

## IV. French nuclear forces

HANS M. KRISTENSEN AND MATT KORDA

As of January 2021, France's nuclear weapon inventory consisted of about 290 warheads. The warheads are allocated for delivery by 48 submarine-launched ballistic missiles (SLBMs) and approximately 50 air-launched cruise missiles (ALCMs) produced for land- and carrier-based aircraft (see table 10.5). However, the 10 warheads assigned to France's carrier-based aircraft are thought to be kept in central storage and are not normally deployed. The estimate of France's nuclear weapon inventory is based on publicly available information. France is relatively transparent about many of its nuclear weapon activities and has publicly disclosed the size of its stockpile and details of its nuclear-related operations in the past.<sup>1</sup>

### The role of nuclear weapons in French military doctrine

France considers all of its nuclear weapons to be strategic and reserved for the defence of France's 'vital interests'.<sup>2</sup> While this concept has appeared in various governmental white papers and presidential speeches for several decades, what constitutes France's 'vital interests' appears to be somewhat vague.

In a speech in February 2020, President Emmanuel Macron suggested that the French nuclear deterrent was intended to deter another state from 'threatening our vital interests, whatever they may be'.<sup>3</sup> Macron also noted that, if deterrence were to fail, 'a unique and one-time-only nuclear warning could be issued to the aggressor State to clearly demonstrate that the nature of the conflict has changed and to re-establish deterrence'.<sup>4</sup> Following that, French nuclear weapons could be used for 'inflicting absolutely unacceptable damages upon that State's centres of power: its political, economic and military nerve centres'.<sup>5</sup>

There is no publicly available evidence to indicate that France has considered incorporating pre-emptive first strikes into its nuclear doctrine.<sup>6</sup> However, the weapons carried by the airborne component of its nuclear

<sup>1</sup> Macron, E., French President, Speech on defence and deterrence strategy, École de Guerre, Paris, 7 Feb. 2020 (in French, with English translation).

<sup>2</sup> Tertrais, B., *French Nuclear Deterrence Policy, Forces and Future: A Handbook*, Recherches & Documents no. 04/2020 (Fondation pour la Recherche Stratégique: Paris, Feb. 2020), pp. 25–29, 62–63.

<sup>3</sup> Macron (note 1).

<sup>4</sup> Macron (note 1).

<sup>5</sup> Macron (note 1).

<sup>6</sup> Tertrais (note 2), pp. 25–29, 62–63.

**Table 10.5.** French nuclear forces, January 2021

All figures are approximate and some are based on assessments by the authors.

Type/designation	No. of launchers	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 <sup>d</sup>
<i>Sea-based missiles (SLBMs)</i>					
M51.2 <sup>f</sup>	48 <sup>g</sup>	2017	>9 000 <sup>h</sup>	4–6 x 100 kt TNO	240
M51.3 <sup>i</sup>	–	[2025]	>[9 000]	[up to 6] x [100 kt] TNO	–
<b>Total inventory</b>					<b>290<sup>j</sup></b>

[ ] = uncertain figure; – = nil or a negligible value; kt = kiloton; SLBM = submarine-launched ballistic missile; TNA = tête nucléaire aéroportée (airborne nuclear warhead); TNO = tête nucléaire océanique (oceanic nuclear warhead).

<sup>a</sup> For aircraft, the listed range is for illustrative purposes only; actual mission range will vary according to flight profile, weapon loading and in-flight refuelling.

<sup>b</sup> The BF3 and MF3 aircraft both carry the ASMP-A (air–sol moyenne portée–améliorée) 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 is widely assumed to have a maximum yield of 300 kt, but lower-yield options for this warhead are thought to be available.

<sup>d</sup> The 10 warheads assigned to France's carrier-based aircraft are thought to be kept in central storage and are not normally deployed.

<sup>e</sup> The first figure is the total number of nuclear-powered ballistic missile submarines (SSBNs) in the French fleet; the second is the maximum number of missiles that they can carry. However, the total number of missiles carried is lower (see note g). Of the 4 SSBNs, 1 is in overhaul at any given time.

<sup>f</sup> The last M51.1 missiles were offloaded from *Le Terrible* in late 2020 in preparation for a one-year refuelling overhaul and upgrade to the more advanced M51.2 missile.

<sup>g</sup> France has only produced enough SLBMs to equip the 3 operational SSBNs (48 missiles).

<sup>h</sup> The M51.2 has a 'much greater range' than the M51.1 according to the French Ministry of the Armed Forces.

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

<sup>j</sup> In Feb. 2020 President Emmanuel Macron reaffirmed that the arsenal 'is currently under 300 nuclear weapons'. A small number of the warheads is thought to be undergoing maintenance and surveillance at any given time.

*Sources:* Macron, E., French President, Speech on defence and deterrence strategy, École de Guerre, Paris, 7 Feb. 2020 (in French); Parly, F., French Minister of the Armed Forces, Speech, ArianeGroup, Les Mureaux, 14 Dec. 2017 (in French); Hollande, F., French President, Speech on nuclear deterrence, Istres Air Base, 19 Feb. 2015 (in French); Sarkozy, N., French President, Speech on the new defence policy, Porte de Versailles, 17 June 2008, (in French); Sarkozy, N., French President, Speech on the white paper on national defence and security, nuclear deterrence and the non-proliferation of nuclear weapons, Cherbourg, 21 Mar. 2008 (in French); Chirac, J., French President, Speech on France's defence policy, Île Longue, Brest, 19 Jan. 2006 (in French); 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: A Handbook*, Recherches & Documents no. 04/2020 (Fondation pour la Recherche Stratégique: Paris, Feb. 2020); and authors' estimates.

forces have characteristics (i.e. a limited range) that other nuclear-armed states consider to be tactical.

In his 2020 speech, President Macron suggested that ‘France’s vital interests now have a European dimension’, and he offered to open a strategic dialogue with other European countries to discuss ‘the role played by France’s nuclear deterrence in our collective security’.<sup>7</sup> However, it appears that this proposal only gained support from a few politicians and has not yet been collectively endorsed by European political parties or governments.<sup>8</sup>

### **Nuclear weapon modernization**

President Macron has reaffirmed the French Government’s commitment to the long-term modernization of France’s air- and sea-based nuclear deterrent forces.<sup>9</sup> Current plans include the modernization of France’s nuclear-powered ballistic missile submarines (SSBNs, or sous-marins nucléaires lanceurs d’engins, SNLE), SLBMs and ALCMs (see below). The 2018 Law on Military Planning for 2019–25 allocates €37 billion (\$42.2 billion) for maintenance and modernization of France’s nuclear forces and infrastructure.<sup>10</sup> This is a significant increase on the €23 billion (\$26.2 billion) allocated to nuclear forces and associated infrastructure by the Law on Military Planning for 2014–19.<sup>11</sup>

The 2021 budget of the Ministry of the Armed Forces (France’s defence ministry) allocated €5 billion (\$5.7 billion) to nuclear weapon-related activity—€0.3 billion (\$0.34 billion) more than in the 2020 budget.<sup>12</sup> It also suggests that a total of €25 billion (\$28.5 billion) would be spent on nuclear modernization between 2019 and 2023.

<sup>7</sup> Macron (note 1).

<sup>8</sup> Berghofer, J., ‘An offer postponed: Berlin’s silence on Macron’s deterrence thinking’, Commentary, European Leadership Network, 25 Aug. 2020.

<sup>9</sup> Macron, E., French President, Speech on the challenges and priorities of defence policy, Toulon, 19 Jan. 2018 (in French).

<sup>10</sup> AFP, ‘Macron promulgue la loi de programmation militaire 2019–2025’ [Macron signs the Law on Military Planning for 2019–2025], *Le Figaro*, 13 July 2018; Loi relative à la programmation militaire pour les années 2019 à 2025 [Law on Military Planning for the Years 2019 to 2025], French Law no. 2018-607 of 13 July 2018, *Journal Officiel de la République Française*, 14 July 2018; and AFP, ‘France to spend 37 bn euros on upgrading nuclear arsenal’, France 24, 8 Feb. 2018. The total defence budget approved for the 7-year period was €295 billion (\$336 billion). On France’s military expenditure see chapter 8, section II, in this volume.

<sup>11</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, *Journal Officiel de la République Française*, 19 Dec. 2013.

<sup>12</sup> French Ministry of the Armed Forces (MAF), *Projet de loi de finances: Année 2021* [Finance bill: Year 2021] (MAF: Paris, Sep. 2020), p. 26; 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 Rose, M., ‘Amid arms race, Macron offers Europe French nuclear wargames insight’, Reuters, 7 Feb. 2020.

## Aircraft and air-delivered weapons

The airborne component of the French nuclear forces consists of land- and carrier-based aircraft. The French Air and Space Force has 40 deployed nuclear-capable Rafale BF3 aircraft based at Saint-Dizier Air Base, north-east France. The French Naval Nuclear Air Force (Force aéronavale nucléaire, FANu) consists of a squadron of 10 Rafale MF3 aircraft for deployment on the aircraft carrier *Charles de Gaulle*. The FANu and its nuclear-armed missiles are not permanently deployed but can be rapidly deployed by the French president in support of nuclear operations.<sup>13</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>14</sup> A midlife refurbishment programme for the ASMP-A that began in 2016 will deliver the first upgraded missiles in 2022 or 2023.<sup>15</sup> The first test of an upgraded ASMP-A took place on 9 December 2020.<sup>16</sup> This will be followed by a qualification firing and subsequent force training firings before the missile's entry into service. The missiles are armed with a nuclear warhead (the tête nucléaire aéroportée, TNA) that has a reported yield of up to 300 kilotons.<sup>17</sup>

The French Ministry of the Armed Forces has initiated research on a successor, fourth-generation air-to-surface nuclear missile (air-sol nucléaire de 4e génération, 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>

<sup>13</sup> Pintat, X. et al., 'Rapport d'information fait au nom de la commission des affaires étrangères, de la défense et des forces armées par le groupe de travail "La modernisation de la dissuasion nucléaire"' [Information report made on behalf of the Committee on Foreign Affairs, Defense and the Armed Forces by the working group 'Modernization of nuclear deterrence'], Report of the French Senate no. 560, 23 May 2017.

<sup>14</sup> Hollande, F., French President, Speech on nuclear deterrence, Istres Air Base, 19 Feb. 2015 (in French); and Tertrais (note 2), p. 62.

<sup>15</sup> French Ministry of the Armed Forces, 'Projet de loi de programmation militaire, 2019–2025' [Military Planning Bill, 2019–2025], Press kit, Feb. 2018, p. 42; Medeiros, J., "'Faire FAS": 55 ans de dissuasion nucléaire aéroportée' [Go FAS: 55 years of airborne nuclear deterrence], *Air Actualités*, Oct. 2019, pp. 32–37, p. 36; and Tertrais (note 2), p. 60.

<sup>16</sup> French Ministry of the Armed Forces, 'Premier tir d'essai du missile stratégique ASMPA-rénové' [First test firing of the ASMPA-renovated strategic missile], 23 Dec. 2020.

<sup>17</sup> 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.

<sup>18</sup> French Ministry of the Armed Forces, 'La dissuasion nucléaire' [Nuclear deterrence], *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 15), p. 36.

## Sea-based missiles

The main component of France's nuclear forces is the Strategic Oceanic Force (Force océanique stratégique, FOST). It consists of four Triomphant-class SSBNs based on the Île Longue peninsula near Brest, north-west France. Each 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. France has produced only 48 SLBMs, enough to equip the 3 operational SSBNs.

The French Navy maintains a continuous at-sea deterrent posture with one SSBN on patrol at all times. It has conducted more than 500 such patrols since 1972.<sup>20</sup>

France continues to modernize its SLBMs and associated warheads. In June 2020 *Le Téméraire*, which had previously been equipped with the older M45 SLBM, became operational with the newer M51 after a successful test launch of the missile.<sup>21</sup> This was the ninth test of the M51.

The M51 is itself being upgraded. The first version, the M51.1, was capable of carrying up to six TN-75 warheads in multiple independently targetable re-entry vehicles (MIRVs), each with an explosive yield of 100 kt. Over the past several years, the M51.1 has been gradually replaced by an upgraded version, the M51.2, which has greater range and improved accuracy. With the deployment of the M51.2 on *Le Téméraire* in mid 2020, the final SSBN left to receive this upgrade, *Le Terrible*, began its major refit in late 2020.<sup>22</sup> Thus, as of January 2021, the M51.1 had officially been removed from service.

The M51.2 is designed to carry a new, stealthier nuclear warhead (the tête nucléaire océanique, TNO), which has a reported yield of up to 100 kt.<sup>23</sup> The number of warheads on some of the missiles has been reduced in order to improve targeting flexibility.<sup>24</sup> France has also commenced design work on another upgrade, the M51.3, with improved accuracy. The first M51.3

<sup>20</sup> French Ministry of the Armed Forces, '500e patrouille d'un sous-marin nucléaire lanceur d'engins' [500th patrol of a nuclear-powered ballistic missile submarine], 12 Oct. 2018.

<sup>21</sup> Parly, F. (@florence\_parly), 'Le sous-marin nucléaire lanceur d'engins (SNLE) Le Téméraire a tiré avec succès un missile balistique stratégique M51 au large du Finistère. Cet essai démontre notre excellence technologique et notre attachement à la souveraineté française.' [The nuclear-powered ballistic missile submarine Le Téméraire successfully fired an M51 strategic ballistic missile off the coast of Finistère. This test demonstrates our technological excellence and our commitment to French sovereignty.], Twitter, 12 June 2020.

<sup>22</sup> French Ministry of the Armed Forces and Naval Group, 'Le SNLE *Le Terrible* transféré de l'Île Longue à la base navale de Brest pour son grand carénage' [The SSBN *Le Terrible* transferred from Île Longue to the Brest naval base for its major refit], Press release, 8 Jan. 2021.

<sup>23</sup> Groizeleau (note 12); and Groizeleau (note 17).

<sup>24</sup> Tertrais (note 2), p. 57.

missiles are scheduled to replace their M51.2 predecessors and become operational in 2025.<sup>25</sup>

In the Law on Military Planning for 2019–25, the French Government announced that it would produce a third-generation SSBN, designated the SNLE 3G.<sup>26</sup> The programme was officially launched in early 2021.<sup>27</sup> The SNLE 3G will eventually be equipped with a further modification of the M51 SLBM, the M51.4.<sup>28</sup> The construction of the first of four submarines in the class is scheduled to begin in 2023 and is expected to be completed by 2035. The other three submarines will be delivered on a schedule of one boat every five years.<sup>29</sup>

<sup>25</sup> French Ministry of the Armed Forces, ‘Missiles balistiques stratégiques (MSBS)’ [Strategic ballistic missiles], 28 Jan. 2020; and Parly, F., French Minister of the Armed Forces, Speech, ArianeGroup, Les Mureaux, 14 Dec. 2017 (in French).

<sup>26</sup> French Ministry of the Armed Forces (note 15), p. 38.

<sup>27</sup> French Ministry of the Armed Forces, ‘Florence Parly, ministre des armées, annonce le lancement en réalisation des sous-marins nucléaires lanceurs d’engins de 3e génération (SNLE 3G)’ [Florence Parly, minister of the armed forces, announces the launch of the 3rd-generation nuclear-powered ballistic missile submarines (SNLE 3G)], 19 Feb. 2021; and Mackenzie, C., ‘France to begin building new ballistic missile subs’, *Defense News*, 22 Feb. 2021.

<sup>28</sup> Tertrais (note 2), pp. 56, 60, 65.

<sup>29</sup> French Ministry of the Armed Forces (note 27); Groizeleau (note 12); and Mackenzie (note 27).