Appendix 15A. World nuclear forces

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I. Introduction

Despite the efforts over the past half-century to reduce and then eliminate nuclear weapons worldwide, and the commitments made by the parties to the 1968 Non-Proliferation Treaty (NPT)[1] to achieve this goal, the five states defined by the NPT as nuclear weapon states—China, France, Russia, the United Kingdom and the United States—continue to deploy more than 16 000 operational nuclear weapons (see table 15A.1). If all warheads are counted—those deployed, spares, warheads in both active and inactive storage, and 'pits' (plutonium cores) held in reserve—the five nuclear-weapon states possess an estimated total of 36 500 nuclear warheads.

The United States has begun to implement the 2001 Nuclear Posture Review (NPR), affecting all aspects of the US nuclear posture: new ballistic missiles, strategic submarines, long-range bombers, nuclear weapons, nuclear weapon production facilities, and nuclear command and control systems.[2] Similarly, in addition to modernizing its nuclear forces, Russia has begun to change its force structure under the 2002 US–Russian Strategic Offensive Reductions Treaty (SORT)[3] by retaining rather than dismantling its intercontinental ballistic missiles equipped with multiple, independently targetable re-entry vehicles (MIRVed ICBMs) and is planning to deploy MIRVed warheads on several new systems. Tables 15A.2 and 15A.3 show the composition of the US and Russian deployed nuclear forces.

The nuclear arsenals of the UK, France and China are considerably smaller than the US and Russian arsenals, but these three states are also modernizing their forces and remain committed to retaining nuclear weapons. Data on the British, French and Chinese delivery vehicles and nuclear warhead stockpiles are presented in tables 15A.4–15A.6. It is unclear whether China 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. The British nuclear weapon stockpile has levelled out at slightly less than 200 warheads: the UK is the only one of the five nuclear weapon states that is not known to be developing new nuclear weapon systems.[4]

[1] 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.

[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>.

[3] The text of SORT is available at URL <http://www.state.gov/t/ac/trt/18016.htm>; the treaty entered into force on 1 June 2003. For the implications of SORT see 'Special Section', *Arms Control Today*, vol. 32, no. 5 (June 2002), pp. 3–23.

[4] For detailed information on recent developments in world nuclear forces see Kristensen, H. M. and Kile, S. N., 'World nuclear forces', *SIPRI Yearbook 2003: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2003), pp. 610–27, and previous editions of the SIPRI Yearbook.

Table 15A.1. World nuclear forces, by number of deployed warheads, January 2004

Country	Strategic warheads	Non-strategic warheads	Total warheads
USA	5 886	1 120	**7 006**[a]
Russia	4 422	3 380	**7 802**[b]
UK	185	–	**185**
France	348	–	**348**
China	282	120	**402**
India	–	–	**(30–40)**[c]
Pakistan	–	–	**(30–50)**[c]
Israel	–	–	**(~200)**[c]
Total			**~16 033**

[a] The total US stockpile, including reserves, contains *c*. 10 400 warheads. In addition, 5000 'pits' (plutonium cores) are in storage as a strategic reserve, while another 7000 pits make up most of the 34 tons of weapon-grade plutonium which the USA has declared in excess of its military requirements.

[b] The total Russian stockpile contains 17 000 warheads, of which *c*. 9200 are in storage and/or awaiting dismantlement.

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

It is particularly difficult to obtain public information about the nuclear arsenals of India, Pakistan and Israel—three states which are not parties to the NPT—and the information which is available is limited and often contradictory. Tables 15A.7–15A.9 present estimates of the size of their nuclear weapon stockpiles and information about their potential nuclear weapon delivery systems.

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 2004, the USA maintained an estimated stockpile of 7006 operational nuclear warheads, consisting of 5886 strategic and 1120 non-strategic warheads. Another 370 warheads are spares. This is a reduction of some 314 operational warheads compared to early 2003, owing to the reduction in the number of ballistic missiles. In addition to these operational warheads, an additional 3000 are held in reserve.

The USA has begun to implement the decisions of the 2001 Nuclear Posture Review, which are intended to reduce the number of 'operationally deployed strategic warheads' to 1700–2200 by the end of 2012 in three phases. Neither the NPR nor the SORT Treaty mandated new reductions compared with past arms control initiatives. Force changes in 2003 involved the implementation of reductions decided by previous administrations as well as the start of weapon modernization programmes set out in the NPR. The US Administration is expected to complete a stockpile management plan in 2004 for the longer-term composition of the US nuclear arsenal.

Strategic nuclear weapons

The US ICBM force was reduced by 17 missiles in 2003 with the ongoing retirement of the Peacekeeper (MX) ICBM. Of an initial force of 50 missiles, 29 were still on alert at the beginning of 2004. The 170 W87 warheads from the retired Peacekeeper missiles have been put in storage and will replace the W62 warheads on Minuteman ICBMs, beginning in fiscal year (FY) 2006. The W62 warhead is scheduled to be retired in 2009. In 2003 work continued on modernizing the guidance and propulsion systems of Minuteman ICBMs.

The USA plans to retain multiple warheads on some ICBMs. Instead of deploying 500 warheads on 500 missiles by 2007, as planned under the abandoned START II Treaty,[5] the US Department of Defense (DOD) is, under the terms of SORT, considering maintaining up to 800 warheads on the US Minuteman missile force.[6]

Four ICBMs were test-launched in 2003: three Minuteman III ICBMs, each carrying three re-entry vehicles; and one Peacekeeper ICBM with eight re-entry vehicles. The launch of the Peacekeeper was intended to verify the missile's accuracy and reliability, even though the missile is being retired.

In 2002 the US Air Force (USAF) issued a new Mission Need Statement (MNS) for the land-based strategic nuclear deterrent to begin the process of replacing the Minuteman III by 2020. The MNS reaffirmed 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] In September 2003 the USAF began the process of soliciting bids for the next-generation land-based strategic deterrent, to replace the Minuteman III beginning in 2018.

In 2003 the US SSBN fleet was reduced from 16 to 15 submarines. This involved the withdrawal of the third of four older SSBNs from strategic service (USS *Georgia*) for conversion to non-nuclear missions. In parallel with the conversion of these four SSBNs, four submarines equipped with the Trident I (C-4) submarine-launched ballistic missile (SLBM) are being modernized to carry the newer and more powerful and accurate Trident II (D-5) missile. Two submarines have been converted so far (USS *Alaska* and USS *Nevada*) and two will be converted in 2005 and 2006 (USS *Henry M. Jackson* and USS *Alabama*, respectively). Development of a Life Extension (LE) modification of the D-5 missile has begun in order to match the extended service life of the SSBN force though 2040. In 2003 the US Navy opened the bid-soliciting process for a new intermediate-range ballistic missile for future submarines.

Two D5 SLBMs were test-fired in 2003: one from USS *Maine* (SSBN-741) on 23 April; and one from USS *Maryland* (SSBN-738) on 5 November, both in the Atlantic Ocean. In the April test, the new W76-1/Mk 4 re-entry vehicle had a modified fuze designed to give the warhead a surface-burst capability. Combined

[5] The 1993 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. In addition, on 14 June 2002, in response to the taking effect on 13 June of the USA's withdrawal from the ABM Treaty, Russia declared that it would no longer be bound by the START II Treaty.

[6] Herbert, A. J., 'The future missile force', *Air Force Magazine*, vol. 86, no. 10 (Oct. 2003), p. 67; and US Department of Defense, Public Affairs, Communication with the author.

[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.

with a new guidance system being developed to give SLBM re-entry vehicles global positioning system (GPS)-like accuracy (less than 10 metres), the modernization programme will significantly enhance the capability of the 100-kt W76 warhead.

Non-strategic nuclear weapons

As of January 2003 the USA had 1120 non-strategic nuclear warheads. These consisted of 800 B61 gravity bombs of three types and 320 W80-0 warheads for Tomahawk land-attack cruise missiles (TLAM/Ns). Despite the significant number of non-strategic warheads, they are not addressed by either the 2001 NPR or the 2002 SORT Treaty.

In 2003 the DOD decided to retain the nuclear-armed version of the Tomahawk missile for deployment on certain Los Angeles, Improved Los Angeles and Virginia Class attack submarines. As a result, the missiles and the W80-0 warheads are expected to undergo refurbishment in order to extend their service lives until about 2040. TLAM/Ns are not deployed at sea under normal circumstances, but if the order is given to do so they can be redeployed on attack submarines in only 30 days.

The 800 operational B61 non-strategic nuclear bombs are earmarked for delivery by various US and NATO-assigned aircraft. Another 500 are in reserve. About 150 of the B61 bombs are deployed at nine airbases in six European NATO member states (Belgium, Germany, Italy, the Netherlands, Turkey and the UK) and are the only US nuclear weapons that are still forward-deployed (other than the long-range missiles carried on SSBNs). The aircraft of non-nuclear weapon NATO countries that are assigned nuclear strike missions with US weapons include Belgian and Dutch F-16 aircraft as well as German and Italian Tornado bombers. A six-year upgrade of all B61-3/4/10 bombs in Europe was completed in 2003; the intention was to enhance 'the safety, use control, and reliability' of the weapons.

New nuclear weapon research

In 2003 the US Congress authorized funding to continue research work on a new nuclear-armed earth-penetrating weapon to replace or augment the existing B61-11 bomb, introduced in 1997. The 2001 NPR determined that there was a need to improve the ability to destroy deeply buried underground facilities with nuclear weapons, and the DOD is studying the conversion of the B61 or B83 nuclear bomb into a Robust Nuclear Earth Penetrator (RNEP). In 2003 Congress also approved a request from the Bush Administration to begin studying advanced concepts for nuclear weapons, including low-yield (less than 5 kt) nuclear weapons.[8]

Nuclear warhead stockpile management

There are two overall categories of nuclear warheads in the US stockpile. The active category includes intact warheads with all components that are either deployed on operational delivery systems or can be deployed 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. The NPR defined a new sub-

[8] See also chapter 15.

Table 15A.2. US nuclear forces, January 2004

Type	Designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads
Strategic forces						
Bombers[b]						
B-52H	Stratofortress	93/56	1961	16 000	ALCM 5–150 kt	430
					ACM 5–150 kt	430c
B-2	Spirit	21/16	1994	11 000	Bombs	800[d]
Subtotal		*114/72*				*1 660*
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	3 x 335 kt	900
LGM-118A	MX/Peacekeeper[f]	29	1986	11 000	10 x 300 kt	290
Subtotal		*540*				*1 490*
SSBNs/SLBMs[g]						
UGM-96A	Trident I (C-4)	72	1979	7 400	6 x 100 kt	432
UGM-133A	Trident II (D-5)	288				
	Mk-4	n.a.	1992	> 7 400	8 x 100 kt	1 920
	Mk-5	n.a.	1990	> 7 400	8 x 475 kt	384
Subtotal		*360*				*2 736*
Strategic subtotal						*5 886*
Non-strategic forces						
B61-3, -4, -10 bombs		n.a.	1979	n.a.	0.3–170 kt	800
Tomahawk SLCM		320	1984	2 500	1 x 5–150 kt	320[h]
Non-strategic subtotal						*1 120*
Total						**7 006**[i]

[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 back-up. 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.

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

[f] From Oct. 2002 to Dec. 2003, 21 Peacekeeper ICBMs were dismantled. Another 13 are scheduled to be dismantled by the end of FY 2004 (i.e., 30 Sep. 2004), with the final 16 to be dismantled in FY 2005.

[g] Of 8 initial SSBNs based at Bangor, 4 are under conversion to nuclear-powered guided-missile submarines (SSGNs) and 2 have been refitted with the completed Trident II (D-5) SLBM. Two D-5-equipped SSBNs based in the Atlantic were shifted to the Pacific in late 2002 and a third will follow in Oct. 2004. The remaining 2 Trident I (C-4)-equipped SSBNs will be upgraded with the D-5 SLBM 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, but D-5 missiles are still counted as carrying 8 warheads each.

[h] The nuclear-armed version of the Tomahawk SLCM is no longer deployed with the fleet but is stored on land.

[i] Another 380 warheads are spares, and *c.* 3000 intact 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. 2004; US Navy, Personal communication with the author; 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 Author's estimates.

category of active warheads—the Responsive Force—which consists of intact warheads that have been removed from operational service but which could relatively quickly be 'uploaded' back on to ballistic missiles and aircraft. The W87 warheads from dismantled Peacekeeper ICBMs and W76 warheads from converted Trident submarines are held in the Responsive Force. As the NPR is implemented over the next 10 years, there will be roughly three times as many warheads in non-operational categories as there are operationally deployed warheads.

In addition to having approximately 10 400 intact active and inactive warheads, the USA keeps about 5000 pits 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. In late 2003, the last W79 warhead was dismantled, completing the destruction of all US nuclear artillery shells, as decided by the Administration of President George H. W. Bush in 1991. A programme is currently under way to repackage the 12 000 pits at Pantex for long-term storage, and small-scale pit production has resumed at Los Alamos National Laboratory. The Bush Administration plans to build a Modern Pit Facility capable of producing
250–900 pits annually.

III. Russian nuclear forces

At the beginning of 2004 Russia had an estimated 7800 operational nuclear warheads, consisting of 4400 strategic and 3400 non-strategic and air defence warheads. This is an increase of approximately 330 warheads over 2003 owing to the withdrawal of nearly 70 ICBMs from operational service.

Estimates of the exact size of the Russian (operational and inactive) nuclear stockpile, especially the non-strategic arsenal, are subject to considerable uncertainty. Some 30 000 nuclear weapons, plus or minus several thousand, may have been in the Soviet arsenal in 1991. US DOD and Central Intelligence Agency (CIA) estimates suggest that Russia dismantled slightly more than 1000 warheads per year during the 1990s; that is, more than 10 000 were dismantled after 1991. If this trend has continued, the remaining Russian arsenal may contain some 17 000 nuclear weapons, plus or minus several thousand. With approximately 7800 weapons considered operational, the remaining 9200 are weapons in storage, some or all of which are to be dismantled.

Table 15A.3. Russian nuclear forces, January 2004

Type	NATO designation	No. deployed	Year first deployed	Range (km)[a]	Warheads x yield	Warheads
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	120	1979	11 000–15 000	10 x 500–750 kt	1 200
SS-19	Stiletto	130	1980	10 000	6 x 500–750 kt	780
SS-24 M1	Scalpel	15	1987	10 000	10 x 550 kt	150
SS-25	Sickle	312	1985	10 500	1 x 550 kt	312
SS-27	(Topol-M)	36	1997	10 500	1 x 550 kt	36
Subtotal		*613*				*2 478*
SLBMs[b]						
SS-N-18 M1	Stingray	96	1978	6 500	3 x 200 kt (MIRV)	288
SS-N-20	Sturgeon	40	1983	8 300	10 x 100 kt (MIRV)	400
SS-N-23	Skiff	96	1986	9 000	4 x 100 kt (MIRV)	384
Subtotal		*232*				*1 072*
Total strategic offensive forces						**4 422**
Strategic defensive forces						
ABMs						
Gorgon/Gazelle		100			1 x 1000 kt/ 1 x 10 kt	100
Grumble[c]		1 100			n.a.	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 forces						**3 380**
Total						**7 802**

[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.

[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 2004; 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 Author's estimates.

In 2003 there were signs that Russia's ICBM force was being renewed. One of the most significant developments was the President Vladimir Putin's announcement in October of a decision to deploy 'tens' of additional SS-19s with 'hundreds of warheads'.[9] The missiles will begin to enter service in 2010 and will remain in service until the end of 2030, possibly with the Tarishchevo and Kozelsk divisions. The SS-19 deployment decision had been preceded by an announcement in 2002 that Russia would retain the 10-warhead SS-18 missile, another weapon that had been slated for destruction under the START II Treaty, 'for another 10 to 15 years' (i.e., 2013–18).[10] According to several reports, development of a new Russian ICBM with a payload of 4.4 tons and up to 10 warheads has begun, for deployment sometime after 2009.[11]

The slow deployment of the SS-27 (Topol-M) ICBM continued in 2003, with a new regiment of six silo-based ICBMs entering operation at the Tatishchevo missile base on 21 December, bringing the total number of Russian SS-27s to 36. The first mobile version of the SS-27 missile, with a single warhead, is expected to become operational in 2004. The mobile SS-27s may carry four to six warheads each.[12]

An SS-27 ICBM was test-launched on 27 March 2003. The Russian Strategic Missile Force announced in December that it planned to conduct 10 ICBM test launches in 2004.

The size of the Russian SSBN force remained unchanged in 2003, although three Borey Class SSBNs are under construction at the Severodvinsk shipyard in northern Russia. The first submarine of the new class is scheduled for delivery in 2005, with the other two to follow by 2011 or 2012. Each Borey Class SSBN will carry 12 SS-N-27 SLBMs (the Bulava-30) with a range of over 8000 km and MIRVed warheads.

[9] Russian Federation, Ministry of Foreign Affairs, 'Concluding remarks by President Vladimir Putin at a meeting with Russian Armed Forces Commanders, Moscow, October 2, 2003', *Daily News Bulleti*n, 3 Oct. 2003. According to a report in *Izvestiya*, this concerns 30 missiles. Litovkin, D., 'We'll get all of them from Capetown to Beijing', *Izvestiya*, 21 Oct. 2003.

[10] The initial announcement in 2002 stated that the SS-18 would be retained until the end of 2016, but the head of the Strategic Missile Force stated in Dec. 2003 that the timeline was 10–15 years. 'Russia plans to keep SS-18 ICBMs for at least 10 more years', Nuclear Threat Initiative/Global Security Newswire, 18 Dec. 2003, URL <http://www.nti.org/d_newswire/issues/2003_12_18.html>.

[11] 'Russia deploys new missile batch', CNN.com, 22 Dec. 2003, URL <http://edition.cnn.com/2003/WORLD/europe/12/22/russia.missiles.ap/>; and 'Russia to continue developing strategic nuclear forces', chinaview.cn, 23 Dec. 2003.

[12] 'Russia deploys strategic nuclear missiles', *New York Times* (Associated Press), 22 Dec. 2003; and 'Russia deploys new missile batch', CNN (Associated Press), 22 Dec. 2003.

Three Russian SLBM test launches were conducted in 2003. The Typhoon Class SSBN *Arkhangelsk* launched an SS-N-23 SLBM from the Northern Fleet area on 15 October. On 11 December the modified Typhoon Class SSBN *Dmitry Donskoi* test-launched an SLBM, probably the new SS-N-27 Bulava, from the White Sea. On 26 December the Delta IV Class SSBN *Yekaterinburg* test-fired an SLBM, probably an SS-N-23, from the Northern Fleet area. The Russian Navy resumed SSBN deterrent patrols in 2003 at a low level, after failing to conduct a single patrol in 2002.[13]

IV. British nuclear forces

The UK maintains an arsenal of about 185 warheads for a fleet of four Trident SSBNs, consisting of 160 operational warheads and an additional 15 per cent of that number for spares. This makes the British arsenal the smallest of the five NPT-defined nuclear weapon states.

One of the SSBNs, the HMS *Vanguard*, has since February 2002 been undergoing nuclear refuelling at the Devonport Naval Base, which leaves three submarines in the fleet for operational deployment. Once this refuelling is completed, in 2004, the HMS *Victorious* is scheduled to follow.

At any given time the sole British Trident submarine on patrol will carry about 40 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. The SSBN on patrol is maintained at a level of 'reduced readiness' with a 'notice to fire' measured in days rather than in a few minutes.

The UK is the only nuclear weapon state that has publicly assigned its SSBNs 'sub-strategic missions'. According to a former 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 strike'.[14] Speaking before Parliament's Defence Committee in March 2002, British Defence Secretary Geoff Hoon asserted that 'states of concern' armed with weapons of mass destruction 'can be absolutely confident that in the right conditions we would be willing to use our nuclear weapons'.[15]

Although the UK is not currently known to have under way a significant strategic weapon modernization programme, modernization of its Trident force closely follows the USA's modernization of the D-5 missile. The 1998 Strategic Defense Review stated the need to maintain the Trident force 'for up to 30 years', matching the extended service life of the USA's Ohio Class SSBN. The 2003 British Defence

[13] See Kristensen and Kile (note 4), p. 615; and Pincus, W., 'Russia resumes strategic sub patrols after year off', *Washington Post*, 5 July 2003, p. A14. A few days later this was denied by a Russian Navy spokesperson. Getmansky, K., 'Nuclear containment,' *Izvestiya*, 11 July 2003, p. 3.

[14] Ormond, D., 'Nuclear deterrence in a changing world: the view from a UK perspective', *RUSI Journal*, vol. 141, no. 11 (June 1996), pp. 15–22.

[15] 'UK restates nuclear threat', BBC News Online, 2 Feb. 2003, URL <http://news.bbc.co.uk/1/hi/uk_politics/2717939.stm>.

Table 15A.4. British nuclear forces, January 2004

Type	Designation	No. deployed	Year first deployed	Range (km)	Warheads x yield	Warheads in stockpile
SLBMs						
D-5	Trident II	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*, vol. 141, no. 11 (June 1996), pp. 15–22; Norris, R. S. *et al., Nuclear Weapons Databook,* vol. 5: *British, French, and Chinese Nuclear Weapons* (Westview Press: Boulder, Colo., 1994), p. 9; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Author's estimates.

White Paper states that decisions on whether to replace Trident are likely to be required in the next session of Parliament.[16]

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 bombers. France continues to modernize its nuclear forces under a programme that includes the third and fourth Triomphant Class SSBNs, a new nuclear warhead for the M51 SLBM, the ASMP-A (Air-Sol Moyenne Portée) cruise missile and the Rafale nuclear-capable strike aircraft.

The backbone of France's nuclear deterrent force consists of a fleet of four operational SSBNs of two classes: two of the new Triomphant Class SSBNs; and two Redoutable Class SSBNs. Since the latter two SSBNs are equipped with different SLBMs (M4 and M45), there are strictly speaking three classes of French SSBNs.

Three SSBNs 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. Because the fourth SSBN will always be in refit, only three sets of missiles with an estimated 288 nuclear warheads are available for three submarines.

Two more Triomphant Class SSBNs are under construction—the first scheduled for completion in late 2004 and the seconod in 2010—to replace the two older SSBNs. From 2010, beginning with the *Le Terrible*, all four Triomphant Class SSBNs will be equipped with the new M51 SLBM currently under development. A full-scale, unarmed version of the M51 was test-fired in January 2004. The longer range of the M51, which is expected to be in excess of 6000 km (possibly 8000 km), will permit French SSBNs to greatly expand their patrol zones and target sets.

The ASMP cruise missile is deployed with the French Air Force and Navy. Three Air Force Mirage 2000N squadrons currently have nuclear strike roles. The ASMP is also deployed on the aircraft carrier *Charles de Gaulle* for delivery by the upgraded

[16] British Ministry of Defence (MOD), *Delivering Security in a Changing World: Defence White Paper,* vol. 1, CM 6041 (Stationery Office: Norwich, Dec. 2003), p. 9, available at URL <http://www.mod.uk/publications/whitepaper2003/>.

Table 15A.5. French nuclear forces, January 2004

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 Etendard	24	1978	650	1 x 300 kt ASMP	10
SLBMs					
M4.71[b]	16	1985	6 000[c]	6 x 150 kt	96
M45	32	1996	6 000[c]	6 x 100 kt	192
Total					**348**

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

[b] The M4.70 with TN-70 warheads was retired in 1996.

[c] The range of the M4 and the 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 Press: 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 Author's estimates.

Super Étendard aircraft. The ASMP is equipped with the 300-kt TN-81 warhead and has a range of about 300 km. It is estimated that France has about 60 operational ASMPs, but additional missiles may be in inactive storage.

A new cruise missile, designated the ASMP-A, is under development for deployment with the French Air Force and Navy to replace the ASMP in late 2007. The over $923 million development contract was awarded in December 2000, and three ground-based test-firings of the ASMP-A are planned for 2004, to be followed by airborne launches from the Mirage 2000N and Rafale in 2005–2006. The ASMP-A will have a significantly longer range and carry a new warhead—the Tête nucléaire aéroportée (TNA), the 'sister' of the M51.2 TNO (tête nucléaire océanique) warhead for the M51 SLBM.

The ASMP-A cruise missile will be integrated with a modified version of the Mirage 2000N, designated the Mirage 2000N K3. Fifty aircraft will be modified.[17] The $170 million contract for integration of the ASMP-A with the Mirage 2000N K3 was awarded in October 2003. The Mirage 2000N K3 aircraft will eventually be replaced by the Rafale F3, which from 2007 is planned to be the multi-purpose fighter-bomber for the French Air Force and Navy. Its roles include conventional ground attack, air defence, air superiority and delivery of the nuclear-armed ASMP-A.

[17] Assemblée Nationale, Au Nom de la Commission de la Défense National et des Forces Armées, sur le project de loi de finances pour 2004 (no. 1093), Tome II, Défense, Dissuasion Nucléaire, 9 Oct. 2003, p. 27.

Nuclear doctrine

Several reports in 2003[18] suggested that France had changed its nuclear doctrine to one resembling that of the USA—that is, one targeting 'rogue' states armed with nuclear, chemical or biological weapons. The reports were wrong because a shift in nuclear doctrine with respect to planning for regional opponents happened gradually during the 1990s. It was most recently reaffirmed by President Jacques Chirac in June 2001, when he stated that the doctrine allows France 'to face the threats that may be aimed against our vital interests by any regional powers who might acquire weapons of mass destruction'. Chirac said that potential targets would include the centres of political, economic and military power. He affirmed that 'France, while remaining faithful to its concept of non-use, has and will conserve the means of maintaining the credibility of its deterrence in the face of all new threats'.[19]

VI. Chinese nuclear forces

China is estimated to have an arsenal of more than 400 nuclear weapons for delivery by aircraft, land-based ballistic missiles and SLBMs. China may also have non-strategic nuclear weapons, possibly for delivery by artillery; however, information is limited and contradictory.

According to US Government reports, a build-up of Chinese nuclear forces is under way which by 2015 may increase the number of China's ballistic missiles capable of striking the USA from 20 to 60 and the number of warheads targeted primarily against the USA 'several-fold' to 75–100 warheads. Whether this build-up will occur remains to be seen. Past predictions by the US intelligence community about Chinese increases have proven highly inaccurate and exaggerated.

China has three new ballistic missiles in development: the road-mobile DF-31 (CSS-X-10) ICBM, a longer-range version of the DF-31 (called the DF-31A or the DF-41), and the Julang II (Great Wave) SLBM. Development of these missiles began in the mid-1980s. There is widespread speculation that China will deploy multiple warheads on some or all of these new missiles. There are also unconfirmed reports that China has in the past carried out launches of the DF-3 and DF-21 ICBMs equipped with multiple warheads.

China has had great difficulty in developing a sea-based nuclear deterrent. The single Xia Class SSBN may not ever have achieved full operational capability. A new SSBN project, designated Project 094, has begun with one submarine under construction, but operational deployment is many years away.

[18] See, e.g., Bryant, L., 'Defense strategy seen shifting to pre-emption', United Press International, 28 Oct. 2003; and Lichfield, J., 'France may allow "first strikes" on rogue states in policy shift', *The Independent*, 28 Oct. 2003.

[19] Chirac, J., Speech before the Institut des Hautes Études de Defense Nationale, 8 June 2001, included as Sheet 27 of 'Part II: Information Sheets' to French Ministry of Defence, 'Bill of Law for the 2003–2008 Military Programme', 2000, URL <http://www.defense.gouv.fr/english/files/d140/fiches_integrale.pdf>.

Table 15A.6. Chinese nuclear forces, January 2004

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.	2004–2005?	8 000	1 x ?	0
SLBM s						
Julang I	CSS-N-3	12	1986	1 700	1 x 200–300 kt	12
Strategic weapons						*282*
Non-strategic weapons						
Artillery/ADMs, Short-range missiles					Low kt	120
Total						**~ 402**

[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 table assumes 150 bombs for the bomber force, with yields estimated at between 10 kt and 3 Mt.

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 Intelligence Center (NAIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Apr. 1999); Norris, R. S. *et al., Nuclear Weapons Databook,* vol. 5: *British, French, and Chinese Nuclear Weapons* (Westview Press: Boulder, Colo., 1994); 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Author's estimates.

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 may be stored in unassembled form, with the plutonium core kept separately from the non-nuclear ignition components.

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.[20]

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).[21] Second, it is not clear that 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.

In addition, there continues to be a 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 plutonium). 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 unsafeguarded power reactors as being a potential part of its military nuclear programme.

India is widely believed to be working to expand its nuclear 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 current nuclear doctrine.[22] Many Western experts have questioned whether India possesses fusion (thermonuclear) and fission nuclear weapons. 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 that it probably was not successful.[23]

Ballistic and cruise missiles

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

The Prithvi I is deployed with the Indian Army in two missile units. It was reported in March 2003 that India had decided to create two additional Prithvi units.[24] A decision was made in 2003 to convert Prithvi missiles to solid-fuel propulsion.

[20] 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 (ISIS), 11 Oct. 2000, URL <http://www.isis-online.org/publications/southasia/stocks1000.html>.

[21] 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, Mar. 2004, URL <http://www.world-nuclear.org/info/inf53.htm>.

[22] For further detail about India's nuclear doctrine see Ramana, M. V. and Mian, Z., 'The nuclear confrontation in South Asia', *SIPRI Yearbook 2003* (note 4), pp. 195–212.

[23] '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>.

[24] 'India introduces Agni missiles into service', NTI/Global Security Newswire, 23 Sep. 2003, URL <http://www.nti.org/d_newswire/issues/thisweek/2003_9_26_misp.html>.

Table 15A.7. Indian nuclear forces, January 2004

Type	Range (km)[a]	Payload (kg)	Status
Ballistic missiles			
Prithvi I (SS-150)	150	800	Flight tested on 26 Mar. 2003; may have a nuclear delivery role
Agni I[b]	800	1 000	Test-launched on 25 Jan. 2002 and 9 Jan. 2003; scheduled to enter service by 2004
Agni II	2 000–2 500[c]	1 000	In low-rate initial production; scheduled to enter service by 2004
Aircraft[d]			
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	Widely speculated that 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] A long-range Agni test-flown to 1500 km was a test-bed missile.

[c] An upgraded version 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 and the Su-30MKI.

Sources: Albright, D., 'India's and Pakistan's fissile material and nuclear weapons inventories, end of 1999', Background Paper, Institute for Science and International Security (ISIS), 11 Oct. 2000, URL <http://www.isis-online.org/publications/southasia/stocks1000.html>; Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997); Bharat Rakshak, Consortium of Indian military websites, URL <http://www.bharat-rakshak.com>; Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group, Ltd: Coulsdon, UK, 2003); 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/Unclassified ballisticmissilefinal.pdf>; World Nuclear Association, 'India and Pakistan', Information and Issues Brief, Mar. 2004, URL <http://www.world-nuclear.org/info/inf53.htm>; *Indian Express,* various issues; *Times of India*, various issues; and Author's estimates.

There is considerable confusion in the media and among independent experts about the Agni I missile, which is sometimes reported to exist in an intermediate-range (1500-km) version and a shorter-range (800-km) version. The initial Agni was an experimental missile that was test flown several times in the period 1989–94 but

never operationally deployed. The Agni I (as identified by the Indian Ministry of Defence) has a range of 800 km and is a single-stage solid-fuel missile that uses the first-stage engine of the Agni II. Both systems can be launched from rail-based or road-mobile launchers.

Both the Agni I and the Agni II missiles are expected to become operational in 2004 with the Indian Army's 334 and 335 Missile Groups, respectively.[25] Development of a longer-range version of the Agni (Agni III), with a range of up to 3000 km, continues. A test launch scheduled for 2003 was delayed to some time in early 2004.

There are reports that India is developing an ICBM known as Surya, based on an indigenous space launch vehicle. The CIA concluded in 2001 that India could convert its Polar Space Launch Vehicle into an ICBM within a year or two of a decision to do so.[26]

Work on development of the naval leg of India's 'triad' of nuclear forces is proceeding slowly. Efforts continue to be made to overcome design and engineering problems on a ship-launched version of the Prithvi II SS-250 short-range ballistic missile, designated the Dhanush. The most recent test was carried out on 21 September 2001, when a missile flew 150 km with a 500-kg payload. Some reports suggest that the Dhanush project may be a technology demonstration programme.

The Defence Research and Development Organization is carrying out advanced design work on a naval missile, designated the Sagarika, that may have a nuclear role. The Sagarika has been described by some sources as a cruise missile; however, the CIA states that it is an SLBM.[27] According to the CIA report, the new SLBM will not be ready for deployment before the next decade. Its intended launch platform is believed to be an indigenous nuclear-powered submarine designated the Advance Technology Vessel (ATV). The ATV programme, which has been under way for two decades, remains plagued by serious design and development problems.

Nuclear command and control

The effort to create a coherent command and control structure for India's nuclear forces, and a clear line of authority for ordering the launch of nuclear weapons, has been slowed by infighting between the Indian military services and political establishment. There was some progress in 2003, however: the Political Council of the Nuclear Control Authority (NCA) convened its first meeting, in September, to review the 'arrangements' being put in place for India's nuclear weapons deployment. The Political Council was created in January 2003 and has the sole authority to order the launch of nuclear weapons. It consists of the Prime Minister; the ministers for domestic, foreign, financial and defence affairs; and the national security adviser.[28]

[25] Raghuvanishi, V., 'India adopts solid fuel missile strategy', *Defense News*, 6 Oct. 2003, p. 42.

[26] US National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, p. 13, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballisticmissilefinal.pdf>.

[27] US National Intelligence Council (note 26).

[28] Bidwai, P., 'India toys with its nuclear button', *Asia Times*, 4 Sep. 2003.

Table 15A.8. Pakistani nuclear forces, January 2004

Type/Designation	Range (km)[a]	Payload (kg)	Status
Aircraft			
F-16A/B	1 600	4 500	32 aircraft, deployed in 3 squadrons; most likely aircraft in the inventory to have a nuclear delivery role
Ballistic missiles[b]			
Ghaznavi (Hatf-3)	290	500	Test-launched 3 Oct 2003; expected to be operational by 2004
Shaheen I (Hatf-4)	600–800	750–1 000	Entered service with Pakistani Army in Mar. 2003
Ghauri I (Hatf-5)	1 300–1 500	700–1 000	Entered service with Pakistani Army in Jan. 2003
Ghauri II (Hatf-5A)	1 600–1 800	1 500	Entered service in Jan. 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.

[b] Pakistan acquired a number of M-11 ballistic missiles from China in the 1990s; however, it is not known whether these missiles have a nuclear role.

Sources: 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>; Albright, D., 'India's and Pakistan's fissile material and nuclear weapons inventories, end of 1999', Background Paper, Institute for Science and International Security (ISIS), 11 Oct. 2000, URL <http://www.isis-online.org/publications/southasia/stocks1000.html>; PakistaniDefence.com (unofficial Internet site of the Pakistani armed forces), URL <http://www.pakistanidefence.com>; NRDC Nuclear Notebook, *Bulletin of the Atomic Scientists*, various issues; and Author's 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, one of the key uncertainties is how much weapon-usable fissile material Pakistan has produced. It is known that Pakistan has pursued gas centrifuge uranium-enrichment technology to produce the material for its nuclear weapons, at the Abdul Qadeer Khan Research Laboratories in Kahuta. 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.

It is estimated here that Pakistan has manufactured 30–50 nuclear weapons. Some of these weapons may 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's nuclear weapons are based on highly enriched uranium, but Pakistan may be slowly developing a plutonium-based nuclear weapon arsenal. The unsafeguarded 50-MW(t) 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 can also produce tritium, which can be used to 'boost' the explosive yield of fission weapons.

Ballistic missiles

Pakistan test-launched three ballistic missiles within a two-week period in October 2003. The first test, of a Ghaznavi (Hatf-3), took place on 3 October, followed by the launch of a Shaheen I (Hatf-4) on 8 October and a Ghauri I (Hatf-5) on 14 October.

The Shaheen I has been declared to be nuclear-capable and was formally inducted into Pakistani Army service at a ceremony in March 2003. Analysts remain divided over whether the single-state 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 transporter–erector–launcher (TEL) as the Ghaznavi.

A follow-on Shaheen II ballistic missile, with a design range exceeding 2000 km, has yet to be flight-tested. The two-stage Shaheen II is believed to use the Shaheen I missile as its second stage. According to the CIA, the successful development of the missile will require continued assistance from Chinese entities or other sources.[29] Pakistan's missile programmes have in the past received considerable technical assistance from China and North Korea.

The Ghauri II is very similar to the Ghauri I, possibly featuring improved engine assembly. Both missiles 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. Pakistani defence sources indicate that the Ghauri I/II entered serial production in late 2002. It was formally handed over to the Pakistani Army for 'full operational use' on 12 January 2003. Pakistan has announced that both versions can carry a nuclear warhead.

A Ghauri III missile, with a design range of 3000 km, is reportedly under development at the Khan Research Laboratories in Kahuta.

IX. Israeli nuclear forces

Israel is widely considered to be a de facto nuclear weapon state. Like India and Pakistan, it is not a party to the NPT. Despite some debate on the subject in the Knesset (Israeli Parliament) over the years, Israel continues to maintain its long-standing policy of nuclear ambiguity under which it officially neither confirms nor denies that it possesses nuclear weapons. However, Israel is believed to have achieved a nuclear weapon capability in the 1960s. Most estimates claim that Israel currently maintains up to approximately 200 nuclear weapons. This means that it may have a larger nuclear arsenal than the UK, which is one of the five legally recognized nuclear

[29] 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>.

Table 15A.9. Israeli nuclear forces, January 2004

Type	Range (km)[a]	Payload (kg)	Status
Aircraft			
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
F-15I Thunder	3 500	11 000	25 aircraft in the inventory; some may have a long-range nuclear delivery role
Ballistic missiles			
Jericho I	500	450–650	*c*. 50–100 missiles; first deployed in 1973; may no longer be fully operational
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

[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: 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: Oxford University Press, 1997); Lennox, D. (ed.), *Jane's Strategic Weapon Systems* (Jane's Information Group, Ltd: Coulsdon, 2003); NRDC Nuclear Notebook, *Bulletin of the Atomic Scientists*, various issues; and Author's estimates.

weapon states under the NPT. Many analysts believe that Israel maintains a 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. Some analysts believe that Israel also possesses a non-strategic nuclear arsenal, possibly consisting of nuclear artillery shells and atomic demolition munitions (ADMs) or landmines.

The Los Angeles Times reported in October 2003 that Israel had modified US-supplied Harpoon cruise missiles on newly acquired German-built Dolphin Class submarines to carry a nuclear warhead.[30] Former Israeli Deputy Defence Minister Efraim Sneh dismissed the report, saying that 'anyone with the slightest understanding of missiles knows that the Harpoon can never be used to carry nuclear warheads'.[31]

[30] Frantz, D., 'Israel adds fuel to nuclear dispute', *Los Angeles Times*, 12 Oct. 2003, p. A1.
[31] 'Experts scorn report on Israel's nuclear submarines', *Haaretz* (Associated Press), 13 Oct. 2003.