Appendix 12A. World nuclear forces, 2005

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I. Introduction

A decade and a half after the end of the cold war, eight states deploy more than 13 000 operational nuclear weapons (see table 12A.1). If all warheads are counted—operational warheads, spares, and those in both active and inactive storage—the eight states possess a total of roughly 27 600 warheads. In addition to these intact weapons, thousands more plutonium cores (pits) are stored as a strategic reserve. The nuclear arsenals vary in both size and capability, ranging from Russia's 7360 operational weapons to those of India and Pakistan, whose combined arsenal still contains fewer than 100 warheads. Despite their different circumstances, however, all the eight states continue to maintain and modernize their arsenals and insist, publicly or covertly, that nuclear weapons play a crucial and enduring role for their national security.

Both Russia and the United States are in the process of reducing their operational nuclear forces under the terms of the 1991 START I Treaty and the 2002 Strategic Offensive Reductions Treaty (SORT).[1] China, India and Pakistan, on the other hand, may increase their arsenals somewhat over the next decade. France appears to have reached an equilibrium of some sort in the size of its arsenal, while the United Kingdom will soon face a decision about the future of its nuclear arsenal. When the current Russian and US reductions have been completed, in 2012, these eight states (assuming no others have joined the 'nuclear club') will still possess a total of about 14 000 intact nuclear warheads. In the USA, implementation of the decisions of the 2001 Nuclear Posture Review (NPR) has begun, entailing a reduction of almost half the total US stockpile and the development of new ballistic missiles, strategic submarines, long-range bomber aircraft, nuclear weapons, nuclear weapon production facilities, and nuclear command and control systems.[2] Similarly, Russia has announced a plan to reduce its land-based strategic missiles in particular but also to retain for another decade, rather than dismantling, some of its intercontinental-range ballistic missiles equipped with multiple, independently targetable re-entry vehicles (MIRVed ICBMs). It will introduce a new ICBM, a new class of strategic submarines and a new cruise missile. Tables 12A.2 and 12A.3, respectively, show the composition of the US and Russian deployed nuclear forces.

[1] 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.

[2] 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>.

* Vitaly Fedchenko assisted in the research for this appendix.

Table 12A.1. World nuclear forces, by number of deployed warheads, January 2005

Country	Strategic warheads	Non-strategic warheads	Total number of deployed warheads
USA	4 216	680	**4 896**[a]
Russia	3 980	3 380	**7 360**[b]
UK	185	–	**185**
France	348	–	**348**
China	282	120	**~400**
India	–	–	**(30–40)**[c]
Pakistan	–	–	**(30–50)**[c]
Israel	–	–	**(~200)**[c]
Total			**~13 470**

[a] The total US stockpile, including reserves, contains *c*. 10 350 warheads. In addition, 5000 plutonium cores (pits) are in storage as a strategic reserve, while another 7000 pits make up most of the 34 tons of weapon-grade plutonium declared in excess of military needs.

[b] The total Russian stockpile contains *c.* 16 000 warheads, of which *c*. 8800 are in storage or awaiting dismantlement.

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

The nuclear arsenals of the UK, France and China are considerably smaller than those of the USA and Russia, but these three states are also modernizing their forces (see tables 12A.5 and 12A.6). The British nuclear weapon stockpile has levelled out at slightly fewer than 200 warheads: the UK is the only one of the five states defined by the 1968 Non-Proliferation Treaty (NPT) as nuclear weapon states (NWSs) that is not known to have new nuclear weapon systems under development (see table 12A.4).[3] Before long, however, the UK will need to make a decision on whether to begin development of a replacement for the Trident system.

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 when the new SLBM is introduced, in about 2010. China is on the verge of deploying 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 about the same size.

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 (see tables 12A.7–12A.9). The information that is available is limited and often contradictory. India and Pakistan are both busy creating operational nuclear strike capabilities, while Israel appears to be taking a wait-and-see position, depending on the situation in Iran.

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

[3] On developments in world nuclear forces see Kristensen, H. M., 'World nuclear forces', *SIPRI Yearbook 2004: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2004), pp. 628–46, and previous editions of the SIPRI Yearbook. The Treaty on the Non-proliferation of Nuclear Weapons entered into force on 5 Mar. 1970; it was extended indefinitely at the 1995 NPT Review and Extension Conference. For a discussion of the run-up to the 2005 NPT Review Conference see chapter 12, section VII.

II. US nuclear forces

As of January 2005, the USA maintained a stockpile estimated at nearly 5000 operational nuclear warheads, consisting of 4216 strategic and 680 non-strategic warheads. Another 315 warheads are spares. This is a reduction of 2100 operational warheads compared to the estimate for early 2004, owing to a reduction in the number of ballistic missiles, the downloading of warheads on sea-based ballistic missiles, and new information about the number of warheads in the US stockpile. In addition, over 5100 warheads are held in reserve, for a total US stockpile of approximately 10 350 warheads.

In June 2004 the Administration of President George W. Bush approved a new Nuclear Weapons Stockpile Plan that will cut the total stockpile 'almost in half' by 2012. The plan implements the 2001 NPR, which mandated a reduction in the number of 'operationally deployed strategic warheads' to 1700–2200 by the end of 2012. The NPR force level was incorporated in SORT. It is estimated that the new US stockpile plan will involve the retirement of some 4300 warheads and result in a total US stockpile of approximately 6000 warheads by 2012, which is more than twice the number allowed under SORT.[4] The discrepancy is because SORT only counts strategic warheads and only those that are considered to be operationally deployed. Other warheads, whether strategic or non-strategic, are not affected by the treaty, which also fails to address reserve warheads.

No verification regime is associated with SORT, and when the START I Treaty expires in 2009 on-site inspections by US and Russian officials of ICBM silos, submarine facilities and bomber bases will cease. Much as during the cold war, satellite surveillance and human intelligence (spying) will again be the primary means by which the world's two largest nuclear weapon powers monitor each other's nuclear force developments.

Land-based ballistic missiles

The US ICBM force was reduced by 17 missiles in 2004 by the retirement programme for the Peacekeeper (MX) ICBM. Of an initial force of 50 missiles, 10 remained on alert at the beginning of 2005. The 400 W87 warheads from the 40 retired Peacekeeper missiles are being converted to replace W62 warheads on Minuteman ICBMs from financial year (FY) 2006. With a yield of 310 kt, the W87 has nearly twice the explosive power of the W62, and this will broaden the range of hardened targets that can be held at risk by the Minuteman missile force. The W62 warhead will be retired in 2009. During 2004, work continued on modernizing the guidance and propulsion systems of the Minuteman ICBM force.

Following the abandonment of the 1993 START II Treaty in 2002,[5] the USA plans to retain multiple warheads on some of its ICBMs: instead of the goal of 500 war-

[4] Norris, R. S. and Kristensen, H. M., 'What's behind Bush's nuclear cuts', *Arms Control Today*, Dec. 2004, pp. 6–12.

[5] The US–Russian Treaty on Further Reduction and Limitation of Strategic Offensive Arms was ratified by the Russian and US legislatures but did not enter into force. On 14 June 2002, in response to the taking effect on 13 June of the USA's withdrawal from the 1972 Treaty on the Limitation of Anti-Ballistic Missile Systems, Russia declared that it would no longer be bound by the START II Treaty.

heads on 500 missiles by 2007, as planned under START II, the US Department of Defense (DOD) is considering maintaining up to 800 warheads for the ICBM force.[6]

Three ICBMs were test launched in 2004: two Minuteman III ICBMs, each carrying three re-entry vehicles (RVs); and one Peacekeeper ICBM with eight RVs. A test launch was conducted even though the weapon system is being retired. The US Air Force has begun planning for a new ICBM to begin replacing the existing Minuteman III missiles from 2018. Notwithstanding the obligations undertaken by the USA under Article VI of the NPT to pursue nuclear disarmament, the Mission Need Statement 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'.[7]

Ballistic missile submarines

In 2004 the US fleet of SSBNs was reduced to 14 boats with the offloading in October of strategic missiles from the USS *Michigan* and USS *Georgia* as part of a programme to convert four older submarines for cruise-missile and special-forces missions. In parallel with the conversion of these four SSBNs to non-nuclear missions, four Trident I (C-4) missile-equipped boats are being modernized to carry the newer, more powerful and more accurate Trident II (D-5) missile. Two have been converted so far (the USS *Alaska* and the USS *Nevada*) and two will be converted in 2005 and 2006 (USS *Henry M. Jackson* and USS *Alabama*, respectively).

The shifting of the emphasis of the US SSBN fleet continued in 2004 with the announcement by the US Navy (USN) in September that two more submarines were to move from Kings Bay, Georgia, to Bangor, Washington. Three SSBNs have changed homeport, in 2002 (USS *Pennsylvania* and USS *Kentucky*) and 2004 (USS *Nebraska*), and two more submarines (USS *Maine* and USS *Louisiana*) will follow in 2005, increasing the US Pacific SSBN fleet to nine submarines. This will temporarily leave only five SSBNs in the Atlantic, the lowest number since US ballistic missile-equipped submarines first deployed to sea in 1961.

The USN purchased five more Trident II (D-5) SLBMs from the FY 2005 budget, and production of the missile has been extended to the end of 2013. The development of a Life Extension modification of the D-5 missiles has begun in order to match the extended service life of the SSBN force until 2040. The USN has also begun planning for a new intermediate-range ballistic missile for future strategic submarines.

[6] Kristensen, H. M., 'To MIRV or not to MIRV', Nuclear Information Project, 2004, URL <http://www.nukestrat.com/us/afn/mirv.htm>; Herbert, A. J., 'The future missile force', *Air Force Magazine*, Oct. 2003, p. 67; and US Department of Defense, Public Affairs, Personal communication with H. Kristensen.

[7] 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.

Table 12A.2. US nuclear forces, January 2005

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
Strategic forces						
Bombers[b]						
B-52H	Stratofortress	93/56	1961	16 000	ALCM 5–150 kt	450[c]
					ACM 5–150 kt	400
B-2	Spirit	21/16	1994	11 000	Bombs	200[d]
Subtotal		*114/72*				*1 050*
ICBMs						
LGM-30G	Minuteman III					
	Mk-12	50	1970	13 000	3 x 170 kt	150
		150			1 x 170 kt[e]	150
	Mk-12A	300	1979	13 000	2–3 x 335 kt	750
LGM-118A	MX/Peacekeeper[f]	10	1986	11 000	10 x 310 kt	100
Subtotal		*510*				*1 150*
SSBNs/SLBMs[g]						
UGM-96A	Trident I (C-4)	48	1979	7 400	6 x 100 kt	288
UGM-133A	Trident II (D-5)	288				
	Mk-4	n.a.	1992	>7 400	6 x 100 kt	1 344
	Mk-5	n.a.	1990	>7 400	6 x 455 kt	384
Subtotal		*360*				*2 016*
Strategic subtotal						*4 216*
Non-strategic forces						
B61-3, -4, -10 bombs		n.a.	1979	n.a.	0.3–170 kt	580[h]
Tomahawk SLCM		320	1984	2 500	1 x 5–150 kt	100[i]
Non-strategic subtotal						*680*
Total						**4 896**[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 and B-2s in the inventory, including those for training, test and reserve. The second figure is the primary mission inventory (PMI) aircraft, i.e., the number of operational aircraft assigned for nuclear and conventional wartime missions.

[c] Another 400 ALCMs are in reserve.

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

[e] Each of the 150 Minuteman III missiles of the 90th Space Wing at F.E. Warren Air Force Base have been downloaded from 3 to 1 W62 warhead.

[f] From Oct. 2002 to Dec. 2004, 40 Peacekeeper ICBMs were dismantled; the last 10 will be withdrawn by the end of FY 2005.

[g] Of 8 initial Bangor-based Ohio Class SSBNs, 4 are under conversion to nuclear-powered guided-missile submarines (SSGNs) and 2 have completed Trident II (D-5) refit. Two Atlantic-based D-5 missile-equipped SSBNs were shifted to the Pacific in late 2002 and a third followed in Oct. 2004. The remaining 2 Trident I (C-4) missile-equipped SSBNs will be upgraded with the D-5 in FY 2005 and FY 2006, respectively. According to START I Treaty counting rules, C-4 missiles are counted as carrying no more than 6 warheads. Although D-5 missiles are counted as carrying 8 warheads each, the US Navy has begun downloading them to meet an interim force level by 2006 as part of the implementation of SORT.

[h] Approximately 480 of these are deployed in Europe.

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

[j] Another 315 warheads are spares, and just over 5100 warheads are kept in the reserve stockpile.

Sources: US Department of Defense, various budget reports; US Department of Energy, various budget reports; US Department of State, START I Treaty MOUs, 1990 through Jan. 2005; US Navy, Personal communication; US Department of Defense, various documents obtained under the Freedom of Information Act; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; US Naval Institute, *Proceedings*, various issues; and Authors' estimates.

Modernization of the W76 RV continues to add surface-burst capability and increased accuracy to the weapon. The modernization programme will significantly enhance the capability of the W76 and add to the types of targets that can be held at risk by the 100-kt warhead. The first delivery to the USN of the surface-burst W76 (designated W76-1/Mk4A) RV is scheduled for 2007, and some 800 warheads will be upgraded by the end of 2012.

Three SLBMs were flight tested in 2003 and two in 2004, one of which was launched at the Pacific Missile Range, the first Pacific SLBM launch in 12 years.

Long-range bombers

The size of the US bomber force remained unchanged in 2004, but the aircraft and their nuclear weapons continued to be upgraded. The US Air Force (USAF) awarded a contract to EMS Technologies in 2004 to develop an Extremely High Frequency satellite communications antenna for the B-2 bomber to ensure secure communication with the Milstar and future Advanced Extremely High Frequency satellites in nuclear missions. The USAF also began applying a new radar-absorbing coat to the B-2: the Alternate High-Frequency Material will improve the stealth of the aircraft and simplify maintenance. Modernization will be completed in 2011.

The USAF began preparations for a ground-based test facility for the Air-Launched Cruise Missile (ALCM) and Advanced Cruise Missile (ACM). Currently, the weapons must be test launched from airborne B-52 bombers, but the USAF plans to begin testing the missiles on the ground. The B-52 is the only carrier of the ALCM/ACM and can also carry gravity bombs.

Non-strategic nuclear weapons

As of January 2005, the USA retained approximately 680 active non-strategic nuclear warheads. These consisted of 580 B61 gravity bombs of three types and 100 W80-0 warheads for Tomahawk Land-Attack Cruise Missiles (TLAM/Ns). Another 1020 non-strategic warheads are in inactive storage. Despite the significant number of warheads, neither the 2001 NPR nor the 2002 SORT Treaty addresses non-strategic nuclear weapons.

The 580 operational B61 non-strategic nuclear bombs are earmarked for delivery by various US aircraft and aircraft assigned to NATO. Another 440 are in reserve. More than 400 of the 580 gravity bombs have been authorized by the president for deployment at eight airbases in six European NATO member states (Belgium, Germany, Italy, the Netherlands, Turkey and the UK) and constitute the only US

nuclear weapons that are still forward-deployed (other than SSBNs). The aircraft of non-nuclear weapon state (NNWS) NATO members that are assigned nuclear strike missions with US weapons include Belgian, Dutch and Turkish F-16 aircraft and German and Italian Tornado bombers.[8]

Only 100 W80-0 warheads for the TLAM/N are active, but another 200 are in inactive storage. After deciding in 2003 to retain rather than retire the TLAM/N, the US Navy has begun efforts to extend the service life of the missile. The Department of Energy plans to extend the service life of the W80 warhead. TLAM/Ns can be deployed on select Los Angeles, Improved Los Angeles and Virginia Class attack submarines. The weapon is not deployed at sea under normal circumstances, but it can be redeployed in only 30 days after a decision to do so.

Nuclear warhead stockpile management and modernization

The US stockpile of active weapons includes intact warheads with all components that are either deployed on operational delivery systems or can be so deployed in a relatively short time. The inactive weapons includes warheads that are held in long-term storage as a reserve with their limited life components (tritium) removed. The 2001 NPR defined a new subcategory of active warheads, called the Responsive Force, which consists of intact warheads that have been removed from operational service but could relatively quickly be 'uploaded' back onto ballistic missiles and aircraft. The W87 warheads from dismantled Peacekeeper ICBMs and W76 warheads from non-strategic Trident submarines are held in the Responsive Force. As the decisions of the NPR are implemented over the next decade, there will be roughly three times as many warheads in non-operational categories as there are operationally deployed warheads.

In addition to the total of about 10 350 intact active and inactive warheads, the USA keeps about 5000 plutonium cores in storage at the Pantex Plant in Texas as a strategic reserve. Approximately the same number of canned assemblies (thermonuclear secondaries) is kept at the Oak Ridge Y-12 Plant in Tennessee. Another 7000 pits held at Pantex make up most of the 34 tons 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. A programme to repackage the 12 000 pits for long-term storage is currently under way at the Pantex facility, and small-scale pit production has resumed at Los Alamos National Laboratory.

In a surprise move in 2004, the US Congress cut funding for design development of a new nuclear-armed earth-penetrating weapon. The cut was a surprise because of the Bush Administration's recent successful effort to repeal a ban from the Clinton era on studying low-yield nuclear weapons. The Congress also cut funding for a new plutonium pit production facility.[9] The Bush Administration is seeking to restore part of the funding in its budget request for FYs 2006 and 2007.

[8] For further background to 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/default.asp>.

[9] See Wald, M., 'Nuclear weapons money is cut from spending bill', *New York Times* (Internet edn), 23 Nov. 2004, URL <http://www.nytimes.com/2004/11/23/politics/23nuke.html>; and chapter 12, section IX.

III. Russian nuclear forces

In February 2004 the Russian Ministry of Defence (MOD) conducted its largest strategic military exercise since 1982, called 'Bezopasnost 2004' (Security 2004). It involved all the elements of Russia's strategic forces and included test firings of sea- and land-based ballistic missiles and ALCMs, strategic bomber sorties, an early-warning satellite launch, and a test of the Moscow anti-ballistic missile (ABM) system.[10] It was marred by the highly publicized failures of two SLBM test launches. In the view of many analysts, one of the purposes of the exercise was to remind the world, especially the USA, that Russia retained a formidable nuclear arsenal and hence was a power to be reckoned with. Others speculated that the exercise was a political manoeuvre in anticipation of the Russian presidential election in March.

Following the exercise, President Vladimir Putin announced that Russia was developing a new nuclear missile system, which had no counterpart elsewhere in the world, that would be able to defeat any strategic missile defence system. Many observers believe that Putin may have been referring to a new hypersonic manoeuvrable RV for the Topol-M ICBM (see below) that is designed to evade missile interceptors.[11]

ICBMs

The ICBMs assigned to the Russian Strategic Rocket Forces (SRF) have traditionally made up the largest element of the Soviet/Russian strategic nuclear forces. The size of this force will gradually decline over the next 10–15 years, as older ICBMs are retired and replaced by a smaller number of fourth-generation missiles. The SRF currently consist of three missile armies: the 27th Guards Missile Army (headquarters in Vladimir), the 31st Missile Army (Orenburg) and the 33rd Guards Missile Army (Omsk). As of December 2004 the armies included 15 missile divisions with operational missiles. According to the long-term plan for Russia's strategic forces, made public in November–December 2004, the number of missile divisions will be reduced to 10–12. The divisions in Kartaly (SS-18 missiles) and Kostroma (SS-24 missiles) are scheduled to be disbanded in 2005.[12]

The SS-27 (RS-12M2, Topol-M) remains the only ICBM currently in production in Russia. On 16 December 2004 the fourth regiment of silo-based Topol-Ms became operational. The regiment is part of the missile division in Tatishchevo, Saratov oblast, which now has a total of 40 Topol-M missiles.

According to Russian press reports, serial production of the Topol-M had to be stopped twice in 2004 because of delays in funding from the MOD. The director-general of the Moscow Institute for Thermal Technology (MITT), which developed the missile, warned in October that the delays threatened to disrupt deployment plans

[10] 'Russian Defense Ministry to conduct first big military exercise in 25 years', *Pravda* (Internet edn), 4 Feb. 2004, URL <http://english.pravda.ru/main/18/88/351/11962_military.html>.

[11] Ischenko, S., 'Putin prepared a surprise: a new strategic weapon has been created in Russia', *Trud*, 20 Feb. 2004, in 'Commentary on Putin's remark about new weapon systems', Foreign Broadcast Information Service, *Daily Report–Central Eurasia (FBIS-SOV)*, FBIS-SOV-2004-0220, 25 Feb. 2004.

[12] 'Strategic Rocket Forces commander outlines plans for the future', Russian Nuclear Forces Project, 12 Dec. 2004, URL <http://russianforces.org/eng/news/archive/000145.shtml>.

Table 12A.3. Russian nuclear forces, January 2005

Type	NATO designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
Strategic offensive forces						
Bombers						
Tu-95MS6	Bear-H6	32	1984	6 500–10 500	6 x AS-15A ALCMs, bombs	192
Tu-95MS16	Bear-H16	32	1984	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	110	1979	11 000–15 000	10 x 500–750 kt	1 100
SS-19	Stiletto	140	1980	10 000	6 x 500–750 kt	840
SS-24 M1	Scalpel	15	1987	10 000	10 x 550 kt	150
SS-25	Sickle	306	1985	10 500	1 x 550 kt	306
SS-27	Topol-M	40	1997	10 500	1 x 550 kt	40
Subtotal		*611*				*2 436*
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						**3 980**
Strategic defensive forces						
ABMs						
Gorgon/Gazelle		100				100
Grumble[c]		1 100				1 100
Non-strategic forces						
Land-based non-strategic						
Bombers and fighters						
Tu-22M Backfire		105			AS-4 ASM,	
Su-24 Fencer		280			AS-16 SRAM, bombs	
Subtotal		*385*				*1 540*[c]
Naval non-strategic						
Attack aircraft						
Tu-22M Backfire		45			AS-4 ASM, bombs	
Su-24 Fencer		50				
Subtotal		*95*				*190*[d]
SLCMs						
SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22						240
ASW weapons						
SS-N-15, SS-N-16, torpedoes		n.a.				210
Total defensive and non-strategic						**3 380**
Total						**7 360**

[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 is not a dedicated ABM system but may have some capability against some ballistic missiles.

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

Sources: US Department of State, START I Treaty Memoranda of Understanding (MOU), 1990 through Jan. 2005; Podvig, P. L. (ed.), *Russian Strategic Nuclear Forces* (MIT Press: Cambridge, Mass., 2001); 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/Unclassified ballisticmissilefinal.pdf>; US Department of Defense, *Proliferation: Threat and Response,* Jan. 2001; US Naval Institute, *Proceedings*, various issues; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

for the Topol-M and jeopardized the retention of critical skills and manufacturing capabilities at the Votkinsk Machine-Building Plant, where the missiles are built.[13] Under the 2005 State Defence Order, four silo-based Topol-M missiles will be procured, compared to six in 2004.[14] On 24 December 2004 a road-mobile version of the Topol-M was successfully launched from the Plesetsk test site. This was the fourth and final test of the road-mobile Topol-M system prior to its scheduled entry into service beginning in 2006. In 2005 three mobile Topol-Ms will be procured.[15]

On 22 December 2004 Russia successfully test launched an SS-18 Satan (R-36M2 or RS-20V Voevoda) missile as part of its programme to extend the service lives of the Soviet-era ICBMs. The missile, which had been on combat alert for 16 years, was launched from the Dombarovsky missile base in the Orenburg region of Russia; the warhead reached its training target at the Kura test range in Kamchatka. All the previous launches of the SS-18 after the collapse of the Soviet Union in 1991—as well as launches of the Dnepr space launch vehicle (a converted SS-18 missile)—were conducted at the Russian-leased Baikonur cosmodrome in Kazakhstan. Older SS-18 missiles will be retired under the new defence plan, but the service life of about 50 newer SS-18s may be extended for another 10–15 years. Russia was supposed to scrap all of its SS-18 heavy missiles under the now abandoned START II Treaty.[16]

SLBMs

In 2004 the size of the Russian SLBM force changed significantly owing to the withdrawal from operational service of the SS-N-20, which was carried on the Typhoon Class SSBN. This leaves only two types of SLBM in service compared to the six SLBM types in service in the late 1980s. Three submarines of the new Borey Class (Project 955) are under construction at the Severnoye Mashinostroitelnoye Predpriyatiye (Sevmash) shipyard in Severodvinsk in northern Russia. The first of the new SSBNs, *Yuri Dolgoruky*, was laid down in November 1996 and is scheduled to be delivered in 2005; its completion has been delayed by funding problems and a

[13] Litovkin, D., 'Strategic Missile Troops commander Nikolay Solovtsov: "we will have something to show withing next few years"', *Izvestiya* (Moscow), 14 Dec. 2004, p. 6, in FBIS-SOV-2004-1214, 15 Dec. 2004.

[14] Barabanov, M., 'Whole Russian army', *Kommersant Vlast* (in Russian), no. 7 (21 Feb. 2005), p. 69, URL <http://www.kommersant.ru/k-vlast/get_page.asp?_id=2005769-22.htm&show=print>.

[15] Plugatarev, I., '"Topol-M" replaces "Molodets" and "Voevoda"', *Nezavisimoe Voennoe Obozrenie* (in Russian), 28 Jan. 2005, URL <http://nvo.ng.ru/printed/forces/2005-01-28/1_topol.html>.

[16] See note 5.

decision to arm it with a new SLBM. It will be followed in 2008 by a second submarine, *Alexander Nevskiy*, which was laid down in March 2004, and by a third in 2010. Three more submarines are planned for construction after 2010.[17]

In addition to these submarines, the Russian Government has decided to keep six Delta IV Class (Project 667 BDRM Delphin) submarines in service. After service-life extension overhauls and refitting with newly produced SS-N-23 (R-29RM) missiles, the Delta IV submarines may be kept in service until 2015–20. Russia also maintains six Delta III Class (Project 667 BDR Kalmar) submarines in service.

The Borey Class SSBNs will each carry 12 SS-NX-30 (Bulava) SLBMs, which are being developed by the MITT. The Bulava programme is based on MITT's land-based Topol-M ICBM. It is a replacement for the SS-NX-28 (D-19M Bark) SLBM programme, which had been cancelled because of technical problems and rising costs. According to Russian media reports, the Bulava is also experiencing design and engineering problems, which means that it may not be able to carry the originally planned payload of 10 warheads over a distance of 8000 km. On 23 September 2004 an unpowered test launch of a Bulava was carried out from the *Dmitry Donskoy* modified Typhoon Class submarine in the White Sea. The missile is expected to begin flight tests in 2005 and is scheduled to enter into service after 2006.

The year 2004 began inauspiciously for the Russian Navy's SSBN force. On 17 February, during the 'Security 2004' exercises, the *Novomosovsk* Delta 4 Class submarine had to abort the launches of two SS-N-23 SLBMs for technical reasons. The following day, an SS-N-23 (R-29M or RSM-54) missile launched by its sister ship, *Kareliya,* reportedly had to be destroyed in flight after it departed from its planned flight trajectory. The Russian Navy subsequently conducted five successful test launches of SLBMs from submarines in the Barents Sea: on 17 March two SS-N-23s were launched from the *Novomosovsk*; on 29 June an SS-N-23 was launched from the Delta IV Class submarine *Yekaterinburg*; and on 8 September an SS-N-18 (R-29R) and an SS-N-23 were launched from the *Borisoglebsk* and *Yekaterinburg*, respectively, with each missile carrying three dummy warheads. On 2 November an SS-N-18 missile was launched in the Sea of Okhotsk by the *Svyatoy Georgiy Pobedonosets*, one of the four Delta III submarines of the Pacific Fleet.

Aircraft

Russia resumed low-rate production of the Tu-160 Blackjack long-range bomber in 2004. Two aircraft are planned for delivery in 2005, one equipped to carry cruise missiles and the other gravity bombs.[18] Russia may begin to deploy a nuclear-armed version of a new long-range ALCM, known as the Kh-102, for its Blackjack and Tu-95 Bear bombers by the end of 2005.

[17] Plugatarev (note 14).

[18] Litovkin, D., 'Air Force will be flying for twice as long', *Izvestiya* (in Russian), 18 Jan. 2005, p. 6.

Table 12A.4. British nuclear forces, January 2005

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

Sources: British Ministry of Defence (MOD), press releases and the MOD Internet site, URL <http://www.mod.uk/issues/sdr/index.htm>; 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.

IV. British nuclear forces

The UK maintains an arsenal of about 185 warheads for use by a fleet of four Vanguard Class Trident SSBNs, consisting of 160 operational warheads and an additional 15 per cent of that number for spares. At any given time one British SSBN will be on patrol, carrying up to 48 warheads on 16 US-produced Trident II (D-5) SLBMs. The second and third SSBNs can be put to sea fairly rapidly, with similar loadings, while the fourth might take longer because of its cycle of 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.

In January 2005 HMS *Victorious* arrived at the Devonport Naval Base for a major refit, including a refuelling of its nuclear reactor. This leaves three SSBNs in the fleet—*Vanguard, Vigilant* and *Vengeance*—for operational deployment. HMS *Vanguard* emerged from Devonport in December 2004, after undergoing a three-year overhaul.

The 2003 Defence White Paper stated that the UK's nuclear deterrent capability is 'likely to remain a necessary element of our security' and anounced plans to consider in the next parliament whether to replace the current deterrent force, which is based on the Trident SSBN.[19] While the nominal retirement date of the four Vanguard Class submarines is still almost two decades away, the government must make a decision by 2006 on whether to upgrade the ageing warheads or scrap the weapons entirely. Another option would be to adapt the Vanguard Class submarines to launch conventionally armed Tomahawk cruise missiles or use them for special forces operations.

The UK is the only NWS that has publicly assigned its SSBNs 'sub-strategic missions'. According to a former British MOD official, 'A sub-strategic strike would be the limited and highly selective use of nuclear weapons in a manner that fell demonstrably short of a strategic strike, but with a sufficient level of violence to convince an aggressor who had already miscalculated our resolve and attacked us that he should halt his aggression and withdraw or face the prospect of a devastating strategic

[19] British Ministry of Defence, *Delivering Security in a Changing World*, Defence White Paper, Cm 6041-I (Stationery Office: London, Dec. 2003), p. 9, URL <http://www.mod.uk/linked_files/publications/whitepaper2003/volume1.pdf>.

strike'.[20] Much like the doctrines of Russia and the USA, the UK's nuclear doctrine has taken on a new role in deterring, or responding to, attacks by NNWSs using chemical or biological weapons. In 2002, an addendum to the 1998 Strategic Defence Review extended the role of nuclear weapons to include deterring 'leaders of states of concern and terrorist organizations'.[21]

V. French nuclear forces

France maintains an operational arsenal of an estimated 348 nuclear warheads for delivery by strategic submarines, carrier-based strike aircraft and land-based aircraft. France continues to modernize its nuclear forces, including construction of the fourth and final Triomphant Class SSBNs, the M51 SLBM with a new nuclear warhead, the ASMP-A (Air-Sol Moyenne Portée) cruise missile and the Rafale nuclear-capable strike aircraft. According to French press reports, the French MOD allocated €3 billion ($3.75 billion) in the 2004 equipment budget for nuclear systems, a figure which accounts for less than 10 per cent of France's total defence expenditure, compared with 17 per cent in 1990.

Ballistic missiles

The backbone of France's nuclear deterrent force is the Force Océanique Stratégique, which consists of a fleet of four SSBNs of two classes: three of the new Triomphant Class SSBNs; and one L'Inflexible (formerly Redoubtable Class) SSBN. Three of these submarines are maintained in the operational cycle, with one or two normally 'on station' in designated patrol areas at any given time, compared with three in the early 1990s.

On 19 November 2004 the naval procurement directorate of the French armament procurement agency Délégation Générale pour l'Armement (DGA) took delivery of *Le Vigilant* SSBN from the prime contractor, DCN Warships & Systems. The vessel is the third of a planned class of four (originally six) nuclear-powered Sous-marins Nucléaires Lanceurs d'Engins–Nouvelle Génération (SNLE–NG) ballistic missile submarines, also called the Triomphant Class after the lead boat, which was launched in 1997. The second boat, *Le Téméraire*, entered service in December 1999. The fourth and final vessel of the class, *Le Terrible*, is scheduled to enter service in 2010. The delivery of the *Le Vigilant* allowed the French Navy to retire *L'Indomptable*, one of the two remaining L'Inflexible Class SSBNs.

The French Navy's four SSBNs are each armed with 16 Aérospatiale M45 missiles. The missiles can carry up to six TN-75 warheads, each with an estimated yield of 100 kt, as well as penetration aids. The accuracy of the TN-75 warhead is not publicly known but has been estimated at a circular error probable (CEP) of 350 metres. From 2010, beginning with the *Le Terrible*, the first three Triomphant Class SSBNs will be retrofitted with the M51.1/TN-75 SLBM, which is currently

[20] Ormond, D., 'Nuclear deterrence in a changing world: the view from a UK perspective', *RUSI Journal*, June 1996, pp. 15–22.

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

Table 12A.5. French nuclear forces, January 2005

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	64	1996	6 000[c]	6 x 100 kt	288
Total					**348**

[a] Range for aircraft assumes combat radius, without in-flight refuelling.

[b] The last M4-equipped SSBN, *L'Indomptable*, was replaced by *Le Vigilant* in Nov. 2004. 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: 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; National Assembly, 'Au Nom de la Commission de la Défense Nationale et des Forces Armées, sur le projet de loi de finances pour 2002 (no. 3262), Tome II, Défense, Dissuasion nucléaire, M. Rene Galy-Dejean (Député)', 11 Oct. 2001, URL <http://www.assemblee-nationale.fr/budget/plf2002/a3323-02.asp>; *Air Actualités*, various issues; *Aviation Week & Space Technology*, various issues; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

entering the production phase. In 2004 EADS Space Transport signed a contract with the DGA, worth more than €3 billion ($3.75 billion), for series production of the M51 over 10 years. The new missile will have a payload of six warheads and a maximum range of 8000 km, which will permit French SSBNs to significantly expand their patrol zones. From 2015 the French Navy plans to take delivery of the improved M51.2 missile, armed with the new Tête Nucléaire Océanique (TNO) warhead.

Strike aircraft

The air component of the French nuclear force consist of two types of aircraft: approximately 60 Mirage 2000Ns, which equip the three French Air Force squadrons currently with nuclear strike roles; and about 24 Super Étendards deployed on the aircraft carrier *Charles de Gaulle*. Both types of aircraft carry the ASMP cruise missile. The ASMP has been equipped with the 300-kt TN81 warhead since 1987 and has a range, depending on the launch altitude, of 80–250 km. It is estimated that France has about 60 operational ASMPs, but additional missiles may be in inactive storage.

A new nuclear-capable cruise missile, designated the ASMP-A, is under development for deployment with the French Air Force and Navy to replace the ASMP beginning in 2007. The ASMP-A will carry the new Tête Nucléare Aéroportée war-

head and has a high level of accuracy—reportedly with a CEP of less than 10 metres at a range of 300–400 km. The ASMP-A was specially designed for the Mirage 2000N and hence will be fitted to this aircraft first, which will be redesignated the Mirage 2000N K3, in 2007. Beginning in 2008, the missile will also be integrated with Rafale air force and navy aircraft. Under current planning, 50 Mirage 2000s, 50 air force Rafales and an unspecified number of navy Rafales will be modified to carry the ASMP-A missile.

VI. Chinese nuclear forces

China is estimated to maintain an arsenal of more than 400 nuclear weapons for delivery by aircraft, land-based ballistic missiles, SLBMs and possibly also non-strategic systems, including artillery. The overall size of the Chinese arsenal appears to have remained largely unchanged since the early 1980s.

According to the latest in a series of US DOD reports on Chinese military developments, China is continuing to gradually modernize and increase its force of nuclear-capable ballistic missiles. The purpose of this modernization programme is to 'improve [China's] nuclear deterrence by increasing the number of warheads that can target the United States and augmenting the nuclear force's operational capabilities for contingencies in East Asia'.[22] The DOD report stated that China could have 30 ICBMs capable of reaching the USA by 2005, and 60 by 2010.

There remains considerable uncertainty about the scope and pace of China's long-term force modernization goals. China is known to have been developing three missiles since the 1980s: the road-mobile DF-31 (Dong Feng, or East Wind) ICBM; a longer-range version of the DF-31, called the DF-31A (or DF-41); and the JL-2 (Julang, or Great Wave) SLBM, the sea-based variant of the DF-31 ICBM. There is widespread speculation that China will deploy multiple re-entry vehicle (MRV) payloads, including a MIRV system, on some or all of these new missiles in order to counter a US missile defence system.[23] According to unconfirmed press reports, in 2002 China successfully conducted its first test of a missile—the medium-range DF-21—carrying multiple dummy warheads. However, US intelligence believes that the size and throw-weight of the DF-5A, an existing ICBM, make it the most likely Chinese missile to be given an MRV or a MIRV capability if China chooses to deploy such a capability.

China continues to develop the DF-31 ICBM: its status is unclear, but some sources indicate that China has begun to operationally deploy the DF-31.[24] There were reports in the Hong Kong press in 2004 that China is developing a rail-mobile version of the DF-31. The system may use technology developed in the Soviet Union for its rail-mobile SS-24 ICBM, which entered service in 1987: Ukraine, where the SS-24 was manufactured, has been identified as the source of the technology.[25]

[22] US Department of Defense, Report to Congress Pursuant to the FY 2000 National Defense Authorization Act, 'Annual Report on the Military Power of the People's Republic of China', 28 May 2004, URL <http://www.dod.gov/pubs/d20040528PRC.pdf>.

[23] An MRV 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.

[24] International Institute for Strategic Studies (IISS), *The Military Balance 2004–2005* (Oxford University Press: Oxford, 2004), p. 170.

[25] 'China develops rail-mobile ICBM', *Jane's Missiles & Rockets*, vol. 9, no. 1 (Jan. 2005) p. 6.

Table 12A.6. Chinese nuclear forces, January 2005

Type	NATO designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads in stockpile
Aircraft[b]						
H-6	B-6	120	1965	3 100	1–3 bombs	120
Q-5	A-5	30	1970	400	1 x bomb	30
Land-based missiles						
DF-3A	CSS-2	40	1971	2 800	1 x 3.3 Mt	40
DF-4	CSS-3	12	1980	5 500	1 x 3.3 Mt	12
DF-5A	CSS-4	20	1981	13 000	1 x 4–5 Mt	20
DF-21A	CSS-5	48	1985–86	1 800	1 x 200–300 kt	48
DF-31	CSS-X-10	n.a.	2005–2009?	8 000	1 x ?	0
SLBMs						
Julang I	CSS-N-3	12	1986	1 700	1 x 200–300 kt	12
Strategic weapons						*282*
Non-strategic weapons[c]						
Artillery/ADMs, Short-range missiles					Low kt	~120
Total						**~400**

[a] Range for aircraft indicates combat radius, without in-flight refuelling.

[b] All figures for bomber aircraft are for nuclear-configured versions only. Hundreds of aircraft are also deployed in non-nuclear versions. The status of China's air-delivered nuclear capability is uncertain.

[c] Information on Chinese non-strategic nuclear weapons is limited and contradictory. There is no confirmation of their existence from official Chinese sources.

Sources: US Department of Defense (DOD), Report to Congress Pursuant to the FY 2000 National Defense Authorization Act, 'Annual Report on the Military Power of the People's Republic of China', 28 July 2003; 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>; US DOD, Office of the Secretary of Defense, 'Proliferation: threat and response', Washington, DC, Jan. 2001, URL <http://www.defenselink.mil/pubs/ptr20010110.pdf>; US Central Intelligence Agency, various documents; US DOD, National Air and Space Intelligence Center (NAIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Aug. 2003, revised); 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.

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. According to a US press report, in July 2004 China launched its first Type 094 nuclear-powered ballistic missile submarine that had been under development for more than decade.[26] The submarine is in the early stages of being outfitted at the Huludao shipyard, located about 400 km northwest of Beijing, and is believed to be based on Russian nuclear submarine technology. The Type 094 is expected to be significantly quieter than the Type 092 and will have enhanced sensors and a more reliable propulsion system.

[26] 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>.

The new submarine is designed to carry 16 JL-2 SLBMs. Some reports suggest that it might be loaded with multiple warheads. Most reports agree that the JL-2 will have a range of about 7500–8000 km. This means that it will have a true intercontinental capability and be able to strike targets throughout the United States from the relative safety of launch points near Chinese waters. The first at-sea test of the JL-2, an unpowered 'pop-up' test, was conducted from a Golf Class trials submarine in January 2001. China reportedly conducted tests of the JL-2 in 2002 and 2003. However, a test that took place in the summer of 2004 was reportedly a failure and may have delayed the development programme. According to the US DOD, the missile is not expected to enter service until the end of the decade.

VII. Indian nuclear forces

It is difficult to estimate the size and composition of India's nuclear arsenal. Published estimates vary widely, ranging from several dozen up to 150 weapons. The cautious estimate presented here is that India's nuclear stockpile contains 30–40 weapons. Some of these weapons may be stored in unassembled form, with the plutonium core kept separately from the non-nuclear ignition components, in accordance with India's no-first-use declaratory policy.

India is widely believed to be working to expand its nuclear weapon stockpile. There have been no official statements specifying the size of the stockpile required for the 'credible minimum deterrence' posture called for in India's nuclear doctrine.

Estimating the inventory

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.[27] A number of factors contribute to the uncertainty in estimating India's inventory of fissile material. First, there are different assessments of the lifetime operating capacity of the CIRUS and Dhruva plutonium production reactors (i.e., of their reliability and efficiency). According to the World Nuclear Association, in the 1990s India's nuclear power reactors had some of the world's lowest operating capacity factors.[28] Second, it is unclear whether India has used all of its available weapon-grade plutonium to fabricate nuclear weapons, as some analysts have assumed. Finally, there are different views on how to take into account the losses and draw-downs of nuclear material that occur during production, processing and testing.

There is also a continuing debate about whether one of the nuclear explosive tests carried out by India in May 1998 used non-weapon-grade plutonium (either in the form of reactor-grade plutonium or a mix of isotopes closer to weapon-grade plu-

[27] One widely cited report estimated that, at the end of 1999, India had an inventory of 240–395 kg of weapon-grade plutonium. This would have been sufficient to manufacture 45–95 nuclear weapons, assuming that each weapon would require 4.5 kg of plutonium. Albright, D., 'India's and Pakistan's fissile material and nuclear weapons inventories, end of 1999', Background Paper, Institute for Science and International Security, 11 Oct. 2000, URL <http://www.isis-online.org/publications/southasia/stocks1000.html>.

[28] World Nuclear Association, 'India and Pakistan', Information and Issues Brief, Nov. 2002, URL <http://www.world-nuclear.org/info/inf53.htm>.

Table 12A.7. Indian nuclear forces, January 2005

Type	Range (km)[a]	Payload (kg)	Status
Ballistic missiles			
Prithvi I (P-I)	150	800	Entered into army service in 1994; may have a nuclear delivery role
Agni I	700	1 000	Missile is 'in process of induction'; third test flight conducted on 4 July 2004
Agni II	>2 000[b]	1 000	Missile is 'in process of induction'; third test flight conducted on 29 Aug. 2004
Aircraft[c]			
Mirage 2000H Vajra	1 850	6 300	Aircraft reportedly has been certified for delivery of nuclear gravity bomb
Jaguar IS Shamsher	1 400	4 760	Some of the 4 squadrons in service may have a 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 range of the 29 Oct. 2004 test was to 1200 km. An upgraded version currently under development may have a range of 3500 km, possibly with a reduced payload.

[c] Other aircraft in the Indian Air Force's inventory which are potentially suitable for a nuclear role are the MiG-27 and the Su-30MKI.

Sources: Indian Ministry of Defence, annual reports and press releases; Vivek Raghuvanshi, 'India grounds Jaguars; BAE assists review', *Defense News*, 14 June 2004, p. 28 and various other articles; Bharat Rakshak, Consortium of Indian military Internet sites, URL <http://www.bharat-rakshak.com>; Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group, Ltd: Coulsdon, 2004); US Department of Defense, National Air and Space Intelligence Center (NAIC), *Ballistic and Cruise Missile Threa*t (NAIC: Wright-Patterson Air Force Base, Ohio, Aug. 2003, revised); 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>; and Authors' estimates.

tonium). If the test gave confidence that this material could be used for weapons, then India may see the large holdings of plutonium associated with its civilian unsafeguarded power reactors as being a potential part of its military nuclear programme.

India also has a uranium enrichment programme and operates two gas centrifuge facilities: a pilot-scale plant at the Bhabha Atomic Research Centre complex and a larger plant that has reportedly been operating since 1990 at Rattehalli, Karnataka.[29] The primary purpose of the latter facility appears to be to produce highly enriched uranium (HEU) for an indigenous nuclear-powered submarine. HEU can also be fabricated for use in nuclear weapons or as the fission trigger (or 'primary') to aid in initiating a fusion reaction in thermonuclear weapons.

[29] Ramana, M., 'An estimate of India's uranium enrichment capacity', *Science and Global Security*, no. 1–2 (Jan.–Aug. 2004), pp. 115–24.

Indian officials claim that the country has developed both fusion (thermonuclear) and fission nuclear weapons. Many Western experts have questioned whether India has in fact achieved a thermonuclear capability. They point to seismic data which suggest that India's test of a 'thermonuclear device' in May 1998 had a significantly smaller yield than was claimed and probably was not successful.[30] However, the tests may have provided India with the capability to produce 'boosted' fission nuclear weapons.

Strike aircraft

At present, aircraft constitute the core of India's nuclear strike capabilities. The Indian Air Force has reportedly certified the Mirage 2000H for the delivery of nuclear gravity bombs. It is widely speculated that that some of the four squadrons of Jaguar IS fighter-bombers may have a nuclear delivery role. Other aircraft in the Indian Air Force's inventory which are potentially suitable for a nuclear role are the MiG-27 and the Su-30MKI.

Ballistic missiles

India has extensive, largely indigenous development and production infrastructures for both short- and medium-range ballistic missiles. Several missiles are believed to have a nuclear role.

The Prithvi ('Earth') was India's sole ballistic missile for many years before the induction into service of the Agni missile. The Prithvi I is a single-stage, road-mobile ballistic missile capable of delivering an 800-kg warhead to a maximum range of 150 km. Reports suggest that an improved liquid propellant is being developed for the missile to improve its range, and a solid propellant engine is being researched. The missile was first test flown in 1988 and entered into service with the Indian Army in 1994. On 23 January 2004 India announced that it had successfully conducted the twenty-third test launch of the Prithvi I at the Integrated Test Range on Wheeler's Island, in the Bay of Bengal, off the coast of the eastern state of Orissa.

An undisclosed number of Prithvi I missiles have been modified to deliver sub-kiloton nuclear warheads. However, Indian defence sources have indicated that the family of longer-range Agni ballistic missiles has largely taken over the Prithvi's nuclear role.[31]

There are two other versions of the Prithvi missile. Unlike the Prithvi I, these do not have a nuclear role. The Prithvi II, which was developed for the Indian Air Force, has an extended range of 250 km and carries a reduced payload (500–700 kg). It was most recently flight tested on 19 March 2004. A naval version of the Prithvi II, called the Dhanush ('Bow') system, was test fired successfully from a ship, INS *Subhadra*, off the coast of Orissa on 7 November 2004.[32]

[30] 'India has fusion, fission bombs: Abdul Kalam', *The Hindu* (Internet edn), 13 Nov. 2001, URL <http://www.hinduonnet.com/thehindu/2001/11/13/stories/02130001.htm>.

[31] 'Pithvi SRBM', Bharat Rakshak: consortium of Indian military websites, updated 8 Dec. 2004, URL <http://www.bharat-rakshak.com/MISSILES/Prithvi.html>.

[32] 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>; and Indian Ministry of Defence, 'Test of Dhanush', Press release, New Delhi, 8 Dec. 2004, URL <http://mod.nic.in/pressreleases/content.asp?id=882>.

The Prithvi III is a two-stage solid fuel missile which can deliver a 1000-kg payload to a range of 300 km at the Integrated Test Range at Wheeler's Island.[33] A modified naval version, known as the Sagarika, is in development and is intended to be launched from a submerged submarine.[34] It was flight tested for the first time on 27 October 2004, when a missile was launched from a specially constructed underwater platform and canister. It flew 230 km before landing in the Bay of Bengal.[35]

There is considerable confusion in the media and among independent experts about the Agni I missile, which is sometimes reported to exist in a medium-range version and sometimes in a shorter-range version. The original Agni missile was a technology demonstrator that was test flown several times between 1989 and 1994 but was never operationally deployed. The current missile, which has been referred to as the 'Agni Short Range' or 'Agni SR', is designated Agni I by the Indian MOD.[36] It is a single-stage solid-fuel missile that uses the first-stage engine of the Agni II and has a range of 700 km. Like the Agni II, it can be launched from rail or road launchers. On 4 July 2004 India announced that it had successfully test fired an Agni I missile from a mobile launcher at the Integrated Test Range. Many analysts saw the test as India's response to Pakistan's series of ballistic missile tests conducted at the end of June.

The medium-range Agni II has a range exceeding 2000 km and can carry conventional as well as nuclear warheads weighing up to 1000 kg. On 29 August 2004 India announced that it had test launched an Agni II missile, which landed in the designated target area 1200 km away in the Bay of Bengal. It was the third test of an Agni II (the previous tests were conducted in April 1999 and January 2001).

The Agni I and Agni II development programmes have been completed and the missiles have entered into production. During 2004 they were inducted into service with the Indian Army's 334 and 335 Missile Groups, respectively.

The development of the Agni III intermediate-range ballistic missile, with a range exceeding 3200 km, continues to experience enginering and systems integration problems. The missile's maiden flight test was repeatedly postponed in 2004. Indian sources indicate that, because of technical problems, the Defence Research & Development Organization has decided to increase the range of the Agni II missile as an interim measure.[37] The nuclear-capable Agni III will be able to reach targets deep inside China.

There are reports that India is developing an ICBM known as Surya, based on an indigenous space launch vehicle. The missile is believed to be a three-stage design, with the first two stages using solid propellant and the third stage using liquid propellant. The programme's status is unclear from published reports.

[33] Indian Ministry of Defence, 'Prithvi-III test fired', Press release, New Delhi, 27 Oct. 2004, URL <http://mod.nic.in/pressreleases/content. asp?id=838>; and Subramanian, T. S., 'Prithvi III test fired for first time', *The Hindu* (Internet edn), 28 Oct. 2004, URL <http://www.hindu.com/2004/10/28/stories/2004102807641300.htm>.

[34] Indian Defence Ministry sources indicate that Sagarika and Prithvi III are 2 different names for the same missile. United News of India, 'Naval Prithvi testing soon', *The Tribune* (Chandigarh) 7 Sep. 1998, URL <http://www.tribuneindia.com/1998/98sep07/head6.htm>.

[35] 'Prithvi's naval variant is successfully test fired', *Times of India* (Internet edn), 28 Oct. 2004, URL <http://timesofindia.indiatimes.com/articleshow/901642.cms>; and 'India tests Prithvi III and Dhanush', *Jane's Missiles and Rockets*, vol. 8, no. 12 (Dec. 2004), p. 5.

[36] Government of India, Ministry of Defence, *Annual Report 2003–2004*, p. 100, URL <http://mod.nic.in/reports/report04.htm>.

[37] 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>.

Table 12A.8. Pakistani nuclear forces, January 2005

Type/Designation	Range (km)[a]	Payload (kg)	Status
Aircraft			
F-16A/B	1 600	4 500	32 aircraft, deployed in 3 squadrons; the most likely aircraft in the inventory to have a nuclear delivery role
Ballistic missiles[b]			
Ghaznavi (Hatf-3)	290	500	Entered service with the Pakistani Army on 21 Feb. 2004; test launched on 29 Nov. 2004
Shaheen I (Hatf-4)	>450	750–1 000	Entered service with the Pakistani Army in Mar. 2003
Ghauri I (Hatf-5)	>1 200	700–1 000	Entered service with the Pakistani Army in Jan. 2003; test launched on 12 Oct. 2004

[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] In the 1990s Pakistan received M-11 ballistic missiles from China which are thought to have formed the basis for developing the Hatf-3.

Sources: US Department of Defense, National Air and Space Intelligence Center (NAIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Aug. 2003, revised); 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.

VIII. Pakistani nuclear forces

It is difficult to estimate the size and composition of Pakistan's nuclear arsenal. As is the case with India, a key uncertainty lies in determining how much weapon-usable fissile material Pakistan has produced. It is known that Pakistan has pursued a gas centrifuge uranium-enrichment method to produce the material for its nuclear weapons, at the Kahuta Research Laboratories (also called the Khan Research Laboratories). However, estimates vary as to how much weapon-grade uranium has been produced, in part because of conflicting reports about the number of centrifuges that Pakistan has in operation. In addition, Pakistan may be developing a capability to build plutonium-based nuclear weapons. The unsafeguarded 50-Megawatt thermal heavy water reactor in the Khushab district of Punjab, which became operational in the spring of 1998, has the capability to produce 10–15 kg of weapon-grade plutonium annually. It is also capable of producing tritium, which could be used to 'boost' the explosive yield of fission weapons. In 2004 Pakistan continued to rule out

giving the International Atomic Energy Agency (IAEA) or other bodies access to its military nuclear facilities and other sensitive sites.

It is estimated here that Pakistan has manufactured 30–50 nuclear weapons. Some of these weapons are likely to be stored in unassembled form at dispersed locations. In February 2000, Pakistan's military government announced the establishment of a National Command Authority to manage the country's nuclear forces.

Pakistan continues to work to increase the size and sophistication of its nuclear weapon arsenal and associated delivery vehicles. In April 2004 Pakistan's ambassador to the United Nations, Munir Akram, said that, while Pakistan has 'strong support' for non-proliferation, it would also continue to develop nuclear weapons and ballistic missiles in order to 'maintain credible minimum deterrence' with regard to its regional rival, India. This was necessary, according to Akram, because India had 'embarked on major programs for nuclear weapons, missiles, antimissile and conventional arms acquisition and development'.[38]

Ballistic missiles

Pakistan has vigorous research and development and procurement programmes under way for advanced-capability ballistic missiles. Its missile programmes have in the past received considerable technical assistance from China and North Korea. Former Prime Minister Benazir Bhutto acknowledged in July 2004 that Pakistan had purchased missile technology from North Korea, but she denied that it aided North Korea with nuclear technology.[39]

On 21 February 2004 the Ghaznavi (Hatf-3) ballistic missile was formally inducted into service with the Pakistani Army. The Ghaznavi is a nuclear-capable short-range missile that can be transported by road on a modified Scud-B wheeled transporter–erector–launcher (TEL). Its single-stage, solid propellant design is believed to be a domestically produced copy of the Chinese M-11 missile. On 29 November 2004 Pakistan announced that it had successfully test launched a Ghaznavi missile. It had been previously flight tested the missile in October 2003 and twice in 2002.

On 8 December 2004 Pakistan announced that it had successfully test launched a Shaheen I (Hatf-4) medium-range ballistic missile. The Shaheen I, which has been declared to be nuclear-capable, entered into service with the Pakistani Army in March 2003. Analysts remain divided over whether the single-stage solid-fuelled 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.

Pakistan test fired a new ballistic missile, the Shaheen II (Hatf-6), for the first time on 9 March 2004. The two-stage Shaheen II is believed to use the Shaheen I missile as its second stage and may be able to carry multiple warheads. With a reported range of over 2000 km, it could reach targets in most of India. Following the test, the US State Department issued a statement 'urging Pakistan and other countries in the region to exercise restraint in their nuclear weapon and missile programmes'.[40]

[38] 'Pak not to allow strategic assets' inspection, missiles capability to continue', *Pak Tribune* (Internet edn), 29 Apr. 2004, URL <http://www.paktribune.com/news/index.php?id=63613>.

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

[40] US Department of State, 'Pakistan: ballistic missile test', Press release, 2004/245, Office of the Spokesman, Washington, DC, 9 Mar. 2004, URL <http://www.state.gov/r/pa/prs/ps/2004/30302.htm>.

On 29 May 2004 Pakistan conducted a flight test of the nuclear-capable Ghauri I (Hatf-5) medium-range ballistic missile. This was followed by a second Ghauri I test on 4 June. A third test was conducted on 12 October, which coincided with the fifth anniversary of General Pervez Musharraf's seizure of power in a military coup. Senior Pakistani officials emphasized that the launches were part of routine testing and not intended as a political signal to any other country. They also said that Pakistan had given India prior notice of the tests, in accordance with two countries' agreed practice. The Ghauri I missile, with a range exceeding 1200 km, and a longer-range variant, the Ghauri II, are based on North Korea's No-dong 1/2 missile technology and have reportedly been developed with extensive design and engineering assistance from North Korea. It was first successfully test launched in April 1998. Serial production of the Ghauri missile began in late 2002 and that it entered into service in January 2003.

A Ghauri III missile is under development. It has a reported design range of 3500 km, making it the longest-range ballistic missile in Pakistan's inventory. According to a Pakistani press report, a successful test of its liquid-fuel engines took place in September 1999. In May 2004 Pakistani officials indicated that the first test launch of the Ghauri III would be conducted in the near future at a testing range near Nowshera, with the impact point in the Arabia Sea. However, the year ended with no tests having taken place.

Strike aircraft

The aircraft of the Pakistani Air Force (PAF) that is most likely to be used in the nuclear weapon delivery role is the US-manufactured F-16 fighter aircraft. 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 three squadrons. In 1988–89 Pakistan had contracted to buy 71 F-16s to augment its existing inventory of 40 F-16A/B aircraft, but in October 1990 the US Government announced that it had embargoed any further deliveries to Pakistan in accordance with the Pressler Amendment. (Approved by the US Congress in 1984, the amendment barred military sales to foreign countries unless the president could certify that the country was not pursuing nuclear weapons.) As a result, only 28 of the 71 aircraft were built and none was delivered.

In 2004 senior Pakistani military officials said that the Bush Administration has indicated that it is willing to sell at least 24 F-16 fighter aircraft to Pakistan, pending congressional approval. President Bush had already waived the Pressler Amendment in a Presidential Determination of September 2001.[41]

IX. Israeli nuclear forces

Along with India and Pakistan, Israel is the only UN member state which remains outside the NPT. Israel is widely considered to be a de facto NWS and is estimated to maintain up to about 200 nuclear weapons. Many analysts believe that Israel has a

[41] The White House, 'President waives sanctions on India, Pakistan', Presidential Determination no. 2001-28, 22 Sep. 2001, URL <http://www.whitehouse.gov/news/releases/2001/09/20010922-4.html>.

Table 12A.9. Israeli nuclear forces, January 2005

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

[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 Jericho I missile, first deployed in 1973, may no longer be full operational.

Sources: Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group, Ltd: Cauldron, 2003); Cohen, A., *Israel and the Bomb* (Columbia University Press: New York, 1998); Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997); 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

recessed nuclear arsenal (i.e., one that is stored but not armed, requiring some preparation before use); hence, 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 is some evidence that Israel may have developed a non-strategic nuclear arsenal, consisting of nuclear artillery shells and atomic demolition munitions (ADMs) or landmines.

Israel continues to maintain its long-standing policy of nuclear ambiguity in which it officially neither confirms nor denies that it possesses nuclear weapons. This policy came under renewed international scrutiny in 2004. At the 2004 Preparatory Committee meeting for the 2005 NPT Review Conference,[42] the League of Arab States and the European Union called for the establishment of a weapons of mass destruction-free zone in the Middle East.[43] In addition, the IAEA reiterated its request that Israel open for inspection its nuclear facility at Dimona. In July 2004, following a visit to Israel by IAEA Director General Mohamad ElBaradei, Israeli Prime Minister Ariel Sharon stated publicly that Israel would consider giving up its 'deterrent

[42] On the work of the Preparatory Committee in 2004 see chapter 12, section VII.

[43] See 'Paper presented on behalf of the States members of the League of Arab States at the third session of the Preparatory Committee for the 2005 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, New York, 28 Apr. 2004, NPT/CONF.2005/PC.III/WP.12, URL <http://daccess-ods.un.org/TMP/6450427.html>.

capability' if its neighbours gave up their weapons of mass destruction and fully implemented a comprehensive regional peace agreement.[44]

There continues to be speculation that Israel has developed a sea-based nuclear capability. In December 2004, Germany agreed to permit the sale to Israel of two diesel-powered Dolphin Class submarines in a $700 million deal. The German Government had halted the deal in November 2003, ostensibly because of financing issues. The new vessels, which are to be built by Kiel-based Howaldtswerke-Deutsche Werft AG beginning in 2005, will join the three Dolphin Class submarines that were delivered to the Israeli Navy in 1998–99. The new sale was controversial because there have been unconfirmed media reports—denied by Israeli officials—that Israel has successfully modified US-supplied Harpoon anti-ship cruise missiles to carry nuclear warheads on its submarines. Among other modifications, this may involved reducing the size of the warheads to fit inside the missiles as well as altering the guidance systems so as to be able to hit land-based targets. The missile's 140-km range may also have been extended. Israeli officials have acknowledged that its Dolphin Class submarines carry Harpoon missiles, which are launched through specially designed torpedo tubes. With nuclear-armed missiles deployed at sea, Israel would have a secure nuclear retaliatory capability to offset the potential vulnerability of its aircraft and land-based missiles to a pre-emptive attack.

[44] 'Israel firm on its "deterrent capability"', *Daily Star* (Lebanon), 30 July 2004, URL <http://www.dailystar.com.lb/article.asp?edition_ID=10&article_ID=6772&categ_id=2>.