7. World nuclear forces

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I. Introduction

At the start of 2011 eight states possessed approximately 20,500 nuclear weapons, of which more than 5000 were deployed and ready for use (see table 7.1). Nearly 2000 of these are kept in a state of high operational alert.

All five legally recognized nuclear weapon states, as defined by the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT)—China, France, Russia, the United Kingdom and the United States—appear determined to remain nuclear powers and are either modernizing or about to modernize their nuclear forces.\(^1\) At the same time, Russia and the USA have undertaken to make further reductions in their strategic nuclear forces in the 2010 Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START), a follow-on treaty to the expired 1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms (START). New START, which was signed in April 2010, supersedes the 2002 Treaty on Strategic Offensive Reductions (SORT).\(^2\) Sections II and III of this chapter discuss the composition of the deployed nuclear forces of the USA and Russia, respectively. The nuclear arsenals of the other three nuclear weapon states are considerably smaller, but all are either deploying new weapons or have announced their intention to do so. Sections IV–VI present data on the delivery vehicles and warhead stockpiles of the UK, France and China, respectively.

Reliable information on the operational status of the nuclear arsenals and capabilities of the three states that have never been party to the NPT—India, Israel and Pakistan—is difficult to find. In the absence of official declarations, the available information is often contradictory or incorrect. India and Pakistan are expanding their nuclear strike capabilities, while Israel appears to be waiting to see how the situation in Iran develops. Sections VII–IX provide information on the Indian, Pakistani and Israeli nuclear arsenals, respectively. The nuclear weapon capabilities of the

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1 According to the NPT, only states that manufactured and exploded a nuclear device prior to 1 Jan. 1967 are recognized as nuclear weapon states. For a summary and other details of the NPT see annex A in this volume.

2 For summaries and other details of START, SORT and New START see annex A in this volume.
II. US nuclear forces

As of January 2011 the USA maintained an estimated arsenal of approximately 2150 operational nuclear warheads, consisting of roughly 1950 stra-
tetric and 200 non-strategic warheads (see table 7.2). In addition to this operational arsenal, about 2850 warheads are held in reserve, for a total stockpile of approximately 5000 warheads. Another 3500 retired warheads are awaiting dismantlement.

This force level is a slight decrease compared with the estimate presented in *SIPRI Yearbook 2010*. The change reflects the limited additional withdrawal from deployment of warheads on intercontinental ballistic missiles (ICBMs) and the removal of warheads for the Tomahawk sea-launched cruise missile (SLCM) from the active stockpile.

### The Nuclear Posture Review and New START

The year 2010 was dominated by the publication of the Nuclear Posture Review (NPR) and the signing and subsequent debate of New START. With US President Barack Obama’s intention to complete New START before START expired in December 2009, the first priority of the NPR process was to assess the impact of the force level goals envisioned by New START. The analysis quickly settled on retaining a triad of land-, sea- and air-based strategic nuclear forces and protecting the force structure against significant changes.

The NPR and New START were both completed in April 2010, setting the direction of the US nuclear posture for the next 5–10 years. The 2010 NPR was the first such review to explicitly include a commitment to the ultimate goal of eliminating all nuclear weapons. Also, for the first time, the NPR elevated the non-proliferation of weapons of mass destruction (WMD) to the same level of importance in the US nuclear posture as nuclear weapon policy itself.

Overall, the NPR and New START will result in modest reductions in the number of deployed strategic warheads and delivery vehicles. However, the NPR did not meet Obama’s pledge made in Prague in 2009 to ‘reduce the role of nuclear weapons in [the USA’s] national security strategy’ to ‘put an

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### Table 7.2. US nuclear forces, January 2011

<table>
<thead>
<tr>
<th>Type</th>
<th>Designation</th>
<th>No. deployed</th>
<th>Year first deployed</th>
<th>Range (km)</th>
<th>Warheads x yield</th>
<th>No. of warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategic forces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bombers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-52H</td>
<td>Stratofortress</td>
<td>93/44</td>
<td>1961</td>
<td>16 000</td>
<td>ALCM 5–150 kt</td>
<td>200&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>B-2</td>
<td>Spirit</td>
<td>20/16</td>
<td>1994</td>
<td>11 000</td>
<td>B61-7, -11, B83-1</td>
<td>100&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>ICBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LGM-30G</td>
<td>Minuteman III</td>
<td>450</td>
<td></td>
<td></td>
<td></td>
<td>500&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mk-12A</td>
<td>250</td>
<td>1979</td>
<td>13 000</td>
<td>1–3 x 335 kt</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Mk-21 SERV</td>
<td>200</td>
<td>2006</td>
<td>13 000</td>
<td>1 x 300 kt</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td><strong>SSBNs/SLBMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGM-133A</td>
<td>Trident II (D5)&lt;sup&gt;g&lt;/sup&gt;</td>
<td>288</td>
<td></td>
<td></td>
<td></td>
<td>1 152</td>
</tr>
<tr>
<td>Mk-4</td>
<td>. . .</td>
<td>1992</td>
<td>&gt;7 400</td>
<td>4 x 100 kt</td>
<td></td>
<td>568</td>
</tr>
<tr>
<td>Mk-4A</td>
<td>. . .</td>
<td>2008</td>
<td>&gt;7 400</td>
<td>4 x 100 kt</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Mk-5</td>
<td>. . .</td>
<td>1990</td>
<td>&gt;7 400</td>
<td>4 x 475 kt</td>
<td></td>
<td>384</td>
</tr>
<tr>
<td><strong>Non-strategic forces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B61-3, -4 bombs</td>
<td>. . .</td>
<td>1979</td>
<td>. . .</td>
<td>0.3–170 kt</td>
<td></td>
<td>200&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td>Tomahawk SLCM</td>
<td>(0)</td>
<td>1984</td>
<td>2 500</td>
<td>1 x 5–150 kt</td>
<td></td>
<td>(0)&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Total deployed warheads</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-2 150&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

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

<sup>a</sup> Aircraft range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

<sup>b</sup> For bombers, the first figure in the ‘No. deployed’ column is the total number in the inventory, including those for training, test and reserve. The second figure is for the primary mission inventory aircraft, i.e. the number of operational aircraft assigned for nuclear and conventional wartime missions.

<sup>c</sup> The total ALCM inventory has been reduced to 528, of which an estimated 200 are deployed. Under New START, each nuclear bomber is only attributed 1 weapon although many more may be stored at bomber bases.

<sup>d</sup> Operational gravity bombs are only included for the B-2A bomber. The B-52H can also deliver bombs, but its nuclear mission is thought to be focused on ALCM since the bomber is not capable of penetrating modern air defence systems.

<sup>e</sup> The 2010 Nuclear Posture Review (NPR) decided to download each ICBM to carry a single warhead in the near future and also to retain an upload capability to re-MIRV the W78 portion of the force if necessary.

<sup>f</sup> Two additional SSBNs are undergoing overhaul at any given time, and their 48 missiles and 192 warheads are not included in the total.

<sup>g</sup> Although D5 missiles were counted under START as carrying 8 warheads each, the US Navy is estimated to have downloaded each missile to an average of 4–5 warheads to meet the SORT-mandated warhead ceiling. Delivery of the W76-1 warhead began in Oct. 2008.

<sup>h</sup> Since 2001 the number of B61 bombs deployed in Europe has been unilaterally reduced by almost two-thirds from 480 to c. 180. Additional warheads are in reserve.

<sup>i</sup> The TLAM/N is being retired in accordance with the 2010 NPR.
Instead, the NPR reaffirmed the importance of nuclear weapons to US national security and recommended retaining a triad of long-range offensive nuclear forces, maintaining the current readiness level of hundreds of ballistic missiles on high alert, retaining large numbers of nuclear warheads in reserve to increase the deployed force if necessary, modernizing delivery vehicles and warheads, and building new warhead production factories. It also rejected a no-first-use policy for the time being and continued nuclear strike planning against non-nuclear armed adversaries.

New START does not contain any sub-limits on strategic forces. Thus, provided that strategic forces remain under the overall limits for deployed warheads and deployed and non-deployed delivery vehicles, there are no limits on how the nuclear forces recommended by the NPR must be structured. The NPR determined that the USA will retain the following nuclear force structure: (a) up to 420 deployed ICBMs, each carrying a single nuclear warhead, with hundreds of additional warheads in reserve for upload; (b) 14 nuclear-powered ballistic missile submarines (SSBNs), possibly 12 towards the end of the 2010s, with up to 240 deployed submarine-launched ballistic missile (SLBMs), each carrying multiple nuclear warheads with hundreds more in reserve for upload; and (c) up to 60 nuclear-capable heavy bombers equipped for gravity bombs and cruise missiles, each bomber counted as a single nuclear warhead but with hundreds of warheads in reserve for upload.

SLBMs and heavy bombers will be the main upload platforms for reserve warheads to increase the number of deployed nuclear warheads if so ordered. It is unclear whether the US Department of Defense (DOD) will decide to retire an additional 20 ICBMs or 20 bombers to meet the New START limit on deployed delivery vehicles. If the USA were to retain all 60 bombers with a maximum force loading of 1136 nuclear weapons, the total US force level of 2626 warheads would still count only as 1550 under New START due to the attribution of only one weapon per bomber.


Including the additional c. 2850 warheads in reserve, the total stockpile is c. 5000 warheads. There are another c. 3500 warheads awaiting dismantlement for a total inventory of c. 8500 warheads. A further c. 15 000 plutonium pits are stored at the Pantex Plant in Texas.
**The nuclear weapon production complex**

With the NPR and statements made during the New START ratification hearings, the Obama Administration made it clear that the USA intends to retain a large nuclear weapon complex for the foreseeable future. Over the next decade, the DOD ‘will invest well over $100 billion in nuclear delivery systems to sustain existing capabilities and modernize some strategic systems’. Likewise, the administration increased its funding request for the nuclear weapon activities of the National Nuclear Security Administration (NNSA) in financial year (FY) 2011 by nearly 10 per cent and another 8.4 per cent for FY 2012. Over the next decade, the NNSA will spend more than $92 billion on maintaining and modernizing nuclear warheads and production facilities. All existing warheads will undergo life-extension programmes and be equipped with new, improved or significantly modified components. Three nuclear weapon production facilities will be constructed with a capacity to produce 80 warheads per year, including the Uranium Processing Facility in Oak Ridge, Tennessee; the Chemistry and Metallurgy Research Replacement (CMRR) in Los Alamos, New Mexico; and the Kansas City Plant in Kansas City, Missouri. The estimated cost of these construction projects up to 2030 is $180 billion.

In addition to maintaining, dismantling and producing modified versions of existing warheads, the new facilities will have a capacity to produce up to 80 plutonium pits for replacement warheads each year. This capacity is about 10 times greater than the number of warheads lost each year to non-nuclear testing of the nuclear explosive package. According to the NPR, the extra capacity will allow a ‘substantial’ reduction of the nuclear stockpile:

By modernizing our aging nuclear weapons-supporting facilities and investing in human capital, we can substantially reduce the number of stockpiled nuclear weapons we retain as a hedge against technical or geopolitical surprise, accelerate the dismantlement of nuclear weapons no longer required for our deterrent, and improve our understanding of foreign nuclear weapons activities.

**Nuclear operations and organization**

Maintenance of the US strategic war plan—OPLAN (Operations Plan) 8010-08 Strategic Deterrence and Global Strike—continued in 2010, with

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Strategic Command (STRATCOM) conducting the Global Thunder nuclear exercise in November 2010 to test the readiness of ICBMs, SLBMs, long-range bombers, refuelling aircraft, and command and control. In recent years, STRATCOM has expanded Global Thunder from a command post exercise to a full nuclear employment exercise that includes force generation and flying operations.\(^\text{12}\)

Air Force Global Strike Command achieved full operational capability on 30 September 2010, after having taken command of all ICBMs and heavy bombers previously organized under US Space Command and Air Combat Command, respectively.\(^\text{13}\) The centralization of US Air Force (USAF) strategic nuclear assets under a single command, the first completely new command activated by the USAF in 27 years, was a response to a serious incident at Minot Air Force Base (AFB), North Dakota, in 2007 in which six cruise missiles carrying nuclear warheads were mistakenly loaded onto a B-52H aircraft and transported to Barksdale AFB, Louisiana.\(^\text{14}\)

**Land-based ballistic missiles**

The NPR decided that the USA will retain 400–420 ICBMs under New START. The force currently consists of 450 missiles with 500 warheads; within the next few years those missiles still equipped with multiple warheads will be downloaded to carry a single warhead each. The multiple independently targetable re-entry vehicle (MIRV) capability of the ICBM force will be retained, however, to preserve the option to upload hundreds of reserve warheads if necessary.

The last W62 warhead was dismantled on 11 August 2010, leaving only W78 and W87 warheads on the ICBM force.\(^\text{15}\) The 170-kiloton W62 has been replaced by the more powerful 300-kt W87/Mk-21 re-entry vehicle, which broadens the range of Minuteman ICBM force targets.

A multi-billion dollar modernization programme is under way to extend the service life of the Minuteman III missile to 2030. The NPR decided that an initial study will begin in 2011–12 to consider a range of deployment options for a replacement missile. This will involve exploring ‘new modes of ICBM basing that could enhance survivability and further reduce any incentives for prompt launch. Such an assessment will be part of the DOD’s


\(^\text{13}\) The ICBMs were transferred on 1 Dec. 2009 and the bombers on 1 Feb. 2010.


study of possible replacements for the current ICBM force’. In 2014 the DOD will recommend a specific way ahead for a follow-on programme.

There were two Minuteman III flight tests in 2010, the same number as in 2009.

Ballistic missile submarines

All 14 US Navy Ohio Class SSBNs carry D5 missiles. Twelve operational SSBNs carry a total of 288 D5 SLBMs, each of which is estimated to carry 4 warheads for a total of about 1152 warheads. With eight SSBNs based in the Pacific Ocean and six in the Atlantic Ocean, and a patrol rate comparable to that during the cold war, more than 60 per cent of US SSBN patrols now take place in the Pacific, compared to an average of only 15 per cent during the 1980s. The SSBN force is organized in two fleets: one overseeing Submarine Group 10 at Kings Bay Naval Submarine Base, Georgia, and the other overseeing Submarine Group 9 at Kitsap Naval Submarine Base near Bangor, Washington.

The US Navy is planning to replace the Ohio Class with 12 boats of a next-generation SSBN, known as SSBNX. Construction will begin in 2019 with launch in 2026. The SSBNX will enter service from 2029 after the first two Ohio Class SSBNs have been retired. The new class will carry 16 SLBMs to permit more boats under future arms control agreements and provide more operational flexibility. The new SSBNX programme is projected to cost $60–80 billion.

Twenty-four additional modified D5 SLBMs were procured in 2010, of a total of 108 missiles being purchased up to 2012 at a cost of more than $4 billion. The first modified D5 (D5LE), which was scheduled for deployment in 2010, will arm the Ohio Class SSBNs for the rest of their service lives up to 2042. Deployment of the W76-1/Mk-4A warhead is under way, with approximately 1200 warheads to be refurbished by 2018. The W76-1/Mk-4 warhead is equipped with a new fuse that allows more flexibility in setting the height of burst to ‘enable W76 to take advantage of [the] higher accuracy of [the] D5 missile’ and bring more targets, including hard targets, within range.

18 Two additional SSBNs are undergoing overhaul at any given time, and their 48 missiles and 192 warheads are not included in the total.
**Strategic bombers**

The US Air Force has 20 B-2 and 93 B-52H bombers, 94 of which—18 B-2s and 76 B-52Hs—are nuclear-capable. However, only 60 of these—16 B-2s and 44 B-52Hs—are thought to have nuclear missions.

Approximately 200 nuclear warheads are estimated to be deployed with the bombers on three bases. These include the aircraft-delivered B61-7, B61-11 (on the B-2 only) and B83-1 gravity bombs and the W80-1 warhead carried on air-launched cruise missiles (ALCMs, on B-52Hs only). Hundreds of additional bombs and cruise missiles are in storage and could be returned to the bases if necessary.

The USAF intends to keep the B-52H in the inventory until at least 2035 for both nuclear and conventional missions. A long-range strike study will be completed in early 2011 to define future options for a replacement bomber, with approximately $1.7 billion earmarked for a follow-on bomber. The USAF also intends to replace the ALCM, which will expire in 2030, with the Advanced Long Range Standoff (LRSO) nuclear cruise missile. Studies will be conducted up to 2013 with a goal of beginning low-rate initial production around 2025.20

**Non-strategic nuclear weapons**

As of January 2011 the USA retained approximately 760 non-strategic nuclear warheads. This includes nearly 200 B61 gravity bombs deployed in Europe, 300 reserve bombs in the USA, and approximately 260 warheads for the Tomahawk Land-Attack Cruise Missile (TLAM/N).

The B61 bombs are deployed at six airbases in five European member states of the North Atlantic Treaty Organization (NATO): Belgium, Germany, Italy, the Netherlands and Turkey.21 Approximately half of the bombs are earmarked for delivery by US F-15E and F-16 aircraft. The aircraft of non-nuclear weapon NATO countries that are assigned nuclear strike missions with US nuclear weapons include Belgian, Dutch and Turkish F-16s and German and Italian Tornados.

The NPR decided to equip a portion of the F-35 Joint Strike Fighter (Block IV) aircraft with nuclear capability but did not explicitly state that

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nuclear weapons should be deployed in Europe. The F-35 will be equipped with the new B61-12, a modified version of the B61-3/4/10 and -7. The NPR also decided to retire the TLAM/N.

**Nuclear warhead modernization**

Extensive life-extension and modernization programmes for all remaining US nuclear warhead types are scheduled for the next decades. The NPR decided that the USA ‘will not develop new nuclear warheads’ but consider the ‘full range’ of life-extension programme options, including ‘refurbishment of existing warheads, reuse of nuclear components from different warheads, and replacement of nuclear components’. This is intended to preclude resumption of live nuclear testing and enable adherence to the 1996 Comprehensive Nuclear-Test-Ban Treaty (CTBT). The NPR also decided that any life-extension programme ‘will only use nuclear components based on previously tested designs, and will not support new military capabilities’. However, this will depend on how ‘new’ military capabilities are defined, since the installation of a new arming, fusing and firing unit, for example, can significantly alter a warhead’s military capability.

**III. Russian nuclear forces**

As of January 2011 Russia had an estimated 2427 operational nuclear warheads (see table 7.3). This number has been adjusted down from that given in *SIPRI Yearbook 2010* to reflect the Russian Government’s declaration in 2010 that all non-strategic nuclear weapons are in storage as well as the retirement of older ICBMs.

Russia continues to reduce its strategic nuclear forces in accordance with its arms treaty commitments and as part of a doctrinal shift away from a ‘substantially redundant’ (suschestvenno izbytochnyi) towards a ‘minimally sufficient’ (garantirovanno dostatochnyi) deterrence posture. Russia’s national security strategy, approved in May 2009, states that it will maintain numerical parity with the USA’s offensive strategic weapons in the most cost-effective way.

On 5 February 2010 Russian President Dmitry Medvedev approved Russia’s newest military doctrine. The doctrine slightly reduces the role

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of nuclear weapons in Russia’s national security policy by introducing stricter criteria for their use.\textsuperscript{27} According to the new doctrine, Russia declared the right to use nuclear weapons in response to an attack from WMD as well as an attack from conventional weapons if ‘the very existence of the state is threatened’. The previous military doctrine, adopted in 2000, approved the use of nuclear weapons ‘in situations critical for the national security’.\textsuperscript{28} The 2010 military doctrine confirms Russia’s military task to maintain ‘strategic stability and the nuclear deterrence capability at the level of sufficiency’ and defines the term ‘sufficiency’ as ‘an ability to inflict “predetermined” damage to an aggressor under any circumstances’.\textsuperscript{29}

According to senior military experts, Russia’s strategic nuclear forces can guarantee ‘minimally sufficient’ deterrence but need qualitative improvements to enhance their survivability for an assured second-strike capability and their ability to penetrate missile defences.\textsuperscript{30} In light of these criteria, Russia continues to prioritize the deployment of a road-mobile ICBM with MIRVs and a new type of SLBM.

\textbf{Strategic bombers}

Russia’s strategic aviation units include two heavy bomber divisions consisting of 13 Tu-160, 31 Tu-95MS16 and 32 Tu-95MS6 aircraft. Russia continues its efforts to overhaul, upgrade and extend the service life of all its strategic bombers.\textsuperscript{31} One of the Tu-160 bombers finished an overhaul in June 2010.\textsuperscript{32} Russia’s non-strategic aviation units include four divisions of Tu-22M3 bombers.

\textbf{Land-based ballistic missiles}

Russia’s Strategic Rocket Forces (SRF) consist of three missile armies, which will be reduced to two by 1 January 2016.\textsuperscript{33}

\begin{itemize}
  \item\textsuperscript{28} President of Russia (note 26); and Sokov, N. (note 27).
  \item\textsuperscript{29} President of Russia (note 26).
  \item\textsuperscript{32} ‘KAPO transferred to the Air Force the refurbished missile carrier Tu-160’, \textit{Kommersant-Kazan}, 28 Aug. 2010.
  \item\textsuperscript{33} Isby, D. C., ‘Russian SRF plans structural changes’, \textit{Jane’s Missiles and Rockets}, vol. 13, no. 2 (Feb. 2009).
\end{itemize}
Table 7.3. Russian nuclear forces, January 2011

<table>
<thead>
<tr>
<th>Type/Russian designation (NATO designation)</th>
<th>No. deployed</th>
<th>Year first deployed</th>
<th>Range (km)</th>
<th>Warhead loading</th>
<th>No. of warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategic offensive forces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bombers</strong></td>
<td>76</td>
<td></td>
<td></td>
<td></td>
<td>-2 427</td>
</tr>
<tr>
<td>Tu-95MS6 (Bear-H6)</td>
<td>32</td>
<td>1981</td>
<td>6 500</td>
<td>6 x AS-15A</td>
<td>192</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 500</td>
<td>ALCMs, bombs</td>
<td>192</td>
</tr>
<tr>
<td>Tu-95MS16 (Bear-H16)</td>
<td>31</td>
<td>1981</td>
<td>6 500</td>
<td>16 x AS-15A</td>
<td>496</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 500</td>
<td>ALCMs, bombs</td>
<td>496</td>
</tr>
<tr>
<td>Tu-160 (Blackjack)</td>
<td>13</td>
<td>1987</td>
<td>10 500</td>
<td>12 x AS-15B ALCMs</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13 200</td>
<td>or AS-16 SRAMs, bombs</td>
<td>156</td>
</tr>
<tr>
<td><strong>ICBMs</strong></td>
<td>-295</td>
<td></td>
<td></td>
<td></td>
<td>-1 007</td>
</tr>
<tr>
<td>RS-20V (SS-18 Satan)</td>
<td>-50</td>
<td>1992</td>
<td>11 000</td>
<td>10 x 500–800 kt</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS-18 (SS-19 Stiletto)</td>
<td>-50</td>
<td>1980</td>
<td>10 000</td>
<td>6 x 400 kt</td>
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<td>RS-12M Topol (SS-25 Sickle)</td>
<td>-120</td>
<td>1985</td>
<td>10 500</td>
<td>1 x 800 kt</td>
<td>-120</td>
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<tr>
<td>RS-12M2 Topol-M (SS-27)</td>
<td>-51</td>
<td>1997</td>
<td>10 500</td>
<td>1 x 800 kt</td>
<td>-51</td>
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<tr>
<td>RS-12M1 Topol-M (SS-27)</td>
<td>18</td>
<td>2006</td>
<td>10 500</td>
<td>1 x (800 kt)</td>
<td>18</td>
</tr>
<tr>
<td>RS-24 (SS-27 Mod 2)</td>
<td>6</td>
<td>2010</td>
<td>10 500</td>
<td>3 x (400 kt)</td>
<td>18</td>
</tr>
<tr>
<td><strong>SLBMs</strong></td>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td>576</td>
</tr>
<tr>
<td>RSM-50 Volna (SS-N-18 M1 Stingray)</td>
<td>64</td>
<td>1978</td>
<td>6 500</td>
<td>3 x 50 kt</td>
<td>192</td>
</tr>
<tr>
<td>RSM-54 Sineva (SS-N-23 Skiff)</td>
<td>96</td>
<td>1986/2007</td>
<td>9 000</td>
<td>4 x 100 kt</td>
<td>384</td>
</tr>
<tr>
<td>RSM-56 Bulava (SS-NX-32)</td>
<td>0</td>
<td>(2011)</td>
<td>8 050+</td>
<td>6 x (100 kt)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Strategic defensive forces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ABMs</strong></td>
<td>-2068</td>
<td></td>
<td></td>
<td></td>
<td>(-700)</td>
</tr>
<tr>
<td>53T6 (SH-08 Gazelle)</td>
<td>68</td>
<td>1986</td>
<td>..</td>
<td>1 x 10 kt</td>
<td>68</td>
</tr>
<tr>
<td>S-300 (SA-10/20 Grumble)</td>
<td>1 900</td>
<td>1980</td>
<td>..</td>
<td>low kt</td>
<td>(-600)</td>
</tr>
<tr>
<td>S-400 Triumf (SA-21 Growler)</td>
<td>-100</td>
<td>2007</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td><strong>Non-strategic forces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-1 380)*</td>
</tr>
<tr>
<td><strong>Land-based non-strategic bombers</strong></td>
<td>682</td>
<td></td>
<td></td>
<td></td>
<td>(-800)*</td>
</tr>
<tr>
<td>Tu-22M (Backfire)</td>
<td>116</td>
<td>1974</td>
<td>..</td>
<td>2 x AS-4 ASM, bombs</td>
<td></td>
</tr>
<tr>
<td>Su-24 (Fencer)</td>
<td>550</td>
<td>1974</td>
<td>..</td>
<td>2 x bombs</td>
<td></td>
</tr>
<tr>
<td>Su-34 (Fullback)</td>
<td>16</td>
<td>2006</td>
<td>..</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Naval non-strategic attack aircraft</strong></td>
<td>147</td>
<td></td>
<td></td>
<td></td>
<td>(-200)*</td>
</tr>
<tr>
<td>Tu-22M (Backfire)</td>
<td>56</td>
<td>1974</td>
<td>..</td>
<td>2 x AS-4 ASM, bombs</td>
<td></td>
</tr>
<tr>
<td>Su-24 (Fencer)</td>
<td>47</td>
<td>1974</td>
<td>..</td>
<td>2 x bombs</td>
<td></td>
</tr>
<tr>
<td>Be-12 (Mail)/IL-38 (May)</td>
<td>44</td>
<td>1967/68</td>
<td>..</td>
<td>1 x depth bomb</td>
<td></td>
</tr>
<tr>
<td><strong>Ground-launched weapons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-range ballistic missiles</td>
<td>?</td>
<td></td>
<td>1 x ?</td>
<td></td>
<td>(?)*</td>
</tr>
<tr>
<td><strong>SLCMs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-220)*</td>
</tr>
<tr>
<td>SS-N-9, SS-N-12, SS-N-19, SS-N-21, SS-N-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ASW and SAM weapons</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-160)*</td>
</tr>
<tr>
<td>SS-N-15/16, SA-N-1/3/6, depth bombs, torpedoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total defensive and non-strategic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-2 080)*</td>
</tr>
<tr>
<td><strong>Total deployed warheads</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-2 427*</td>
</tr>
</tbody>
</table>
As of January 2011 Russia had approximately 50 RS-20V Voevoda heavy ICBMs on combat duty. Russia has an ongoing life-extension programme for the missiles and has announced plans to keep them in service until
The development of a new heavy ICBM to replace the RS-20V continued to be discussed in Russia in 2010. Russia has approximately 120 RS-12M Topol ICBMs deployed, a reduction of nearly 30 missiles compared with early 2010. The RS-12M is a three-stage, solid-fuelled, road-mobile ICBM with a single warhead, which entered into service in 1985. The RS-12M system is undergoing a life-extension programme. As part of this programme, there were two successful test launches of the missile in 2010.

The RS-12 Topol-M has been developed in both road-mobile (RS-12M1) and silo-based (RS-12M2) versions. As of January 2011 Russia was believed to have 18 RS-12M1 and 51 RS-12M2 missiles in service.

In 2010 Russia began deploying the RS-24 missile, a modified version of the RS-12M1 which carries three MIRVs. Adding the MIRV capability to the existing single-warhead version of the missile was made possible by the expiry of START in December 2009. As of January 2011 Russia had reportedly deployed six RS-24 missiles.

In November 2010 Russian military officials confirmed that the production of the RS-12M1 would be abandoned in favour of the RS-24, and the commander of the SRF announced that ‘the Topol-M mobile missile system will not be supplied to the [SRF] in the future’. However, deployment of the silo-based RS-12M2 appears to continue, with four more missiles planned for 2011 and another four for 2012.

The RS-12M2 missile and the RS-24 missile are expected to become the backbone of the SRF. The SRF stated that by 2016 the Topol-M and RS-24 systems will constitute at least 80 per cent of the ICBM force. To reach this goal, Russia will have to retire many of its RS-20V, RS-18 and RS-12M
Ballistic missile submarines and sea-launched ballistic missiles

As of January 2011 the Russian Navy operated a total of 11 SSBNs, down from 12 in early 2010 due to the retirement of a Delta III Class (Project 667BDR Kalmar) submarine. Four remaining Delta III submarines, each carrying 16 RSM-50 SLBMs, are deployed with the Pacific Fleet. Six Delta IV Class (Project 667BDRM Delfin) submarines are deployed with the Northern Fleet. Five of these have undergone an overhaul which extended their service life by 10 years and included the installation of the new modification of the RSM-54 Sineva missile. Russia also keeps in service one Project 941 Akula (Typhoon Class) submarine for use as a test platform. In 2010 Russia successfully conducted four underwater test launches of currently deployed types of SLBM: the RSM-50 and RSM-54.

Russia is building three SSBNs of a new class, the Project 955 Borei. The lead boat in the class, the Yuri Dolgorukii, conducted a number of successful sea trials in 2010. Russia announced plans to build up to eight SSBNs of this class, each of which are designed to be armed with 16 RSM-56 Bulava missiles.

In 2010 the troubled development of the Bulava, a three-stage, solid-fuelled SLBM, continued to receive attention from the media and senior officials in Russia. Once fitted on the Project 955 SSBNs, the Bulava is supposed to supplement and eventually replace the Delta IV/RSM-54 system. During 2010, Bulava missiles were successfully test-launched on 7 and 29 October. Seven of the previous 12 tests of the Bulava were unsuccessful.

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51 [In the framework of the State Armament Program for 2007–2015 it is planned to introduce eight SSBNs of “Borei” class to the Russian Navy], ARMS-TASS, 19 Mar. 2010, <http://armstass.su/?page=article&aid=82203&cid=25>.
14, with an additional 2 pop-up tests (i.e. tests of the mechanism which ejects the missile from the submarine). A test launch from the *Yurii Dolgorukii* scheduled for December 2010 was postponed until mid-2011.\(^{54}\)

**Non-strategic nuclear weapons**

The Russian Government indicated in 2010 that it had reduced its inventory of non-strategic (or tactical) nuclear weapons by 75 per cent.\(^{55}\) This was done pursuant to the implementation of two non-legally binding unilateral initiatives on non-strategic nuclear weapons, undertaken in 1991–92 together with parallel initiatives by the USA.\(^{56}\) The figure exceeded the 60 per cent reduction declared by a Russian official in 2007, and it may reflect the dismantlement by Russia of additional weapons.\(^{57}\)

There is considerable uncertainty about the size and location of Russia's non-strategic nuclear inventory, which continues to be characterized by a high degree of secrecy and a lack of transparency. Estimates about the size of the Soviet inventory of non-strategic nuclear weapons in 1991 ranged from approximately 15 000 to 21 700.\(^{58}\) Using the Russian Government's claim of an approximate 75 per cent reduction since 1991, the number of non-strategic nuclear weapons today would include 3700–5400 warheads. This number roughly fits the ‘3000–5000 plus’ range used during a NATO briefing on the NPR in September 2009.\(^{59}\)

Yet these warhead numbers are well in excess of the nominal warhead capacity of Russia's remaining nuclear-capable naval, air force and air defence delivery platforms, which is an estimated 2080 warheads. Most of the remaining 1600–3300 non-strategic weapons are probably retired and awaiting dismantlement.

In 2010 new claims and media reports arose concerning alleged Russian deployment of non-strategic nuclear weapons near NATO territory. These were denied by Russian officials.\(^{60}\)


\(^{57}\) ‘Russia determined to keep tactical nuclear arms for potential aggressors’, *Pravda*, 31 Oct. 2007.


IV. British nuclear forces

The United Kingdom’s nuclear deterrent consists exclusively of a sea-based component: four Vanguard Class Trident SSBNs, Trident II (D5) SLBMs and associated warheads, and support infrastructure (see table 7.4). The UK leases the SLBMs from the US Navy, under a system of ‘mingled asset ownership’. D5 missiles are randomly selected from the stockpile at the US Navy’s Trident facility in Kings Bay, Georgia, and loaded onto British submarines. The submarines then go to the Royal Naval Armaments Depot at Coulport, Argyll, where the missiles are fitted with nuclear warheads designed and manufactured at the Atomic Weapons Establishment (AWE), in Aldermaston, Berkshire. The UK possesses an arsenal of about 160 operational nuclear warheads available for use by the Trident SSBNs.\(^{61}\)

Each Vanguard Class SSBN is equipped with 16 Trident II (D5) missiles, carrying up to 48 warheads in total. It is believed that a number of the D5 missiles are deployed with only one warhead instead of three; this warhead may also have a reduced explosive yield.\(^{62}\) The flexibility in warhead loadings reflects the decision by the British Ministry of Defence (MOD) in 1998 to give a ‘sub-strategic’, or limited-strike, role to the Trident fleet aimed at enhancing the credibility of the British deterrent.\(^{63}\)

In a posture known as Continuous at Sea Deterrence (CASD), one British SSBN is on patrol at all times.\(^{64}\) The second and third SSBNs can be put to sea rapidly, but there are not enough missiles in the British inventory to simultaneously arm the fourth submarine. Since the end of the cold war, the SSBN on patrol has been kept at a level of reduced readiness with its missiles de-targeted and a ‘notice to fire’ measured in days.

The Vanguard Class SSBNs will reach the end of their service lives from 2024.\(^{65}\) The Royal Navy plans to renew the Trident system by replacing the...
In October 2010 the British MOD released a new Strategic Defence and Security Review, the first since 1997, that affirmed the government’s commitment to develop a submarine-based nuclear deterrent based on the current Trident system. As a cost-saving measure, the new submarines will have a smaller missile compartment equipped with 12 launch tubes rather than the 16 carried by the Vanguard Class submarines. Only 8 launch tubes will be operational in normal circumstances. The maximum number of nuclear warheads carried on each submarine will decrease from 48 to 40, a posture that would require deployment of five warheads on each missile.

In announcing the results of the review, the British Prime Minister, David Cameron, said that in light of the current budget crisis the government would delay the ‘main gate’ decision—on the detailed acquisition plans, design and number of submarines—until ‘about 2016’, after the next general election. This means that the first of the new generation of SSBNs may not be in operation until 2028 or 2029, four to five years after the first Vanguard submarine is due to be withdrawn, in 2024. The service lives of the Vanguard submarines are to be prolonged in accordance with the government’s commitment to reliably sustain the CASD posture. The British Secretary of State for Defence, Liam Fox, estimated the additional cost of maintaining the Vanguard Class submarines until 2028 to be £1.2–1.4 bil-

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**Table 7.4. British nuclear forces, January 2011**

<table>
<thead>
<tr>
<th>Type</th>
<th>Designation</th>
<th>No. deployed</th>
<th>Year first deployed</th>
<th>Range (km)(^a)</th>
<th>Warheads x yield</th>
<th>Warheads in stockpile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Submarine-launched ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Trident II</td>
<td>48</td>
<td>1994</td>
<td>&gt;7 400</td>
<td>1–3 x 100 kilotons</td>
<td>225(^b)</td>
</tr>
</tbody>
</table>

\(^a\) Range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

\(^b\) Fewer than 160 warheads are operationally available, c. 144 to arm 48 missiles on 3 of 4 nuclear-powered ballistic missile submarines (SSBNs). Only 1 SSBN is on patrol at any time, with up to 48 warheads. In 2010 it was decided that the number of operational warheads will be reduced to a maximum of 120, of which 40 will be on patrol at any given time.


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\(^{67}\) British Ministry of Defence (note 66), para. 3.11, p. 38.

lion ($1.8–2.1 billion). The Trident replacement programme will cost an estimated £20 billion ($30 billion). It was announced in July 2010 that the programme will be paid for from the MOD’s core budget, rather than Treasury reserve funds.

The 2010 Strategic Defence and Security Review revealed that the inventory of operational nuclear warheads will be reduced from about 160 to no more than 120. Likewise, the overall size of the nuclear stockpile, including non-deployed weapons, will decrease from the current 225 warheads to ‘not more than 180 by the mid 2020s’. The review indicated that the government would defer a decision about whether to refurbish or replace the nuclear warhead carried on the D5 SLBM until the next parliamentary term; the current warhead could remain in service until at least the late 2030s. The delay will defer an estimated £500 million ($750 million) of spending over the next 10 years. In the meantime, British SLBMs appear to be earmarked to receive the W76-1/Mk-4A, an upgraded version currently in production in the USA to replace the W76/Mk-4 deployed on US SLBMs. The upgraded weapon has increased military capabilities, according to British and US defence officials.

**The United Kingdom–France nuclear cooperation agreement**

On 2 November 2010 the British Prime Minister, David Cameron, and French President Nicolas Sarkozy signed bilateral treaties on defence and on nuclear cooperation. The nuclear agreement envisioned the establishment of ‘joint radiographic/hydrodynamics facilities’, one in France and one in the UK, to conduct computer-based testing of nuclear weapon components to ensure their safety and reliability in the absence of explosive testing of nuclear weapons. A nuclear simulation centre will be built in Valduc, France, and start operating from 2014. The Valduc laboratory will be supported by a joint technology development centre at Aldermaston, which will enable French and British scientists to model the performances

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69 British House of Commons, ‘Oral answers to questions, defence: Trident replacement’, Hansard, 8 Nov. 2010, column 1.


72 British Ministry of Defence (note 66), para. 3.9, p. 39.


Table 7.5. French nuclear forces, January 2011

<table>
<thead>
<tr>
<th>Type</th>
<th>No. deployed</th>
<th>Year first deployed</th>
<th>Range (km)(^d)</th>
<th>Warheads x yield</th>
<th>Warheads in stockpile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land-based aircraft</strong>(^b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mirage 2000N</td>
<td>-20</td>
<td>1988</td>
<td>2750</td>
<td>1 x up to 300 kt TNA</td>
<td>-20</td>
</tr>
<tr>
<td>Rafale F3</td>
<td>-20</td>
<td>2010–11</td>
<td>2000</td>
<td>1 x up to 300 kt TNA</td>
<td>-20</td>
</tr>
<tr>
<td><strong>Carrier-based aircraft</strong>(^b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rafale MK3</td>
<td>-10</td>
<td>2010–11</td>
<td>2000</td>
<td>1 x up to 300 kt TNA</td>
<td>-10</td>
</tr>
<tr>
<td><strong>Submarine-launched ballistic missiles</strong>(^c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M45</td>
<td>32</td>
<td>1996</td>
<td>6000(^d)</td>
<td>4–6 x 100 kt TN-75</td>
<td>160(^e)</td>
</tr>
<tr>
<td>M51.1</td>
<td>16</td>
<td>2010–11</td>
<td>6000</td>
<td>4–6 x 100 kt TN-75</td>
<td>80</td>
</tr>
<tr>
<td>M51.2</td>
<td>0</td>
<td>(2015)</td>
<td>6000</td>
<td>4–6 x TNO</td>
<td>0</td>
</tr>
<tr>
<td><em><strong>Total</strong></em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>-300(^f)</strong></td>
</tr>
</tbody>
</table>

\(^{a}\) Aircraft range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.

\(^{b}\) A small number of the previous-generation Air–Sol Moyenne Portée (ASMP, medium-range air-to-surface) missiles may remain in service until completely replaced by the ASMP-A in 2011.

\(^{c}\) France transitioned to a posture of 4 SSBNs in the mid-1990s, which meant having enough SLBMs to equip 3 operational SSBNs, with the fourth SSBN being overhauled.

\(^{d}\) The range of the M45 is listed as only 4000 km in a 2001 report from the French National Assembly’s National Defence Commission.

\(^{e}\) The missile upgrade started with the Le Vigilant submarine does not affect its warheads, which will be fitted back to the new M51.1 missiles.

\(^{f}\) France does not have a reserve but may have a small inventory of spare warheads for a total stockpile of c. 300 warheads.


of nuclear materials and technologies to ensure the ‘viability, safety and security in the long term’ of their nuclear weapon arsenals.\(^{76}\) Officials emphasized that the two countries would continue to maintain independent nuclear deterrent forces under the agreement.

\(^{76}\) UK–France Summit 2010 (note 74).
V. French nuclear forces

France’s nuclear forces consist of aircraft and SSBNs, carrying a total of about 300 warheads (see table 7.5). A 2008 white paper on defence and national security included important clarifications concerning French nuclear forces. France will continue to rely on the ‘principle of strict sufficiency’ (corresponding to a ‘minimum deterrence’ policy) as a guarantor of its security and the ‘operational credibility’ of the French nuclear arsenal, which relies on ‘permanent submarine patrols and airborne capability’.

In September 2010 the new Triomphant Class SSBN, Le Terrible, entered service, joining a fleet of three previously commissioned SSBNs of the same class—Le Triomphant, Le Téméraire and Le Vigilant. Le Terrible is equipped with 16 M51.1 SLBMs. The M51.1 is a three-stage, solid-fuelled missile with an estimated maximum range of 6000–8000 kilometres that can carry up to six TN-75 warheads. Before entering service, Le Terrible successfully test-launched the M51.1 SLBM on 27 January and 10 July 2010. The other three Triomphant Class SSBNs will be rearmed with the M51.1 by 2017. The upgrade of Le Vigilant began in July 2010. An improved version of the M51.1, the M51.2, is designed to carry the new Tête Nucléaire Océanique (TNO, oceanic nuclear warhead) and will replace the M51.1 after 2015.

By the end of 2010 the aircraft component of the French nuclear forces consisted of two land- and one sea-based nuclear-capable aircraft squadrons, comprised of Mirage and Rafale combat aircraft. The Mirage 2000N aircraft of the 3/4 Limousin Fighter Squadron will be replaced by Rafales in 2018. The aircraft can carry either the Air–Sol Moyenne Portée (ASMP,
medium-range air-to-surface) or the ASMP-Améliorée (ASMP-A) missile. A total of 90 ASMP missiles were produced, along with 80 TN-81 300-kt warheads for them. The follow-on cruise missile ASMP-A is currently being introduced to all three squadrons. The ASMP-A missiles carry the Tête Nucléaire Aeroportée (TNA, airborne nuclear warhead), which is a new thermonuclear warhead that is reported to have a selectable yield of 20 kt, 90 kt and 300 kt. The delivery of the remaining ASMP-A missiles and the retirement of the ASMP will be completed in 2011.

France remains committed to sustaining its nuclear weapon complex, including research and development capabilities. In 2010 it signed an agreement with the UK for technical cooperation and the exchange of classified information in the areas of nuclear weapon safety and security and stockpile certification (see section IV above).

VI. Chinese nuclear forces

China is estimated to have an arsenal of approximately 200 nuclear weapons earmarked for delivery mainly by ballistic missiles and aircraft (see table 7.6). Additional warheads may be in reserve, giving a total stockpile of about 240.

There are no credible reports indicating that the size of the Chinese nuclear weapon stockpile has changed significantly in recent years. However, China has been increasing the number of medium- and long-range missile-delivery systems as part of a long-term modernization programme aimed at developing a more survivable force and more flexible nuclear retaliatory options. According to a 2009 report by the US Air Force, China has ‘the most active and diverse ballistic missile development program in the world’ and its ‘ballistic missile force is expanding in both size and types of missiles’.

In March 2011 the Chinese Government released the latest of its biennial defence white papers. The new document reiterated China’s commitment to the policy of no-first-use of nuclear weapons and its intention to limit its nuclear capabilities to the minimum level required for national security. However, the white paper did not provide information about the capabilities and operational status of the country’s nuclear forces. The 2008 white paper had described how China’s nuclear forces would grad-

83 Lennox (note 34), p. 44.
84 French Senate (note 80), chapter 2, section I.C.
ually be brought to increased levels of alert during a crisis to deter an adversary and prepare for a retaliatory nuclear attack.\(^87\)

China’s land-based ballistic missiles are operated by the People’s Liberation Army (PLA) Second Artillery. According to the data published annually by the US DOD, in 2010 China’s nuclear-capable missile arsenal consisted of the ageing liquid-fuelled DF-3A (Dong Feng, or East Wind) intermediate-range ballistic missile and the more modern road-mobile, solid-fuelled DF-21 medium-range ballistic missile, which was assigned ‘regional deterrence missions’.\(^88\) In addition, China had two older types of ICBM: the silo-based, liquid-fuelled DF-5A missile and the smaller, liquid-fuelled DF-4. The Second Artillery is deploying modern mobile ICBM systems that are intended to enhance the survivability of the Chinese missile force by enabling the weapons to operate over a larger area.\(^89\) This includes the DF-31, a road-mobile, solid-fuelled missile that was first deployed in 2006, as well as a longer-range (in excess of 11,200 km) variant, the DF-31A.

China has had difficulty in developing a sea-based nuclear deterrent. It built a single Type 092 (Xia Class) SSBN armed with 12 intermediate-range solid-fuel, single-warhead JL-1 (Ju Long, or Great Wave) SLBMs. The submarine has never conducted a deterrent patrol and is not thought to be fully operational. China is currently building and deploying the Type 094 (Jin Class) SSBN. As of 2010, three submarines were reportedly either in service or in various stages of construction and outfitting. The US DOD estimated that China may eventually deploy ‘up to five’ Type 094 SSBNs.\(^90\) There have been reports indicating that one of the submarines had been deployed to a new base near Yulin, Hainan, on the South China Sea.\(^91\)

Each Jin Class SSBN will carry 12 three-stage, solid-fuelled SLBMs, the JL-2, which is a sea-based variant of the DF-31 ICBM. The JL-2 has an estimated range of 7200 km. The missile is believed to be armed with a single nuclear warhead.\(^92\) According to the US DOD, the JL-2 has encountered technical difficulties, ‘failing several of what should have been the final


\(^{88}\) US Department of Defense (DOD), *Military and Security Developments Involving the People’s Republic of China 2010*, Annual Report to Congress (DOD: Washington, DC, Mar. 2010), p. 66. Although China has its own system for defining missile ranges (see table 7.5), the US DOD definitions are used here: short range = <1100 km; medium range = 1100–2750 km; intermediate range = 2750–5500 km; and intercontinental range = >5500 km.

\(^{89}\) US Department of Defense (note 88), p. 34.

\(^{90}\) US Department of Defense (note 88), pp. 2–3.


\(^{92}\) US Department of Defense (note 88), p. 34.
Table 7.6. Chinese nuclear forces, January 2011

<table>
<thead>
<tr>
<th>Type/Chinese designation (US designation)</th>
<th>No. deployed</th>
<th>Year first deployed</th>
<th>Range (km)$^a$</th>
<th>Warhead loading</th>
<th>No. of warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land-based missiles</strong>$^b$</td>
<td>130</td>
<td>1971</td>
<td>3 100$^c$</td>
<td>1 x 3.3 Mt</td>
<td>12</td>
</tr>
<tr>
<td>DF-3A (CSS-2)</td>
<td>-12</td>
<td>1971</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DF-4 (CSS-3)</td>
<td>-12</td>
<td>1980</td>
<td>5 500</td>
<td>1 x 3.3 Mt</td>
<td>12</td>
</tr>
<tr>
<td>DF-5A (CSS-4)</td>
<td>20</td>
<td>1981</td>
<td>13 000</td>
<td>1 x 4–5 Mt</td>
<td>20</td>
</tr>
<tr>
<td>DF-21 (CSS-5)</td>
<td>60</td>
<td>1991</td>
<td>2 100$^d$</td>
<td>1 x 200–300 kt</td>
<td>60</td>
</tr>
<tr>
<td>DF-31 (CSS-10 Mod 1)</td>
<td>&lt;10</td>
<td>2006</td>
<td>&gt;7 200</td>
<td>1 x . .</td>
<td>&lt;10</td>
</tr>
<tr>
<td>DF-31A (CSS-10 Mod 2)</td>
<td>&lt;15</td>
<td>2007</td>
<td>&gt;11 200</td>
<td>1 x . .</td>
<td>&lt;15</td>
</tr>
<tr>
<td><strong>SLBMs</strong></td>
<td>(36)</td>
<td>(36)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JL-1 (CSS-N-3)</td>
<td>(12)</td>
<td>1986</td>
<td>&gt;1 770</td>
<td>1 x 200–300 kt</td>
<td>(12)</td>
</tr>
<tr>
<td>JL-2 (CSS-NX-14)</td>
<td>(24)</td>
<td>(2011)</td>
<td>&gt;7 200</td>
<td>1 x . .</td>
<td>(24)</td>
</tr>
<tr>
<td><strong>Aircraft</strong>$^e$</td>
<td>&gt;20</td>
<td>(1972–. .)</td>
<td>3 100</td>
<td>1 x bomb</td>
<td>(20)</td>
</tr>
<tr>
<td>H-6 (B-6)</td>
<td>20</td>
<td>1965</td>
<td></td>
<td></td>
<td>(20)</td>
</tr>
<tr>
<td>Attack (. .)</td>
<td>. .</td>
<td>1972–. .</td>
<td></td>
<td>1 x bomb</td>
<td>. .</td>
</tr>
<tr>
<td><strong>Cruise missiles</strong></td>
<td>150–350</td>
<td>2007</td>
<td>&gt;1 500</td>
<td>1 x . .</td>
<td>(-240)$^g$</td>
</tr>
<tr>
<td>DH-10</td>
<td>150–350</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$. . = not available or not applicable; ( ) = uncertain figure; kt = kiloton; Mt = Megaton; SLBM = submarine-launched ballistic missile.

$^a$ Aircraft range is for illustrative purposes only; actual mission range will vary.

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

$^c$ The range of the DF-3A may be greater than is normally reported.

$^d$ The DF-21A (CSS-5 Mod 2) variant is believed to have a range of up to 2500 km.

$^e$ Figures for aircraft are for nuclear-configured versions only.

$^f$ It is unclear if the DH-10 has nuclear capability, but US Air Force intelligence lists the weapon as ‘conventional or nuclear’, the same as for the Russian nuclear-capable AS-4.

$^g$ Additional warheads are thought to be in storage to arm future DF-31, DF-31A and JL-2 missiles. The total stockpile is believed to comprise c. 240 warheads.


round of flight tests’, and it was unclear when the system would become operational.93

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It is thought that China has a small stockpile of nuclear bombs for delivery by aircraft. Although the PLA Air Force is not believed to have units whose primary purpose is to deliver the bombs, a declassified 1993 US report assesses that ‘some units may be tasked for nuclear delivery as a contingency mission’. The most likely aircraft for nuclear missions is the ageing H-6 bomber and possibly a more modern fighter-bomber. China is also developing an air-launched version of a ground-launched land-attack cruise missile, the DH-10 (also designated CJ-10) that may be for delivery by the H-6 aircraft. The US Air Force describes the capability of the DH-10 as ‘conventional or nuclear’, the same designation used for other dual-capable cruise missiles. However, it is uncertain whether China has assigned a nuclear role to air- or ground-launched cruise missiles.

VII. Indian nuclear forces

It is estimated that India has an arsenal of 80–100 nuclear weapons. This estimate is based on calculations of India’s inventory of weapon-grade plutonium as well as the number of operational nuclear-capable delivery systems.

India’s nuclear weapons are believed to be plutonium-based. As of 2010 India’s weapon-grade plutonium stockpile was estimated to be between 0.36 and 0.64 tonnes. The plutonium was produced by the 50-year old 40-megawatt-thermal (MW(t)) plutonium-production reactor (CIRUS) near Mumbai, which shut down at the end of 2010, and the 25-year old 100-MW(t) Dhruva reactor. Dhruva is capable of producing an estimated 11–18 kilogram weapon-grade plutonium per year, sufficient for 2–6 bombs, depending on weapon design and fabrication skills. India appears to be basing its future weapon plutonium needs on production in fast breeder reactors. A 1250-MW(t) prototype fast breeder reactor is nearing completion at Kalpakkam, which also houses a reprocessing facility that is not subject to International Atomic Energy Agency (IAEA) safeguards. The reactor has recently experienced delays, but at 75 per cent operating capacity it could potentially produce around 140 kg of weapon-grade plutonium per year, or enough for 28–35 weapons.

96 See appendix 7A, table 7A.2.
### Table 7.7. Indian nuclear forces, January 2011

<table>
<thead>
<tr>
<th>Type</th>
<th>Range (km)</th>
<th>Payload (kg)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aircraft</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mirage 2000H Vajra</td>
<td>1 850</td>
<td>6 300</td>
<td>Has reportedly been certified for delivery of nuclear gravity bombs</td>
</tr>
<tr>
<td>Jaguar IS Shamsher</td>
<td>1 400</td>
<td>4 760</td>
<td>Some of 4 squadrons may have a nuclear delivery role</td>
</tr>
<tr>
<td><strong>Land-based ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prithvi I (P-I)</td>
<td>150</td>
<td>800</td>
<td>Entered service in 1994; widely believed to have a nuclear delivery role; fewer than 50 launchers deployed; most recent test flight on 15 Apr. 2009</td>
</tr>
<tr>
<td>Agni I</td>
<td>&gt;700</td>
<td>1 000</td>
<td>Most recent Indian Army operational test on 25 Nov. 2010; deployed with the Indian Army's 334 Missile Group</td>
</tr>
<tr>
<td>Agni II</td>
<td>&gt;2 000</td>
<td>1 000</td>
<td>Most recent Indian Army operational launch 17 May 2010; possibly operational soon</td>
</tr>
<tr>
<td>Agni II Prime</td>
<td>&gt;2 500</td>
<td>1 000</td>
<td>Launch on 10 Dec. 2010 failed; status unknown</td>
</tr>
<tr>
<td>Agni III</td>
<td>&gt;3 000</td>
<td>1 500</td>
<td>Under development; test-launched 3 times, most recently on 7 Feb. 2010; induction possibly in 2011</td>
</tr>
<tr>
<td>Agni IV</td>
<td>&lt;5 000</td>
<td>. .</td>
<td>Under development; test launch possible in 2011</td>
</tr>
<tr>
<td><strong>Sea-based ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dhanush</td>
<td>350</td>
<td>500</td>
<td>Test-launched on 11 Mar. 2011; induction under way</td>
</tr>
<tr>
<td>K-15d</td>
<td>700</td>
<td>500–600</td>
<td>Under development; test-launched from a submerged pontoon on 26 Feb. 2008; will probably test-launch from the INS <em>Arihant</em> in 2012</td>
</tr>
</tbody>
</table>

. . = not available or not applicable.

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

*fr* India has also begun developing a subsonic cruise missile with a range of 1000 km, known as the Nirbhay (Fearless), which may have a nuclear capability.

*fr* The original Agni I, now known as the Agni, was a technology demonstrator programme that ended in 1996. The Indian Ministry of Defence refers to Agni I as A1.

*fr* The K-15 is possibly the same missile as the Sagarika described by US intelligence. According to unconfirmed Indian media reports, a land-based version of the K-15, known as the Shourya, was test-launched for the first time on 12 Nov. 2008.

In addition, India has an estimated stockpile of about 1.0–1.6 tonnes of uranium enriched to 93 per cent uranium-235.\footnote{See appendix 7A, table 7A.1.} The enrichment is taking place at the uranium centrifuge facility at Rattehalli Rare Materials Plant to produce HEU for use as naval reactor fuel.\footnote{International Panel on Fissile Material (note 97), pp. 123–24. See also appendix 7A, table 7A.3.}

Indian warheads are not thought to be routinely mated with their delivery systems but rather are kept separate in storage facilities.\footnote{Norris, R. S. and Kristensen, H. M., ‘Indian nuclear forces, 2010’, Bulletin of the Atomic Scientists, vol. 66, no. 5 (Sep./Oct. 2010), pp. 76–81.}

**Strike aircraft**

Aircraft constitute the most mature component of India’s nuclear strike capabilities (see table 7.7). The Indian Air Force (IAF) has reportedly certified the Mirage 2000H Vajra multi-role aircraft for delivery of nuclear gravity bombs. In addition, it is believed that some of the IAF’s four squadrons of Jaguar IS Shamsher combat aircraft may have a nuclear delivery role.\footnote{Naik, P. V., ‘IAF aiming for diverse capabilities, says vice chief of air staff, Air Marshall V. P. Naik in his keynote address on fighter technology and advance systems’, India Strategic, Oct. 2008.}

**Land-based missiles**

India’s land-based missile arsenal consists of the Prithvi and the Agni series. The Prithvi I (SS-150) is a single-stage, liquid-fuelled, road-mobile short-range ballistic missile (SRBM) that can carry a 1000-kg warhead to a maximum range of 150 km. It is widely believed that a number of Prithvi I missiles have been modified for nuclear roles. The Prithvi I was first tested in 1988 and was inducted into service in 1994.\footnote{Mian, Z., Nayyar, A. H. and Ramana, M. V., ‘Bringing Prithvi down to earth: the capabilities and potential effectiveness of India’s Prithvi missile’, Science and Global Security, vol. 7, no. 3 (1998).}

The Prithvi II and the Prithvi III SRBMs are variants of the Prithvi I, but they are not believed to have nuclear delivery roles.

In recent years, the Prithvi’s nuclear role has been largely taken over by the Agni series. The Agni was developed by India’s Defence Research and Development Organisation (DRDO) as a part of its problem-plagued integrated guided missile development programme.\footnote{Verma, B., ‘How DRDO failed India’s military’, Rediff, 15 Jan. 2008, <http://www.rediff.com/news/2008/jan/15guest.htm>.
} The Agni I is a single-stage, solid-fuelled missile that is capable of delivering a 1000-kg warhead to a maximum distance of approximately 700–800 km. The Indian Army successfully test-launched an Agni I missile on 25 November 2010.\footnote{Rout, H. K., ‘India test-fires nuclear-capable Agni-I missile’, Times of India, 25 Nov. 2010.} The Agni II is a two-stage, solid-fuelled missile that can deliver a similar pay-
load to a maximum range of 2000 km. The DRDO has been developing a variant of the Agni II, known as the Agni II Prime (sometimes called Plus), which has an extended range of 2500 km and incorporates several technological advances, including improved propulsion and stage-separation systems. The missile’s inaugural flight test, on 10 December 2010, was unsuccessful.\textsuperscript{106} In addition, the DRDO continues to develop the Agni III, a two-stage, solid-fuelled missile capable of delivering a 1500-kg payload to a range of 3000–3500 km. The Agni III was successfully flight-tested for the third time on 7 February 2010, after which DRDO officials declared that the missile was ready for induction into service.\textsuperscript{107}

**Sea-based missiles**

The DRDO has tested components of an underwater missile launch system and is developing a two-stage ballistic missile that can be launched from a submerged submarine using a gas-charged booster.\textsuperscript{108} Indian MOD statements have designated the missile as the K-15, although other sources have referred to it as the Sagarika (Oceanic) project.\textsuperscript{109} The new nuclear-capable missile will be able to deliver a 500-kg payload to a distance of up to 700 km. The DRDO is reportedly developing a larger SLBM, known as the K-4, which may have a range of up to 3500 km.\textsuperscript{110} Both missiles are expected to be eventually deployed on an indigenously constructed SSBN that is the product of India’s long-running Advanced Technology Vessel (ATV) programme. The first of the submarines, the INS \textit{Arihant}, was launched in 2009 and may enter service by 2012.\textsuperscript{111}

India also continues to work on the Dhanush missile, a naval version of the Prithvi II, which is launched from a stabilization platform mounted on surface ships. It can reportedly carry a 500-kg warhead to a maximum range of 350 km and is designed to be able to hit both sea- and shore-based targets.

**VIII. Pakistani nuclear forces**

Pakistan is estimated to possess 90–110 nuclear weapons that can be delivered by aircraft and missiles (see table 7.8). This represents an increase


\textsuperscript{111} Pandit, R., ‘In a year India will have nuclear triad: Navy chief’, \textit{Times of India}, 3 Dec. 2010.
over the figure presented in *SIPRI Yearbook 2010* and reflects a revised estimate of Pakistan’s military plutonium production capabilities and delivery platforms.

Pakistan’s current nuclear arsenal is believed to use HEU, but there is evidence that Pakistan is moving towards an arsenal based on plutonium. Warheads using plutonium could be lighter and more compact than those using HEU to achieve the same yield. Such warheads could either be fitted onto smaller missiles, possibly including cruise missiles, or would give already deployed ballistic missiles longer ranges.

As of 2010 Pakistan was estimated to have a stockpile of 2.2–3.0 tonnes of 90 per cent HEU, and is currently producing 120–180 kg HEU each year, enough for 10–15 warheads. The enrichment is believed to be taking place at the uranium centrifuge facilities at Kahuta and Gadwal. As of 2010 Pakistan had accumulated an estimated inventory of 80–120 kg of separated weapon-grade plutonium.\(^{112}\) Pakistan is expanding its plutonium-production capabilities at the nuclear complex at Khushab, Punjab. Its first plutonium production reactor, the 40–50 MW(t) Khushab-I, produces 5.7–11.5 kg of plutonium annually, depending on operational efficiency, enough for 1–3 nuclear weapons, depending on weapon design and fabrication skills.\(^{113}\) A second plutonium production reactor, Kushab-II, appears to have a similar design and power. It may have started operation in late 2009 or 2010.\(^{114}\) The first weapon-grade plutonium from Khushab-II could become available in 2011. Construction work on a third reactor at the Khushab site began in 2006, and satellite imagery indicates that work on a fourth reactor has also started.\(^{115}\) Rumours of possible Chinese assistance in building the fourth reactor appear to have been unfounded.\(^{116}\) When the two new reactors become fully operational, Pakistan’s annual weapon-grade plutonium-production capacity could eventually double. Combined with the annual HEU production, this could potentially boost Pakistan’s annual production of fissile material to the equivalent of 13–27 bombs per year. This will depend, however, on the country having sufficient capacity to reprocess spent fuel.\(^{117}\)

\(^{112}\) See appendix 7A, tables 7A.1–7A.3.

\(^{113}\) *International Panel on Fissile Material* (note 97), p. 132.


### Table 7.8. Pakistani nuclear forces, January 2011

<table>
<thead>
<tr>
<th>Type</th>
<th>Range (km)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Payload (kg)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aircraft</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-16A/B</td>
<td>1 600</td>
<td>4 500</td>
<td>32 aircraft, deployed in 3 squadrons; most likely aircraft to have a nuclear delivery role</td>
</tr>
<tr>
<td><strong>Land-based ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghaznavi (Hatf-3)</td>
<td>~400</td>
<td>500</td>
<td>Entered service with the Pakistani Army in 2004; fewer than 50 launchers deployed; most recent test launch on 8 May 2010; believed to be a copy of the M-11 missile acquired from China in the 1990s</td>
</tr>
<tr>
<td>Shaheen I (Hatf-4)</td>
<td>&gt;450&lt;sup&gt;b&lt;/sup&gt;</td>
<td>750–1 000</td>
<td>Entered service with the Pakistani Army in 2003; fewer than 50 launchers deployed; most recent test launch on 8 May 2010</td>
</tr>
<tr>
<td>Shaheen II (Hatf-6)</td>
<td>2 500</td>
<td>(-1 000)</td>
<td>First 2 army operational readiness launches on 19 and 21 Apr. 2008; expected to become operational soon</td>
</tr>
<tr>
<td>Ghauri I (Hatf-5)</td>
<td>&gt;1 200</td>
<td>700–1 000</td>
<td>Entered service with the Pakistani Army in 2003; fewer than 50 launchers deployed; last test-launched on 20 Dec. 2010</td>
</tr>
<tr>
<td><strong>Cruise missiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babur (Hatf-7)</td>
<td>600–700&lt;sup&gt;c&lt;/sup&gt;</td>
<td>. .</td>
<td>Under development; test-launched on 10 Feb. 2011; sea- and air-launched versions also under development</td>
</tr>
<tr>
<td>Ra’ad (Hatf-8)</td>
<td>350</td>
<td>. .</td>
<td>Under development; air-launched; first 2 test launches on 25 Aug. 2007 and on 8 May 2008</td>
</tr>
</tbody>
</table>

. . = not available or not applicable; () = uncertain figure.

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

<sup>b</sup> Some Pakistani sources state that the Shaheen I has a range exceeding 600 km.

<sup>c</sup> Since 2006 the range of flight tests has increased from 500 km and the goal is now 1000 km.

Strike aircraft

In its nuclear weapon delivery role, the Pakistani Air Force (PAF) is most likely to use the US-produced F-16 combat aircraft. The PAF also operates approximately 156 Mirage III and Mirage V aircraft, of which the latter might also have a nuclear role.

Pakistan is developing an air-launched cruise missile, known as the Ra’ad (Hatf-8), which will have a range of 350 km. The Ra’ad was test-launched in August 2007 and May 2008 from a Mirage III aircraft.\textsuperscript{118} The missile is believed to be nuclear capable.

Land-based missiles

Pakistan has two land-based, short-range ballistic missiles that are believed to have nuclear delivery roles. The Ghaznavi (Hatf-3) is a single-stage, solid-fuelled, road-mobile missile which was inducted into service in 2004. The Shaheen (Hatf-4) is a solid-fuelled missile that entered into service in 2003. The two missiles were most recently test-launched on 8 May 2010.\textsuperscript{119}

The Ghauri I (Hatf-5) is Pakistan’s only medium-range ballistic missile. It is a single-stage, liquid-fuelled, road-mobile missile with a range exceeding 1200 km. A Ghauri I missile was successfully tested by the Army Strategic Force Command’s strategic missile group on 20 December 2010.\textsuperscript{120} The Shaheen II (Hatf-6) is a two-stage, solid-fuelled, road-mobile missile with a range of 2500 km. It has been under development for more than a decade and may soon become operational.

Pakistan is continuing to develop the Babur (Hatf-7) ground-launched cruise missile. On 10 February 2011 it conducted the latest in a series of a flight tests of the nuclear-capable cruise missile.\textsuperscript{121} Pakistan plans to develop air- and sea-launched versions.

IX. Israeli nuclear forces

Israel continues to maintain its long-standing policy of nuclear opacity: it neither officially confirms nor denies that it possesses nuclear weapons.\textsuperscript{122}

\textsuperscript{121} According to an official press release, the Babur cruise missile has a range of 600 km. Pakistani Inter Services Public Relations, Press Release no. PR40/2011-ISPR, 10 Feb. 2011, \texttt{<http://www.ispr.gov.pk/front/main.asp?o=t-press_release&id=1666>}.
In May 2010 a British newspaper published what it claimed were secret South African documents from the 1970s that purportedly revealed an Israeli offer to sell nuclear weapons to the South African Government. Israeli officials denied that such an offer had ever been made.

The size of the Israeli nuclear weapon stockpile is unknown, but Israel is widely believed to have produced enough plutonium for 100–200 warheads. According to one estimate, Israel possessed 0.8 tonnes of weapon-grade plutonium as of 2010. Only part of this plutonium may have been used to produce weapons. It is estimated here that Israel has approximately 80 intact nuclear weapons, of which 50 are warheads for delivery by ballistic missiles and the rest are bombs for delivery by aircraft (see table 7.9). In 2010 there continued to be media speculation that Israel may have developed a nuclear-capable SLCM, based on the US-made Harpoon mis-

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**Table 7.9. Israeli nuclear forces, January 2011**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range (km)</th>
<th>Payload (kg)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-16A/B/C/D/I</td>
<td>1 600</td>
<td>5 400</td>
<td>205 aircraft in the inventory; some are believed to be certified for nuclear weapon delivery</td>
</tr>
<tr>
<td>Falcon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ballistic missiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jericho II</td>
<td>1 500–</td>
<td>750–</td>
<td>c. 50 missiles; first deployed in 1990; test-launched on 27 June 2001</td>
</tr>
<tr>
<td></td>
<td>1 800</td>
<td>1 000</td>
<td></td>
</tr>
<tr>
<td>Jericho III</td>
<td>&gt;4 000</td>
<td>1 000–</td>
<td>Test-launched on 17 Jan. 2008; status unknown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 300</td>
<td></td>
</tr>
</tbody>
</table>

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

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

*c The Shavit space launch vehicle, if converted to a ballistic missile, could deliver a 775-kg payload to a distance of 4000 km.

sile, for its fleet of three Type 800 Dolphin Class diesel-electric submarines purchased from Germany.\textsuperscript{125} Israel has denied these reports.\textsuperscript{126}

X. North Korea’s military nuclear capabilities

North Korea demonstrated a military nuclear capability by carrying out underground nuclear test explosions in October 2006 (with an estimated yield of less than 1 kt) and May 2009 (with an estimated yield of about 2–3 kt).\textsuperscript{127} In both tests the estimated yield of the explosions was much lower than the yields of the initial nuclear tests conducted by other states. The US intelligence community called the 2006 test a failure and considered that the 2009 test ‘was apparently more successful than the 2006 test’.\textsuperscript{128} It also assessed that North Korea had the capability to produce nuclear weapons, although it was unclear whether it had done so.\textsuperscript{129} There has been considerable speculation that North Korea may have obtained weapon design assistance from abroad.\textsuperscript{130}

As of December 2010 North Korea was estimated to have produced and separated 24–42 kg of plutonium. This would be sufficient to build up to eight nuclear weapons, assuming that each weapon used 5 kg of plutonium.\textsuperscript{131} The amount of plutonium that North Korea has separated from the spent fuel of its 5-megawatt electric graphite-moderated research reactor at Yongbyon, North Pyongan, and hence the number of warheads it may have produced, has been the subject of debate. North Korea announced in 2009 that it had resumed the reprocessing of the remaining fuel rods from the Yongbyon reactor.\textsuperscript{132} In 2010 commercial satellite imagery showed new


\textsuperscript{129} Clapper (note 127). Doubt remains among non-governmental analysts about whether North Korea has the design and engineering skills needed to manufacture a fully functional nuclear weapon that could be used in an operational military capacity.


\textsuperscript{131} Some reports suggested that North Korea may have used a smaller amount of plutonium in its weapon design. See ‘N. Korea plutonium figures vary’, \textit{Chosun Ilbo}, 30 June 2008; and Fifield, A., ‘Defector says North Korea “has one-tonne nuclear bomb”’, \textit{Financial Times}, 20 July 2005.

construction and excavation activity at the Yongbyon site, although the purpose of the activity was unclear.  
North Korea has long been suspected by the USA of pursuing an undeclared uranium enrichment programme aimed at producing HEU for use in nuclear weapons. In 2009 North Korea issued a number of statements acknowledging that it had an enrichment programme under way for producing fuel for future nuclear power reactors.  
James R. Clapper, the Director of US National Intelligence, reiterated in February 2011 that North Korea ‘has pursued a uranium enrichment activity in the past, which we assess was for weapons’. In November 2010 North Korea showed a delegation of US scientists a new uranium enrichment facility, located in a former fuel-rod fabrication building at Yongbyon. The scientists were told that the facility ‘contained 2000 centrifuges in six cascades’; that it was built between April 2009 and November 2010; and that it was producing uranium with an average enrichment level of 3.5 per cent for a civilian light-water reactor programme. One of the visiting scientists reported that the plant was significantly more advanced than he had expected, although he could not confirm whether the centrifuges were operational. US officials concluded that the plant could not have been built in the stated time frame without a network of undeclared nuclear facilities and activities elsewhere in the country. In early 2011 a confidential report prepared by a panel of experts for the United Nations Security Council similarly concluded that North Korea might have additional nuclear-related facilities.

XI. Conclusions

In 2010 Russia and the USA continued to reduce their deployed strategic nuclear offensive forces pursuant to meeting the warhead limit set by SORT. Under New START, concluded during the year, the two states will make further modest reductions in these forces. The new agreement did

137 Hecker (note 136), p. 4.
not place limits on the Russian and US stockpiles of non-strategic and non-deployed nuclear warheads.

Despite signs of growing momentum for nuclear arms control and disarmament efforts in 2010, all of the legally recognized nuclear weapon states appeared determined to retain their nuclear arsenals for the indefinite future and were either modernizing their nuclear forces or had announced plans to do so. The US Nuclear Posture Review reaffirmed the importance of the current nuclear force posture to US national security and recommended modernizing the nuclear weapon production complex. France and the UK signed a bilateral agreement on technical cooperation to ensure the long-term safety and reliability of their nuclear weapons. China is deploying a new generation of land- and sea-based nuclear forces.

Among the de facto nuclear weapon states, India and Pakistan continued to expand their nuclear strike capabilities, while Israel appeared to be waiting to see how Iran’s nuclear programme developed. There remained considerable uncertainty about North Korea’s nuclear weapon capabilities.