

IV. French nuclear forces

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As of January 2023 France's nuclear weapon stockpile consisted of about 290 warheads, the same number as in January 2022. 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 7.5). 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 stockpile is based on publicly available information.¹ France is relatively transparent about many of its nuclear weapon activities and has in the past publicly disclosed the size of its stockpile and details of its nuclear-related operations.²

This section begins by outlining the role played by nuclear weapons in France's military doctrine and its nuclear modernization programmes. It then describes its air-delivered and sea-based weapons.

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'.³ While this concept has appeared in various governmental white papers and presidential speeches for several decades, what constitutes France's 'vital interests' remains unclear. In February 2020 President Emmanuel Macron announced that 'France's vital interests now have a European dimension';⁴ however, in October 2022 he clarified that these interests 'would not be at stake if there was a nuclear ballistic attack in Ukraine or in the region', suggesting that the threshold for nuclear weapon use by France may be higher than previous comments had implied.⁵

In addition, France's report to the 10th review conference of the 1968 Treaty on the Non-Proliferation of Nuclear Weapons, held in 2022, states that 'For deterrence to work, the circumstances under which nuclear weapons would be used are not, and should not be, precisely defined, so as not to enable a

¹ Kristensen, H. M. and Korda, M., 'Estimating world nuclear forces: An overview and assessment of sources', SIPRI Commentary, 14 June 2021.

² Macron, E., French President, Speech on defence and deterrence strategy, École de Guerre, Paris, 7 Feb. 2020 (in French, with English translation).

³ 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.

⁴ Macron (note 2). See also Kristensen, H. M. and Korda, M., 'French nuclear forces', *SIPRI Yearbook 2021*.

⁵ 'Avec Emmanuel Macron' [With Emmanuel Macron], *L'événement*, France 2, 12 Oct. 2022 (author translation).

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Table 7.5. French nuclear forces, January 2023

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

Type/designation	No. of launchers	Year first deployed	Range (km) ^a	Warheads x yield	No. of warheads
<i>Land-based aircraft</i>					
Rafale BF3 ^b	40	2010–11	2 000	1 x [<300 kt] TNA ^c	40
<i>Carrier-based aircraft</i>					
Rafale MF3 ^b	10	2010–11	2 000	1 x [<300 kt] TNA ^c	10 ^d
<i>Sea-based missiles (SLBMs)</i>					
	4/64 ^e				240
M51.1	16	2010	>6 000	4–6 x 100 kt TN 75	80
M51.2 ^f	32 ^g	2016	>9 000 ^h	4–6 x 100 kt TNO	160
M51.3 ⁱ	–	[2025]	>[9 000]	[up to 6] x 100 kt TNO	–
Total stockpile					290^j

– = nil or a negligible value; [] = uncertain SIPRI estimate; kt = kiloton; SLBM = submarine-launched ballistic missile; TNA = *tête nucléaire aéroportée* (air-launched nuclear warhead); TNO = *tête nucléaire océanique* (sea-based nuclear warhead).

^a For aircraft, the listed range is for illustrative purposes only; actual mission range will vary according to flight profile, weapon payload and in-flight refuelling.

^b The BF3 and MF3 aircraft both carry the ASMPA (*air-sol moyenne portée-améliorée*) air-launched cruise missile (ALCM). Most sources report that the ASMPA has a range of 500–600 kilometres, although some suggest that it might be over 600 km.

^c There is uncertainty as to the yield of the new TNA warhead. Some non-official sources continue to attribute a yield of 300 kt to the TNA, the same yield as the previous TN81 warhead carried by the original ASMP missile. However, MBDA, the manufacturer of the ASMPA missile that carries the TNA, has stated that the warhead has a ‘medium energy’ yield, which is thought to be less than 100 kt. The TNA also appears to be based on the same design as the TNO, which is believed to have a yield of 100 kt. In the absence of official or consistent authoritative sources, these numbers should be treated as uncertain estimates.

^d The 10 warheads assigned to France’s carrier-based aircraft are thought to be kept in central storage and are not normally deployed.

^e 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.

^f SIPRI estimates that 1 SSBN—*Le Vigilant*—has yet to be upgraded to carry the M51.2 SLBM and its accompanying TNO warhead.

^g France has 48 SLBMs in service—enough to equip the 3 operational SSBNs.

^h The M51.2 has a ‘much greater range’ than the 6000-km range of the M51.1 according to the French Ministry of the Armed Forces.

ⁱ The M51.3 is under development and has not yet been deployed.

^j In Feb. 2020 President Emmanuel Macron reaffirmed that the arsenal ‘is currently under 300 nuclear weapons’. A few of the warheads are thought to be undergoing maintenance and inspection at any given time.

Sources: Speeches (in French) of French presidents and defence ministers: Macron, E., Speech on defence and deterrence strategy, École de Guerre, Paris, 7 Feb. 2020; Parly, F., French Minister of the Armed Forces, Speech, ArianeGroup, Les Mureaux, 14 Dec. 2017; Hollande, F., Speech on nuclear deterrence, Istres Airbase, 19 Feb. 2015; Sarkozy, N., Speech on the new defence policy, Porte de Versailles, 17 June 2008; Sarkozy, N., Speech on the white paper on national defence and security, nuclear deterrence and the non-proliferation of nuclear weapons, Cherbourg,

21 Mar. 2008; and Chirac, J., Speech on France's defence policy, Île Longue, Brest, 19 Jan. 2006. Other sources: 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.

potential aggressor to calculate the risk inherent in a potential attack.⁶ France reserves the right to issue 'a sole, one-time-only nuclear warning', suggesting that it could use a nuclear weapon against a military, political or symbolic target as a signal to a potential adversary.⁷

The Macron administration has strongly reaffirmed a commitment to the long-term modernization and strengthening of France's air- and sea-based nuclear forces.⁸ Current plans include the modernization of aircraft and ALCMs and of nuclear-powered ballistic missile submarines (SSBNs, or *sous-marins nucléaires lanceurs d'engins*, SNLEs) and SLBMs (see below). By 2040 France is expected to have fielded a next-generation combat aircraft equipped with a new cruise missile and four new SSBNs equipped with an upgraded ballistic missile.

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 Airbase in 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.⁹

The Rafale aircraft are equipped with medium-range air-to-surface cruise missiles (*air-sol moyenne portée-améliorée*, ASMPA), which are currently

⁶ 10th NPT review conference, National report of France, NPT/CONF.2020/42/Rev.1, 1 Aug. 2022, p. 3. On the review conference see also 'The 10th review conference of the Non-Proliferation Treaty', chapter 8, section II, in this volume.

⁷ 10th NPT review conference, NPT/CONF.2020/42/Rev.1 (note 6), p. 4.

⁸ Macron, E., French President, Speech on the challenges and priorities of defence policy (in French), Toulon, 19 Jan. 2018; and Élysée, 'Transformer nos armées : le Président de la République présente le nouveau projet de loi de programmation militaire' [Transforming our armed forces: The President of the Republic presents the new military programming bill], 20 Jan. 2023.

⁹ 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 no. 560, French Senate, 23 May 2017.

being refurbished.¹⁰ In March 2022 France conducted a second successful flight test of the new version, the *air-sol moyenne portée-amélioré rénové* (ASMPA-R). It subsequently approved the start of serial production of the missiles and midlife refurbishment of the upgraded missile inventory, which will keep the ASMPA in service until 2035.¹¹ The ASMPA-R missiles are equipped with the same warhead as the ASMPA, the *tête nucléaire aéroportée* (TNA, air-launched nuclear warhead), which the missile's producer (MBDA) says has a 'medium energy' yield.¹²

The Ministry of the Armed Forces has begun developing a successor: a 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.¹³ The ASN4G is scheduled to reach initial operational capability in 2035 to replace the ASMPA-R.¹⁴ France is also modernizing and expanding its fleet of Rafale aircraft. The French military budget for 2023 includes plans for the delivery of 13 new Rafale aircraft to the armed forces.¹⁵

Sea-based missiles

The main component of France's nuclear forces is the Strategic Oceanic Force (*Force océanique stratégique*, FOST). It consists of four Le Triomphant-class SSBNs based on the Île Longue peninsula near Brest, north-west France. Each can carry 16 SLBMs; however, at any given time one SSBN is out of service for overhaul and maintenance work and is therefore not armed. France has 48 SLBMs in service—enough to equip the three operational SSBNs.

The French Navy maintains a continuous at-sea deterrence posture with one SSBN on patrol at all times. In March 2022 there were reports that the French Navy had deployed more than one SSBN for the first time since the 1980s, possibly in response to Russia's invasion of Ukraine.¹⁶ It is unclear

¹⁰ For further detail see Kristensen and Korda (note 4), p. 366.

¹¹ Mills, C., *Nuclear Weapons at a Glance: France*, Research Briefing no. 9074 (House of Commons Library: London, 28 July 2022), p. 10; and Scott, R., 'Successful flight test of upgraded ASMPA missile paves way for refurbishment', *Janes*, 30 Mar. 2022.

¹² MBDA, 'ASMPA: Air-to-ground missile, medium range, enhanced'.

¹³ 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.

¹⁴ Medeiros, J., "'Faire FAS" : 55 ans de dissuasion nucléaire aéroportée' ['Go FAS': 55 years of airborne nuclear deterrence], *Air Actualités*, Oct. 2019, p. 36.

¹⁵ Jennings, G., 'France begins Rafale F4 flight trials', *Janes*, 21 May 2021; and French Ministry of the Armed Forces (MAF), *Projet de loi de finances: 2023—LPM 2019—2025 Année 5* [Finance bill: 2023—Military Programming Law 2019—2025 year 5] (MAF: Paris, Sep. 2022), p. 41.

¹⁶ Jézéquel, S., 'Pourquoi la France a-t-elle fait appareiller trois sous-marins nucléaires au départ de l'Île-Longue ?' [Why did France sail three nuclear submarines from Île-Longue?], *Le Télégramme*, 21 Mar. 2022.

whether this practice will continue or whether it was a one-off test of the capability.

France's SLBM, the M51, is undergoing a series of upgrades. The missile is equipped with multiple independently targetable re-entry vehicles (MIRVs) and the first version, the M51.1, can carry up to six 100-kiloton TN 75 warheads. The second version, the M51.2, is armed with a new warhead, the *tête nucléaire océanique* (TNO, sea-based nuclear warhead), which is assumed to have a yield of 100 kt.¹⁷ SIPRI estimates that one of France's four SSBNs, *Le Vigilant*, has yet to be upgraded to carry the M51.2 SLBM and its accompanying TNO warhead. To allow for targeting flexibility, some of the SLBMs carried by France's SSBNs carry fewer warheads than others.¹⁸ France has also commenced design work on another upgrade, the M51.3, which will have improved accuracy. It is due to be operational in 2025.¹⁹

A production programme for a third-generation SSBN, designated the SNLE 3G, was officially launched in early 2021.²⁰ The SNLE 3G will eventually be equipped with a further modification of the M51 SLBM, the M51.4.²¹ 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.²²

¹⁷ 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.

¹⁸ Tertrais (note 3), p. 57.

¹⁹ 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 (in French), ArianeGroup, Les Mureaux, 14 Dec. 2017.

²⁰ 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.

²¹ Tertrais (note 3), pp. 56, 60, 65.

²² French Ministry of the Armed Forces (note 20); Groizeleau, 'Dissuasion : 25 milliards en cinq ans' (note 17); and Mackenzie (note 20).