



## BRIEFING PAPER

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# The French Nuclear Deterrent

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## Summary

France first tested a nuclear weapon in 1960, eight years after the UK and four years before China. In doing so it became the fourth nuclear weapon state after the US, Russia (formerly the Soviet Union) and the UK. It is one of the five recognised nuclear states under the *Nuclear Non-Proliferation Treaty 1968* (NPT).

### **Nuclear policy**

France has a policy of “strict sufficiency”, whereby France maintains its nuclear arsenal at the lowest possible level compatible with the strategic context; while the use of nuclear weapons is strictly limited to extreme circumstances of self-defence.

This has been France’s position for several years and was reiterated most recently in a [speech by President Macron](#) in February 2020.

France is one of the five recognised nuclear weapon states under the NPT and as such has an obligation to pursue effective disarmament under article VI of that treaty.

France signed the Comprehensive Test Ban Treaty in 1996 and ratified it in 1998. Although the treaty is yet to enter force, France has maintained its moratorium on testing. In February 1996 France also announced that it had halted the production of fissile material for weapons purposes and that it would dismantle the production facilities dedicated to its weapons programme. The French Government advocates an immediate moratorium on the production of fissile materials by all states, and immediate negotiation of a Fissile Material Cut-off Treaty (FMCT).

France does not participate in NATO’s nuclear planning mechanisms and its nuclear forces are not formally assigned to NATO.

### **Disarmament achievements**

By the end of the Cold War France had approximately 540 nuclear warheads in its stockpile. Since 1991, however, France has scaled back its nuclear arsenal by almost 50 per cent, with a reduction in both its overall holdings and also the withdrawal of several weapons systems. Significantly, in 1996 France announced its intention to withdraw its remaining strategic land-based ballistic missile capability at Plateau d’Albion, making it the only nuclear weapon state to have dismantled, in its entirety, a ground-launched nuclear capability. It also reduced its ballistic missile submarine fleet from five to four vessels, marking a one-third reduction in the size of its submarine-based nuclear deterrent since 1991.

France has reduced its alert levels twice since the end of the Cold War and in 1997 announced that it had de-targeted all of its nuclear forces.

In 2008 then President Sarkozy announced a further one-third reduction in its airborne component with the withdrawal of one nuclear squadron. He also stated that France’s nuclear stockpile would be reduced to fewer than 300 warheads, a position that still stands today.

In a speech in February 2015 President Hollande ruled out any further reductions in France's nuclear stockpile outside of any drastic reductions in other countries' nuclear arsenals that would dramatically improve the global security environment. He also committed France to not building any new types of weapon but stated that it would modernise its existing forces, while remaining within the boundaries of existing agreements. In February 2020 President Macron reiterated that position.

### **Force structure and modernisation**

France now has fewer than 300 nuclear warheads, all of which are deployed and operational. France's nuclear deterrent comprises a submarine-launched and air-launched component, providing it with both strategic and tactical nuclear capabilities.

Over the last few years, France has been modernising its nuclear arsenal, through the deployment of a new *Triomphant* class of ballistic missile submarines (SSBN), the replacement of its combat aircraft in a nuclear role, the upgrade of both its submarine and air-launched nuclear-armed missile capabilities and the deployment of new nuclear warheads.

The bulk of the French deterrent is maritime based, with the Navy having responsibility for around 80 per cent of the nuclear arsenal. The majority of that capability is delivered through its fleet of four *Triomphant* class SSBN, each of which is capable of deploying up to 16 M-51/ M-51.2 submarine-launched ballistic missiles. The Navy retains a total of 48 SLBM in its inventory. Like the UK, France's SSBN maintain a continuous at-sea deterrent (CASD) posture.

The French Navy also operates a single squadron of Rafale MF3 aircraft equipped with nuclear-armed ASMP-A cruise missiles. Those aircraft are deployed aboard its aircraft carrier the *Charles de Gaulle*.

The airborne component of the nuclear deterrent comprises approximately 20 per cent of total nuclear forces. The French Air Force has two squadrons assigned to the nuclear role, comprising 40 Rafale F3 aircraft, equipped with 54 nuclear-armed medium-range ASMP-A cruise missiles.

Modernisation of the French nuclear deterrent is ongoing. Preliminary design work has begun on a next generation SSBN to replace the *Triomphant* class. Design work has also commenced on a new M-51.3 SLBM. Research on a next generation missile to replace the ASMP-A air-launched cruise missile from 2035, has also begun.

### **Procurement and support**

A two-way technical cooperation channel exists with the United States on nuclear safety and security and since 1992, with the establishment of the Anglo-French Joint Nuclear Commission, there has been collaboration with the UK in the coordination of nuclear policy and doctrine. In 2010 Anglo-French co-operation went one step further following the signing of a [nuclear treaty](#) outlining co-operative measures governing the stewardship of existing nuclear stockpiles. The treaty was labelled as "historic" and "unprecedented" in the level of military co-operation that it envisaged. At the UK-France summit in

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2014 both countries agreed to expand their technical cooperation under the treaty.

In all other respects, however, France has sought to independently build and maintain all the necessary components of its nuclear arsenal. The aircraft and submarine platforms for the French nuclear deterrent are all designed and built by French companies. France also has its own facilities for maintenance and support.

French insistence of independence in all aspects of design and acquisition has meant significantly higher costs for its deterrent programme. However, that trade-off has received significant domestic support in France, which historically has associated the possession of nuclear weapons with national independence. All of the main political parties' support retention of the nuclear deterrent, in contrast to the UK, while domestic public support is also high.

### **Cost**

Historically France's nuclear weapons programme has taken up approximately 10-11 per cent of the total French defence budget annually. In 2020 it is estimated to be 12.5 per cent, which equates to approximately €6 billion (£5.3 billion).

In comparison the UK's nuclear deterrent costs 6 per cent of the annual defence budget (£2.3 billion, based on current defence expenditure).

In 2018 funding was approved for France's ongoing nuclear modernisation programme up to 2025. €37 billion was assigned to maintain and modernise France's nuclear forces and infrastructure, a significant increase from the €23 billion assigned for 2014-2019.

# 1. Background

France first tested a nuclear weapon in 1960, eight years after the UK and four years before China. In doing so it became the fourth nuclear weapon state after the US, Russia (formerly the Soviet Union) and the UK. It is one of the five recognised nuclear states under the *Nuclear Non-Proliferation Treaty 1968*.

French nuclear testing was conducted in the Sahara and in the South Pacific and the last French tests took place in 1996, just prior to the conclusion of the *Comprehensive Nuclear Test Ban Treaty* (CTBT).<sup>1</sup> In February 1996 France also announced that it had halted the production of fissile material for weapons purposes and that it would dismantle the production facilities dedicated to its weapons programme.

The French nuclear deterrent is the one that is most often compared to the UK's nuclear forces. While there are similarities in terms of policy, posture and size, there are also significant differences in terms of industrial support and cost. In contrast to the UK, all of the major political parties in France support an independent nuclear deterrent, and domestic support is also high.

A brief summary of the French nuclear deterrent is available in Library briefing paper CBP 7566, [Nuclear weapons: country comparisons](#). This paper provides more detail on each aspect of the French nuclear deterrent.

It is also part of a wider [Library briefing series on nuclear weapons](#).

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<sup>1</sup> France signed and ratified the *Comprehensive Test Ban Treaty* in 1998

## 2. Nuclear Policy

France has a policy of “strict sufficiency”, whereby France maintains its nuclear arsenal at the lowest possible level compatible with the strategic context.

This has been France’s position for several years and was reiterated most recently in a [speech on defence and nuclear deterrence](#) by President Macron in February 2020:

Seeking peace, France is committed to a disarmament approach, which furthers global stability and security. France has a unique track record in the world, in keeping with its responsibilities and interests, having dismantled irreversibly its land-based nuclear component, its nuclear test facilities, its fissile material for weapons production facilities, and having reduced the size of its arsenal, which is currently under 300 nuclear weapons. These decisions are in line with our rejecting any type of arms race and our keeping the format for our nuclear deterrent at a level of strict sufficiency.

France does not participate in NATO’s nuclear planning mechanisms and its forces are not formally assigned to NATO, although it does contribute to the overall deterrent effect of the Alliance. France is committed to strengthening the “Alliance’s nuclear culture”.<sup>2</sup>

In keeping with his desire to see greater cooperation in European defence through the EU’s Common Security and Defence Policy (CSDP), President Macron has also suggested that the French nuclear deterrent should play a central role in Europe’s collective security. In his February 2020 speech he called for strategic dialogue to this end and outlined the potential for other European countries to be involved in military exercises conducted by French deterrent forces. He stopped short, however, of proposing the sharing of any nuclear assets:

On that point, our independent decision-making is fully compatible with our unwavering solidarity with our European partners. Our commitment to their security and their defence is the natural expression of our ever-closer solidarity. Let’s be clear: France’s vital interests now have a European dimension.

In this spirit, I would like strategic dialogue to develop with our European partners, which are ready for it, on the role played by France’s nuclear deterrence in our collective security.

European partners which are willing to walk that road can be associated with the exercises of French deterrence forces. This strategic dialogue and these exchanges will naturally contribute to developing a true strategic culture among Europeans.<sup>3</sup>

The French proposal has been greeted with interest by some European countries notably Germany, Poland and the Baltic States. However, it has also been met with scepticism from pro-disarmament states such as Austria and, potentially more significantly, the NATO Secretary General who reportedly commented:

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<sup>2</sup> Speech of the President on the [Defense and Deterrence Strategy](#), 7 February 2020

<sup>3</sup> *ibid*

We already have a European nuclear deterrence capability, with a doctrine, and it is an active one. It is institutionalized and has existed for decades. It is the Europeans' ultimate security guarantee and we must do nothing that could weaken or compromise it.<sup>4</sup>

In the longer-term France has repeatedly outlined its commitment to nuclear disarmament. The French Government supports upholding the nuclear non-proliferation treaty (NPT), universal ratification of the Comprehensive Test Ban Treaty (CTBT), immediate negotiation of a Fissile Material Cut-off Treaty (FMCT) and the continuation of work on nuclear disarmament verification.

However, France's traditional view is that disarmament cannot be an objective in itself and must be tied to improvements in international security first. As such, France rejects the notion of unilateral disarmament. In its National Report to the 2015 NPT Review Conference the French government stated:

The goal of nuclear disarmament cannot be considered separately from collective security. Nuclear disarmament is possible only if the strategic context is taken into account and should be viewed as part of a gradual process that will guarantee all parties undiminished security and prevent a new arms race.<sup>5</sup>

In February 2020 President Macron reiterated this position:

I cannot [...] set France the moral objective of disarming our democracies while other powers, or even dictatorships, would be maintaining or developing their nuclear weapons.

For a nuclear-weapon State like France, unilateral nuclear disarmament would be akin to exposing ourselves as well as our partners to violence and blackmail, or depending on others to keep us safe.

I refuse this prospect. And let us not be naïve: even if France, whose arsenal cannot be in any ways compared to that of the United States and Russia, were to give up its weapons, the other nuclear powers would not follow suit.<sup>6</sup>

“Even if France, whose arsenal cannot be in any ways compared to that of the United States and Russia, were to give up its weapons, the other nuclear powers would not follow suit”.

President Macron,  
February 2020

## 2.1 Declaratory Policy

The purpose of French nuclear doctrine is to “limit the role of deterrence to extreme circumstances of self-defence”.<sup>7</sup>

However, France reserves the right to use nuclear weapons first in a conflict. Specifically, the French Government reserves the right to conduct “a unique and one-time-only” limited nuclear strike to demonstrate to an aggressor that “the nature of the conflict has changed and to re-establish deterrence”.<sup>8</sup>

<sup>4</sup> “Macron’s strategic vision for Europe”, *Strategic Comments*, April 2020

<sup>5</sup> Report submitted by France to the NPT Review Conference, 2015 ([NPT/CONF.2015/10](#))

<sup>6</sup> Speech of the President on the [Defense and Deterrence Strategy](#), 7 February 2020

<sup>7</sup> *ibid*

<sup>8</sup> *ibid*

France has also pledged not to use nuclear weapons against non-nuclear weapon states party to the NPT and abiding by their non-proliferation commitments.

## 2.2 Nuclear arms control agreements

France is a signatory to several treaties and agreements relating to nuclear weapons and their delivery systems, which confer obligations on the French Government with respect to its nuclear policies. The most notable is the Nuclear Non-Proliferation Treaty.

### **Nuclear Non-Proliferation Treaty (NPT)**

France is one of the five recognised nuclear weapon states under the *Nuclear Non-Proliferation Treaty 1968*.<sup>9</sup> The objective of the treaty is to prevent the spread of nuclear weapons and weapons-related technology, further the goal of nuclear disarmament, and promote cooperation in the peaceful uses of nuclear energy. Significantly, the treaty represents the only binding commitment in a multilateral treaty to the goal of disarmament by the five recognised nuclear weapon states. Article VI states:

Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict and effective international control.

However, the question of whether the nuclear weapon states have sufficiently fulfilled the requirements of Article VI continues to be contentious. The NPT was never intended to allow for the possession of nuclear weapons indefinitely and while there have been notable nuclear reductions over the years by all five nuclear weapons states, those same states have also been accused of undermining any political commitments to disarmament by simultaneously undertaking extensive modernisation programmes of their respective nuclear forces.<sup>10</sup>

The failure of the 2015 NPT Review Conference to agree a final document, largely due to the inability of the five nuclear weapons states to agree firm commitments towards nuclear disarmament,<sup>11</sup> served to reiterate this belief that the nuclear weapon states are failing in their NPT obligations.

One of the consequences of this perceived failure was a renewed push for multilateral nuclear disarmament negotiations within the context of the UN General Assembly. In 2017 UN-mandated negotiations on a treaty prohibiting the development, stockpiling and use of nuclear weapons subsequently began.

Despite the short negotiating time, a [Treaty on the Prohibition of Nuclear Weapons](#) was adopted on 7 July 2017. It is the first multilateral,

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<sup>9</sup> Under the NPT the United States, Russia, China, France and the UK are recognised nuclear weapon states.

<sup>10</sup> Library briefing paper CBP7566, [Nuclear weapons: country comparisons](#), examines these modernisation programmes in greater detail.

<sup>11</sup> See ["Is there a future for the NPT?"](#), *Arms Control Today*, July/August 2015

legally-binding, instrument for nuclear disarmament to have been negotiated in 20 years.

None of the nuclear weapon states, including France, have signed and ratified the treaty, which is set to enter force on 22 January 2021.<sup>12</sup> Many critics have questioned what such a treaty will achieve if the nine nuclear states do not participate.

### **Comprehensive Test Ban Treaty**

France signed the Comprehensive Test Ban Treaty in 1996 and ratified it in 1998. Although the treaty is yet to enter force,<sup>13</sup> France has maintained its moratorium on testing. It is committed to universal ratification of the CTBT as soon as possible.

### **Fissile Material Cut-Off Treaty**

In February 1996 France announced that it had halted the production of fissile material for weapons purposes and that it would dismantle the production facilities dedicated to its weapons programme.

The French government advocates an immediate moratorium on the production of fissile materials by all states, and immediate negotiation of a *Fissile Material Cut-off Treaty* (FMCT). In February 2015 former President, Francois Hollande, confirmed that France would submit a draft treaty text to the disarmament community and called for negotiations on that instrument to begin without further delay. That [text](#) was subsequently presented to the NPT Review Conference in April 2015. However, discussions on the FMCT are still yet to begin within the [Conference on Disarmament](#).<sup>14</sup>

### **Nuclear Weapons Free Zones**

France is a Party to the protocols to:

- The [Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean](#) (Treaty of Tlatelolco)
- The [South Pacific Nuclear Free Zone Treaty](#) (Treaty of Rarotonga)
- The [African Nuclear-Weapon-Free Zone Treaty](#) (Treaty of Pelindaba)
- The [Treaty on a Nuclear-Weapon-Free Zone in Central Asia](#) (Treaty of Semipalatinsk).

As a consequence of its ratification, France has given an undertaking not to test or station nuclear weapons on territories within those zones.

France has not yet signed the protocol to the [Southeast Asian Nuclear-Weapon-Free-Zone Treaty](#) (the Bangkok treaty).

In addition, France is a party to the [Antarctic Treaty 1959](#), which bans nuclear tests and weapons in Antarctica.

France also supports plans to create a Middle East nuclear-free zone and has called on states to implement the resolution seeking to establish this

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<sup>12</sup> The treaty is examined in greater detail in [Negotiating a Treaty on the Prohibition of Nuclear Weapons](#), House of Commons Library

<sup>13</sup> The Treaty is still awaiting ratification by the US and China

<sup>14</sup> The Conference on Disarmament is the body tasked with negotiating this treaty.

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zone that was first adopted by the 1995 NPT Review and Extension Conference.<sup>15</sup>

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<sup>15</sup> Nuclear weapon-free zones are discussed in greater detail in Library Briefing paper CBP7634, [\*Nuclear weapons: disarmament and non-proliferation regimes\*](#)

### 3. Disarmament achievements

By the end of the Cold War France had approximately 540 nuclear warheads in its stockpile. Since 1991, however, France has scaled back its nuclear arsenal by almost 50 per cent, with a reduction in both its overall holdings but also the withdrawal of several weapons systems.

In 1991 France announced a number of decisions regarding its nuclear posture. The AN52 free-fall bomb, carried by Jaguar and Mirage III aircraft would be decommissioned and dismantled. The ballistic submarine fleet would be reduced from six to five, following the retirement from service of the lead vessel of the *Redoutable* class of SSBN. France's ground-launched capabilities would also be reduced with the early withdrawal of its short-range Pluton missiles and the scaling down of its replacement (the Hadès missile programme) from 120 to 30 units. It also announced the elimination of the S45 surface-to-surface missile, which was due to replace the S3D missile already deployed at the Plateau d'Albion nuclear base in south eastern France. In 1992 the Hadès missile programme was subsequently terminated, thereby completely eliminating France's ground-launched tactical nuclear capabilities. In 1992 the alert levels of France's nuclear forces were also reduced, both in terms of the number of weapon systems on alert and the response time.

France is the only nuclear weapons state to have dismantled, in its entirety, a ground launched nuclear capability.

In 1996 a further review of France's nuclear posture was conducted as part of a wider defence review. That review called for French nuclear forces to be consolidated on fewer platforms and for a new generation of nuclear weapons to be developed. As a result France announced the withdrawal of its remaining strategic land-based ballistic missile capability at Plateau d'Albion. The dismantling of France's S3D missiles was completed in 1998, making France the only nuclear weapon state to have dismantled, in its entirety, a ground-launched nuclear capability. It also withdrew its Mirage IV strategic aircraft from the nuclear role and reduced its SSBN fleet from five to four vessels, marking an overall reduction of one-third in the seaborne component since 1991. This represented the first significant decrease in stockpile numbers, with France possessing an estimated 450 nuclear warheads in 1996/97.<sup>16</sup>

France also reduced its alert levels for the second time since the end of the Cold War. It reduced the number of ballistic missile submarines permanently deployed at sea to just one SSBN, and with the withdrawal of the ground-launched capability at Plateau d'Albion, France no longer had any nuclear forces on permanent high alert.

As outlined above, in 1996 France declared that it had halted the production of fissile material for weapons purposes and that it would dismantle the production facilities dedicated to its weapons programme. The decommissioning of the Pierrelatte enrichment facility has since

<sup>16</sup> Kristensen and Norris, "Global nuclear weapons inventories 1945-2013", *Bulletin of the Atomic Scientists*, 2013

been completed. Decommissioning of the Marcoule reprocessing facility began in 1997 and is due to be completed in 2035.<sup>17</sup>

In 1997 France announced the de-targeting of all of its nuclear forces.

A decade later, in March 2008, the then President, Nicholas Sarkozy, set out further changes to French nuclear capabilities. He stated that the French nuclear arsenal would be reduced to fewer than 300 warheads,<sup>18</sup> and that one of France's land-based squadrons of nuclear-armed aircraft would be withdrawn, thereby reducing the airborne component of the nuclear deterrent by one third.

Those decisions reflect the size and structure of France's current nuclear forces. In 2015 former President Hollande ruled out any further reductions in France's nuclear stockpile outside of any drastic reductions in other countries' nuclear arsenals that would dramatically improve the global security environment. He also committed France to not building any new types of weapon but stated that it would modernise its existing forces, while remaining within the boundaries of existing agreements.

In his February 2020 speech President Macron reiterated that position, stating that France "will continue to take the decisions necessary to maintain their long-term operational credibility at the level of strict sufficiency required by the international environment".<sup>19</sup>

### Box 1: Summary of disarmament since the end of the Cold War

- By the end of the Cold War France had approximately 540 nuclear warheads in its stockpile.
- 1991 – The AN52 free-fall bomb was decommissioned early and dismantled. The ground-launched, short-range Pluton missile was withdrawn (completed in 1993). The Hadès missile programme was scaled down from 120 to 30 units; while the S45 surface-to-surface missile programme, intended to replace the S3D missile, was terminated.
- 1992 – The Hadès missile programme was terminated, resulting in the complete withdrawal of France's sub-strategic ground-launched nuclear capability. The alert level of France's nuclear forces was reduced, both in terms of response time and the number of weapons on alert.
- 1992 – the next generation SSBN programme (the *Triomphant* class under development) was reduced from six boats to four.
- 1996 – France announced the decommissioning of its remaining ground-launched strategic ballistic missile capability at Plateau d'Albion. It withdrew its Mirage IV strategic aircraft from the nuclear role, reduced its n-service SSBN fleet from five to four and reduced its alert levels for the second time since the end of Cold War. France also announced an end to the production of fissile materials for weapons purposes and the decommissioning of its production facilities.
- 1997 – France de-targeted all of its nuclear forces.

<sup>17</sup> Report submitted by France to the NPT Review Conference, 2015 ([NPT/CONF.2015/10](#))

<sup>18</sup> Compared to an estimated stockpile of 350 which President Chirac announced in 2006

<sup>19</sup> Speech of the President on the [Defense and Deterrence Strategy](#), 7 February 2020

- 2006- President Chirac announced an estimated stockpile of 350 warheads.
- 2008 – President Nicholas Sarkozy set out plans to reduce the French nuclear arsenal to fewer than 300 warheads and to disband one of France’s land-based squadrons of nuclear capable aircraft, thereby reducing France’s airborne nuclear capability by one third.

## 4. Force structure and capabilities modernisation

The French nuclear deterrent was initially developed as an air-launched capability, followed by a land-based ballistic missile force and then a submarine-based ballistic missile capability.

As outlined above, since the end of the Cold War France has scaled back its nuclear arsenal. France's official position is that it now has "fewer than 300 nuclear warheads", all of which are deployed and operational.<sup>20</sup> Analysts largely concur that the French stockpile is 290 warheads.

After withdrawing its ground-based ballistic missile force from service in 1996, France's nuclear forces now comprise a submarine-launched and air-launched component, which provide it with both strategic and tactical nuclear capabilities. France has made clear that it remains important to retain both systems as they have different characteristics and are complementary, providing a "range of necessary and sufficient options".<sup>21</sup> Analysts have suggested that the French M-51 submarine-launched ballistic missile is less accurate than a Trident SLBM (deployed by the US and UK), therefore maintaining an airborne capability provides France with more options for discriminate targeting.<sup>22</sup>

Over the last decade, France has been modernising its nuclear arsenal, through the deployment of a new *Triomphant* class of SSBN, the replacement of its combat aircraft in a nuclear role, the upgrade of both its submarine and air-launched nuclear-armed missile capabilities and the deployment of new warheads. And that process is ongoing.

Like the other nuclear weapon states, France also retains a stockpile of fissile material, estimated to be approximately 30 tons of HEU and 6 tons of plutonium.<sup>23</sup>

### 4.1 Maritime forces

The bulk of the French deterrent is maritime-based, with the Navy having responsibility for around 80 per cent of the nuclear arsenal.

#### Nuclear submarine (SSBN) fleet

The majority of that capability is delivered through its fleet of four *Triomphant* class ballistic missile submarines (SSBN) which have entered service since 1997 and have a service life of approximately 35 years.<sup>24</sup> Each SSBN is capable of carrying up to 16 M-51 submarine-launched ballistic missiles (SLBM). Preliminary design work has begun on a next

France currently possesses fewer than 300 nuclear warheads, all of which are deployed and operational.

The nuclear deterrent comprises an airborne and submarine-launched component.

Over the last decade France has been modernising its nuclear forces.

<sup>20</sup> Report submitted by France to the NPT Review Conference, 2015 ([NPT/CONF.2015/10](#))

<sup>21</sup> Speech by President Hollande, 19 February 2015

<sup>22</sup> "France's nuclear conservatism", *Strategic Comments*, February 2015

<sup>23</sup> International Panel on Fissile Materials, *Global Fissile Material Report 2019*

<sup>24</sup> The *Triomphant* class submarine has replaced the *Redoutable* class. The first of class entered service in 1997, the second in 1999, the third in 2004 and the fourth in 2010.

generation SSBN to replace the *Triomphant* class. Designated the SNLE 3G, construction of the first of class is scheduled to start in 2023 with the first boat expected in service in the early 2030s.<sup>25</sup>

The Navy retains a total of 48 SLBM in its inventory.<sup>26</sup> The new M-51 came into service in 2010 and provides greater range, accuracy and operational flexibility than its predecessor, the M-45. It has an approximate range of around 6,000 km when carrying a full payload of up to six warheads of variable yields and penetration aids, although that range would reportedly increase to 8,000km if only a single warhead is carried.<sup>27</sup> The process of replacing all the Navy's M-45 SLBM with the M51 was completed in August 2018.

The majority of the M-51 SLBM has the same payload as the M-45, in the form of the TN75 warhead. However, France has also been developing a new, more robust,<sup>28</sup> nuclear warhead, the Tête Nucléaire Oceanique (TNO). That warhead is carried on upgraded M-51.2 missiles, which is incrementally replacing the M-51. The M-51.2 has a greater range than the original M-51 SLBM, with some analysts suggesting that it could have a maximum range of 9,000km, dependant on payload.<sup>29</sup>

France adopts an evolutionary approach to upgrading its missile technologies, which is also thought to exploit synergies with France's space sector.<sup>30</sup> Design work has therefore commenced on a new M-51.3 SLBM. According to the French Ministry of Defence it is scheduled to be operational and begin replacing the M-51.2 in 2025. Proposals for an M-51.4 SLBM are also on the table.

The concept for the TNO<sup>31</sup> was tested during France's 1995-1996 final nuclear testing campaign and as such represents the new generation of French nuclear weapons in a test-ban context.

Like the UK, France's SSBN maintain a continuous at-sea deterrent (CASD) posture.<sup>32</sup> One SSBN is in maintenance at any given time.

The nuclear submarine fleet is based at Île Longue near Brest.

## Naval air squadron

The French Navy also operates a single squadron of 10 Rafale MF3 aircraft,<sup>33</sup> equipped with nuclear-armed, medium range, ASMP-A cruise missiles. Those aircraft are capable of being deployed aboard its aircraft carrier the *Charles de Gaulle*. The ASMP-A entered serviced in 2009

<sup>25</sup> The first of the *Triomphant* class entered service in 1997. With a 35-year lifespan, it could be expected to be decommissioned in 2032.

<sup>26</sup> [Speech by President Hollande](#), 19 February 2015

<sup>27</sup> Bruno Tertrais, "Nuclear policy: France stands alone", *Bulletin of the Atomic Scientists*, July/August 2004

<sup>28</sup> Robust warheads are less sensitive, for example, to the ageing of components.

<sup>29</sup> Bruno Tertrais, [French Nuclear Deterrence, Policy, Forces and Future: A Handbook](#), February 2020

<sup>30</sup> It has been suggested that research and development work on the M-51 is closely connected with development of the Ariane satellite launch vehicle (see "Ballistic trajectory: French SLBM technology developments boost operational output", *Jane's Defence Weekly*, 25 September 2018)

<sup>31</sup> And its air-launched equivalent, the Tête Nucléaire Aero-Portée (TNA)

<sup>32</sup> CASD has been maintained since November 1972.

<sup>33</sup> The Rafale MF3 replaced the Super-Etendard in 2015

and has improved manoeuvrability, enhanced accuracy and an increased range of 600km. It is also equipped with the new Tête Nucléaire Aero-Portée (TNA) warhead which is the air-launched equivalent of the TNO.

When not deployed on the carrier, the squadron is based at Landivisiau naval aviation base in northern France.

### 4.2 Air Forces

The airborne component of the nuclear deterrent comprises approximately 20 per cent of total nuclear forces.

The French Air Force has two squadrons assigned to the nuclear role, comprising approximately 40 Rafale F3 aircraft (20 apiece).<sup>34</sup> The Rafale F3 is equipped with the ASMP-A cruise missile and TNA warhead.

A mid-life refurbishment for the ASMP-A missile began in 2016 which will deliver the first upgraded missiles in 2022-2023 and keep them in service until 2035.

Research on a next generation missile has also begun. Designated the ASN4G (air-to-surface nuclear fourth generation), the missile will have enhanced stealth and manoeuvrability to counter potential improvements in air defence technologies. The ASN4G is expected to replace the ASMP-A in 2035.

The ASN4G will also be deployed aboard France's next generation of combat aircraft, which is due to enter service in the 2040s. In 2018 France and Germany announced they would jointly develop a sixth generation combat aircraft (the [Future Combat Air System](#)) that could potentially be nuclear-capable.

Both Rafale F3 squadrons are based at Saint Dizier airbase, east of Paris. They can, however, be deployed from any of the three designated nuclear bases: Saint Dizier, Istres and Avord. The Luxeuil air force base lost its nuclear role in 2011.

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<sup>34</sup> The Rafale F3 began taking over the nuclear strike mission from the Mirage 2000N in 2009. The last of the nuclear capable Mirage 2000N retired in 2018.

## 5. Procurement and Support

A two-way technical cooperation channel exists with the United States on nuclear safety and security. Since 1992, with the establishment of the Anglo-French Joint Nuclear Commission, there has also been collaboration with the UK in the coordination of nuclear policy and doctrine.<sup>35</sup> In 2010 Anglo-French co-operation went one step further following the signing of a treaty outlining co-operative measures governing the stewardship of existing nuclear stockpiles (see below).

In all other respects, however, France has independently built and maintained all of the necessary components of its nuclear arsenal.

### 5.1 Industrial Complex

The aircraft and submarine platforms for the French nuclear deterrent are all designed and built by French companies.

The Rafale F3/ MF3, its predecessor the Super Étendard, and the Mirage 2000N (which recently retired from service) are all aircraft designed and manufactured by the French company Dassault. The *Triomphant* class ballistic missile submarines, and their associated systems, were designed and manufactured by the French naval contractor DCNS (formed in 2007 from the amalgamation of DCN and the naval business of Thales).

The ASMP-A and M-51/ M-51.2 missiles (and their predecessors the ASMP and M-45) are all products of another French company, Aerospatiale Matra, which is now part of the pan-European company MBDA.

France has its own facilities for maintenance and support, and has built a number of new facilities to ensure the safety and reliability of the French-designed and built warheads without resorting to full scale testing:

A number of new facilities comprise the program. The Ile-de-France Center at Bruyères-le-Châtel, south of Paris, contains the Téra supercomputer that powers computer simulations. Located at Moronvilliers near Reims, the AIRIX linear electron beam accelerator takes flash radiographic pictures of nuclear weapons components under dynamic conditions. It began operation in January 2001. Construction of the Laser Megajoule facility began in May 2003 at the Centre d'Etudes Scientifiques et Techniques d'Aquitaine, southwest of Bordeaux. The laser, which consists of 240 laser beams (30 lines of eight beams) converging on a target just a few millimeters in diameter, will simulate fusion reactions, like those caused by hydrogen bombs.<sup>36</sup>

Final assembly of nuclear warheads takes place at the French Atomic Energy Commission's Valduc Centre near Dijon and the devices are

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<sup>35</sup> A history of nuclear cooperation with the US and the UK is examined in Bruno Tertrais, *French Nuclear Deterrence Policy, Forces and Future: A Handbook*, February 2020

<sup>36</sup> Robert S. Norris and Hans M. Kristensen, "French nuclear forces, 2008", *Bulletin of the Atomic Scientists*, September/October 2008

stored at a related Ministry of Defence facility pending delivery or disassembly.

Submarine support facilities are located at the Île Longue naval base near Brest where the warheads are mated with the re-entry vehicles and missiles. The ballistic missile submarine command centre was also re-located to Brest in 2000; while communication facilities continue to operate from Rosnay. While on patrol, communication is also maintained through four C-160H Astarté communication relay aircraft.

Protection while on operations is provided by French nuclear attack submarines, maritime patrol aircraft, anti-submarine frigates and minesweepers.

### 5.2 Cooperation with the UK

In 2010 the UK and France signed two defence co-operation treaties (often referred to as the Lancaster House treaties), intended to further collaboration in terms of interoperability, procurement, logistics and support, and industrial co-operation:

- [Treaty between the United Kingdom and the French Republic for Defence and Security Cooperation](#), Cm 8174, November 2010
- [Treaty between the United Kingdom and the French Republic relating to Joint Radiographic/Hydrodynamics Facilities](#), Cm 8289, November 2010

Significantly, the latter Treaty outlined greater co-operation in the nuclear sphere, specifically with respect to the stewardship of both countries' nuclear stockpiles. The treaty was labelled as "historic" and "unprecedented" in the level of military co-operation that it envisaged.

The nuclear Treaty established the following provisions:

- Co-operation, including the exchange of relevant classified information, which will focus on the following areas: safety and security of nuclear weapons, stockpile certification, counter nuclear or radiological terrorism.
- As a result, both Parties will jointly build and operate a dedicated radiographic and hydrodynamics facility at Valduc in France and will co-operate in a joint radiography and diagnostics technology programme in a joint facility (Technology Development Centre) at AWE Aldermaston in the UK. The output of this joint facility shall comprise development work to underpin the technologies used in the French facility throughout its operational life (**article 1**). The TDC facility will be designed, constructed and commissioned by 2014; while the French facility will be built and commissioned in two stages in 2014 and 2016 (**article 4**).
- Either Party will be able to conduct independent hydrodynamics trials needed for its national programmes at the facility in France.
- Joint use of the facilities will not imply that all the work conducted by the Parties shall be shared.
- The technical, financial, security and administrative arrangements for both joint facilities will be set out in separate and appropriately

classified agreements which will be finalised no later than 31 March 2011 (**article 2**).

- The French Directeur des Applications Militaires (DAM) and the UK's Chief Scientific Adviser will meet at least once a year to review the implementation and effectiveness of these arrangements and approve the future direction. They will also report progress to the Senior Level Group established under the defence and security co-operation treaty (**article 3**).
- The French facility shall comprise separate areas for solely national (manned by either UK or French personnel only) and joint use; whereas the TDC will comprise shared areas within a shared facility. Both Parties will have guaranteed and unhindered access to both facilities for 50 years or until such time as mutually agreed by both Parties (**article 5**).
- The UK will meet the costs related to the design, construction, operation, maintenance, decommissioning and dismantlement of the TDC; while France will meet the costs of phase 1 of the French facility. After 1 January 2015, with the exception of work being undertaken solely in support of national programmes the Parties will share all costs and benefits as a result of their participation in the joint programme equitably (**article 6**).
- Waste from trials and experiments at either facility will remain the property and responsibility of the originating state (**article 10**).
- Nothing in the treaty governs the release, use, exchange or disclosure of information, classified or otherwise, in which intellectual property rights exist unless written authorisation of the owner of those rights has been obtained (**article 12**).
- The treaty will remain in force for the entire life cycle of the facilities, including in-service upgrades, which is expected to be 50 years, or until such time as mutually agreed by both Parties. Following receipt of final investment approvals to proceed with phase 2 of the French facility, 10 year notice of withdrawal may be given by either Party. Where the obligations under this treaty may conflict with future treaty obligations which may arise, either Party may withdraw with one year's notice (**article 17 and 18**). If France withdraws from the French facility within the first 25 years of the treaty coming into force, the UK may recover the full cost of UK capital investment in the facility. Reciprocal arrangement shall apply in the event of the UK's withdrawal from the TDC (**article 18**).

At the UK-France summit in 2014 both countries agreed to expand their technical cooperation under the treaty:

30. We are making excellent progress with the development of world class scientific facility Epure in Valduc to underwrite the safe and assured performance of our respective nuclear weapon stockpiles. Final national investment approvals were recently granted by the two Governments: a significant step that deepens our commitment in accordance with the Treaty. It was agreed today to optimize the efficiency of the Teutates project by taking benefit of the refurbishment of a facility located in Aldermaston. We also have agreed to subject more of the technical and scientific data that underpins warhead certification to peer review; to work together on developing energetic materials for the future; and to conduct joint research at the laser facilities located at AWE Orion and CEA/DAM - LMJ.

There is no greater evidence of the value we both attach to the bilateral relationship than our willingness to work together in this most sensitive area.<sup>37</sup>

### 5.3 Level of Independence

There has been a longstanding debate over the independence of the French nuclear deterrent in comparison to the UK. What has been widely acknowledged is that the French insistence of independence in all aspects of design and acquisition has meant significantly higher costs.

However, that trade-off has received significant domestic support in France, which historically has associated the possession of nuclear weapons with national independence, in particular from the United States. All of the main political parties support retention of the nuclear deterrent,<sup>38</sup> in contrast to the UK; while domestic public support is strong. French opinion polls on the nuclear issue are relatively rare. A poll conducted by Expression Publique in October 2006 found that 71 per cent of the population supported the maintenance of a French nuclear deterrent.<sup>39</sup> In a separate poll for the French Ministry of Defense in 2007, 57 per cent thought that France could not ensure its defence without the nuclear deterrent. 43 per cent of respondents were also in favour of modernisation, while 35 per cent supported maintaining the deterrent in its current state and only 17 per cent were in favour of reducing it.

In March 2006 the late Sir Michael Quinlan, a former Permanent Under-Secretary of State at the Ministry of Defence, spoke in his evidence to the Defence Select Committee about the different perceptions of nuclear independence in France and the UK, suggesting that there are:

two different kinds of independence which are different levels of insurance policy with different costs. One is independence of procurement, which the French for the most part have gone for at high cost; the other is independence of operation. We have gone for the latter which costs a great deal less. It means in the last resort, when the chips are down and we are scared, worried to the extreme, we can press the button and launch the missiles whether the Americans say so or not. We have not got independence for procurement and the result of that is that if, over a very long period, we became deeply estranged from the Americans and they decided to rat on their agreements, we would be in schtuk, great difficulty, and I think one needs to distinguish between those two different sorts of independence.<sup>40</sup>

Bruno Tertrais also referred to that distinction in his evidence to the committee, commenting that:

The French nuclear programme was, and still is, intimately linked with its concept of independence and, I add, its independence vis à vis the United States, because that is what it is all about.

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<sup>37</sup> [France-UK Summit: Declaration on Security and Defence](#), 31 January 2014

<sup>38</sup> The Green Party in France is the only party calling for nuclear disarmament

<sup>39</sup> Bruno Tertrais, ["French perspectives on nuclear weapons and nuclear disarmament"](#), *France and the United Kingdom*, The Henry L. Stimson Center, 2009

<sup>40</sup> Defence Committee, [The Future of the UK's Strategic Nuclear Deterrent](#), HC 986, Q.49

Michael [Quinlan], whom I believe you heard, said that there were two concepts of independence: the British one and the French one. These are two concepts of nuclear independence. The British and French do not have the same concept of nuclear independence, although in both cases the intimate link between nuclear status and the relationship with the United States is very important.<sup>41</sup>

He went on to highlight two reasons why there was little political debate among the main parties in France about the nuclear issue:

In 1967 we took the strategic decision to be fully independent for survival and that required an independent nuclear deterrent. That has remained very firmly in the French strategic culture. The second reason which is linked to the first is that basically the sensitivity of the debate in this country, as I understand it, and your relationship with the United States is by its nature very different from what we have; in other words, all nuclear debate is linked to the debate about your relationship with the United States. Ours is in a very different position.<sup>42</sup>

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<sup>41</sup> Defence Committee, [The Future of the UK's Strategic Nuclear Deterrent](#), HC 986, Q.201

<sup>42</sup> Ibid, Q.224

## 6. Costs

Historically France's nuclear weapons programme has taken up approximately 10-11 per cent of the total French defence budget annually.<sup>43</sup> In 2020 the French nuclear deterrent is expected to account for 12.5 per cent of the defence budget,<sup>44</sup> approximately €6 billion (£5.3 billion).

In comparison the UK's nuclear deterrent costs 6 per cent of the annual defence budget (£2.3 billion, based on current defence expenditure).<sup>45</sup>

In 2008 the Bulletin of the Atomic Scientists estimated that the cost of procuring the new *Triomphant* class SSBN, through life was approximately €16bn, including construction, maintenance and personnel over 25 years. If the cost of the missiles and warheads is incorporated, that estimate is thought to double to approximately €32bn.<sup>46</sup>

In 2018 funding was approved for France's ongoing nuclear modernisation programme up to 2025. €37 billion was assigned to maintain and modernise France's nuclear forces and infrastructure, a significant increase from the €23 billion assigned for 2014-2019.

It has been noted that significant cost reductions have been achieved in the French deterrent programme, and specifically in its ballistic missile research and development, by exploiting synergies with France's space sector.<sup>47</sup>

### Box 2: Suggested Reading

- Bruno Tertrais, [French Nuclear Deterrence Policy, Forces and Future: A Handbook](#), February 2020
- Jeffrey Lewis and Bruno Tertrais, "Deterrence at three: US, UK and French nuclear cooperation", *Survival*, August/September 2015
- "France's nuclear conservatism", *Strategic Comments*, February 2015
- ["France's enduring nuclear det errent"](#), *BBC News Online*, 28 March 2012

<sup>43</sup> Robert S. Norris and Hans M. Kristensen, 'French nuclear forces, 2005', *NRDC: Nuclear Notebook*, July/August 2005

<sup>44</sup> Bruno Tertrais, French Nuclear Deterrence Policy, *Forces and Future: A Handbook*, February 2020

<sup>45</sup> The costs of the UK's nuclear deterrent are examined in greater detail in Library Briefing CBP8166, [The cost of the UK's strategic nuclear deterrent](#)

<sup>46</sup> Robert Norris and Hans Kristensen, ["French nuclear forces 2008"](#), *Bulletin of the Atomic Scientists: Nuclear Notebook*, September/October 2008

<sup>47</sup> It has been suggested that research and development work on the M-51 is closely connected with development of the Ariane satellite launch vehicle (see "Ballistic trajectory: French SLBM technology developments boost operational output", *Jane's Defence Weekly*, 25 September 2018)

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