Appendix 10A. World nuclear forces

HANS M. KRISTENSEN and JOSHUA HANDLER

I. Introduction

The world's eight nuclear weapon states maintain a total of about 17 150 deployed nuclear warheads, of which the United States and Russia together hold 93 per cent. Of the smaller nuclear weapon states, China has slightly over 400 warheads, France 348, and Israel and the United Kingdom each about 200. The two new nuclear weapon states, Pakistan and India, have 24–48 warheads each, although it is thought that not all of them are fully deployed.

In addition to these deployed warheads, thousands more are held in reserve; these are not counted in official declarations on the size of stockpiles. In recent years, an increasing proportion of the warheads have been transferred from declared categories into 'unaccountable' categories. If all warheads are counted—deployed, spares, those in both active and inactive storage, and 'pits' (plutonium cores) held in reserve—the total world stockpile consists of an estimated 36 800 warheads.

During 2001 Russia and the USA continued to reduce their deployed strategic nuclear delivery vehicles within the framework of the 1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I Treaty). Their reductions were completed on 1 December 2001. The USA pledged to make further reductions in its operational warheads and Russia promised to follow suit, although there was disagreement over whether these reductions would be made within the framework of a traditional arms control treaty or as parallel, non-legally binding initiatives. The latter approach was followed when Russia and the USA decided to withdraw from deployment several types of non-strategic (or tactical) nuclear weapons. Both countries continue to maintain sizeable inventories of non-strategic weapons, which remain unconstrained by any formal arms control agreement.[1]

All the nuclear weapon states have nuclear weapon modernization and maintenance programmes under way and appear to be committed to retaining nuclear weapons for the foreseeable future.

In the USA, the 2001 Nuclear Posture Review (NPR) revealed long-term plans for new ballistic missiles, strategic submarines, long-range bombers and nuclear weapons. US modernization plans call for the deployment of new Trident II missiles on older Trident nuclear-powered ballistic-missile submarines (SSBNs). Russia is modernizing its strategic forces by deploying new intercontinental ballistic missiles (ICBMs) and additional strategic bombers and is slowly constructing a new generation of SSBNs. Moreover, both countries continue to underscore the role of nuclear weapons in their security policies. Tables 10A.3 and 10A.5 show the composition of the US and Russian deployed nuclear forces.

The nuclear arsenals of the UK, France and China are considerably smaller than those of Russia and the USA, but these countries also remain committed to retaining their nuclear arsenals. Data on the British, French and Chinese delivery vehicles and nuclear warhead stockpiles are presented in tables 10A.6, 10A.7 and 10A.8, respec-

[1] For an overview of US and Russian tactical nuclear weapon inventories and the proliferation risks and arms control challenges arising from them see appendix 10B.

Table 10A.1. World nuclear forces, January 2002[a]

Country	Strategic warheads	Non-strategic warheads	Total warheads
USA	6 480	1 120	**7 600**
Russia	4 951	3 380	**8 331**
UK	185	–	**185**
France	348	–	**348**
China	282	120	**402**
India	–	–	**(30–35)**[a]
Pakistan	–	–	**(24–48)**[a]
Israel	–	–	**(~200)**[a]
Total			**~17 150**

[a] By the number of deployed warheads. The stockpiles of India, Pakistan and Israel are thought to be only partly deployed.

tively. China's strategic modernization plan has received a great deal of attention, but whether its efforts are aimed at deploying a much larger strategic force or a more modern force of the same size is still unclear. Meanwhile, France is currently engaged in developing and deploying a new generation of SSBNs, submarine-launched ballistic missiles (SLBMs) and air-launched weapons. The nuclear weapon stockpile of the UK is about the same size as that of Israel, owing to the unilateral reductions that have been made by both countries (table 10A.11).

It is particularly difficult to obtain official information about the nuclear arsenals of India and Pakistan. Tables 10A.9 and 10A.10 present estimates of the size of their stockpiles and information about their potential nuclear weapon delivery means.

The figures in the tables are estimates based on publicly available information and the authors' best estimates. The uncertainties are reflected in the text.

II. US nuclear forces

The United States maintains an estimated stockpile of about 7600 active deployed nuclear warheads, consisting of 6480 strategic and 1120 non-strategic warheads. Another 370 are spares, while about 2700 intact warheads are held in reserve. In addition to these over 10 600 intact warheads, about 5000 plutonium pits are stored at the Oak Ridge Y-12 Plant in Oakridge, Tennessee, and at the Pantex Plant in Amarillo, Texas.[2] Approximately the same number of canned assemblies (thermonuclear secondaries) are maintained as a strategic reserve. This stockpile is considerably larger than the 5949 'accountable' warheads announced by the State Department on 5 December 2001, after the completion of the final reductions mandated by the START I Treaty. The main reasons for this discrepancy are that the treaty only counts warheads on strategic launchers, attributes 'artificial' weapon loads to bombers, and ignores non-strategic weapons and warheads in the reserve. The START number is widely but often incorrectly cited by the media in reports on the size of the total US nuclear arsenal.

[2] For a description of the facilities in the US nuclear weapon complex see appendix 10C.

Table 10A.2. US nuclear warhead status and modifications, January 2002

Warhead	Number of warheads[a] and status of work
B61-3/5/10	840 deployed (150 in Europe); 450 in storage; Common Radar testing completed in 2000; life extension programme continued in 2001. Refurbishment programme to begin later this decade.
B61-7	370 deployed; 100 in storage. Refurbishment scheduled for 2006–2008.
B61-11	50 deployed; 5 in storage; introduced in 1997; fully certified in 2000. Refurbishment scheduled for 2006–2008.
W62	315 deployed; 300 in storage; all to be retired by 2009.
W76	2880 deployed; 336 in storage; completed multi-year dual-revalidation programme in 2000. Refurbishment of 800 warheads planned for 2007–12, with the remaining 2400 warheads scheduled for 2012–22, depending on a future decision.
W78	920 deployed; 600 to be transferred to 'responsive force' by 2007; life extension programme under way, including replacement of gas transfer system.
W80-0/1	900 deployed; 900 in storage; Phase 6.2/6.2A Study (feasibility, design, and cost study) completed in 2000; Phase 6.3 Study (development engineering) scheduled to start in 2001. A refurbishment programme—including new neutron generators, a gas transfer system and the redesign of the warhead electrical system—is scheduled to refurbish 600 warheads in 2006–10. If approved, the remaining warheads will be refurbished in 2011–17.
B83-0/1	420 deployed; 200 in storage; Common Radar testing completed in 2000; life extension programme continued in 2001. Candidate for new warhead modifications.
W84	400 in storage.
W87	550 deployed; 200 expected to be transferred to Minuteman IIIs (Safety Enhanced Reentry Vehicle programme) and 350 to the 'responsive force' by 2006; full-scale life extension programme under way to refurbish primary and secondary warhead components. About 375 were completed by early 2002 and the rest will be completed by late 2003.
W88	400 deployed; plutonium pit re-manufacturing under way at Los Alamos, with 3 development and 3 standard pits produced in FY 2001. Delivery of the first 'certifiable' pit is scheduled for 2003 and the first new war-reserve warheads are scheduled to enter the stockpile in 2007.

[a] The number of deployed warheads includes spares.

Sources: US Department of Energy; US Department of Defense; Norris, R. *et al.,* 'NRDC Nuclear Notebook: US nuclear forces, 2002', *Bulletin of the Atomic Scientists*, May/June 2002, URL < http://www.thebulletin.org/issues/nukenotes/mj02nukenote.pdf>; Natural Resources Defense Council, 'Faking nuclear restraint: the Bush Administration's secret plan for strengthening US nuclear forces', Press Release, Washington, DC, 13 Feb. 2002, URL <http://www.nrdc.org/media/pressreleases/020213a.asp>; and 'Alterations, modifications, refurbishments and possible new designs for the US nuclear weapons stockpile', Nuclear Watch of New Mexico, 2001, URL <http://www.nukewatch.org/weaponsfactsheet.html>.

The Administration of President George W. Bush completed a year-long Nuclear Posture Review of US nuclear forces in December 2001 and announced that the number of US 'operationally deployed strategic warheads' would be reduced to

1700–2200 over the next 10 years.[3] The NPR appears to have abandoned the 1993 Treaty on Further Reduction and Limitation of Strategic Offensive Arms (START II Treaty, not in force) and the proposed START III accord and instead sets the following new three-phase schedule for reductions.

Phase 1 (2003–2006): reduce the number of 'accountable' warheads by 1300 'as a result of the retirement of Peacekeeper, the Tridents and the like'.

Phase 2 (2006–2007): reduce the number of accountable strategic warheads further by 'taking additional operationally deployed warheads off existing ICBMs and SLBMs down to a level of about 3800' by fiscal year (FY) 2007.

Phase 3 (2008–2012): make 'the force structure decisions on how we will be bringing down the force to 1700 to 2200 operationally deployed warheads'.

The NPR did not announce any new cuts in the number of US warheads or weapons. The decisions to retire the MX/Peacekeeper ICBM, reduce the SSBN fleet to 14 submarines, dismantle the W62 warhead and denuclearize the B-1B bomber were all made in 1994, during the previous NPR. What will change is the way in which warheads are categorized and counted. The 2001 NPR preserves the existing force structure. 'The drawdown of the operationally deployed strategic nuclear warheads will preserve force structure in that . . . no additional strategic delivery platforms are scheduled to be eliminated from strategic service'.

Unlike the counting rules agreed in the 1972 and 1979 Strategic Arms Limitation Treaties (SALT) and the START Treaties, warheads removed from weapon systems in overhaul, such as submarines in dry dock, are not included in the projected level of about 3800 warheads in 2007 or the goal of 1700–2200 warheads by 2012. The Bush Administration has said that it will only count *operationally deployed strategic warheads*.

Overall, the force level set by the NPR reaffirms the force structure planning developed by the US Strategic Command (STRATCOM) nearly a decade ago: the number of operationally deployed strategic warheads will remain at around 2000; the 'triad' of strategic forces will be retained; and the modernization of nuclear forces will continue.

The 'enduring nuclear stockpile'

The about 7600 deployed US strategic and non-strategic nuclear warheads consist of 13 different versions of eight basic warhead designs: the B61-3, B61-4, B61-7, B61-10, B61-11, W62, W76, W78, W80-0, W80-1, B83-1, W87 and W88. Two other warhead types are maintained in reserve: the W84, which previously armed the ground-launched cruise missiles (GLCMs) destroyed under the 1987 Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles (INF Treaty); and the B83-0 strategic bomb. Except for the W62, which will be dismantled in 2009, these basic warhead designs make up what the US Department of Defense (DOD) refers to

[3] US Department of Defense, Transcript of special briefing on the Nuclear Posture Review, 9 Jan. 2002, available at URL <http://www.defenselink.mil/news/Jan2002/t01092002_t0109npr.html>. The Congress-mandated NPR was completed in Dec. 2001 and submitted to Congress on 8 Jan. 2002. A copy of the classified report was leaked to the press in Mar. 2002. Arkin, W., 'Secret plan outlines the unthinkable', *Los Angeles Times*, 10 Mar. 2002, URL <http://www.latimes.com/news/opinion/la-op-arkinmar10.story>. Excerpts of the report are available at URL <http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm>.

as the 'enduring nuclear stockpile' of weapons that will constitute the US nuclear arsenal over the next few decades.

The reliability of the stockpile is certified annually in a joint report to the president from the commander-in-chief of STRATCOM, the Nuclear Weapons Council and the three national nuclear weapon laboratories. Reliability is certified by randomly selecting an average of 99 warheads (11 of each of the eight basic designs and 11 of the non-deployed W84 warheads) each year and physically examining all the critical components; a few are even subjected to 'fatal' experiments that destroy the warhead. After full-scale US nuclear testing was halted in 1992, a new programme of 'subcritical' testing was started at the Nevada Test Site (NTS) in 1997 to simulate the behaviour of nuclear weapons.[4] The first subcritical test was conducted at the U1A complex at the NTS on 2 July 1997, followed by a second test on 18 September 1997. Three more tests were conducted in 1998, two in 1999, five in 2000 and two in 2001. A new series started on 14 February 2002, when a joint US–British test codenamed Vito was conducted at the NTS. The time required to return the NTS to a full-scale nuclear testing capability is 36 months, but the NPR recommended that it be shortened to no more than one year.

The tools developed to certify the reliability of the stockpile without full-scale nuclear testing bring new capabilities to modify and re-manufacture existing warheads and even to develop new ones. Between 1995 and 1997, for example, this capability enabled the development, certification and deployment of the B61-11 earth-penetrating bomb. However, the NPR identified an operational need for a more capable nuclear earth-penetrating capability than that of the B61-11, and the USA is currently studying development of the Robust Nuclear Earth Penetrator by incorporating 'an existing warhead' (probably the B61 or the B83) into a penetration weapon weighing about 5000 lbs (2273 kg). Other modifications to warheads are likely to be made in the refurbishments scheduled for all warheads in the enduring stockpile.

'Phantom arsenals'

Arms control agreements have ignored certain categories of warhead and created notional numbers for others, but the framework for the START III accord that the USA and Russia agreed to in 1997 sought to increase transparency in stockpiles, address non-strategic nuclear warheads and make reductions irreversible. The 2001 NPR reverses this effort by further limiting the warheads that are counted, ignoring non-strategic nuclear warheads and increasing the portion of the total stockpile held in reserve. As mentioned above, of the various categories, the 2012 force level of 1700–2200 warheads includes only 'operationally deployed strategic warheads'.

The NPR continues the trend of removing more warheads from the 'accountable' category and putting them into various unaccountable categories. Before the START I Treaty was signed, about 5 per cent of the total stockpile was in the 'reserve' category. The Administration of President Bill Clinton decided during the 1994 NPR that 'most weapons' removed from active status should not be destroyed but be placed in reserve to maintain a 'hedge' against unforeseeable developments. If START II, with 3500 'accountable' strategic warheads, had been implemented, it was expected that the reserve stockpile would increase to a greater than 1 : 1 ratio with the deployed

[4] Although subcritical tests do not produce a nuclear yield, they expose small amounts of plutonium to powerful chemical explosions in order to provide data for physical examination and computer simulation of nuclear warhead performance.

stockpile. As the NPR is implemented over the next decade, the ratio is expected to increase to 1 : 3. By 2012 there will be more than three times as many warheads in various 'unaccountable' categories as there are operationally deployed warheads.

The NPR creates an entirely new category of unaccountable warheads: the 'responsive force'. This will consist of active warheads that are not on deployed systems but are not considered inactive. Responsive force warheads are kept in secure storage but are available to be returned to the operationally deployed force to meet contingencies. Depending on the particular weapon system, this may take days, weeks, months, or as long as a year or more. For warheads in the inactive category, on the other hand, their limited-life components, such as tritium and neutron generators, have usually been removed. When the weapon is transferred to the active stockpile, these components are reinstalled in the weapon, which is a more time-consuming process.

Strategic bombers

The USA has two types of long-range bomber certified for nuclear missions: the B-2A Spirit and the B-52H Stratofortress. These bombers can deliver either cruise missiles or gravity bombs or a combination of both, but they are not maintained on day-to-day alert. Because the US bomber force is shrinking, only about 430 Air-Launched Cruise Missiles (ALCMs) and 430 Advanced Cruise Missiles (ACMs) are deployed, with several hundred other ALCMs in reserve. Unlike ICBMs and SSBNs, the bomber fleet was de-alerted by President George Bush in 1991, but the bombers continue to exercise their nuclear mission and can be returned to alert status within a few days if so ordered. In addition to front-line US Air Force personnel, Air Force Reserve personnel also take part in nuclear operations.

The B-2A bombers are deployed with the 509th Bombardment Wing at Whiteman Air Force Base (AFB), Missouri, where they are organized in two squadrons: the 393rd squadron, which was declared operational on 1 April 1997, and the 325th, which was activated on 8 January 1998. The first aircraft was delivered on 17 December 1993, and the 21st and final aircraft arrived in 1999. All six aircraft from the original test programme have been modified to full operational capability (FOC), bringing the total number to 21. The B-2A is scheduled to be replaced in about 2040, and a follow-on bomber programme was begun in 1998.

The B-2A is configured to carry various combinations of nuclear and conventional munitions. The nuclear weapons include the B61-7, B61-11 and B83 gravity bombs. Each B-2A can be armed with a load of either B61 or B83 bombs, but not a mix. The B-2A is designated as the 'only' carrier of the new B61-11 earth-penetrating nuclear bomb introduced in November 1997. When the B61-11 was first produced, each aircraft would initially have been forced to load with one or the other B61 version, but in late 1995 STRATCOM issued a new requirement for mixed loads of B61-7 and B61-11 bombs. All the aircraft are being upgraded to Block 30 versions, which can carry all three types of nuclear bomb and an assortment of conventional bombs, munitions and missiles. The upgrade is scheduled to be completed in 2002. Of the 21 aircraft, only 16 are considered primary mission inventory (PMI) aircraft assigned to nuclear and conventional wartime missions.

Modernization of the B-2A bomber is continuing. Like the B-52H, the B-2A is being equipped with the Air Force Mission Support System (AFMSS), a new system used for planning sorties that are part of the Single Integrated Operational Plan (SIOP). Development problems with the AFMSS in 1997 delayed full nuclear certifi-

cation of the B-2A, but the problems have been resolved and the AFMSS is scheduled to support extremely high frequency (EHF) Satellite Communications (SATCOM) system integration on the B-2A from 2002.[5]

The bat-winged B-2 bomber has been plagued by technical problems, partly because of its sensitive radar-absorbing surface. In March 2002 the Air Force announced that cracks had developed in the titanium plates behind the rear exhausts of 16 of the 21 aircraft. During 2001, the average B-2 was available for combat duty only 31 per cent of the time, half of the US Air Force's goal of 60 per cent.

A total of 94 B-52H bombers are operationally deployed, of which 56 are PMI aircraft. The 1994 NPR recommended retaining only 66 B-52Hs, but the Air Force has decided to undergo a transition to a force of 76 aircraft. The current force of 94 B-52Hs has been consolidated at two bases: the 2nd Bomb Wing at Barksdale AFB, Louisiana; and the 5th Bomb Wing at Minot AFB, North Dakota. The B-52H is scheduled to remain in operation until 2040 and has recently been equipped with the AFMSS to modernize its SIOP mission planning capability. As the only carrier of cruise missiles, the B-52H is referred to by the Air Force as the 'workhorse of nuclear weapons employment'. Each B-52H can carry up to 20 ALCMs/ACMs, with ALCMs carried both internally (up to 8 missiles) and externally (up to 12 missiles); the ACM is only carried externally.

The ALCM, or AGM-86B, is equipped with the W80-1 warhead with a yield of 5–150 kt. Although only about 430 ALCMs are deployed, hundreds of others are held in reserve. Between 1982 and 1986 a total of 1739 ALCMs were produced by Boeing for the US Air Force. The Air Force states that there are approximately 1140 ALCMs in the active inventory.[6] Another 200 ALCMs are kept in inactive storage but could be fully reconstituted within about six months. Long-range Air Force planning envisages an ALCM force of 760 missiles in FYs 1999–2003, and a $134 million Service Life Extension Program (SLEP) is under way to extend the service life of the missile until 2030.

The ACM, or AGM-129A, is equipped with the 5- to 150-kt W80-1 warhead. Compared with the ALCM, the ACM has a significantly longer range (over 2000 nautical miles) and greater accuracy. It also has stealth features to increase its survivability. The ACM is designed to evade air- and ground-based defences and strike heavily defended, hardened targets at any location. There are currently about 400 missiles in the inventory. Originally, as many as 1461 ACMs were planned, but the DOD announced in January 1992 that production would stop at 640 missiles. The current design life expires in 2003–2008, but a SLEP will enter a third phase in 2002 to extend the service of the ACM until 2030.

Although the B-1B Lancer was for years described as a 'conventional-only' aircraft, the Air Force maintained the bomber in 'Nuclear Rerole' status; that is, it could be returned to nuclear missions within months if necessary.[7] Under the Nuclear Rerole Plan, spare B61 and B83 nuclear bombs were maintained in STRATCOM's Active Reserve Stockpile. According to the NPR, the B-1 will no longer be in 'Rerole' status, but the bombs will be retained. Of the original 100 B-1Bs, 92 are left.

Conceptual development of a new strategic bomber to replace the B-1B, B-2A and B-52H began in 1998.

[5] See also chapter 11 in this volume.

[6] 'Memo (U), ACC/LGWNA, calendar year 97 cruise missile activity/inventory', 15 June 1997, obtained under the Freedom of Information Act.

[7] See URL <http://www.nautilus.org/nukestrat/USA/bombers/b1rerole.html>.

Intercontinental ballistic missiles

As of January 2002, the USA deployed 550 operational ICBMs of two types: 500 Minuteman IIIs and 50 MX/Peacekeepers. All of the missiles are maintained at a high alert rate (over 98 per cent) and can be launched at short notice. During 2000, for example, the 341st Space Wing at Malmstrom AFB kept 200 Minuteman III missiles on alert 99.74 per cent of the year, a record for the ICBM force. ICBMs provide 'prompt' strike capability but, since the signing of the 1994 US–Russian Agreement to De-target Strategic Nuclear Missiles,[8] target coordinates have normally not been stored in the missiles' on-board guidance system; they can, however, be reloaded within a few minutes. ICBMs carry a total of 1700 warheads of three types.

The 500 operationally deployed Minuteman IIIs are located at three bases: 200 are deployed at Malmstrom AFB, Montana, in four missile squadrons (10th, 12th, 490th and 564th) of 50 missiles each as part of the 341st Space Wing; 150 are deployed at Minot AFB, North Dakota, in three missile squadrons (740th, 741st and 742nd) as part of the 91st Space Wing; and 150 are deployed at F.E. Warren AFB, Wyoming, in three missile squadrons (319th, 320th and 321st) as part of the 90th Space Wing. In addition to the 500 operational Minuteman III missiles, there are 107 missiles for spares, operational testing and evaluation, ageing and surveillance. The destruction of silos at Ellsworth AFB, South Dakota, and Whiteman AFB—two bases that once deployed Minuteman II ICBMs—was completed by December 2001, in accordance with the START I Treaty.

Total Minuteman III warhead loading dropped from 1500 to 1200 warheads in 2001. The change was needed to meet the limits on force levels set by the START I Treaty and involved downloading the 150 missiles in the 90th Space Wing from three W62 warheads to one each. The remaining 350 Minuteman missiles still carry three warheads each, but all Minuteman III missiles will be downloaded to single-warhead configuration by 2007 in order to meet the schedule set by the NPR.

An extensive modernization of the Minuteman missile force continues under a $5.5 billion five-part programme intended to improve the accuracy and reliability of the weapon and extend its service life beyond 2020.

1. The missile alert facilities (Launch Control Centers) were equipped with Rapid Execution and Combat Targeting (REACT) consoles in 1996, reducing by 50 per cent the time it takes to target the missiles. REACT is scheduled to undergo a $55 million SLEP in 2002–2005 to correct deficiencies.

2. The Guidance Replacement Program (GRP) is replacing the current NS-20 guidance system with the new NS-50 system, improving accuracy and extending service life, at a cost of $1.9 billion. The GRP was initiated in August 1993. Initial production began in March 1998 and full-rate production was achieved in December 1999. Eight annual contracts for 652 NS-50 guidance sets (a total value of $1.3 billion) are planned to be awarded by 2008. The new guidance system was expected to increase the accuracy of the Minuteman III to nearly that of the current MX ICBM—a circular error probable (CEP) of 100 metres—but it may not achieve that goal, according to DOD progress reports. Despite these setbacks, installation of the NS-50 continues. The initial operational capability (IOC) was achieved on 20 July 2000 at Malmstrom

[8] This agreement was contained in the Moscow Declaration of the US and Russian presidents, signed on 14 Jan. 1994, available at URL <http://www.fas.org/nuke/control/detarget/docs/940114-321186.htm>.

AFB, when the first 10 sets on operational Minuteman III missiles (plus four spares) exceeded the 30-day on-alert requirement.

3. The Propulsion Replacement Program (PRP) involves re-pouring the first and second stages and re-manufacturing the third stage of the Minuteman III missile; it incorporates the latest solid-propellant and bonding technologies and replaces obsolete or environmentally unsafe materials and components. Nine missiles were scheduled to undergo propulsion replacement in FY 2001, followed by 33, 86 and 96 missiles in the subsequent three years.

4. The Propulsion System Rocket Engine SLEP involves refurbishing the fourth, post-boost, liquid propulsion stage of the Minuteman III.

5. The Safety Enhanced Reentry Vehicle (SERV) Program, scheduled to begin in 2002, will replace all the remaining W62 and some W78 warheads on Minuteman IIIs with the newer W87 warhead from deactivated MX ICBMs. More than $250 million is earmarked for SERV to 2006 to design, develop and test the modifications needed to implement this programme. Flight testing will occur before the new Minuteman III/W87 is deployed. The present authors estimate that the 150 missiles at Warren AFB and the 50 at Malmstrom AFB will be equipped with the W87, while the other 150 Minuteman IIIs at Malmstrom and the 150 at Minot AFB will retain the W78.

The first experimental launch of a combined GRP/PRP Minuteman III ICBM took place on 13 November 1999, from Vandenberg AFB, California, to the Kwajalein Missile Range in the Pacific Ocean. Normally, three full-scale test launches are conducted each year, but four took place in 2000. One missile was launched in February 2001, and two test launches were scheduled for September but were cancelled after the terrorist attacks of 11 September 2001. Test launches for 2002 were scheduled for February, June and September.

All of the 50 MX/Peacekeeper ICBMs are currently operational. The Bush Administration plans to deactivate the weapon system in phases over a three-year period beginning on 1 October 2002. Withdrawal will occur in conjunction with the introduction of the Trident II missile into the Pacific-based submarine fleet. Current plans call for the MX silos to be retained, rather than destroyed as specified in the SALT and START treaties. MX booster stages will also be retained for potential use as space launch or target vehicles. The majority of the W87 warheads will arm Minuteman III ICBMs and the balance will be placed in the 'responsive force'.

Studies are under way to consider the acquisition of a new ICBM to be ready in 2018. Among the new ICBM capabilities which the DOD says it needs are extended range and the ability to hit re-locatable, hard and deeply buried targets.

Ballistic missile submarines

Eighteen Ohio Class (or Trident) submarines constitute the current US SSBN fleet. The US administration plans to cut the number to 14 by FY 2007 (of which two will be in overhaul at any given time and will not be counted as part of the 'operationally deployed force'). The four oldest SSBNs (*Ohio*, *Michigan*, *Florida* and *Georgia*) will be converted to carry up to 154 conventional SLCMs each and may also be used to support the Special Operations Forces, although the submarines remain accountable under the START I Treaty. To balance the future 14-submarine fleet between the Atlantic and Pacific oceans, the home port of three submarines may be moved from

Kings Bay, Georgia, to Bangor, Washington, beginning in 2002, establishing a seven-submarine force on each coast.

The US Navy has extended the Trident hull life to 44 years. The first of the 14 SSBNs that will remain in service is scheduled for retirement in 2029. The DOD is currently studying two options for a new SSBN that would be introduced in 2029. The first is a variant of the Virginia Class nuclear-powered submarine (SSN). The second is a dedicated SSBN, either a new design or a derivative of the Trident. The new project would begin in 2016.

Trident SSBNs carry two types of SLBM. Seven Pacific-based submarines carry the Trident I (C-4) missile and 10 Atlantic-based submarines carry the Trident II (D-5) missile. There is also one newly converted Trident II SSBN at Bangor, the USS *Alaska*, which completed its refit in November 2001. *Alaska* is expected to conduct its first Trident II test launch in the spring of 2002 but is already counted as a Trident II SSBN under the START I Treaty. The other three SSBNs scheduled for Trident II refit are, in order of their conversion, *Nevada* (SSBN-733), *Henry M. Jackson* (SSBN-730) and *Alabama* (SSBN-731).

Although the Trident I missile is being retired it is still being flight tested. On 9 December 2001 the *Ohio* launched a salvo of four Trident Is. A total of 570 Trident I missiles were produced between 1976 and 1986, and 222 missiles have been launched in 117 different flight test events. Each event has involved firing from one to four missiles. Of the 222 attempted launches, 188 were successful, while the remaining 34 failed for various reasons. Until the early 1990s, Trident I flight tests were carried out in both the Atlantic and Pacific oceans, but since 29 July 1993, after the last Trident I test was conducted at the Pacific Test Range, all SLBM flight tests have been at the Atlantic Test Range off the coast of Florida.

Procurement of the Trident II (D-5) continues at a rate of 12 missiles per year. A total of 384 Trident II missiles were purchased by 2001. As a result of the upgrading of four Trident I-equipped SSBNs and the extension of the service life of the submarines from 30 to 44 years, the total number of Trident II missiles to be procured will increase from 390 to 568, at an additional cost of $12.2 billion. The total cost of the programme is now $37 543.9 billion, or $66 million per missile. To arm the submarines throughout their entire life, existing Trident II missiles will be upgraded to a new variant called the D-5A. Of the 568 Trident IIs, 288 will arm 12 operational SSBNs (with another two in overhaul at any given time), 48 will be held in reserve to arm the two submarines in overhaul, while the remaining missiles will be expended in flight tests.

Four Trident II (D-5) missiles were test launched from two SSBNs in 2001. Since January 1987, 116 Trident II missiles have been expended in 72 test-launch events. Each event may launch from one to four missiles. Compared to the performance of the Trident I programme, the Trident II programme has been extraordinarily successful. Of the 116 missiles launched, only five failed or did not work, and since December 1989 the programme has accomplished a record of 94 consecutive successful launches, making the Trident II the most reliable strategic nuclear missile ever built. Despite this proven reliability, the DOD has said that the current level of flight tests, which is set by the Strategic Command, is the 'minimum acceptable to meet weapon system reliability requirements'.[9] STRATCOM's analysis suggests that it may be necessary to increase flight test requirements in the future.

[9] US Department of Defense, Office of the Secretary of Defense, 'Report on the D5 missile program for the Committees on Armed Services of the Senate and House of Representatives', 12 Jan. 2000, p. 7,

The US Department of State declared in December 2001 that the SSBN force carried a total of 3120 warheads, a reduction from 3456 warheads in 2000. The reduction was necessary to comply with the warhead limit set by the START I Treaty and involved downloading all Trident I (C-4) SLBMs from eight to no more than six warheads each. To meet the reductions in 'operationally deployed strategic forces' for 2012 there will be further SLBM downloading after 2007.

The SLBMs can carry two types of re-entry vehicle (RV) and warhead: either the Mk-4 with the W76 warhead or the Mk-5 with the W88 warhead. The W76/Mk-4 is by far the more numerous, with as many as 2736 warheads deployed on 16 submarines. Since its construction began in 1976, Lockheed Martin Missile and Space Operations has manufactured more than 5000 Mk-4 re-entry body assembly kits for the US and British navies. Refurbishment of the W76 is scheduled to begin in 2007 in order to ensure that the W76/Mk-4 re-entry body can support SSBN operations until 2040.

The Mk-5 RV carries the W88 warhead, the most powerful missile warhead in the US arsenal. W88 warhead production ceased after the Rocky Flats Plant closed in 1989 after 400 warheads had been completed. Although President Bush announced in February 1992 that no more W88s would be built, the 400 warheads were insufficient to support pit surveillance activities. Small-scale production of plutonium pits for the W88 therefore resumed at the TA55 facility at Los Alamos National Laboratory in 2000 to replenish the W88 pits destroyed in reliability testing. The first 'war reserve' pits are scheduled to enter the stockpile in 2007, and the current plan for the TA55 facility is to produce 20 pits per year by 2007. The facility cannot meet the increased warhead refurbishment requirement set by the NPR, however, so development of a Modern Pit Facility has begun.

In October 2003 the Navy is expected to deploy a new SLBM Retargeting System (SRS) after more than a decade in development. The SRS will enable SSBNs 'to quickly, accurately, and reliably retarget missiles to targets' and 'to allow timely and reliable processing of an increased number of targets'. The operational requirement for the SRS dates from October 1989, and the system will 'reduce overall SIOP processing' time and 'support adaptive planning'. SSBNs at sea will have a greater capability to attack fixed and mobile sites.[10]

Design of a new SLBM warhead is under way in the Navy's SLBM Warhead Protection Program (SWPP). The SWPP maintains the capability to develop replacement nuclear warheads for both the W88/Mk-5 and the W76/Mk-4. One design is described as 'near-term' and the other as 'long-term'.

Non-strategic nuclear weapons

The USA retains about 1120 non-strategic nuclear weapons, consisting of 800 B61 gravity bombs of three modifications and 320 Tomahawk Land-Attack Cruise Missiles (TLAM/Ns), a portion of which are in reserve or inactive. Although the number of non-strategic nuclear weapons has declined dramatically compared with the number in the cold war period and may change further in the future, the NPR announced no new reductions.

released under the Freedom of Information Act, available at URL <http://www.nautilus.org/nukestrat/USA/subs/index.html>.

[10] US Department of Defense, 'Summary explanation of significant SAR cost changes (as of December 31, 2001)', Apr. 2002, URL <http://www.defenselink.mil/news/Apr2002/d20020411changes.pdf>.

Table 10A.3. US nuclear forces, January 2002

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	430
B-2	Spirit	21/16	1994	11 000	Bombs	800[c]
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[d]	150
	Mk-12A	300	1979	13 000	3 x 335 kt	900
LGM-118A	MX/Peacekeeper	50	1986	11 000	10 x 300 kt	500
Subtotal		*550*				*1 700*
SSBNs/SLBMs						
UGM-96A	Trident I (C-4)[e]	168	1979	7 400	6 x 100 kt	1 008
UGM-133A	Trident II (D-5)	264				
	Mk-4		1992	> 7 400	8 x 100 kt	1 728
	Mk-5		1990	> 7 400	8 x 475 kt	384
Subtotal		*432*				*3 120*
Strategic subtotal						*6 480*
Non-strategic forces						
B61-3, -4, -10 bombs		. .	1979	. .	0.3–170 kt	800[f]
Tomahawk SLCM		325	1984	2 500	1 x 5–150 kt	320[g]
Non-strategic subtotal						*1 120*
Total						**7 600**[h]

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

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

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

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

[e] The Trident I (C-4) missiles carried on 7 SSBNs based in the Pacific Ocean have been downloaded from 8 to no more than 6 warheads each to meet the START I warhead ceiling. Three of these SSBNs will be upgraded to carry the Trident II (D-5) and the remaining 4 will be converted to non-nuclear missions. By 2006, all US SSBNs will carry the Trident II.

[f] Approximately 150 of these are forward deployed in 7 European countries. Almost 500 more have been transferred to the inactive reserve.

[g] The TLAM/N is no longer deployed with the fleet but is stored on land.

[h] Another 370 warheads are spares, and 2700 additional intact warheads are kept in the reserve stockpile.

Sources: US Department of Defense, various budget reports; START I Treaty MOUs, Sep. 1990, 5 Dec. 1994, 1 July 1995, 1 Jan. 1996, 1 July 1996, 1 Jan. 1997, 1 July 1997, 1 Jan. 1998, 1 July 1998, 1 Jan. 1999, 1 July 1999, 1 Jan. 2000, 1 July 2000, 1 Jan. 2001, 1 July 2001

and 1 Apr. 2002; US Department of State; Cohen, W., Secretary of Defense, *Annual Report to the President and the Congress* (US Department of Defense: Washington, DC, Jan. 2001), pp. 89–99; International Institute for Strategic Studies, *The Military Balance 2001/2002* (Oxford University Press: Oxford, 2001); US Senate Committee on Foreign Relations, START II Treaty, Executive Report 104-10, 15 Dec. 1995; US Navy, personal communication; US Department of Defense, various documents obtained under the Freedom of Information Act; Natural Resources Defense Council, 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

An ample supply of nearly 1300 B61 non-strategic nuclear bombs exists for various US and European NATO aircraft. Most of the bombs are stored at Kirtland AFB, New Mexico, and Nellis AFB, Nevada, for delivery by F-16C/D Fighting Falcon and F-15E Strike Eagle aircraft, with a small number deployed in Europe (see below). The F-117A Nighthawk is also considered nuclear-capable but is normally not listed in the US Air Force budget for nuclear weapons support and is maintained at a lower level of nuclear readiness than the other aircraft. In 1992 the Air Combat Command recommended de-nuclearization of the F-117A to free resources for training and on-board computer capacity, but the Air Force intervened and decided to maintain the platform in a nuclear-capable configuration. The DOD is considering whether to extend the life of the dual-capable F-16s and F-15Es or to make a block upgrade to the Joint Strike Fighter (JSF). The JSF is being designed to permit future nuclear capability after it enters service in 2012.[11]

Approximately 150 B61 bombs remain forward deployed at 10 airbases in seven European NATO states. The Weapons Storage and Security System (WS3) used to store the weapons at these locations was installed between 1990 and 1998, and plans are under way to modernize the WS3 before 2005 to maintain the system for another decade. A service-life extension study for the B61 began in 1999. The aircraft of NATO countries that are assigned nuclear missions include US-supplied F-16 aircraft and German and Italian Tornado bombers. Several NATO countries that are currently assigned strike missions with US nuclear bombs are considering purchase of the JSF.

All of the about 320 TLAM/Ns (with W80-0 warheads) were removed from their previous storage areas at Naval Air Station (NAS) North Island in San Diego, California, and Naval Weapon Station (NSW) Yorktown in Norfolk, Virginia, and are now stored at the Strategic Weapons Facilities, with strategic weapons for the SSBNs. NWS Yorktown was de-certified in August 1997 after its complement of TLAM/Ns was shipped to the Strategic Weapons Facility Atlantic at Kings Bay, which was first certified to receive the missiles in April 1997. NAS North Island's nuclear certification expired in April 1998 after all of its TLAM/Ns had been airlifted to the Strategic Weapons Facility Pacific in Bangor, Washington.

As a result of the 1994 NPR, surface vessels are no longer equipped to carry nuclear-armed Tomahawk missiles. However, the option to redeploy them on attack submarines was retained. While most US attack submarines were credited with some nuclear capability during the cold war, most SSNs today do not have nuclear missions. In the Pacific Fleet, for example, less than half of the number of attack submarines regularly undergo nuclear certification. The reduced nuclear requirement is further illustrated by the fact that SSNs which pass inspection are subsequently de-certified to save resources for more urgent non-nuclear responsibilities. If the order is given to do so, however, TLAM/Ns can be redeployed in only 30 days. To

[11] For more on the Joint Strike Fighter, see chapter 8 in this volume.

ensure training and force integration, TLAM/N operations are now included in STRATCOM's annual 'Global Guardian' nuclear exercises.

As directed in the 2001 NPR, the DOD will evaluate the future of the TLAM/N and decide whether to replace, retire, or retain and enhance the missile.

Nuclear command and control

The 2001 NPR calls for improved command, control, communication and intelligence (C3I) systems. The measures include expansion of the current architecture to 'a true national command and control conferencing system' that would supplement the programmes that were under way before the NPR was completed.

Currently, the EHF system on the Milstar satellites is scheduled to take over the nuclear command and control function from the Defense Satellite Communications System (DSCS) in 2003. Development is also under way of a constellation of Advanced Extremely High Frequency (AEHF) Military Satellite Communications (MILSATCOM) satellites to replenish the existing Milstar satellites and provide additional capabilities.[12] The first AEHF, called Pathfinder, is scheduled to be launched in December 2006, and three AEHF spacecraft are planned to achieve an IOC in FY 2008. According to the NPR, the purpose of these satellites is to 'provide nuclear survivable (e.g., against high altitude electromagnetic pulse), anti-jam, low and medium data rate communications to strategic and tactical users'. The NPR identifies a replacement satellite for the AEHF, the Advanced Wideband System (AWS), which is scheduled to be launched in FY 2009.

To integrate all of these command and control capabilities, the MILSATCOM Terminals programme is developing equipment, at a cost of more than $2.3 billion, that will enable users to communicate via Milstar, AEHF, Ultra High Frequency (UHF), Wideband Gapfiller System (WGS), Defense Satellite Communications System (DSCS) and other military satellites, as well as commercial satellites, to support Aerospace Expeditionary Force requirements and maintain essential strategic connectivity for nuclear forces.

In FY 2003 the DOD will also initiate an Extremely High Frequency (EHF) communications satellite programme 'primarily for national and strategic users requiring nuclear protected communications in the mid-latitude and polar regions'.[13] The first satellite is scheduled to be launched in FY 2009. The polar capability will complement the Navy Polar EHF satellites currently being deployed, which are designed to provide *inter alia* nuclear command and control in high-latitude areas. The first operational test of Navy Polar EHF was conducted with the attack submarine USS *Scranton* (SSN-756) during a deployment to the Arctic Ocean in June 2001.

Extensive modernization of nuclear command and control aircraft is also under way. A fleet of 16 E-6B TACAMO ('Take Charge And Move Out') aircraft serve as the primary relay stations for Emergency Action Messages (EAM) from the National Command Authority (NCA) to SSBNs at sea. TACAMO, which is also known as the Airborne Launch Control Center (ALCC), can—under restricted conditions—launch any missile in the Minuteman ICBM force. Additional modernization is under way to transfer the Air Force EC-135 Airborne National Command Post (ABNCP) to the E-6B, thereby consolidating command and control of all strategic forces in a single

[12] See also chapter 11 in this volume.
[13] US Department of Defense (note 3), p. 27.

airborne platform. When the modernization programme has been completed, TACAMO's improved ability to relay EAMs from the NCA to strategic forces will permit the commander-in-chief of the US Strategic Command to directly execute command and control of those forces. An IOC was achieved on 1 October 1998, with the implementation of SIOP-99, and an FOC is scheduled for October 2003, coinciding with the entry into force of the SIOP-04 war plan.

III. Russian nuclear forces

Russia was estimated to have an arsenal of 8331 operational nuclear warheads, consisting of 4951 strategic and 3380 non-strategic and air defence warheads, at the beginning of 2002. The primary changes from 2001 involved the further decrease in the number of MIRVed (equipped with multiple, independently targetable re-entry vehicles) ICBMs and SSBNs, which reduced the total number of deployed strategic warheads from 5606 in 2001 to 4951 in 2002. The number of SS-18 ICBMs and Typhoon and Delta IV SSBNs removed from service is particularly notable. The number of non-strategic nuclear weapons deemed operational declined slightly from 3590 in 2001 to 3380 in 2002.

The number of deployed strategic nuclear weapons is lower than the 5520 START I-accountable warheads attributed to Russia in December 2001, after the force reductions mandated by the START I Treaty had been completed. This is because START I counts launchers which have been deactivated or otherwise removed from service as remaining deployed with their associated warheads until several further steps have been taken to eliminate or convert them.

In 2000 President Vladimir Putin announced that Russia was interested in reductions to 1500 or fewer strategic warheads, and resources began to be shifted from nuclear to conventional forces—both of which underscored the likelihood that Russia's strategic forces will continue to decline. In June 2001 the Strategic Rocket Forces (SRF), long the leading service in the Soviet and Russian armed forces, was downgraded to a branch of the armed forces, and there were some indications that SRF troops would be subordinated to the Russian Air Force. Further decreases in the missile forces are expected; an aide to the commander-in-chief of the Russian Strategic Rocket Forces said in an interview on Russian radio that the number of ICBMs could be reduced to some 500 over the next few years. The number of missile units would be halved as well.[14]

Strategic aviation

Strategic bombers are part of the Russian Air Force's 37th Air Army. According to the 31 January 2002 START I Treaty Memorandum of Understanding (MOU), Bear bombers are deployed at the following airbases (ABs): the Bear-H16—16 at Ukrainka AB in Siberia (79th Heavy Guard Bomber Regiment), 13 at Engels AB (121st Heavy Bomber Regiment) and 2 at Ryazan AB; and the Bear H-6—25 at Ukrainka, 5 at Engels and 2 at Ryazan.

According to the 31 January 2002 START I MOU, 15 Blackjacks are based at Engels AB. Eight of these bombers were transferred from Ukraine to Russia in late

[14] 'Russian strategic missile forces to be cut by a third by 2006—aide to commander', BBC Worldwide Monitoring, 25 Dec. 2001.

1999 and early 2000 in exchange for partial payment of Ukrainian natural gas debts to Russia. The operational status of the bombers transferred from Ukraine is unclear, however, since they reportedly require moderate to extensive overhaul and modernization.[15] One of these is a new bomber delivered in May 2000 by the Kazan Gorbunov production plant. The Tu-160 force may increase slightly in the coming years. Although there was a lack of funding in 2001, three more Blackjacks are under construction, one of which may be delivered by late 2002 or early 2003.[16] The Tu-160s are to undergo modernization to extend their service lives and, according to Air Force Commander-in-Chief Vladimir Mikhailov, to allow them to carry 'new types of missiles with conventional and nuclear warheads'.[17]

The larger force led to the creation of a new unit for the Tu-160s, the 22nd Donbass Guard Heavy Bomber Aviation Division (Tu-160s had operated as part of the 121st Heavy Bomber Regiment).

In exercise activities, on 14 February 2001 a pair of Tu-160 Blackjack bombers flew along Norway's northern border and some four medium-range Tu-22 Backfire bombers flew near Japanese airspace. This resulted in Norway dispatching interceptor aircraft and Japan lodging a protest over possible violation of its airspace. On 16 February a Tu-95 Bear-H bomber launched a strategic cruise missile and two Tu-22M Backfire bombers launched non-strategic cruise missiles as part of the same general military exercise, which also included the ICBM and SLBM launchers listed below. A large Pacific area air exercise which was to involve Tu-160, Tu-95 and Tu-22 strategic and theatre bombers started on 10 September. Blackjack bombers were spotted at the Anadyr AB, and additional US and Canadian interceptors had been moved to the area to monitor the exercise. However, the Russian Defence Ministry cancelled the exercise after the 11 September 2001 attacks at the request of the US Government, which wanted to ensure that there would be no incidents involving aircraft flying towards the USA.

Intercontinental ballistic missiles

SS-18s. The September 1990 START I MOU states that 204 SS-18s were deployed in Russia (30 at Aleysk, 64 at Dombarovskiy, 46 at Kartaly and 64 at Uzhur). Another 104 were deployed at two basing areas in Kazakhstan. The START I Treaty called for the number of warheads on heavy ICBMs to be reduced to 1540. This meant that the number of SS-18s was to be reduced by half by the end of 2001, the date of START I final implementation.

Russia has more than fulfilled its START I obligations. The SS-18 missiles in Kazakhstan and their warheads had been shipped back to Russia by April 1995. In Russia, 60 SS-18s have been removed from service, leaving 144 (52 at Dombarovskiy, 46 at Kartaly and 46 at Uzhur; the division at Aleysk was disbanded in 2001 and its silos destroyed). The START II Treaty banned all MIRVed heavy ICBMs, although up to 90 SS-18 silos may be converted for deployment of single-warhead ICBMs. However, since the START II Treaty has not entered into force and

[15] Nikolayev, Y., '"Black Jacks" sent for reforging', *Izvestiya*, 19 Jan. 2002 (in Russian).

[16] AVN Military News Agency, 'Russian Air Force to commission new Tu-160 strategic bomber', 28 Mar. 2002; Interfax, 'Russian Air Force to get 3 Tu-160 bombers', 29 Mar. 2002; and AVN Military News Agency, 'Russia plans strategic aviation overhaul', 2 Jan. 2002.

[17] AVN Military News Agency, 'Russia starts modernization of Tu-160 strategic bombers', 5 Apr. 2002.

its future is in doubt, Russia may retain MIRVed SS-18s, although some may be retired by the middle of this decade, if not before, because of their age. Two variants of the SS-18 have been deployed—the older RS-20B and the newer RS-20V. Under START all SS-18s are counted as carrying 10 warheads, but the RS-20B variant can carry a single warhead and a few of these may be deployed. The range of fully loaded SS-18s is 11 000 km. Single-warhead missiles have a range of 15 000 km. Warheads on the RS-20B have yields of 500–550 kt and, on the RS-20V, 550–750 kt.

SS-19s. According to the September 1990 START I Treaty MOU, 170 SS-19s were in Russia (60 at Kozelsk and 110 at Tatishchevo). Another 130 were at two basing areas in Ukraine (the Ukrainian missiles were taken out of service by mid-1996). A November 1995 Ukrainian–Russian agreement included the sale of 32 SS-19s, which had been stored in Ukraine, back to Russia. Some SS-19s in Russia are being withdrawn from service (33 so far, at Tatishchevo) to allow space for new SS-27 missiles, which are deployed in SS-19 silos. Under START II, Russia may keep up to 105 SS-19s downloaded to a single warhead (they currently carry six warheads). Because START II has not entered into force, Russia may retain MIRVed SS-19s, although their numbers may decrease later in the decade because of ageing.

SS-24s. According to the December 1994 START I MOU, 46 SS-24s were in service in Russia—10 silo-based and 36 rail-based. Another 46 were in Ukraine (the Ukrainian missiles were taken out of service by mid-1996; the last silo for housing them was destroyed in 2001). The 10 silo-based SS-24 M2s deployed at Tatishchevo were removed from service in 2000 to accommodate deployments of new SS-27 silo-based missiles. Thirty-six rail-based SS-24M1s were at garrisons at Bershet, Kostroma and Krasnoyarsk. There are plans to remove them from service.

SS-25s. In Russia, the road-mobile, single-warhead SS-25 missile system is known as Topol. When the Soviet Union was dissolved, a number of SS-25s were left in Belarus. By 1997 the last of these missiles and their warheads had been shipped back to Russia. There are 360 SS-25s deployed at 10 basing areas in Russia. The deployment of new regiments of SS-25s (nine missiles each) ended by 1997 as Russia shifted to producing and deploying the follow-on to the SS-25—the Topol-M, or the SS-27, as it is designated by the US Government.

SS-27s. Flight testing of the SS-27 began on 20 December 1994. Two silo-based SS-27s were put on 'trial service' in December 1997 at the Tatishchevo missile base near Saratov in south-western Russia. One regiment of 10 missiles was declared operational in December 1998 and a second regiment with another 10 missiles in December 1999. A third regiment was activated in late December 2000, but with only four missiles out of the planned 10 because of a cut in the anticipated funding for 2000. Another five missiles were deployed in 2001, bringing the total deployed to 29. The SS-27s are housed in former SS-19 and SS-24 silos at Tatishchevo.

In 1998 the Strategic Rocket Forces intended to deploy 20–30 new SS-27 Topol-M missiles per year over the next three years and 30–40 per year for three years after that, but deployments have fallen far short of this schedule. Only six more missiles may be deployed in 2002 and only 50–60 by the end of 2005, considerably fewer than the 160–220 previously anticipated.

At least five ICBM launches took place in 2001: on 16 February, an SS-25 missile was launched from Plesetsk; on 27 June, an SS-19 missile was launched from Baikonur; on 3 October, a training launch of a 15-year-old SS-25 missile was conducted from Plesetsk; on 26 October, a more than 25-year-old SS-19 missile was launched from Baikonur (to test the ability of Russia to download warheads on

Table 10A.4. Russian SSBN and SSN/SSGN patrols per year, 1991–2001

Patrols	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
SSBNs	37	28	19	19	14	12	13	11	7	6	1
SSNs/SSGNs	18	9	13	14	13	14	11	13	9	3	1
Total	**55**	**37**	**32**	**33**	**27**	**26**	**24**	**24**	**16**	**9**	**2**

Source: US Navy, Office of Naval Intelligence.

SS-19s under START II and to confirm the reliability of the SS-19's service life extension); and on 1 November, an SS-25 missile was test fired from Plesetsk.

Strategic submarines and SLBMs

The September 1990 START I MOU listed 62 SSBNs. At the end of 2001, only 14 were thought to remain operational: 6 Delta IIIs, 6 Delta IVs and 2 Typhoons. All Yankee, Delta I and Delta II SSBNs have been withdrawn from operational service. Of the original six Typhoon submarines, one was being scrapped in 2001, another was being prepared for scrapping and two more appear to be out of service. Unless further funding is found or a replacement for the ageing SS-N-20 missiles is developed, the remaining Typhoons are likely to be retired. Of the original 14 Delta IIIs, seven have been removed from service and one has been converted to a deep submergence rescue vehicle (DSRV) carrier. Of the original seven Delta IVs, one has been removed from service.[18] In 1999, in order to keep the remaining Delta IVs in service, it was decided to restart the SS-N-23 production line. There are reports that a new variant of this SLBM is being considered to carry 10 warheads instead of four.[19] Steps are also being taken to extend the service life of the deployed SS-N-23s. Operational SSBNs in the Northern Fleet are based on the Kola Peninsula (at Nerpichya and Yagelnaya) and in the Pacific Fleet (at Rybachiy, 15 km south-west of Petropavlovsk) on the Kamchatka Peninsula.

The keel of the first of a new Borey Class SSBN was laid in November 1996. Construction has been intermittent and was suspended altogether in 1998 while the submarine was being redesigned to accommodate a new SLBM. The Russian Navy intends to have the first boat in commission in 2005 or shortly thereafter, but it is unclear whether there will be adequate funding to finish it by then.

Combat training launches of SLBMs in 2001 included the following. On 16 February, the Delta IV Class Northern Fleet submarine K-407 *Novomoskovsk* launched an SS-N-23 from the Barents Sea; on 5 June, a Northern Fleet SSBN launched an SLBM (type not reported); on 18 September, the Delta III Class Pacific Fleet submarine K-223 *Podolsk* launched an SS-N-18 SLBM from the Sea of

[18] A succession of Delta IVs has been and will be in refit at the submarine shipyard in Severodvinsk, lowering at least by 1 the number available for deployment. E.g., the *Yekaterinburg* was undergoing repairs from 1996 to 2002.

[19] Krutikov, Y. and Safonov, D., 'A missile in somebody else's eye', *Izvestiya*, 19 June 2001; and Golotyuk, Y., 'Ten warheads are better than three', *Vremya Novostei,* 16 Mar. 2001.

Okhotsk; and on 18 October, the Typhoon Class Northern Fleet submarine TK-20 *Severstal* launched two SS-N-20 SLBMs from the White Sea before returning to its base at Nerpichya in November.

Economic problems, a shrinking SSBN fleet and perhaps safety concerns in the aftermath of the sinking of the *Kursk* in August 2000 have led to a large decrease in the number of SSBN patrols—along with nuclear-powered general-purpose submarine (SSN/SSGN) patrols—from 1991 to 2001, as shown in table 10A.4.[20]

The Russian nuclear stockpile and non-strategic nuclear weapons

Estimating the size of the Russian nuclear arsenal, and specifically the non-strategic nuclear weapon arsenal, is difficult. Some 30 000 nuclear weapons, plus or minus several thousand, may have been in the Soviet arsenal in 1991. Estimates of the dismantlement rates of Russian warheads vary from several hundred to 1000–2000 per year. US Defense Department 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 have been dismantled since 1991.[21] If so, the remaining arsenal may contain some 20 000 nuclear weapons, plus or minus several thousand. Approximately 5000 of these may be deployed on strategic nuclear weapon systems, while some 3400 may be non-strategic weapons kept for operational use by the Russian Navy and Air Force, including those for air defence. The remainder are non-strategic and strategic weapons in storage, some or all of which are destined for dismantlement.

In October 1991 and January 1992, as part of the US–Russian Presidential Nuclear Initiatives, Russia announced that it would take several unilateral steps to withdraw and eliminate some non-strategic nuclear weapons. With regard to the Russian Navy, non-strategic nuclear weapons were removed from surface ships and submarines and placed in regional or central storage sites. Nuclear weapons deployed on naval aircraft, or at front-line storage facilities servicing naval airbases, were also placed in regional or central storage sites. One-third of the Navy's non-strategic nuclear weapons were eliminated by 1996. The number of ships capable of carrying nuclear weapons has declined from about 400 in 1990 to about 100 in 2001.

With regard to the Russian Ground Forces, all nuclear weapons are thought to have been withdrawn from operational forces by 1998 and consolidated at regional or central storage sites. Although final elimination of Ground Forces nuclear weapons was expected in 2000–2001, Russia announced in April 2002 that the destruction of nuclear warheads for tactical missiles, nuclear artillery shells and nuclear mines continues. If there is sufficient funding, Russia will finish eliminating all Ground Forces nuclear weapons by 2004. With regard to the Air Force, half of its inventory of nuclear air-bombs has been eliminated. Half of the warheads for surface-to-air missiles were also destroyed. In 1992, President Yeltsin declared that production of nuclear warheads for ground-launched tactical missiles, nuclear artillery shells and nuclear mines had recently been halted. In April 2002, the Russian Government

[20] Some SSBNs may be ready to launch their SLBMs while in port.

[21] For further detail about Russia's nuclear warhead dismantlement activities as well as attendant changes in the size and composition of the Russian nuclear weapon complex since the end of the cold war see appendix 10C.

Table 10A.5. Russian nuclear forces, January 2002

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	31	1984	6 500–10 500	16 x AS-15A ALCMs, bombs	496
Tu-160	Blackjack	15	1987	10 500–13 200	12 x AS-15B ALCMs or AS-16 SRAMs, bombs	180
Subtotal		*78*				*868*
ICBMs						
SS-18	Satan	144	1979	11 000–15 000	10 x 500–750 kt	1 440
SS-19	Stiletto	137	1980	10 000	6 x 500–750 kt	822
SS-24 M1	Scalpel	36	1987	10 000	10 x 550 kt	360
SS-25	Sickle	360	1985	10 500	1 x 550 kt	360
SS-27	. .	29	1997	10 500	1 x 550 kt	29
Subtotal		*706*				*3 011*
SLBMs						
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						**4 951**
Strategic defensive forces						
SAMs						
SA-5B Gammon, SA-10 Grumble		1 200				**1 200**
Non-strategic forces						
Land-based non-strategic						
Bombers and fighters						
Tu-22M Backfire		105			AS-4 ASM, AS-16 SRAM, bombs	
Su-24 Fencer		280				
Subtotal		*385*				*1 540*
Naval non-strategic						
Attack aircraft						
Tu-22M Backfire		45			AS-4 ASM, bombs	
Su-24 Fencer		50				
Subtotal		*95*				*190*
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		. .				210
Total defensive and non-strategic						**3 380**
Total						**8 331**

[a] Range for aircraft indicates operational range at maximum and standard payloads

Sources: START I Treaty Memoranda of Understanding (MOU), 1 Sep. 1990, 5 Dec. 1994, 1 July 1995, 1 Jan. 1996, 1 Jan. 1997, 1 July 1997, 1 Jan. 1998, 1 July 1998, 1 Jan. 1999, 1 July 1999, 1 Jan. 2000, 1 July 2000, 31 July 2001 and 31 Jan. 2002; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; International Institute of Strategic Studies, *The Military Balance 2001/2002* (Oxford University Press: Oxford, 2001); Podvig, P. (ed.), *Russian Strategic Nuclear Forces* (MIT Press: Cambridge, Mass., 2001); *Strategic Nuclear Forces*, Volume 1 of *Russia's Arms and Technologies, the XXI Century Encyclopedia* (Arms and Technologies Publishing House: Moscow, 2000); US Navy, Office of Naval Intelligence memos on 'Russian strategic and general purpose nuclear submarine patrols' covering 1991–2001, released under the Freedom of Information Act to Program on Science and Global Security, Princeton University; *Jane's Fighting Ships*, 2001–2002; and *Combat Fleets of the World 2000–2001* (Naval Institute Press: Annapolis, Md., 2000); US National Intelligence Council, *Foreign Missile Developments and the Ballistic Missile Threat Through 2015*, Dec. 2001; US National Intelligence Council, *Annual Report to Congress on the Safety and Security of Russian Nuclear Facilities and Military Forces*, Feb. 2002; US Department of Defense, *Proliferation: Threat and Response,* Jan. 2001; Ivanov, I. S., Minister of Foreign Affairs of the Russian Federation, 'Statement at the Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons', New York, 25 Apr. 2000; 'Statement of the delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty', New York, 11 Apr. 2002; and Authors' estimates.

repeated that production of these three types of nuclear weapon system had been 'completely stopped'.[22]

IV. British nuclear forces

The UK maintains an arsenal of about 185 warheads for use by a fleet of four nuclear-powered ballistic missile submarines, 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, and it may even be exceeded in size by Israel's nuclear arsenal.

[22] 'Yeltsin delivers statement on disarmament', Moscow Teleradiokompaniya Ostankino Television First Program Network (in Russian), 29 Jan. 1992, in Foreign Broadcast Information Service, *Daily Report–Central Eurasia (FBIS-SOV)*, FBIS-SOV-92-019, 29 Jan. 1992; Lobov, V., General of the Army, 'The motherland's armed forces today and tomorrow', *Krasnaya Zvezda*, 29 Nov. 1991; Yakovlev, G. (Gen.), 'Realization of reduction and limitation programs for nuclear weapons and the opportunity of an information exchange on amount of produced fissile materials and their localization', Talk prepared for the US–Russian Workshop on CTB, Fissile Material Cutoff and Plutonium Disposal, 15–17 Dec. 1993, Washington, DC, Natural Resources Defense Council, Federation of American Scientists, Moscow Physical–Technical Institute; Maslin, Y. (Col. Gen.), 'Remarks on US and Russian perspectives on the Cooperative Threat Reduction Program', made at the US Defense Special Weapons Agency Conference, 'Walking the walk: controlling arms in the 1990s', in 'Summary of the Fifth Annual International Conference on Controlling Arms', 3–6 June 1996, Norfolk, Va.; Press Conference with Lt. Gen. Igor Valynkin, Chief of the 12th Main Directorate of the Russian Ministry of Defence, regarding the nuclear security in Russian Federation armed forces, Russian Ministry of Defense, Official Kremlin International News Broadcast, 25 Sep. 1997 (Federal News Service); and 'Statement of the delegation of the Russian Federation at the First Session of the Preparatory Committee for the 2005 NPT Review Conference under Article VI of the Treaty', New York, 11 Apr. 2002, Russian Ministry of Foreign Affairs, Information and Press Department Internet site, URL <http://www.ln.mid.ru/website/bl.nsf/900b2c3ac91734634325698f002d9dcf/f8906fa2a4723ef843256ba300394eae?OpenDocument>.

The Royal Air Force (RAF) previously operated eight squadrons of dual-capable Tornado GR.1/1A aircraft. At the end of March 1998, with the withdrawal of the last remaining WE-177 bombs from operational service, the nuclear role of the Tornado was terminated. This brought to an end a four-decade-long history of RAF aircraft carrying nuclear weapons. By the end of August 1998 the remaining WE-177 bombs had been dismantled. The about 40 Tornadoes previously based at RAF Bruggen in Germany were reassigned to RAF Lossiemouth and RAF Marham in the UK by the end of 2001. The base at Bruggen will be closed.

Strategic submarines

The fourth and final Vanguard Class SSBN, *Vengeance*, was launched on 19 September 1998, commissioned on 27 November 1999 and deployed on its first patrol in February 2001. The *Vengeance* followed the HMS *Vanguard*, which sailed on its first patrol in December 1994. The second submarine, *Victorious*, entered service in December 1995, while the third, *Vigilant*, was launched in October 1995 and became operational in the autumn of 1998. The Vanguard Class submarine has a total complement of 205, providing a Ship's Company of 130 for patrols. The current estimated cost of the programme is $18.8 billion.

Each Vanguard Class SSBN carries 16 US-produced Trident II (D-5) SLBMs. Each missile carries one to three warheads, which are thought to be variations of the US W76 warhead enclosed in a US Mk-4 re-entry vehicle. The range of the missile can be extended by reducing the number of RVs. In its 'sub-strategic' configuration (see below), for example, a missile carrying a single warhead, it would have a range of more than 10 000 km.

There are no specifically British or US Trident II missiles but there is a pool of SLBMs at the Strategic Weapons Facility Atlantic at the Kings Bay Submarine Base, Georgia. The UK has title to 58 SLBMs but does not actually own them. A missile that is deployed on a US SSBN may at a later date be deployed on a British one, or vice versa. British SSBNs conduct their missile flight tests at the US Eastern Test Range off the coast of Florida. The *Vanguard* conducted two successful Demonstration and Shakedown Operations (DASOs) in May and June 1994, launching two Trident II missiles. The *Victorious* held DASOs in July and August 1995, with two missiles fired. In October 1997 the *Vigilant* launched two missiles during two DASOs, and on 21 September 2000 the *Vengeance* launched a missile during a single DASO exercise.

The current operational characteristics of the SSBN force were laid out by the Labour Government in July 1998 with the announcement of the results of the Strategic Defence Review (SDR). The decisions with regard to the British nuclear forces were the following.

1. Only one SSBN will be on patrol at any time, carrying a reduced load of 48 warheads—half the Conservative Government's announced ceiling of 96.
2. The submarine on patrol will be at a reduced alert state and will carry out a range of secondary tasks; its missiles will be detargeted and, after notice, the SSBN will be capable of firing its missiles within several days rather than several minutes, as during the cold war.
3. There will be fewer than 200 operationally available warheads, a one-third reduction from the Conservative Government's plans.

4. The number of Trident II (D-5) missiles already purchased or ordered was reduced from 65 to 58.

As a result of these decisions, the total explosive power of the operationally available weapons was reduced by almost 70 per cent compared to the force level planned under the Conservative Government. The explosive power of each Trident submarine will be one-third less than that carried on the Chevaline-armed Polaris submarines, the last of which was retired in 1996. At any given time the sole SSBN on patrol will carry about 40 warheads. 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.

Several factors enter into the calculation of the number of warheads in the British stockpile. It is assumed that the UK will produce only enough warheads for three boatloads of missiles, a practice it followed with the Polaris missile. As stated in the SDR, there will be 'fewer than 200 operationally available warheads' in the stockpile and no more than 48 warheads per SSBN. The government also stated that it will be the practice that normally only one SSBN will be on patrol, with the other three in various states of readiness.

A further consideration is the 'sub-strategic mission'. A Ministry of Defence (MOD) official described it as follows: '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'.[23] Shortly after the US 2001 Nuclear Posture Review was leaked to the press, in March 2002, British Defence Secretary Geoff Hoon stated 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'.[24]

The sub-strategic SSBN mission was briefed to the NATO Nuclear Planning Group in June 1995 and commenced late that year on board the *Victorious*. The mission was scheduled to 'become fully robust' when the *Vigilant* entered service in 1998, according to the 1996 Statement on the Defence Estimates.[25] If this has remained the policy, then some Trident II SLBMs already have a single warhead and are assigned targets once covered by WE-177 gravity bombs. For example, when the *Vigilant* is on patrol, 10, 12 or 14 of its SLBMs may carry up to three warheads per missile, while the other two, four or six missiles may be armed with just one warhead. There is some flexibility in the choice of yield of the Trident warhead: choosing to detonate only the unboosted primary could produce a yield of 1 kt or less, while choosing to detonate the boosted primary could produce a yield of a few kilotons. With these two missions an SSBN would have about 36–44 warheads on board during its patrol.

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

[24] Joint Memorandum submitted by the Ministry of Defence and Foreign and Commonwealth Office, Parliamentary Defence Committee, 26 Feb. 2002.

[25] British Ministry of Defence, *Statement on the Defence Estimates 1996,* Cm 3223 (Her Majesty's Stationery Office: London, 1996), chapter 2, para. 203, available at URL <http://www.archive.officialdocuments.co.uk/document/mod/defence/ch2.htm>.

Table 10A.6. British nuclear forces, January 2002

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), *Defence White Paper 1999*, Cm 4446 (Her Majesty's Stationery Office: London, 1999); MOD press releases and the MOD Internet site, URL <http://www.mod.uk/issues/sdr/index.htm>; British Ministry of Defence, *Strategic Defence Review* (MOD: London, July 1998); MOD, *Statement on the Defence Estimates 1996,* Cm 3223 (Her Majesty's Stationery Office: London, 1996); 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. V: British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 9; British House of Commons, *Parliamentary Debates (Hansard)*; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

Nuclear warhead maintenance

In 2000 the MOD awarded a contract for the operation of the Atomic Weapons Establishment (AWE) to an industrial consortium consisting of Lockheed Martin, Serco Limited and British Nuclear Fuels Limited. The 10-year contract is for £2.2 billion ($3.6 billion). On 1 April 1999 the Chief of Defence Logistics assumed overall responsibility for the routine movement of nuclear weapons within the UK. Day-to-day duties are being transferred, in phases, from RAF personnel to the MOD Police, with support from AWE civilians and the Royal Marines. The process will occur gradually and will be completed by 31 March 2002.

V. French nuclear forces

France maintains an operational arsenal of 348 nuclear warheads for delivery by land-based strike aircraft, ballistic missile submarines and naval aviation on a single aircraft carrier. The modernization of the French nuclear forces continues, including construction of the third and fourth 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. The 2002 French defence budget increases funding for nuclear forces to FFr 17.2 billion ($2.5 billion), a 13 per cent increase over 2001.

The main lines of the current force structure were set out in February 1996 when President Jacques Chirac announced several reforms for the French armed forces, including the nuclear forces, for the period 1997–2002. This involved a combination of withdrawing several systems and modernizing others. The most significant of these changes involved a decision to eliminate land-based missiles as a component of the nuclear forces. All 18 S3D intermediate-range ballistic missiles (IRBMs) based on the Plateau d'Albion were deactivated, starting on 16 September 1996; it took two years and cost $77.5 million to fully dismantle the silos and the complex. After the land-based missiles had been deactivated, Chirac declared during his visit to Moscow in

September 1997 that 'no nuclear weapon in France's deterrent force was thenceforth targeted'.[26] Other actions included completion of the dismantlement of the South Pacific test facilities at Mururoa and Fangataufa. France stopped the production of plutonium for weapons in 1992 and of highly enriched uranium (HEU) in 1996. It has closed down and pledged to dismantle the Marcoule reprocessing plant and the Pierrelatte enrichment plant, which it started in 1998.

Nuclear strike aircraft

Three squadrons with 60 Mirage 2000Ns currently have nuclear strike roles. Two of these (*Dauphine* and *La Fayette*) are based at Luxeuil and the third (*Limousin*) at Istres. Since the 1991 Persian Gulf War, in which France was unable to use the night-attack capability of the then nuclear-only Mirage 2000N, the aircraft has been given some conventional capability to increase its utility. However, in a speech in May 1994 President François Mitterrand identified the 'N' in Mirage 2000N as standing for nuclear ('Mirage 2000N, c'est-à-dire nucleaires')[27] and Dassault, the producer of the aircraft, states on its Internet site that the 'primary assignment' of the Mirage 2000N is the nuclear strike role.[28]

The predecessor to Mirage 2000N, the Mirage IVP, was converted from its nuclear role in July 1996 and retired after 32 years of service. The Mirage IVP's ASMP missiles may have been reassigned to the Mirage 2000N. Five Mirage IVPs were retained for reconnaissance missions and are in the 1/91 Gascogne squadron at Mont-de-Marsan. The other aircraft were put into storage at Châteaudun.

The Mirage 2000N will eventually be replaced by the Rafale (B-301), which is planned to be the multi-purpose French Navy and Air Force fighter-bomber for the 21st century. Its roles include conventional ground attack, air defence, air superiority and nuclear delivery of the ASMP and/or ASMP-A. The naval version (Rafale M) entered the inventory in 2001 with Squadron 12F at Landivisiau and first entered service on board the *Charles de Gaulle* during its deployment in support of US operations in Afghanistan in early 2002. In both cases the initial role was air defence, but the Rafale M will gradually replace the nuclear strike mission of the Super Étendard on board the carrier. The Air Force's Rafale D will attain a nuclear strike role in about 2005. The Air Force still plans to buy a total of 234 Rafales, although it appears that delivery may be extended over some time.

The ASMP is equipped with the 300-kt TN-81 warhead. It is estimated that France has about 60 operational ASMPs, but additional missiles may be in inactive storage. There are conflicting reports about the inventory of missiles and warheads. A report from the French Senate stated in 1991 that France initially produced 80 warheads and 90 ASMP missiles. In May 1994, however, when 15 Mirage IVPs (plus three spares) still had nuclear roles and only 45 Mirage 2000Ns were operational, President Mitterrand identified 60 ASMP missiles for use by both air force and navy aircraft.[29] He did not disclose the number of warheads, however, and used different language

[26] Bourgo, N., Ambassador and Permanent Representative of France to the Conference on Disarmament, Statement on draft resolution A/C.1/53/L.16, 13 Nov. 1998, available at URL <http://www.gas.org/news/france/981113Ebis.htm>.

[27] 'Intervention de Monsieur François Mitterrand sur la politique française de dissuasion' [Statement by Mr François Mitterrand on French deterrent policy], Palais de l'Elysée, 5 May 1994, pp. 4–5.

[28] Dassault Aviation, Dassault Défense, 'Mirage 2000 N', n.d. [2002], URL <http://www.dassault-aviation.com/defense/gb/armes/M2000/presentation/m2000ND.cfm>.

[29] Bourgo (note 26).

Table 10A.7. French nuclear forces, January 2002

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					
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 Assemblée Nationale.

Sources: Assemblée Nationale, Au Nom de la Commission de la Défense Nationale et des Forces Armées, sur le project de loi de finances pour 2002 (no. 3262), Tome II, Défense, 'Dissuasion Nucléaire', M. René Galy-Dejean (Député), 11 Oct. 2001, available at URL <http://assemblee-nationale.fr/budget/plf2002/a3323-02.asp>; French Ministry of Defence, 'Activities of the naval forces', Fact sheet [n.d. (2000)], URL <http://www.defense.gouv.fr/marine/anglais/present/dim2000/e_missions2.htm>; 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; Address by M. Jacques Chirac, President of the Republic, at the Ecole Militaire, Paris, 23 Feb. 1996; Assemblée Nationale, *Projet de loi relatif à la programmation militaire pour les années 1997 à 2002,* no. 2766 (20 May 1996), section 2.3.4, Evolution de l'équipement des forces armées (1996–2002), p. 45; Intervention de Monsieur François Mitterrand sur la politique française de dissuasion [Statement by Mr François Mitterrand on French deterrent policy], Palais de l'Elysée, 5 May 1994, pp. 4–5; Norris, R. S. *et al.*, *Nuclear Weapons Databook, Vol. V: British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994), p. 10; *Air Actualités*, various issues; *Aviation Week & Space Technology*, various issues; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

to describe the number of missiles assigned to the different types of aircraft. For the Mirage IVP, he gave a fixed number, saying, 'we possess 15 missiles' ('nous disposons de quinze missiles'). For the Mirage 2000N/Super Etendard aircraft, however, the number was less precise, namely, 'these forces possess 45 missiles' ('les forces disposent de quarante-cinq missiles'), indicating that the exact number may be dependent on the number of operational aircraft.[30] Since then an additional 15 Mirage 2000Ns have become operational.

The ASMP is scheduled to be replaced by a longer-range (500 km as opposed to 300 km) version, sometimes called the 'ASMP Plus' (the official name is ASMP Amélioré, ASMP-A). The FFr 870 million ($117.5 million) development and production contract was awarded to EADS Aérospatiale Matra Missiles on 29 December 2000. The new missile is scheduled to enter service in 2007 on the Mirage 2000N and

[30] Bourgo (note 26).

in 2008 on the Rafale. The ASMP-A may be equipped with a modified warhead designated the TNA (tête nucléaire aeroportée).

Ballistic missile submarines

France has in operation four SSBNs of three classes: two of the new Triomphant Class SSBNs, one L'Inflexible Class SSBN and one Redoubtable Class SSBN.[31] The two Triomphant SSBNs each carry 16 M45 SLBMs with six of the new TN-75 warheads, which are thought to have been tested at the Mururoa test site in 1995. *Le Triomphant* (S616) was rolled out from its construction shed in Cherbourg on 13 July 1993 and became operational in September 1996. The second SSBN, *Le Téméraire* (S617), which was commissioned in December 1999, some six months behind schedule, successfully test launched an M45 missile in May 1999. The schedule for the third submarine, *Le Vigilant* (S618), has slipped and it will not be ready for delivery until December 2003 and for full service until December 2004. FFr 1.9 billion ($256.5 million) was allocated for the fourth SSBN (S619) in September 2000, but this boat is not scheduled to enter service until 2010. The total cost of the Triomphant Class programme is estimated to be FFr 96.3 billion ($13 billion).

France has deployed 48 SLBMs of two versions: 16 M4s with six 150-kt TN-71 warheads each; and 32 M45s equipped with six 100-kt TN-75 warheads each. Until 2000, the two older SSBNs both carried 16 M4 SLBMs. Faced with the delay of the third Triomphant SSBN, however, France converted *L'Inflexible* to carry the newer M45 SLBM in 2000–2001.[32] *L'Inflexible* test launched the M45 in April 2001. The conversion was a necessary, albeit expensive, solution to match a reduced inventory of only three sets of SLBMs (2 M45s and 1 M4). Without this refit France would, in certain situations, have been able to deploy only two SSBNs as opposed to three. The last M4-equipped SSBN, *L'Indomptable*, was refitted to carry the M4 in 1989. This missile carries six TN-71 warheads; the TN-70, which previously armed the M4, was retired in 1996.

A new SLBM, the M51, is scheduled to replace the M45 and the M4 in 2010, coinciding with the completion of the fourth Triomphant SSBN. The M51 is expected to have a range in excess of 6000 km (possibly 8000 km) and carry up to six warheads. The M51, which is a modified version of the cancelled M5 missile, was initially planned to carry an entirely new type of warhead (TNO, tête nucléaire océanique) but will instead be equipped with a more robust version of existing designs. The French Ministry of Defence credited the M51 with a 'capability of hitting several widely separated targets thanks to the spacing system incorporated in the upper compartment'. It further stated that the missile 'can adapt to changes in the interception threat' and 'will be hardened against nuclear attack'.[33] The first flight test is scheduled for 2005 and the first test launch from an SSBN in 2007.

France has undergone a transition to an operational inventory of 288 warheads for two sets of M45 SLBMs and one set of M4 SLBMs, enough to arm three of four SSBNs. There was also a lower number of missiles than launch-tubes when there were five submarines in the fleet, at which point only four sets of M4 SLBMs were

[31] Some sources list the L'Inflexible Class and the Redoubtable Class as the same SSBN class.

[32] French Ministry of Defence, 'FOST and the submarine force, n.d. [updated 24 Apr. 2002], URL <http://www.defense.gouv.fr/marine/anglais/present/dim/e_forces2.htm>.

[33] Ministry of Defence, 'The French armaments policy: industrial state, European strategy, operational capability', 2001, fiche 20.

procured. Of the four submarines, three are maintained in the operational cycle, although only one or two are normally 'on station' in designated patrol areas at any given time, compared with three in the early 1990s.

The SSBN force is organized under the Oceanic Strategic Task Force (Force Océanique Stratégique, FOST) and home-ported at the Île Longue base in Brest. The French Navy has recently reorganized its submarine fleet and will base all of its submarines (including SSNs formerly at Toulon) at Brest in the future. Under this reform the SSBN command centre at Houilles (Yvelines) will also be relocated to Brest, although communications facilities at Rosnay (Indre) will continue. Communication with SSBNs on patrol is also maintained with 4 C-160H Astarté communications relay aircraft.

French SSBNs are protected during their transit by nuclear attack submarines, maritime patrol aircraft (Atlantique 2), anti-submarine frigates and minesweepers. SSBN protection will also be an important mission for the planned Barracuda Class SSN. Like the SSBNs, French attack submarines each have two crews to optimize their operational availability.

Naval nuclear aviation

The nuclear-powered aircraft carrier *Charles de Gaulle* has finally entered service, after technical problems (including a propeller failure) delayed delivery for almost five years. France has spent over FFr 20 billion ($2.8 billion) on the 40 500-ton carrier, or over FFr 7 billion ($1 billion) more than its 1987 estimate of FFr 13 billion ($1.8 billion). Another FFr 50 billion ($7.1 billion) has been spent on 60 Rafale M and three E-2C Hawkeye aircraft. France is currently considering whether to include funding for a second carrier in its 2003–2008 defence spending plan, but this carrier may be built with a non-nuclear propulsion system in order to save money.

The *Charles de Gaulle*, which has a crew of 1850, can accommodate 35–40 aircraft. The first 10 Rafale Ms were deployed on the ship in 2002 when it was dispatched to the Arabian Sea for operations in support of the war in Afghanistan. The Rafale Ms were used for air defence and the *Charles de Gaulle* carried a single squadron of Super Étendards (presumably with about 10 ASMPs) for strike operations. The Navy plans to purchase a total of 60 Rafale Ms, of which the first 16 will perform an air-to-air role. However, it appears that the pace of delivery will be slow and only 19 Rafale Ms will be delivered in 2003–2008. Missions for subsequent aircraft will include the ASMP and/or the ASMP Plus.

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, submarine-launched ballistic missiles and possibly also non-strategic systems, including artillery.

Predictions of a Chinese build-up of nuclear forces continue to be made. In early 2002 the US CIA predicted that 'the overall size of Chinese strategic ballistic missile forces' over the next 15 years will increase to 75–100 warheads, deployed 'primarily

against the United States'.[34] In addition, the CIA stated that China would have about 24 shorter-range DF-31 and DF-4 (CSS-3) missiles that could reach parts of the USA. For comparison, a 1999 CIA estimate had concluded that by 2015 China would probably have added 'a few tens' of more survivable land- and sea-based mobile missiles with smaller warheads and that 'tens of missiles' would be targeted against the USA.[35] This estimate was followed by Pentagon statements in 2000 that China does not seem to have aspirations for a large strategic force and, although modernization is under way, 'their strategic force is really quite small'.[36] Rumours that China has deployed nuclear weapons in Tibet have not been confirmed.

China's modernization of its missile force partly influenced the 1997 US presidential guidance for nuclear weapons planning to increase US targeting of China. After President Clinton signed Presidential Decision Directive-60 (PDD-60) in November 1997, STRATCOM brought China back under SIOP planning. It had been removed in 1982 following the normalization of Sino-US relations. The return of China to SIOP planning was followed by the creation of the Chinese Integrated Strategic Operations Plan (CHISOP), a hypothetical Chinese nuclear war plan created by STRATCOM planners and used to 'wargame' US nuclear strike plans against Chinese nuclear forces. The 2001 NPR reaffirmed this development.

Nuclear aviation

The Chinese bomber force is based on Chinese-produced versions of 1950s-vintage Soviet aircraft. With the retirement of the H-5, a copy of the Soviet Il-28 Beagle medium-range bomber, the main bomber is the H-6. This aircraft is based on the Soviet Tu-16 Badger medium-range bomber, which entered service with Soviet forces in 1955. China began producing the H-6 in the 1960s. It was used to drop weapons in two nuclear tests, a fission bomb in May 1965 and a multi-megaton bomb in June 1967. China attempted unsuccessfully to purchase Tu-22M Backfire aircraft from Russia in 1993 to replace the H-6. Future candidates for the nuclear strike mission may include Russian-designed Su-27 and Su-30 Flanker fighter-bombers, although there is no official Chinese confirmation of a nuclear role for these aircraft.

Land-based ballistic missiles

Chinese nuclear-capable land-based ballistic missiles consist of four different types with ranges that span from 1800 km to 13 000 km. China defines missile ranges as follows: short-range, less than 1000 km; medium-range, 1000–3000 km; long-range, 3000–8000 km; and intercontinental range, over 8000 km.

The 2800-km range DF-3 (NATO designation CSS-2) missile has been deployed for more than 25 years and is gradually being retired. Estimates on the number of operational missiles vary considerably, ranging from 40 to 150 missiles. The weapon

[34] Central Intelligence Agency, 'Foreign missile developments and the ballistic missile threat through 2015', Unclassified summary of a National Intelligence Estimate, 9 Jan. 2002, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballisticmissilefinal.htm>.

[35] Central Intelligence Agency, 'Foreign missile developments and the ballistic missile threat to the United States through 2015', Sep. 1999, URL <http://www.cia.gov/nic/pubs/other_products/foreign_missle_developments.htm>.

[36] Bacon, K., Assistant Secretary of Defense (Public Affairs), News Briefings, 12 Sep. 2000, URL <http://www.defenselink.mil/news/Sep2000/t09122000_t0912asd.html>, and 12 Dec. 2000, URL <http://www.defenselink.mil/news/Dec2000/t12122000_t1212asd.html>.

is deployed in Dalong, Datong, Dengshahe, Ching-yu, K'un-ming, Lianxiwang, Tonghua and Yidu, and the US Department of Defense Annual Report to Congress in 2000 described the CSS-2 as 'China's primary regional missile system'.[37] The two-stage, liquid-fuelled missile is deployed in silos and in a transportable mode but is not mentioned by the 2002 CIA report and may be phasing out with the deployment of the DF-31.

The 5500-km range DF-4 (CSS-3) is also deployed, but only about 'a dozen' missiles are listed by the 2002 CIA report. According to this report, the weapon is 'almost certainly' intended as a retaliatory deterrent against targets in Russia and Asia, although it could also reach parts of the USA.

The liquid-fuelled DF-5 (CSS-4) is China's only truly intercontinental missile. It has a range of 13 000 km and is deployed in silos. Estimates of the number of missiles vary. The 2002 CIA National Intelligence Estimate lists 'about 20' missiles, while a June 2000 US Defense Department report claimed that China had built 18 DF-5 silos.[38] The US National Air Intelligence Center stated that as of 1998 the deployed DF-5 force consisted of 'fewer than 25' missiles.[39] A CIA report leaked to *The Washington Times* shortly before President Clinton's visit to China in June 1998 estimated that 13 of the DF-5 missiles were targeted at the USA. A senior US administration official subsequently said that China does not keep its nuclear warheads mounted on its missiles but keeps them in separate storage. The DF-5 is deployed in Hsuan-hua, Lo-ning and Shuangjiang.

The DF-21 (CSS-5) is a two-stage solid-propellant missile carried in a canister on a transporter–erector–launcher (TEL). The missile has a range of 1800 km and is deployed in Ching-yu, Chuxiong, Datong, Liangkengwang and Tonghua. An improved Mod. 2 version has not been deployed.

In addition to these operational missiles, China has three new ballistic missiles in development: the road-mobile DF-31 (CSS-X-10); a longer-range version of the DF-31; and the Julang II SLBM. Development of these missiles began in the mid-1980s. The DF-31, which is thought to be in the flight-test stage of development, is a three-stage, solid-propellant, mobile ICBM with a range of about 8000 km and a CEP of 0.3–0.5 km. The missile has been flight tested three times, most recently on 4 November 2000 with several decoy warheads. The flight path was much shorter than the missile's estimated range of 8000 km. A DF-31 TEL was displayed in a 'northwestern town' in 2001, and a report cited a 'classified US intelligence report' which concluded that the DF-31 would have its first 'operational capability by the end of 2001'.[40] The 2002 CIA report predicted that garrison deployment of the DF-31 will take place by 2006, that the missile will be targeted primarily against Russia and Asia, and that 12 DF-31s could be deployed by 2015. The longer-range version of the DF-31 is expected to be deployed at some time in the latter half of the decade.

The Julang II SLBM is under development for deployment with a new Type 094 Class SSBN. Some reports suggest that the missile is a variant of the DF-31 and that it underwent tests in October 1997 that simulated launching the missile from

[37] US Department of Defense, 'Annual report on military power of People's Republic of China', 2000, section III: The security situation in the Taiwan Strait, URL <http://usinfo.state.gov/regional/ea/uschina/dodrpt00.htm>.

[38] Central Intelligence Agency (note 34); and Bacon (note 36).

[39] US Department of Defense, National Air Intelligence Center (NAIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Apr. 1999).

[40] Gertz, B., 'China ready to deploy its first mobile ICBMs', *Washington Times* (Internet edn), 6 Sep. 2001, URL <http://asp.washtimes.com/printarticle.asp?action=print&ArticleID=20010906-16891927>.

submarine tubes. The 2002 CIA report does not confirm this, however, but lists the Julang II as a separate missile that may be deployed in the last half of this decade.

Allegations of Chinese theft of US nuclear warhead designs have fuelled speculation that China may soon deploy missile systems with multiple warheads. The CIA estimates that China has had the technical capability to develop and deploy MRV (multiple re-entry vehicle) payloads for many years, including a MIRV system, but has not done so.[41] If China needed an MRV capability in the short term, according to the CIA, one option might be to use a DF-31-type RV to develop and deploy a simple MRV or MIRV capability on the DF-5 in a few years. However, the CIA concluded that 'Chinese pursuit of a multiple RV capability for its *mobile* ICBM and SLBMs would encounter significant technical hurdles and would be costly'.[42] In contrast, the so-called Cox Report of 1999 concluded that China, with 'aggressive development of a MIRV system', could deploy 'upwards of 1000 thermonuclear warheads on ICBMs by 2015'.[43]

The USA's continued forward deployment of SSBNs in the Pacific, combined with its programme to develop and deploy an advanced missile defence system, may stimulate Chinese efforts to deploy a multiple-warhead system and mobile ICBMs in an attempt to reduce the vulnerability of its nuclear deterrent to pre-emptive strikes.

Ballistic missile submarines

China has had great difficulty in developing a sea-based deterrent. After decades of development, it has only managed to deploy one operational Xia Class (Project 092) SSBN. The submarine carries 12 Julang I SLBMs, each equipped with a single warhead. Although the submarine participated in a naval exercise in December 2000, it may not have achieved FOC.

The *Xia*, which was built at Huludao Naval Base and Shipyard in the northern Bohai Gulf and launched in April 1981, is equipped with the 1700-km range Julang I SLBM. The missile was initially test launched from a Golf Class diesel-powered submarine in late 1982, and a full-scale submerged launch from the *Xia* took place in 1988. The following year the *Xia* was deployed to the Jianggezhuang Submarine Base, where the nuclear warheads for its Julang I missile are believed to be stored.

The *Xia* began a major refit in 1995 and is not thought to have ever sailed beyond China's regional waters. Production of a second Xia Class submarine was started but never finished.

A new SSBN project, designated Project 094, has begun with one submarine under construction. Three to five more may be planned. The new class is expected to carry 16 three-stage Julang II SLBMs. The CIA expects the missile to be tested 'within the next decade'. Given previous difficulties with the development of a sea-based deterrent and the lack of a multiple-warhead system on land, operational deployment of the Project 094 system may be many years away. The new Julang (Giant Wave) may have

[41] 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.

[42] Central Intelligence Agency (note 34), (emphasis in original).

[43] Report of the Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China, 3 Jan. 1999 (classified) (the Cox Report), URL <http://www.fas.org/spp/starwars/congress/1999_r/cox/preface.htm>.

Table 10A.8. Chinese nuclear forces, January 2002

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
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 between 10 kt and 3 Mt.

Sources: US Central Intelligence Agency, 'Foreign missile developments and the ballistic missile threat through 2015', Unclassified summary of a National Intelligence Estimate, 9 Jan. 2002, URL <http://www.cia.gov/nic/pubs/other_products/Unclassifiedballisticmissile final.htm>; US Department of Defense, Office of the Secretary of Defense, 'Proliferation: threat and response', Washington, DC, Jan. 2001, URL <http://www.defenselink.mil/pubs/ptr20010110.pdf>; Department of Defense, Report to Congress Pursuant to the FY2000 National Defense Authorization Act, 'Annual Report on the Military Power of the People's Republic of China', June 2000, URL <http://www.defenselink.mil.news/Jun2000/china 06222000.html>; Moore, F. W., *China's Military Capabilities* (Institute for Defense and Disarmament Studies: Cambridge, Mass., June 2000), URL <http:www.comw.org/cmp/fulltext/iddschina.html>; Kan, S. A. *et al., China's Foreign Conventional Arms Acquisitions: Background and Analysis,* Congressional Research Service (CRS) Report for Congress (Library of Congress: Washington, DC, 10 Oct. 2000); US State Department International Information Programs, *Pentagon Spokesman's Regular Briefing,* 12 Dec. 2000; Baker III, A. D., 'Combat fleets', *US Naval Institute Proceedings*, Dec. 2000, p. 90; US Department of Defense, 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. V: British, French, and Chinese Nuclear Weapons* (Westview: Boulder, Colo., 1994); US Central Intelligence Agency, various documents; 'NRDC Nuclear Notebook', *Bulletin of the Atomic Scientists*, various issues; and Authors' estimates.

a range of up to 8000 km and is estimated by the CIA to 'probably' be able to target the USA from launch areas near China.

Non-strategic weapons

Information on Chinese non-strategic nuclear weapons is limited and contradictory. There is no confirmation of their existence from official Chinese sources. Several low-yield nuclear tests conducted in the late 1970s and a large military exercise in June 1982 simulating the use of non-strategic nuclear weapons suggest that they may have been developed.

According to the US Defense Intelligence Agency (DIA), non-strategic weapons may consist of atomic demolition munitions (ADMs) (nuclear landmines), aircraft bombs and short-range ballistic missiles. The latter include the DF-15 (CSS-6), also called the M-9; and the DF-11 (CSS-X-7), also called the M-11. Both are solid-fuelled, dual-capable SRBMs and were deployed in 1995. The DF-15 has a range of 200–600 km and may carry a 10-kt neutron warhead or a 20-kt warhead. One regiment-size DF-15 unit is deployed in south-eastern China and may soon be augmented by an additional unit. The DF-11 is thought to have a range of 200–300 km. An improved version was displayed in a military parade in Beijing on 1 October 1999. Western estimates of the number of SRBMs possessed by China range from 100 to 300 DF-15s and from 40 to 100 DF-11s. In 1984 the DIA did not believe that Chinese ground forces had been equipped with artillery-fired nuclear projectiles, although this capability could have been added later.

China is reported to be developing long-range cruise missiles with ranges of 1500–2500 km. A missile programme known as X-600 appears to be based partly on Russian and US cruise missile designs. Although there is speculation about a possible nuclear capability for one of the systems, this has not been confirmed. China's other cruise missiles include the SS-N-22 missiles on two Russian-built Sovremenny Class destroyers imported from Russia. In the Russian Navy the SS-N-22 is credited with a nuclear capability, but there are no reports that China plans to equip the missile with a nuclear warhead.

VII. Indian nuclear forces

The size and composition of India's nuclear arsenal are difficult to determine. Unofficial and semi-official estimates range from a few to almost 100 nuclear warheads. An estimate is made here of a stockpile of 30–35 nuclear warheads (fewer than Pakistan has), of which some may not yet be fully assembled. This stockpile is thought to be expanding, though, and India is estimated to have produced enough fissile material for 45–95 nuclear warheads.

The Indian Atomic Energy Commission (AEC) stated that the series of five nuclear test explosions in May 1998 involved both fission and fusion weapon designs. The government claims that the first three tests, which were carried out on 11 May 1998, achieved yields of 43 kt (a 'thermonuclear' device), 12 kt (a fission device) and 200 tons (a low-yield device). If the devices actually produced the yields claimed by Indian weapon scientists, one would have expected to observe a seismic signal strength corresponding to 55 kt, or 5.76 on the Richter scale. Instead, the average recorded magnitude was 5.0, which indicates a probable yield of 12 kt, with the range possibly as low as 5 kt and as high as 25 kt. A mid-point of 12 kt is less than one-quarter of what Indian weapon scientists claimed, calling into question whether the thermonuclear milestone was achieved and whether the tests were 'completely successful' and gave India 'the capability to design and fabricate weapons ranging from

low yield to around 200 kilotons', as India's AEC Chairman Rajgopal Chidambaram stated in October 2000.[44]

India established the National Security Council in April 1999 to implement its nuclear weapon policy, but its progress in setting up a nuclear command and control system is unknown. On 17 August 1999 a widely publicized draft document on Indian nuclear doctrine (prepared by a 27-member National Security Advisory Board) called for the creation of a 'credible minimum deterrent' to be based 'on a triad of aircraft, mobile land-based missiles and sea-based assets'.[45] The Board's recommendations, however, had no official standing.

While the Indian Army and Air Force have been refining their respective nuclear strategies, the government has been considering a proposal by the Tri-Services Chiefs of Staff Committee to create a strategic nuclear force. The proposal followed a report by the Group of Ministers which proposed that a Chief of Defence Staff (CDS) be established to act as a military advisor to the Prime Minister on issues related to the management and control of nuclear weapons and strategic forces. The CDS would 'exercise administrative control, as distinct from operational military control over these strategic forces'.[46]

In 2001, even during heightened tension with Pakistan, Indian government officials reaffirmed India's commitment to a nuclear no-first-use policy. However, an Indian Foreign Ministry official said in 2001 that a '"no first strike" policy does not mean India will not have a first strike capability'. He explained that India was 'working toward having a first strike capability' but added that how this option would be exercised was a political decision within the 'no first strike' policy.[47]

On 31 May 2001 the Indian Defence Ministry released a report describing its principal security concerns and detailing plans for modernization of the armed forces. Not surprisingly, Pakistan's support of terrorist groups headed the list of security concerns. After the 13 December 2001 terrorist attack on the Indian Parliament, allegedly carried out by Pakistan-backed guerrillas, the two nations mobilized their armed forces. This led to a tense situation and heated exchange of words. India reportedly moved Prithvi short-range missiles to positions near its border with Pakistan.

Strike aircraft

India has several types of aircraft that could be used to deliver a nuclear weapon, but the most likely are the MiG-27 and the Jaguar, given their range, payload and speed. The MiG-27 Flogger is a nuclear-capable Soviet aircraft produced in the 1970s and 1980s. Hindustan Aeronautics licence-assembled 165 aircraft which India calls the Bahadhur (Valiant or Brave). The single-seat aircraft weighs almost 18 000 kg when fully equipped and has a range of approximately 800 km. It can carry up to 4000 kg of bombs on external hard points. There are nine operational squadrons. It is not known which of India's bases may host nuclear-capable aircraft, but one likely candidate is Hindan, north of New Delhi. Some 50 MiG-27MLs are deployed there, less

[44] 'India can build 200kt nuclear weapons', *Jane's Defence Weekly*, 8 Nov. 2000, p. 6.

[45] 'Draft report of the National Security Advisory Board on Indian nuclear doctrine', 17 Aug. 1999, URL <http://www.meadev.gov.in/govt/indnucld.htm>.

[46] Government of India, 'Reforming the national security system', Recommendations of the Group of Ministers, 2001, p. 100, URL <http://mod.nic.in/newadditions/rcontents.htm>.

[47] Ahmedullah, M., 'Indian Air Force advocates "first strike capability"', *Defense News*, 2 Jan. 2001, p. 1.

than 640 km from Lahore, Pakistan. A few aircraft from Squadrons 2, 9 or 18 may be specially modified to carry one or more nuclear bombs.

The Jaguar IS/IB, known as the Shamsher (Sword), was nuclear-capable with the British Royal Air Force from 1975 to 1985 and with the French Air Force from 1974 to 1991. Originally a joint Anglo-French aircraft, the first 40 were supplied by British Aerospace, with the remaining 91 assembled or manufactured by Hindustan Aeronautics. The Jaguar has a gross weight of 15 450 kg and a range of 1600 km with a maximum external load of 4775 kg. There are four operational squadrons. It is not known which bases may host nuclear-capable aircraft, but one likely candidate is Ambala, 525 km from Islamabad. A few aircraft from Squadrons 5 or 14 may be specially modified to carry one or more nuclear bombs. In the Indian Air Force organization, Hindan and Ambala are part of the Western Command, located at Palam and reporting to headquarters in New Delhi.

Other aircraft, such as the Su-30K and Mirage 2000H, could be equipped to deliver nuclear bombs but are more likely to be used for air defence missions. A Mirage 2000H may have been used in May 1994 to test-drop a dummy nuclear bomb, but this has not been officially confirmed. In late 1999 India was reported to have initiated preliminary talks with France about the purchase of up to 18 Mirage 2000Ds to form part of its nuclear strike force.[48] Ten Mirage 2000H/THs were ordered in September 2000, and the Indian Air Force is said to have plans to acquire 126 Mirage 2000-5s for seven squadrons as the 'backbone' of India's airborne nuclear strike force. In December 2000 India signed a $3 billion contract with Russia for the licensed production of 140 Su-30MKI aircraft at Hindustan Aeronautics over the next 17 years. Forty Su-30K fighters procured in 1996 may also be upgraded to MKI standard. Air Chief Marshal A. Y. Tipnis said prior to the deal that the indigenous Su-30MKI will 'enable the Air Force to finalize its vision-2020 long term perspective planning',[49] which involves acquiring up to 20 squadrons of multi-role aircraft over the next 15–20 years. The first Indian-produced Su-30MKI is scheduled to roll off the production line in 2004 and will be supported by six Ilyushin-78 Midas tanker aircraft acquired from Uzbekistan.[50] During 2001, India also attempted, unsuccessfully, to lease a small number of Russian Tu-22 Backfire bombers. France has offered to sell its new Rafale aircraft to India.

Land-based missiles

India deploys one ballistic missile, the 150-km range Prithvi I SRBM. The Prithvi (Earth) is a single-stage, dual-engine, liquid-fuelled, road-mobile missile which began development in 1983 and was first tested in 1988. There have been 15 tests since 1988. The Prithvi II, an improved version with an extended range of 250 km, is under development. It was test fired on 31 March 31 2001. Of the two versions, only the Prithvi I is assessed by the CIA to have a nuclear role.

Several versions of the Agni (Fire) IRBM are under development. The initial version, which was flight tested three times between 1989 and early 1994 to a range of up to 1500 km, is thought to have been shelved. Instead, development of an improved version (Agni II) with a range of more than 2000 km is under development. The

[48] Bedi, R., 'India's ties with France will soar with Mirage buy', *Jane's Defence Weekly*, 1 Sep. 1999, p. 13.
[49] 'India to buy more Mirage from France', *India Today News*, 7 Oct. 2000.
[50] Thapar, V., 'IAF to get mid-air refueling aircraft', *Hindustan Times*, 6 Aug. 2001.

Table 10A.9. Indian nuclear forces, January 2002

Type/Designation	Range (km)[a]	Payload (kg)	Comment
Aircraft			
MiG-27 Flogger/Bahadhur	800	3 000	At Hindan Air Base
Jaguar IS/IB/Shamsher	1 600	4 775	At Ambala Air Base
Missiles			
Prithvi I	150	1 000	Deployed, may have nuclear role
Agni I	1 500	1 000	Flight tested but status unclear.
Agni II	> 2 000	1 000	Flight tested in Jan. 2001, deployment expected soon. A 700-km range version was flight tested on 25 Jan. 2002.

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

Sources: US Department of Defense, Office of the Secretary of Defense, 'Proliferation: threat and response', Washington, DC, Jan. 2001, URL <http://www.defenselink.mil/pubs/ptr20010110.pdf>; Indian Ministry of Defence; Indian Air Force; Indian Ministry of External Affairs; 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>; US Department of Defense, National Air Intelligence Center (NAIC), *Ballistic and Cruise Missile Threat* (NAIC: Wright-Patterson Air Force Base, Ohio, Apr. 1999); 'Draft report of the National Security Advisory Board on Indian nuclear doctrine', 17 Aug. 1999, URL <http://www.meadev.gov.in/govt/indnucld.htm>; US Central Intelligence Agency, 'Foreign missile developments and the ballistic missile threat to the United States through 2015', Sep. 1999, URL <http://www.cia.gov/nic/pubs/other_products/foreign_missle_developments.htm>; Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997); Burrows, W. E. and Windrem, R., *Critical Mass* (Simon & Schuster: New York, 1994); *Jane's Defence Weekly*, various issues; and Authors' estimates.

missile, which is 20 metres long, weighs about 16 tons and can carry a 1000-kg payload 2000–2500 km. The first test in April 1999 covered 2000 km in 11 minutes and may have involved a nuclear warhead assembly without the plutonium core. The second flight was on 17 January 2001 from a mobile launcher at the Chandipur missile test range off the eastern coastal state of Orissa. The missile, which was said to be in 'final operational configuration', flew 2200 km and, according to Indian officials, landed less than 100 metres from its intended target. After the test, Defence Minister Jaswant Singh informed the Indian Parliament that the 'Agni II is planned to be inducted into the armed forces during 2001–02'.[51] Both road- and rail-mobile versions of Agni II are under development and are expected to become the mainstay of India's nuclear-armed missile force.[52]

A new short-range version of the Agni II, with a range of about 700 km, was test launched from Wheeler's Island on the Indian east coast on 25 January 2002.

[51] 'Production of Agni missile begins: govt', *Times of India*, 25 July 2001, URL <http://timesofindia.indiatimes.com/articleshow.asp?art_id=1186900905>.

[52] Central Intelligence Agency (note 34).

Rumours of a longer-range Agni III with a range of up to 3500 km have not been confirmed.

Rumours also persist about Indian plans for an ICBM programme, referred to as the Surya (Sun). Most components needed for an ICBM are available from India's indigenous space programme. The CIA predicts that it would take one to two years for India to convert the Polar Space Launch Vehicle (PSLV) to an ICBM after a decision is made to do so.[53] The latest model, the four-stage PSLV-C3 is capable of launching a satellite weighing up to 1200 kg into polar sun-synchronous orbit (570 km) or a 3500-kg satellite into low earth orbit (400 km). Three satellites were placed in orbit on 22 October 2001. An attempt to develop a Geo-Synchronous Satellite Launch Vehicle (GSLV) made headway on 18 April 2002, when a 401-tonne, 49-metre tall GSLV launched from the Sriharikota High Altitude Range (SHAR) Centre placed a 1540-kg satellite into an elliptical geostationary transfer orbit (181-km perigee and 32 051-km apogee). Further GSLV progress to achieve full geostationary equatorial orbit (36 000 km above the same point on earth) would allow India to place permanent command and control satellites in orbit.

Naval weapons

In addition to air- and land-based nuclear-capable forces, India is working on at least two naval systems that may be equipped to carry nuclear warheads in the future. The submarine-launched Sagarika (Oceanic) missile, begun in 1991, is in an advanced stage of development. The CIA designates it as an SLBM and predicts that it will not be deployed until 2010 or later. Another potential candidate is the Dhanush (Bow) SLBM, which has been under development since 1983 for possible completion in 2003. A test firing on 11 April 2000 was only a 'partial success' and may delay the programme further. The 8.56-metre missile, which is a naval version of the army's Prithvi, is capable of carrying a 1000-kg payload to a range of 250 km. It was launched from the reinforced helicopter deck of the INS Subhadra, a modified offshore patrol vessel anchored some 20 km offshore in the Bay of Bengal. Neither the Dhanush nor the Sagarika has been declared nuclear-capable by Indian authorities.

The Advanced Technology Vessel (ATV), a nuclear-powered submarine project that has been under way in various stages since at least 1985, may be a navy nuclear-weapon launch platform. Design and operational experience was gained from operation of a Charlie I Class nuclear-powered cruise missile submarine (INS *Chakra*) leased from the Soviet Union from 1988 to 1991. Full-scale work on the ATV began in 1991, shortly after the INS Chakra was returned to Russia, and construction started in 1997. A launch date may be scheduled for 2007 at the Mazagon Dockyard in Mumbai (design work has taken place in Vishakapatnam on the east coast), but technical challenges are likely to delay the ATV further. Efforts to lease one or more nuclear submarines from Russia continue. The ATV is thought to be based partly on the INS Chakra, but the reactor is reported to be of Indian design. A land-based prototype reactor has been built and is believed to be undergoing testing at the Indira Gandhi Centre for Atomic Research at Kalpakkam in southern India. Vice Admiral R. N. Ganesh, who commanded the INS Chakra, was appointed as new director general of the ATV project in 2000 in an apparent attempt to kick-start the much delayed project.

[53] Central Intelligence Agency (note 34).

VIII. Pakistani nuclear forces

It is extremely difficult to estimate the number and types of nuclear weapons in Pakistan's arsenal. Outside experts estimate that Pakistan may possess a stockpile of 24–48 nuclear weapons, of which only some may be fully operational. The implosion design of the weapons uses a solid-core of HEU rather than plutonium, requiring an estimated 15–20 kg of HEU per warhead.

Seismic measurements of the nuclear test explosions conducted by Pakistan on 28 and 30 May 1998 suggest that the yields were of the order of 9–12 kt and 4–6 kt, respectively—lower than the yields announced by the Pakistani Government. Early Chinese tests in the 1960s used similar bomb designs, and it is suspected that Chinese experts assisted Pakistan in developing its nuclear weapon programme in the 1970s and 1980s. Over a 20-year period Pakistan pursued a gas centrifuge uranium-enrichment method to produce the material for its nuclear weapons, at the Abdul Qadeer Khan Research Laboratories in Kahuta. There is some uncertainty about how many centrifuges Pakistan has and thus how much weapon-grade uranium has been produced. By the early 1990s, some 3000 centrifuges were thought to be operating. The most cautious estimate is that Pakistan has produced enough fissile material for 30–52 nuclear weapons. A moratorium on HEU production was declared in 1991. It is unclear when production was resumed but it is thought to have started well before the 1998 nuclear tests.

Like the other nations that have developed nuclear weapons, Pakistan does not seem content with a first-generation nuclear weapon and may be pursuing advanced designs and refinements. The 40–50 Megawatt thermal (MWth) Khushab reactor constructed at Joharabad in the Khushab district of Punjab has the capability to produce weapon-grade plutonium. Loading the reactor's target materials with lithium-6 could produce tritium. Producing plutonium provides the Pakistani military with several options: making weapons with plutonium cores, mixing plutonium with HEU to make composite cores or using tritium to 'boost' a weapon's explosive yield. Separation of the plutonium is reported to take place at the 'New Labs' reprocessing plant near the Pakistan Institute of Nuclear Science and Technology (PINSTECH) at Rawalpindi. Through these efforts Pakistan seems to be positioning itself to increase and enhance its nuclear forces significantly in the coming years.

In November 2000 Pakistan placed its key nuclear institutions under the control of the National Command Authority, established in February 2000 in an apparent effort to create an effective nuclear command and control system. After the terrorist attacks of 11 September 2001, attention was focused on the security of Pakistan's nuclear arsenal. One potential danger to the arsenal is the seizure of nuclear weapon control by extremist Islamists within the intelligence service, the armed forces, the nuclear weapon programme and the population at large. President General Pervez Musharraf reportedly took several actions in the autumn of 2001 to mitigate this problem: he fired his chief of intelligence and other officers, detained several suspected retired nuclear weapon scientists, redeployed the arsenal to at least six new secret locations and appointed Lieutenant General Ghulam Mustafa as the first three-star commander of the upgraded strategic command.[54]

[54] Mufson, S., 'US worries about Pakistan nuclear arms', *Washington Post*, 4 Nov. 2001, p. A27; Moore, M. and Khan, K., 'Pakistan moves nuclear weapons', *Washington Post*, 11 Nov. 2001, p. A01; Albright, D., 'Securing Pakistan's nuclear weapons complex', Institute for Science and International Security, Oct. 2001, URL <http://www.isis-online.org/publications/terrorism/stanleypaper.html>; and

Strike aircraft

The aircraft of the Pakistani Air Force that is most likely to be used in the nuclear weapon delivery role is the US-manufactured F-16, although other aircraft, such as the Mirage V or the Chinese-produced A-5, could also be used. Twenty-eight F-16A (single-seat) and 12 F-16B (two-seat) trainers were delivered to the Pakistani Air Force between 1983 and 1987. At least eight of the original order are no longer in service. In December 1988 Pakistan ordered 11 additional F-16A/Bs as attrition replacements but to date they have not been delivered because of the 1984 Pressler Amendment, which forbids military aid to suspected nuclear weapon states. The US Government announced on 6 October 1990 that it had embargoed any further arms deliveries to Pakistan. The 11 embargoed aircraft are being stored in the Arizona desert near Davis-Monthan AFB. In September 1989 plans were announced for Pakistan to acquire 60 more F-16s. Of that order, 17 were built by the end of 1994, but because of the embargo they were not delivered and were also stored at Davis-Monthan AFB. In a Presidential Determination signed on 22 September 2001, President Bush waived the Pressler Amendment, but the aircraft have not been released for delivery.

The F-16s most likely to have been modified to carry nuclear weapons are deployed with Squadrons 9 and 11 at Sargodha AB, 160 km north-west of Lahore. The F-16 has a range of 1600 km, or more if drop tanks are used. It can carry up to 5450 kg externally on one under-fuselage centreline pylon and on six under-wing stations. Given the weight and size payload constraints of the F-16, if it carried a nuclear bomb it would probably weigh about 1000 kg and be attached to the centreline pylon. The assembled nuclear bombs and/or bomb components for these aircraft may be stored in an ammunition depot near Sargodha. Another possibility is that, fearing a first strike by India if war were to break out, Pakistan stores the weapons at other operational or satellite bases further to the west, near the border with Afghanistan, where the F-16s would disperse to pick up the bombs.

Ballistic missiles

The Ghauri missile is thought to be Pakistan's only operational nuclear-capable missile, although other missiles in the Pakistani arsenal could be configured to carry a nuclear warhead. The single-stage Ghauri I was first flight tested on 6 April 1998 to a distance of 1100 km, probably with a payload of up to 700 kg. The liquid-fuelled Ghauri is basically a North Korean No Dong missile, which is a Scud derivative. A two-stage Ghauri II missile was flight tested on 14 April 1999, three days after the Indian Agni II test flight. It was launched from a mobile launcher at Dina, near Jhelum, and landed in Jiwani, near the coast in the south-western Baluchistan province, after an eight-minute flight. A third version of the Ghauri, with an unconfirmed range of up to 3000 km, is under development and was test launched on 15 August 2000.

Sawant, G. C., 'India mulls options as Pak upgrades its nuclear command', *National Network*, 11 Apr. 2002.

Table 10A.10. Pakistani nuclear forces, January 2002

Type/Designation	Range (km)[a]	Payload (kg)	Comment
Aircraft			
F-16A/B	1 600	5 450	At Sargodha AB
Missiles			
Shaheen I (Hatf-4)	700	1 000	Test fired 15 Apr. 1999; possible nuclear role
Ghauri I (Hatf-5)	1 300–1 500	500–750	Test fired on 6 Apr. 1998. Version of North Korean No Dong missile
Ghauri II (Hatf-6)	2 000–2 300	750–1 000	Test fired on 14 Apr. 1999

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

Sources: Islamic Republic of Pakistan, Official Internet site, URL <http://www.pak.gov.pk/>; Embassy of Pakistan, Washington, DC; US Department of Defense, Office of the Secretary of Defense, *Proliferation: Threat and Responses*, released in Jan. 2001, URL <http://www.defenselink.mil>; US Central Intelligence Agency, National Intelligence Office for Strategic and Nuclear Programs, *Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015*, Sep. 1999, and Jan. 2002; 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); Burrows, W. E. and Windrem, R., *Critical Mass* (Simon & Schuster: New York, 1994); 'Three-Four-Nine: The Ultimate F-16 Site', URL <http://www.f-16.net/reference/users/f16_pk.html>; *Jane's Intelligence Review,* various issues; and Authors' estimates.

Other missiles may also be candidates for nuclear capability. The single-state solid-fueled Shaheen I (Eagle) was test fired on 15 April 1999 and is thought to have a range of 700 km and carry a payload of 1000 kg. The road-mobile Shaheen I, which is said by some to be based on either the Chinese M-9 or M-11, was said to be in serial production by late 2000,[55] and may have a nuclear role. Pakistan has obtained 30 or more complete M-11 missiles from China since 1992 and subsequently received Chinese assistance for the construction of maintenance and storage facilities. The M-11 missiles may be stored at the depot near Sargodha.

The two-stage Shaheen II medium-range missile was unveiled at the Pakistan Day parade on 23 March 2000, and the US CIA estimates that the missile has a range of 2500 km and a 1000-kg payload.[56] The solid-fuelled missile is transported on a 16-wheel mobile launcher similar to the Russian MAZ-547V that used to transport the Soviet Union's SS-20 IRBM. The Shaheen II may have a nuclear role in the future.

[55] Farooq, U., 'Pakistan starts production of Shareen 1 missile', *Jane's Defence Weekly*, 4 Oct. 2000, p. 4.

[56] Central Intelligence Agency (note 34).

IX. Israeli nuclear forces

Israel has not confirmed or denied that it has nuclear weapons. It is thought to have as many as 200 nuclear warheads, consisting of aircraft bombs, missile warheads and non-strategic weapons. Although a 2001 US DOD report omits Israel from its review of the Middle East, a 1991 US Strategic Air Command study lists Israel as a 'de facto' nuclear weapon state along with India and Pakistan.[57]

Since the late 1990s, the question of the continued validity of Israel's long-standing policy of nuclear ambiguity has been raised in several contexts: parliamentary pressure for a policy review in 1997–98; the nuclear tests by India and Pakistan in 1998; rumours in 2000 of Iran's alleged development of a nuclear weapon capability; and the terrorist attacks in the United States of 11 September 2001. However, no apparent change has resulted from these debates. Defence Minister Yitzhak Mordechai stated in July 1998 that the 30-year policy not to be the first to introduce nuclear weapons into the region was 'a formula that has served us well and, at least for the time being, should remain in place'. The policy 'has achieved a deterrent', a senior defence official was reported to have said, 'yet it hasn't broken any taboos'.[58]

Israel first began to separate plutonium at the Dimona facility in 1966, and design work on the first nuclear explosive device was successfully completed around the same time. On the eve of the Six-Day War of June 1967, Israel reportedly 'improvised' two deliverable nuclear explosive devices.[59] After the war, efforts to build an operational nuclear arsenal intensified and an explosion on 22 September 1979 high in the atmosphere over the South Indian Ocean off the coast of South Africa is believed by some to have been a clandestine Israeli test. Today, nuclear weapons are assembled at the design laboratory at Yodefat Rafael facility, outside Haifa, known as Division 20. Dimona, in the Negev desert, is the location of a plutonium–tritium production reactor and underground chemical separation and nuclear component fabrication facilities. Nuclear weapon research and design takes place at the Soreq Center near the town of Yavne and the 'Soreq Center runs the full nuclear gamut of activities . . . required for nuclear weapons design and fabrication', according to a 1987 Pentagon study.[60] The Soreq Center shares a security zone with the Palmikhim AB, from where missiles are assembled and test launched into the Mediterranean Sea. Operational nuclear weapons are thought to be stored near the Tel Nof AB, south-east of Tel Aviv, which is also adjacent to the Sdot Micha AFB for the Jericho missiles. Some sources say that these weapons may be stored at the nearby Tirosh depot, but all three facilities may form part of a larger complex (it is only 9 km from Tel Nof in the north to Sdot Micha in the south).

Strike aircraft

Over the past 30 years Israel has had many different types of aircraft capable of carrying nuclear bombs. These include the F-4 Phantom, the A-4 Skyhawk and, more

[57] US Department of Defense, Office of the Secretary of Defense, *Proliferation: Threat and Responses*, released in Jan. 2001, URL <http://www.defenselink.mil>; US Strategic Air Command, 'The Phoenix Study', Sep. 1991, p. 67, URL <http://www.nautilus.org/nukestrat/USA/Force/phoenix.html>.

[58] Blanche, E., 'Nuclear reactions', *Jane's Defence Weekly*, 17 June 1998, p. 22; and Rodan, S., 'Israel mulls nuke stance amid new threats', *Defense News*, 29 June–5 July 1998, p. 3.

[59] Cohen, A., *Israel and the Bomb* (Columbia University Press: New York, 1998), pp. 273–74.

[60] 'Strategic Israel', MSNBC International News, n.d. [1998], URL <http://archive.msnbc.com/modules/Israel_Strategic/>.

Table 10A.11. Israeli nuclear forces, January 2002

Type	Year first deployed	Range (km)[a]	Comment
Aircraft			
F-16A/B/C/D/I Fighting Falcon	1980	1 600	Bombs probably stored at Tel Nof
F-15I Thunder	1998	3 500	Selected for long-range strike role
Land-based missiles			
Jericho I	1972	1 200	Possibly 50 at Sdot Micha
Jericho II	1984–85	1 800	Possibly 50 at Sdot Micha, on TELs in caves
Non-strategic/battlefield[b]			
Artillery and landmines			

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

[b] The status of Israeli non-strategic nuclear weapons is unknown.

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); Hough, H., 'Could Israel's nuclear assets survive a first strike?', *Jane's Intelligence Review*, vol. 9, no. 9 (1997), pp. 407–10; Burrows, W. E. and Windrem, R., *Critical Mass* (Simon & Schuster: New York, 1994), pp. 275–313; 'US Strategic Air Command/XP, "Secret/ Phoenix"', 11 Sep. 1991, p. 67, released under the US Freedom of Information Act and available at URL <http://www.nautilus.org/nukestrat/USA/Force/phoenix.html>; Hersh, S. M., *The Samson Option* (Random House: New York, 1991); *Jane's Defence Weekly*, various issues; *Defense* News, various issues; and Authors' estimates.

recently, the F-16 and the F-15E. In January 2000 the Israeli Government purchased 50 F-16Is from the USA worth about $2.5 billion. Israel will begin to take delivery of the aircraft at the beginning of 2003, and the last aircraft will be supplied two years later. An additional 52 F-16Is were ordered in December 2001 and will be delivered by 2008. In four previous orders, Israel purchased or received 260 F-16s between 1980 and 1995. These included 103 F-16A, 22 F-16B, 81 F-16C and 54 F-16D models. A number of nuclear bombs may be allocated to dedicated, certified aircraft, probably at the Tel Nof AB.

Ballistic missiles

Israel's quest for a missile capability began simultaneously with its quest for nuclear weapons. In April 1963—several months before the Dimona reactor began operating—Israel signed an agreement with the French company Dassault to produce a surface-to-surface ballistic missile. Israeli specifications called for a two-stage missile capable of delivering a 750-kg warhead 235–500 km with a CEP of less than 1 km. The missile system, known as the Jericho (or MD-620), was also to take less than two hours to prepare, launch from fixed or mobile bases and fire at a rate of four to eight per hour. In early 1966 it was reported that Israel had purchased the first instalment of

30 missiles,[61] but soon after the June 1967 Six-Day War France imposed an embargo on new military equipment. Because of the French embargo, Israel began to produce the Jericho missile on its own. In 1974 the CIA cited the Jericho as evidence that Israel had made nuclear weapons—it stated that the Jericho made little sense as a conventional missile and was 'designed to accommodate nuclear warheads'.[62]

Israel subsequently developed the Jericho II, a missile similar to the US Pershing II IRBM. In May 1987 it tested an improved version of the Jericho II that flew 800 km. A document published in 1989 by the US Arms Control and Disarmament Agency gave the maximum range of the improved Jericho as 1450 km, long enough to reach the southern border of the Soviet Union.[63] Israel pursued technology in the USA and elsewhere for the missile, including a terminal guidance system using radar imaging. It is thought that the range has been increased to 1800 km. An article published in 1994 reported that about 50 Jericho II missiles were stored at the Sdot Micha base, some 45 km south-east of Tel Aviv in the Judean Hills.[64] According to an analysis of satellite images of the base, the missiles appear to be stored in caves. Upon warning they would be dispersed on their TELs so as not to be destroyed. The shorter-range Jericho I is deployed nearby in approximately equal numbers. In April 2000 Israel test launched a Jericho missile into the Mediterranean Sea. The missile landed near a US warship and the crew reportedly thought that they were under attack. Israel did not inform the USA of the test in advance.

Other weapon systems

There are also reports that Israel has developed nuclear artillery shells and possibly ADMs, stored at the Eilabun storage facility west of the Sea of Galilee. Following a report in March 2000 that Israel planned to lay neutron landmines to deter a Syrian attack following a withdrawal from the Golan Heights, Israeli Deputy Defence Minister Ephraim Sneh responded that 'this report is truly stupid. The person that wrote it not only doesn't know, but also doesn't understand anything'.[65]

In addition to the Israeli aircraft and missiles listed in table 10A.11, there are persistent rumours that Israel may also be pursuing a sea-based nuclear capability for its three new Dolphin Class submarines. Israeli officials repeatedly dismissed the rumours in 2000, and the Israeli Navy stated that the submarines 'are completely conventional' and that 'these foreign sources have fantasies'.[66] Israel has attempted to acquire long-range BGM-109 Tomahawk cruise missiles, but the US Government rejected an Israeli request for 48 missiles in March 2000.

[61] Finney, J. W., 'Israel said to buy French missiles', *New York Times*, 7 Jan. 1966, p. 1.

[62] Central Intelligence Agency, 'Prospects for further proliferation of nuclear weapons', DCI NIO 1945/74, 4 Sep. 1974.

[63] Arms Control and Disasrmament Agency (ACDA), 'Ballistic missile proliferation in the developing world', *World Military Expenditures and Arms Transfers 1988* (ACDA: Washington, DC, June 1989), pp. 17–20.

[64] Hough, H., 'Could Israel's nuclear assets survive a first strike?', *Jane's Intelligence Review*, vol. 9, no. 9 (1997), pp. 407–10.

[65] 'Sneh denies nuclear landmine report', *Jane's Defence Weekly*, 5 Apr. 2000, p. 6.

[66] Rodan, S., 'Israel received last Dolphin-class submarine', *Jane's Defence Weekly*, 8 Nov. 2000, p. 16; and Mahnaimi, U. and Campbell, M., 'Israel makes nuclear waves with submarine missile test', *Sunday Times*, 18 June 2000.