France’s nuclear arsenal consists of approximately 300 warheads, a number that has remained stable in recent years. The warheads are earmarked for delivery by 48 submarine-launched ballistic missiles (SLBMs) and 54 air-launched cruise missiles (ALCMs), which provides France with both strategic and tactical nuclear capabilities.\(^1\) France has allocated 12 per cent (c. €22 billion) of its annual defence budgets for 2014–19 to maintaining and modernizing its nuclear forces and infrastructure at a level of ‘strict sufficiency’.\(^2\)

The main component of France’s strategic nuclear deterrence force consists of four Triomphant class nuclear-powered ballistic missile submarines (SSBNs), each of which carries 16 submarine-launched ballistic missiles (SLBMs). The French Navy maintains that one SSBN is on operational patrol at all times. The SSBN force is complemented by nuclear-capable land- and sea-based combat aircraft (see table 11.5).

France continues to modernize its SSBN force. The French Navy is modifying the Triomphant class submarines to carry the M51 SLBM, which replaces the ageing M45 missile. Work is expected to be completed by 2019. As of December 2016 three submarines were carrying the initial version of the missile (the M51.1). Work on upgrading the fourth submarine has begun and is expected to be completed in 2018.\(^3\) Each of the missiles is capable of carrying 4–6 multiple independently targetable (MIRV) warheads. An M51.1 missile was successfully test launched by Le Triomphant on 1 July 2016.\(^4\)

The SSBN fleet will be equipped with an enhanced version of the missile (the M51.2), which has increased range and improved penetration aids.\(^5\) The M51.2 is designed to carry the new, more robust Tête Nucléaire Océanique (TNO, Oceanic Nuclear Warhead), which has a reported yield of up to

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world nuclear forces

France has commenced design work on an M51.3 SLBM, which will have a longer range and improved accuracy.

France is also beginning design work on an M51.3 SLBM, which will have a longer range and improved accuracy.


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Table 11.5. French nuclear forces, January 2017

<table>
<thead>
<tr>
<th>Type</th>
<th>No. deployed</th>
<th>Year first deployed</th>
<th>Range (km)a</th>
<th>Warheads x yield</th>
<th>No. of warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land-based aircraft</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mirage 2000N</td>
<td>20</td>
<td>1988</td>
<td>2 750</td>
<td>1 x up to 300 kt TNA</td>
<td>20</td>
</tr>
<tr>
<td>Rafale F3b</td>
<td>20</td>
<td>2010–11</td>
<td>2 000</td>
<td>1 x up to 300 kt TNA</td>
<td>20</td>
</tr>
<tr>
<td><strong>Carrier-based aircraft</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rafale MF3</td>
<td>10</td>
<td>2010–11</td>
<td>2 000</td>
<td>1 x up to 300 kt TNA</td>
<td>10</td>
</tr>
<tr>
<td><strong>Submarine-launched ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M51.1</td>
<td>48</td>
<td>2010</td>
<td>&gt;6 000</td>
<td>4–6 x 100 kt TN-75</td>
<td>240d</td>
</tr>
<tr>
<td>M51.2</td>
<td>..e</td>
<td>(2017)</td>
<td>&gt;6 000f</td>
<td>4–6 x 150 kt TNO</td>
<td>..</td>
</tr>
<tr>
<td>M51.3g</td>
<td>0</td>
<td>..</td>
<td>(&gt;6 000)</td>
<td>(up to 6 x 150 kt) TNO</td>
<td>0</td>
</tr>
<tr>
<td>Reserves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>300h</td>
</tr>
</tbody>
</table>

.. = not available or not applicable; () = uncertain figure; kt = kiloton; TNA = Tête Nucléaire Aéroportée (Airborne Nuclear Warhead); TNO = Tête Nucléaire Océanique (Oceanic Nuclear Warhead).

a Aircraft range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading.
b The Rafale carries the ASMP-A air-launched cruise missile.
c France has only produced enough submarine-launched ballistic missiles (SLBMs) to equip 3 operational nuclear-powered ballistic missile submarines (SSBNs); the 4th SSBN is out of service for overhaul and maintenance work at any given time. The remaining M45 SLBMs were retired in Dec. 2016 at the start of the upgrade of Le Téméraire to carry the M51 SLBM.
d Although the M51 SLBM can carry up to 6 warheads, the number of warheads is believed to have been reduced on some of the missiles in order to improve targeting flexibility.
e The French Navy is transitioning from the M51.1 to the M51.2. The M51 SLBM test launched from Le Triomphant on 1 July 2016 may have been an M51.2.
f The M51.2 has a greater range than the M51.1, according to the French Ministry of Defence.
g The M51-3 is under development and has not yet been deployed.
h President François Hollande confirmed a cap of 300 warheads in a speech in Feb. 2015.


150 kilotons. France has commenced design work on an M51.3 SLBM, which will have a longer range and improved accuracy. France is also beginning

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6 French Senate (note 5).
preliminary design work on a next-generation SSBN with the goal of having a successor submarine to the Triomphant class in service by 2035.\footnote{Hollande (note 1); and Le Drian, J. Y., French Minister of Defence, ‘Discours de clôture du colloque pour les 50 ans de la dissuasion’ [Conference closing speech for the 50th anniversary of deterrence], 21 Nov. 2014.}

The airborne component of French nuclear forces consists of two squadrons of land-based Mirage 2000N and Rafale F3 combat aircraft. The remaining Mirage 2000Ns will be replaced by Rafale B aircraft by 2018.\footnote{Hollande (note 1).} The French Navy also operates a single squadron of Rafale MF3 aircraft deployed aboard its aircraft carrier \textit{Charles de Gaulle.}

The Rafale aircraft are equipped with the extended-range Air-Sol Moyenne Portée-Améliorée (ASMP-A, Medium-Range Air-to-Surface–Improved) air-launched cruise missile, which entered service in 2009. A midlife refurbishment programme for the ASMP-A is scheduled to begin in 2022. This will allow the missile to continue in service until the mid-2030s.\footnote{French Senate (note 5), p. 52; and Tran, P., ‘France studies nuclear missile replacement’, \textit{Defense News}, 30 Nov. 2014.} The missiles are armed with the Tête Nucléaire Aéroportée (TNA, Airborne Nuclear Warhead), which has a reported yield of up to 300 kt. The French Ministry of Defence has initiated studies for a successor missile, designated air-sol nucléaire fourth-generation (ASN4G, air-to-surface nuclear fourth-generation), with enhanced stealth and manoeuvrability to counter potential technological improvements in air defences.\footnote{Le Drian (note 8); and Lagneau, L., ‘Les défis technologiques posés par l’ASN4G, le futur missile des Forces aériennes stratégiques’ [The technological challenges posed by ASN4G, the future missile of the Strategic Air Forces], Zone Militaire, Opex360.com, 18 Apr. 2016.}