud-B wheeled transporter–erector–launcher (TEL), is believed to be a domestically produced copy of the Chinese M-11 missile.

The Shaheen I (Hatf-4), which has been declared to be nuclear-capable, entered into service with the Pakistani Army in 2003. Analysts remain divided over whether the single-stage, solid-fuel Shaheen I is a version of the Chinese M-9 missile or an improved Chinese M-11 missile. It uses the same wheeled TEL as the Ghaznavi and has a range of 600–800 km, depending on the payload. The two-stage Shaheen II (Hatf-6) is believed to use the Shaheen I missile as its second stage and may be able to carry multiple warheads. Its reported range of 2000–3000 km means that it can reach targets across India. On 19 March 2005 Pakistan announced that it had successfully test-fired a Shaheen II ballistic missile. Pakistan said that it had given India prior notice of the test, in accordance with the informal practice that they agreed in 1999. Development flight-tests are expected to continue in 2006.

Pakistani defence officials have stated that the medium-range Ghauri missiles have a nuclear delivery role. The 1500 km-range Ghauri I (Hatf-5) missile and a longer-range variant, the Ghauri II, are based on North Korea's No-dong 1/2 missile technology and reportedly have been developed with extensive design and engineering assistance from North Korea. The Ghauri I was first successfully test-launched in April 1998. Pakistani defence sources indicate that limited production of the Ghauri began in late 2002 and that it entered into service in January 2003, although developmental work was still continuing. A Ghauri II (or Hatf-5A) missile is under development by the NDC and the KRL and will feature improved propellants and a new motor assembly. The status of the programme is unclear. Pakistan is also reportedly developing a Ghauri III missile with a design range of 3500 km, which would make it the longest-range ballistic missile in the country's inventory. In May 2004 Pakistani officials indicated that the first test-launch of the Ghauri III would be conducted in the near future; however, the test had not taken place by the end of 2005. Some ana-

[116] For a description of Pakistan's missile design and production capabilities see Kampani, G., 'Pakistan profile: missile overview', Nuclear Threat Initiative, Country Profiles, updated Feb. 2005, URL <http://www.nti.org/e_research/profiles/Pakistan/Missile/index_3066.html>.

[117] Takeishi, E., 'Bhutto: we bought missile technology', *Asahi Shimbun* (Internet edn), 19 July 2004, URL <http://www.asahi.com/english/world/TKY200407190155.html>.

Table 13A.8. Pakistani nuclear forces, January 2006

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)	290	500	Entered service with Pakistani Army in 2004. Believed to be a copy of M-11 missile acquired from China in 1990s
Shaheen I (Hatf-4)	600–800	750–1 000	Entered service with Pakistani Army in 2003
Ghauri I (Hatf-5)	1 200	700–1 000	Entered service with Pakistani Army in 2003

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

Sources: International Institute for Strategic Studies, *The Military Balance 2004–2005* (Routledge: London, 2004); US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Aug. 2003), URL <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, URL <http://www.cia.gov/cia/publications/bian/bian_apr_2003.htm>; US Central Intelligence Agency, National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballisticmissilefinal.pdf; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

lysts have speculated that the Ghauri III may either be a North Korean Taepodong missile or draw extensively on components and technologies from the latter programme.[118]

On 11 August 2005 Pakistan carried out the first test-flight of a ground-launched cruise missile, designated the Babur (Hatf-7), at a new test range in Baluchistan.[119] Pakistani officials indicated that the 500-km range cruise missile was capable of carrying a nuclear warhead, although it has not been confirmed that the Babur will have a nuclear role.

[118] Kampani (note 116).

[119] Sharif, A., 'Pakistan test-fires its first cruise missile', *Dawn* (Internet edn), 12 Aug. 2005, URL <http://www.dawn.com/2005/08/12/top2.htm>.

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. Other aircraft, such as the Mirage V or the Chinese-produced A-5, could also be used.

Pakistan currently maintains 32 F-16s in service, deployed in 3 squadrons. In 1988–89 Pakistan had contracted with the USA to buy 71 F-16s to augment its existing inventory of 40 F-16A/B aircraft. However, in October 1990 the US Government announced that it had embargoed any further deliveries in accordance with the Pressler Amendment.[120] As a result, only 28 of the 71 aircraft were ever built and none was delivered.

On 26 March 2005, the Bush Administration announced that it was notifying Congress of plans to sell 75 F-16s to Pakistan.[121] US officials said that the deal, which was intended to reward Pakistan for its cooperation in the war on terrorism, would not affect the military balance in the region—in part because India would probably proceed with its own purchase of advanced aircraft, either from the USA or from another supplier.[122] In August 2005 the Pakistani Air Force's Deputy Chief of Air Staff (Operations), Air Vice Marshal Shehzad Aslam Chaudary, said that the USA had offered to give Pakistan two F-16 aircraft as a goodwill gesture; they arrived in Pakistan before the end of the year. He added that the aircraft were not part of the deal to purchase 75 F-16s from the USA.[123] In November 2005 Pakistan announced that it would postpone the purchase in order to make available more financial resources to provide relief to victims of the previous month's devastating earthquake.[124]

VIII. Israeli nuclear forces

The size of the Israeli nuclear weapon stockpile is unknown but is widely suggested to contain 100–200 warheads. The Institute for Science and International Security estimated in 2004 that Israel possessed some 0.56 tonnes of military plutonium,[125] or the equivalent of about 110 warheads, each containing 5 kg of plutonium. Only part of the plutonium may have been used, however, and the US Defense Intelligence Agency estimated in 1999 that Israel had assembled 60–80 nuclear warheads.[126] Many analysts believe that Israel has a recessed nuclear arsenal (i.e., one that is stored

[120] Approved by the US Congress in 1984, the Pressler Amendment barred military sales to foreign countries unless the president could certify that the country was not pursuing the acquisition of nuclear weapons.

[121] Baker, P., 'Bush: US to sell F-16s to Pakistan', *Washington Post* (Internet edn), 25 Mar. 2005, URL <http://www.washingtonpost.com/wp-dyn/articles/A800-2005Mar25.html>.

[122] On international arms transfers see chapter 10 in this volume.

[123] 'F-16 deal update', PakistaniDefence.com, Aug. 2005, URL <http://www.pakistanidefence.com/news/MonthlyNewsArchive/2005/August2005.htm>.

[124] 'Musharraf postpones F-16 purchase to provide more quake relief', Voice of America (VOA) News (Internet edn), 4 Nov. 2005, URL <http://www.voanews.com/english/archive/2005-11/2005-11-04-voa10.cfm?CFID=27784474&CFTOKEN=85289695>.

[125] Albright, D. and Kramer, K., 'Plutonium Watch: tracking plutonium inventories', Institute for Science and International Security, June 2004, URL <http://www.isis-online.org/global_stocks/plutonium_watch2004.html >, p. 5.

[126] US Defense Intelligence Agency (note 92). The DOD predicted that the Israeli stockpile in 2020 would consist of 65–85 weapons, suggesting that the stockpile is not increasing in size.

Table 13A.9. Israeli nuclear forces, January 2006

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 27 June 2001
Submarines			
Dolphin			Rumoured to be equipped with nuclear-capable cruise missiles; denied by Israeli officials

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

[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 ballistic missile, could deliver a 775-kg payload a distance of 4000 km. The Jericho I, first deployed in 1973, is no longer thought to be operational.

Sources: Cohen, A., *Israel and the Bomb* (Columbia University Press: New York, N.Y., 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 'Ballistic missile primer' (unpublished) for an updated analysis, URL <http://www.puaf.umd.edu/Fetter/1990-MissilePrimer.pdf>); 'NRDC Nuclear Notebook'. *Bulletin of the Atomic Scientists*. various issues: and Authors' estimates.

but not armed, requiring some preparation before use); if true, the warheads for Israel's purported nuclear weapon delivery systems may not actually be deployed. These delivery systems are believed to be strike aircraft, land-based ballistic missiles and possibly SLCMs. There are also rumours that Isreal may have developed nuclear-capable SLCMs for its Dolphin Class submarines and non-strategic nuclear weapons such as nuclear artillery shells and atomic demolition munitions or landmines.