

## IV. French nuclear forces

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France's nuclear arsenal consists of approximately 290 warheads. The warheads are earmarked for delivery by 48 submarine-launched ballistic missiles (SLBMs) and 50 air-launched cruise missiles (ALCMs) produced for land- and carrier-based aircraft (see table 10.5). France considers all of its nuclear weapons to be strategic, even though the weapons carried by the airborne component of its nuclear forces have characteristics (i.e. a limited range and yield) that other nuclear-armed states consider to be tactical.<sup>1</sup>

The main component of France's nuclear forces is the Strategic Oceanic Force (Force Océanique Stratégique, FOST). It consists of four Triomphant class nuclear-powered ballistic missile submarines (SSBNs) based on the Île Longue peninsula near Brest. Each of the SSBNs is capable of carrying 16 SLBMs. However, one SSBN is out of service for overhaul and maintenance work at any given time and is not armed. The submarines began to enter operational service in 1997, replacing six older Redoubtable class SSBNs.<sup>2</sup> The French Navy has maintained a continuous at-sea deterrent posture, whereby one SSBN is on patrol at all times, since the establishment of the FOST in 1972.<sup>3</sup>

France continues to modernize its SLBMs and associated warheads. In 2018 the French Navy completed work to modify the Triomphant class submarines to carry the M51 SLBM, which replaced the M45 missile.<sup>4</sup> The M51 is currently deployed in two versions. The M51.1 is capable of carrying up to six multiple independently targetable re-entry vehicle (MIRV) TN-75 warheads, each with an explosive yield of 100 kilotons. It is being replaced by an upgraded version known as M51.2, which has greater range and improved accuracy. The M51.2 is designed to carry the new, stealthier oceanic nuclear warhead (tête nucléaire océanique, TNO), which has a reported yield of up to 100 kilotons.<sup>5</sup> The number of warheads on some of the missiles has been

<sup>1</sup> Hollande, F., French President, 'Discours sur la dissuasion nucléaire : Déplacement auprès des forces aériennes stratégiques' [Speech on nuclear deterrence: Visit to the strategic air forces], Istres, 25 Feb. 2015.

<sup>2</sup> *Le Triomphant* entered active service in July 1997, while the fourth and final submarine in the class, *Le Terrible*, entered service in Sep. 2010. Tertrais, B., *French Nuclear Deterrence Policy, Forces and Future*, Recherches & Documents no. 01/2019 (Fondation pour la Recherche Stratégique: Paris, Jan. 2019), p. 61.

<sup>3</sup> French Ministry of the Armed Forces, '500e patrouille d'un sous-marin nucléaire lanceur dengins' [500th patrol of a nuclear-powered ballistic missile submarine], 12 Oct. 2018.

<sup>4</sup> Navy Recognition, 'Final French Navy SSBN "Le Temeraire" upgraded for M51 SLBM', 18 Aug. 2018. *Le Terrible* was equipped with launch tubes for the M51 missile during its construction.

<sup>5</sup> Groizeleau, V., 'Dissuasion : 25 milliards en cinq ans pour le renouvellement des deux composantes' [Deterrence: 25 billion in five years for the renewal of the two components], *Mer et Marine*, 2 Oct. 2019; and Groizeleau, V., 'Dissuasion : F. Hollande détaille sa vision et l'arsenal français' [Deterrence: F. Hollande outlines his vision and the French arsenal], *Mer et Marine*, 20 Feb. 2015.

reduced in order to improve targeting flexibility.<sup>6</sup> France has commenced design work on a new M51.3 SLBM with improved accuracy. It is scheduled to replace the M51.2 and become operational in 2025.<sup>7</sup>

France has also begun preliminary design work on a third-generation SSBN, designated the SNLE 3G, which will eventually be equipped with a new modification of the M51 (M51.4) SLBM.<sup>8</sup> The construction of the first of four submarines in the class is scheduled to begin in 2023.<sup>9</sup> The aim is to have an operational successor to the Triomphant class submarine in service by the early 2030s.<sup>10</sup>

The airborne component of the French nuclear forces consists of land- and carrier-based aircraft. The French Air Force has 40 deployed land-based nuclear-capable Rafale BF3 aircraft. It retired the last of its nuclear-capable Mirage 2000N aircraft in 2018.<sup>11</sup> All the Rafale BF3s are normally based at Saint-Dizier Air Base. The year 2019 marked 55 years of continuous nuclear alert by the French Air Force.<sup>12</sup>

The French Naval Nuclear Air Force (Force Aéronavale Nucléaire, FANu) consists of a squadron of 10 Rafale MF3 aircraft aboard the aircraft carrier the *Charles de Gaulle*. The ship returned to operational service in early 2019 after completing a mid-life refit that included refuelling its two nuclear reactors. Its first deployment following the refit was to Singapore and lasted from March to July.<sup>13</sup> The year 2019 marked the 40th anniversary of the FANu.<sup>14</sup>

The Rafale aircraft are equipped with medium-range air-to-surface cruise missiles (air-sol moyenne portée-améliorée, ASMP-A), which entered service in 2009. France produced 54 ASMP-As, including test missiles.<sup>15</sup> A mid-life refurbishment programme for the ASMP-A that began in 2016 will

<sup>6</sup> Tertrais (note 2), p. 63.

<sup>7</sup> French Ministry of the Armed Forces, 'Missiles balistiques stratégiques (MSBS)' [Strategic ballistic missiles], 28 Jan. 2020; and French Ministry of the Armed Forces, 'Discours de Florence Parly, ministre des Armées prononcé à l'usine des Mureaux, ArianeGroup, le 14 décembre 2017' [Speech by Florence Parly, Minister of the Armed Forces, presented at the Mureaux factory, ArianeGroup], 14 Dec. 2017.

<sup>8</sup> Tertrais (note 2), pp. 63, 67.

<sup>9</sup> Groizeleau, 'Deterrence: 25 billion in five years for the renewal of the two components' (note 5).

<sup>10</sup> 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 on the 50th anniversary of deterrence], French Ministry of Defence, Paris, 20 Nov. 2014.

<sup>11</sup> French Ministry of the Armed Forces, 'La dissuasion aéroportée passe au tout Rafale' [Airborne deterrence goes to the Rafale], 5 Sep. 2018; and Huberdeau, E., 'L'Adieu au Mirage 2000N' [Farewell to the Mirage 2000N], *Air & Cosmos*, 22 June 2018.

<sup>12</sup> French Ministry of the Armed Forces, 'Les FAS à l'honneur dans le nouveau numéro d'Air actualités' [FAS in the spotlight in the new issue of Air actualités], 18 Oct. 2019.

<sup>13</sup> French Ministry of the Armed Forces, 'CLEMENCEAU: Fin de mission pour le groupe aéronaval' [CLEMENCEAU: End of mission for the Carrier Strike Group], 9 July 2019.

<sup>14</sup> French Ministry of the Armed Forces, 'Fin des travaux de refonte à mi-vie du porte-avions : La ministre des Armées sur le Charles de Gaulle' [Completion of the mid-life refit of the aircraft carrier: The minister of defence on the Charles de Gaulle], 9 Nov. 2018.

<sup>15</sup> Hollande (note 1); Tertrais (note 2), p. 65.

**Table 10.5.** French nuclear forces, January 2020

Type	No. deployed	Year first deployed	Range (km) <sup>a</sup>	Warheads x yield	No. of warheads
<i>Land-based aircraft</i>					
Rafale BF3 <sup>b</sup>	40	2010–11	2 000	1 x [up to 300 kt] TNA <sup>c</sup>	40
<i>Carrier-based aircraft</i>					
Rafale MF3 <sup>b</sup>	10	2010–11	2 000	1 x [up to 300 kt] TNA <sup>c</sup>	10
<i>Submarine-launched ballistic missiles<sup>d</sup></i>					
M51.1	16	2010	>6 000	4–6 x 100 kt TN-75	80 <sup>e</sup>
M51.2	32 <sup>f</sup>	2017	>9 000 <sup>g</sup>	4–6 x 100 kt TNO	160
M51.3 <sup>h</sup>	0	[2025]	>[9 000]	[up to 6 x 100 kt] TNO	0
<b>Total</b>					<b>290<sup>i</sup></b>

[ ] = uncertain figure; kt = kiloton; TNA = tête nucléaire aéroportée (airborne nuclear warhead); TNO = tête nucléaire océanique (oceanic nuclear warhead).

<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> The Rafale BF3s and MF3s carry the ASMP-A air-launched cruise missile (ALCM). Most sources report that the ASMP-A has a range of 500–600 km, although some suggest that it might be over 600 km.

<sup>c</sup> The TNA has a reported maximum yield of 300 kt but lower-yield options are thought to be available.

<sup>d</sup> France has only produced enough submarine-launched ballistic missiles (SLBMs) to equip 3 operational nuclear-powered ballistic missile submarines (SSBNs); the fourth SSBN is out of service for overhaul and maintenance work at any given time.

<sup>e</sup> 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.

<sup>f</sup> The French Navy is transitioning from the M51.1 to the M51.2. The last M51.1 missiles will be replaced in 2020.

<sup>g</sup> The M51.2 has a ‘much greater range’ than the M51.1, according to the French Ministry of the Armed Forces.

<sup>h</sup> The M51.3 is under development and has not yet been deployed.

<sup>i</sup> In a speech in Feb. 2020, President Emmanuel Macron reaffirmed that the arsenal ‘is currently under 300 nuclear weapons’. A small number of stockpiled warheads are undergoing maintenance and surveillance at factories.

*Sources:* Macron, E., French President, ‘Discours du Président Emmanuel Macron sur la stratégie de défense et de dissuasion devant les stagiaires de la 27ème promotion de l’école de guerre’ [Speech by President Emmanuel Macron on strategic defence and deterrence to officers of the 27th graduation of the military academy], Paris, 7 Feb. 2020; French Ministry of the Armed Forces, ‘Discours de Florence Parly, ministre des Armées prononcé à l’usine des Mureaux, ArianeGroup, le 14 décembre 2017’ [Speech by Florence Parly, Minister of the Armed Forces, presented at the Mureaux factory, ArianeGroup], 14 Dec. 2017; Hollande, F., French President, ‘Discours sur la dissuasion nucléaire: Déplacement auprès des forces aériennes stratégiques’ [Speech on nuclear deterrence: Visit to the strategic air forces], Istres, 25 Feb. 2015; Sarkozy, N., French President, Speech on defence and national security, Porte de Versailles, 17 June 2008; Sarkozy, N., French President, ‘Presentation of SSBM “Le Terrible”’, Speech, Cherbourg, 21 Mar. 2008; Chirac, J., French President, Speech during visit to the Strategic Forces, Landivisiau, L’Île Longue, Brest, 19 Jan. 2006; French Ministry of Defence/Ministry of the Armed Forces, various publications; French National Assembly, various defence bills; *Air Actualités*, various issues; *Aviation Week & Space Technology*, various issues; *Bulletin of the Atomic Scientists*, ‘Nuclear notebook’, various issues; Tertrais, B., *French Nuclear Deterrence Policy, Forces and Future*, Recherches & Documents no. 01/2019 (Fondation pour la Recherche Stratégique: Paris, Jan. 2019); and authors’ estimates.

deliver the first upgraded missiles in 2022 or 2023.<sup>16</sup> The missiles are armed with a nuclear warhead (tête nucléaire aéroportée, TNA) that has a reported yield of up to 300 kt.<sup>17</sup> The French Ministry of the Armed Forces has initiated research on a successor missile—air-sol nucléaire (air-to-surface nuclear), fourth-generation (ASN4G)—with enhanced stealth and manoeuvrability to counter potential technological improvements in air defences.<sup>18</sup> The ASN4G is scheduled to replace the ASMP-A in 2035.<sup>19</sup>

French President Emmanuel Macron has reaffirmed the government's commitment to the long-term modernization of France's air- and sea-based nuclear deterrent forces.<sup>20</sup> In 2018 he signed the law on military planning for 2019–25 following its approval by the French parliament.<sup>21</sup> Among other provisions, the law allocated €37 billion (\$43.7 billion) to maintain and modernize France's nuclear forces and infrastructure.<sup>22</sup> This marked a significant increase on the €23 billion (\$27.1 billion) allocated to nuclear forces and associated infrastructure in the law on military planning for 2014–19.<sup>23</sup> The Ministry of the Armed Forces' budget for 2020 allocated €4.7 billion (\$5.3 billion) for the modernization of nuclear forces.<sup>24</sup>

<sup>16</sup> French Ministry of the Armed Forces, 'Projet de loi de programmation militaire, 2019–2025' [Law on military planning, 2019–2025], Dossier de presse [Press kit], Feb. 2018, p. 42; and Medeiros, J., "'Faire FAS": 55 ans de dissuasion nucléaire aéroportée' ['Go FAS': 55 years of airborne nuclear deterrence], *Air Actualités*, Oct. 2019, p. 36; and Tertrais (note 2), p. 67.

<sup>17</sup> Groizeleau, 'Deterrence: F. Hollande outlines his vision and the French arsenal' (note 5).

<sup>18</sup> French Ministry of the Armed Forces, 'La dissuasion nucléaire: Synthèse du point-presse du Ministère des Armées' [Nuclear deterrence: Summary of the press briefing by the Ministry of the Armed Forces], *Actu Défense*, 14 June 2018, p. 1; and Tran, P., 'France studies nuclear missile replacement', *Defense News*, 29 Nov. 2014.

<sup>19</sup> Medeiros (note 16).

<sup>20</sup> Macron, E., French President, 'Déclaration de M. Emmanuel Macron, Président de la République, sur les défis et priorités de la politique de défense' [Statement by Emmanuel Macron, President of the Republic, on the challenges and priorities of defense policy], Toulon, 19 Jan. 2018.

<sup>21</sup> AFP, 'Macron promulgue la loi de programmation militaire 2019–2025' [Macron signs the law on military programming 2019–2025], *Le Figaro*, 13 July 2018.

<sup>22</sup> AFP, 'France to spend 37 bn euros on upgrading nuclear arsenal', *France24*, 8 Feb. 2018. The total defence budget approved for the 7-year period was €295 billion (\$348 billion).

<sup>23</sup> Loi relative à la programmation militaire pour les années 2014 à 2019 [Law on military planning for the years 2014 to 2019], French Law no. 2013-1168 of 18 Dec. 2013.

<sup>24</sup> Groizeleau, 'Deterrence: 25 billion in five years for the renewal of the two components' (note 5); and Rose, M., 'Amid arms race, Macron offers Europe French nuclear wargames insight', *Reuters*, 7 Feb. 2020.