

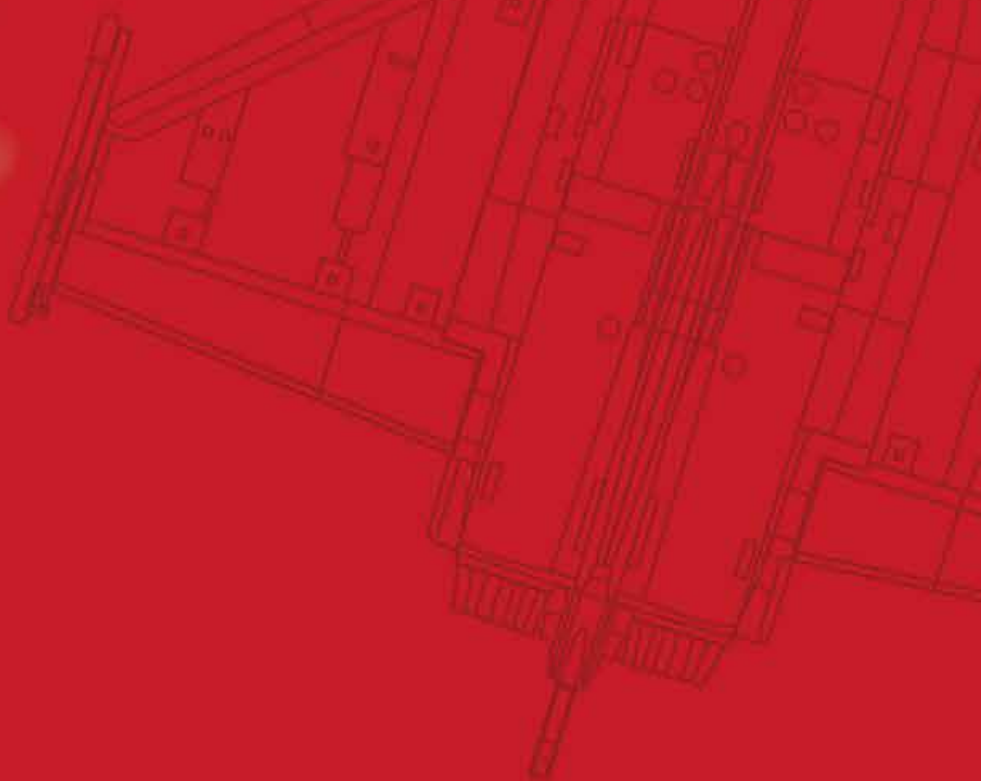
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Air Nuclear Components



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The views, thoughts and opinions expressed in this issue belong solely to the authors, and not the Ministry of French Armed Force, the Department of Defense of the United States, the United States School of Advanced Air and Space Studies, the Mitchell Institute for Aerospace Studies, the North Atlantic Treaty Organisation, the Pakistan Minister of Defence, the Indian Ministry of Defence and the Center for Air Power Studies.

Overview

Jean-Christophe Noël

Dear readers,

During a recent informal discussion with a keen observer of nuclear deterrence, he confided that, “*in the nuclear field, [there are] those who know but don’t speak, and those who speak but don’t know.*” It is true that when a written or verbal exchange concerns the very existence of nations, everyone thinks twice before divulging information. One might agree, however, that there are more encouraging words to be heard before embarking on creating an entire issue on airborne nuclear components.

Yet, there is no shortage of reasons to support such a project. First, there is the celebration of the sixtieth anniversary of the first nuclear alert by the French Air Force on 8 October 1964. A *Mirage IV* armed with its *AN-11* bomb and a *C-135* at the Mont-de-Marsan air base were readied for the first time to respond to any request from the Head of State. This alert has never been lifted since. Beyond the festive aspects consistently appreciated by both the young and the old, these anniversaries offer the opportunity to evaluate past performances, appreciate present achievements, and look ahead to future challenges.

Secondly, there is the increasingly pronounced contestation of the world order, notably by certain nuclear-weapon states (NWS). The return of war in Europe and tensions in Asia, for example, raise new questions about the nuclear dynamics that may be set in motion. Could the role of airborne components be modified or strengthened in this context? No one knows yet, but it is an incentive to better understand their associated challenges.

The third reason, and by no means the least, is that we believe it is essential for aviators who do not belong to the French Strategic Air Forces (*Forces aériennes stratégiques*, or FAS) to better explore this major command. As it sometimes operates on the fringes of the “conventional” French Air and Space Force (FASF), indeed it emits both mystery and wariness. These aviators may discover in this issue that the FAS, instead, structures a large part of their FASF, while indirectly influencing their working environment.

We therefore believe that it is essential for aviators to become acculturated to nuclear issues and, in order to decentralise and enrich their strategic awareness, to observe the way in which other air forces approach these problems.

To fulfil this ambitious programme, we have turned to both military and academic authors, involving French and international contributors alike. You will see that they all know and speak... quite a bit! Each author has attempted to answer our questions as best as they can within the, at times, very restrictive framework allowed by national doctrines or within the necessary restraint on existential subjects of their nations. We thus warmly extend our gratitude to all of them.

For the first time in this review, this issue uncharacteristically opens with three prestigious interviews.

The first is by Paul Zajac, the new Director for Strategic Affairs within the Military Applications Division at the Alternative Energies and Atomic Energy Commission (*Commissariat à l'énergie atomique et aux énergies alternatives*, or CEA). Thanks to the clarity and precision of his responses, our readers will be provided with the foundations to navigate with certitude through the academic discourse of military nuclear power. In particular, his evocation of the three nuclear ages notably offers the essential reference points to properly contextualise the various contributions in this issue.

The second interview is with General Jérôme Bellanger, then-commander of the *Forces aériennes stratégiques* at the time of this interview. He offers, in particular, an assessment of his three years in command. He also describes with vivid details the specificities of the FAS, illustrating how they fully integrate into the current geopolitical fluctuations.

General Anthony J. Cotton, commander of U.S. Strategic Command (USSTRATCOM), is our last interviewee. He gives a brief introduction of his command and recounts to us the essentials of the current U.S. doctrine. This is referenced as “integrated deterrence”, which is intended to provide the United States with the means to simultaneously confront the nuclear threats from Russia and China.

After appreciating how these three individuals depict the challenges of nuclear deterrence according to their positions and levels of responsibility, readers will be able to explore the subsequent detailed articles on airborne components with its distinctive themes. The first part of this issue deals with the French airborne component.

Its first article, written by Colonel Benoît Cornu, expresses in a perfectly concrete manner the level of destruction of a nuclear explosion. Readers will quickly grasp that these weapons are indeed “of a different nature”, which justifies the radical differences between conventional doctrines and those governing nuclear forces.

The second text is written by General Jean-Patrice Le Saint, then Chief of Staff of the *Forces aériennes stratégiques*. The author walks us through the sixty years of existence of the FAS, focusing on its capabilities and highlighting the numerous challenges that this command has always managed to overcome. As he states from the outset, “*today, its blade is sharper than ever.*”

In the third article, General Philippe Steininger, former commander of the FAS, examines how the deterrence mission has profoundly transformed the French Air

Force. This evolution began in the early sixties and has since affected all areas, from equipment to infrastructure, including structures and command. The FAS itself has moved from hyper-specialisation to carrying out more varied missions. This occurs all while continuing to ensure its primary function with the necessary rigour and efficiency.

The fourth article by *Capitaine de Vaisseau* (OF-5) Didier Chastel is a most welcomed presentation of the Nuclear Naval Aviation Force (*Force aéronavale nucléaire*, or FANU), which is less well-known compared to the FAS or the Strategic Oceanic Force (*Force océanique stratégique*, or FOST). The author notably revisits its origins and its specificities, highlighting that such a force can make our deterrence “more resilient” and offer “added subtlety”.

The final article is written by the Gendarmerie for the Security of Nuclear Weapons (*Gendarmerie de la sécurité des armements nucléaires* or GSAN), another essential entity that is little-known, who ensures the governmental control of nuclear weapons. For obvious reasons, its members rarely express themselves. This indigent article illustrates the decisive role they play in ensuring the credibility of the French deterrence policy.

The second part of this issue deals with airborne components of other countries. It seemed pertinent to us to observe the relationships that other nuclear actors have developed with their own airborne components. Our authors, in each case, emphasise the strategic ambitions of their home country, the particularities of their national doctrines, the history of their airborne component, as well as the current or future challenges they will face in the future.

Elizabeth Paige Reid’s article inaugurates this section. It focuses on the nuclear forces of the United States Air Force (USAF). In particular, she presents the four major “waves” of reflection, prompted by academic research, that have influenced U.S. doctrines. She describes the principles of integrated deterrence before noting with concern the U.S. population’s lack of knowledge or even interest about nuclear issues.

This article is complemented by the contribution of Mark A. Gunzinger, who introduces the *B-21 Raider*, the future USAF strategic bomber. This text is a veritable plea for the modernisation of the USAF’s fleet of aircrafts and the revaluation of the strategic bombing mission – be it either conventional or nuclear. The author suggests that the *B-21* is a formidable deterrent for the United States, capable of neutralising a large number of targets – 100,000 potential points of impact or more – in highly contested environments. The *Raider* could well become the new emblem of air power.

Without leaving the Western camp, the North Atlantic Treaty Organisation (NATO) also possesses a nuclear component. André Dumoulin recounts its history and addresses the consequences of the emergence of new operational obstacles (cyber threats) or geopolitical challenges (return high-intensity warfare).

Along with France, Russia is the other European country that deploys an airborne component. Its Long-Range Aviation (LRA) constitutes its main formation. Pierre

Grasser sets out to give us a closer look into this very particular corps that survived the end of the Cold War, despite severe budget cuts. Today, it regularly carries out conventional assaults against Ukraine.

We then move to a different continent with Hugo Caste and project ourselves towards Asia. The author proposes a contextualisation of regional issues. He emphasises the growing gravity of proliferation episodes in this geographical area, with North Korea as its latest example. He reviews the nuclear policies and doctrines of the countries that possess the bomb and raises the security issues posed by their rivalries or ambitions. He concludes by focusing on the role that the nuclear airborne components of these countries play in this very particular context.

We then give the floor to two authors – one from India and the other from Pakistan –, who describe more precisely the orientations of their countries' doctrines and the constitution of their airborne components. Let us remember that our aim is not to support or validate one point of view over the other. It is indeed Manpreet Sethi on one hand and Adil Sultan on the other who express themselves in their own names as recognised researchers. The purpose is to decentralise our perspective and better appreciate how these countries consider security issues. It is about grasping how air power can or cannot respond to their own strategic problems.

The third part addresses better known notions that are always interesting to revisit on a regular basis, or debates that have periodically, or recently, sparked new reflections. The first article is by *Lieutenant-Colonel* (R., OF-4) Emmanuel Nal, who examines the meaning of the word “doctrine” from a philosophical perspective. His approach will not fail to interest the writers of conventional doctrines by proposing another point of view, particularly in terms of methodology.

Olivier Schmitt and Mathéo Schwartz then address a subject that has sparked much conversation in the United States, namely the relationship between conventional and nuclear forces. They rigorously and precisely account for the various discussions that have animated academic, military, and political spheres over time to think about this relationship, particularly within the specific U.S. framework of extended deterrence.

Finally, Stéphane Delory ponders what type of missiles the delivery systems of nuclear airborne components should carry to achieve the desired results. He takes into account airborne bombs and missiles, cruise missiles, high-velocity missiles, and finally hypersonic missiles. Historical, capability-based, and doctrinal reflections are cross-referenced to depict, in particular, that the choice of a weapons system always remains closely linked to the strategies adopted for strikes.

The traditional history section opens with an article by Jean-Charles Fouchier on French heavy and medium bomber units at the end of the Second World War. Readers will be able to approach the usual classic issues, such as the integration of aviators who remained within the Armistice Army between 1940 and 1942 with those who had joined London. This also involves more novel issues relating to the instruction or morale of crews in a very demanding wartime context.

Louise Matz then offers a historical overview of the FAS that complements the texts of Generals Steininger and Le Saint. In particular, she reviews the sixty years of uninterrupted operational alert to ensure the permanent mission of nuclear deterrence. She emphasises the constantly renewed capacity for innovation of FAS aviators who must continuously adapt to international dynamics and technological progress.

Melvin Deaile then takes stock of the history of the Strategic Air Command (SAC). He too emphasises this command's adaptability. He notably evokes three salient moments in the SAC's lifetime to illustrate this aptitude. The first moment corresponds to General LeMay's assumption of command in 1948, which had radically transformed the SAC into a deterrent force. The second refers to the implementation of "alert missions", with B-52s permanently ensuring a very demanding airborne alert from both a human and logistical point of view. The last moment corresponds to SAC commitment in conventional missions, making a notable contribution particularly in Korea, Vietnam, or during Operation *Desert Storm* in 1991.

We take advantage of this special issue to introduce two new sections. The first has been requested for some time. It involves publishing older texts by air strategists to stir up the thinking of today's aviators. What better choice than Pierre Marie Gallois to illustrate the theme of this issue! We thus reproduced the thesis he defended in December 1954 as part of his year at the French Air War Superior School (*École supérieure de guerre aérienne*, or ESGA).

Patrick Bouhet contextualises the writing of this work with the author's fascinating career. We take this opportunity to thank François Géré, director of the French Institute of Strategic Analysis (*Institut français d'analyse stratégique*, or IFAS) and the Military Academy Library (*Bibliothèque de l'École militaire*) – particularly Véronique Maréchal – who both kindly entrusted us with the original document.

The other section we propose presents testimonies from aviators in action. Melvin Deaile takes up his pen again to narrate his bombing mission carried out over Afghanistan in early October 2001. This flight is remarkable for its duration: over 44 hours, making it the longest bombing mission in history. A remarkable account and show of publicity to illustrate the potential of air power.

Our most faithful readers will find their bearings again with the review section that follows this testimony. Two reviews are presented. The first is written by David Pappalardo and focuses on *The Fragile Balance of Terror: Deterrence in the New Nuclear Age*, a book written under the direction of Vipin Narang and Scott D. Sagan. Although published in 2022 just before the outbreak of the war in Ukraine, it brilliantly evokes certain present and future challenges of the third nuclear age. The second is penned by Hugo Caste, who discusses Nicolas Roche's book *Pourquoi la dissuasion* (in English: *Why Deterrence*), published in 2017. This work is now an essential French "classic" for all those who wish to deepen their thinking on the military nuclear subject.

And yet, this issue is still not finished. A series of reproductions of magnificent paintings illustrating aircraft or scenes from FAS life occupy the last pages of this issue. They have all been brought to life by painters of the French Air and Space Forces. Each of them, with their own style and their vision of military aviation, forged over years of passion and observation, manages to convey an impression of power and determination, leaving no doubt about the FAS's ability to fulfil its mission.

I would like to sincerely thank once again the increasingly small "inner circle" of *Vortex*, Pierre Vallée and Emmanuel Batisse, without whom this issue could not have been published.

If you wish to share your thoughts on the content of this issue, request for any information, or propose a piece, please do not hesitate to contact us at vortexlarevue@gmail.com.

We wish you an excellent reading.

AIR NUCLEAR COMPONENTS
Interviews

Interview with Paul Zajac

Jean-Christophe Noël



Paul Zajac is the Director for Strategic Affairs within the Military Applications Division at the Commissariat à l'énergie atomique et aux énergies alternatives (CEA, or in English: Alternative Energies and Atomic Energy Commission). He is also a fellow at the Interdisciplinary Centre on Strategic Issues of the École Normale Supérieure.

You are currently heading the Directorate for Strategic Affairs within the Military Applications Division at the French Atomic Energy Commission. Since when did you have an interest in military nuclear affairs? What specific dossiers have you previously handled in this field? Could you also introduce the directorate you are leading and its key responsibilities?

Let me start by giving you a brief overview of the Military Applications Division (DMA) of the French Atomic Energy and Alternative Energies Commission (AEC). This division is headed by Jérôme Demoment since April 2024. The DMA was initially set up in 1958 by General de Gaulle as the prime contractor and project manager for France's nuclear defence programme. This continues to be its core mission today. The DMA is responsible for the design, development, and the manufacturing of nuclear warheads, their maintenance as well as their provisions to the armed forces. Furthermore, it serves as the contracting authority for the design of nuclear boilers and the supply of cores for the French Navy's nuclear-powered vessels, which include submarines and aircraft carriers. It also provides the French government with

key expertise in the fight against nuclear proliferation. Lastly, the DMA ensures the availability and long-term viability of the strategic materials that are essential for nuclear weapons and propulsion.

Within the DMA, the *Direction des affaires stratégiques* (Directorate for Strategic Affairs), which I lead, fulfils several critical functions. Firstly, it contributes to the strategic analysis and forecasting work on nuclear deterrence issues. This not only benefits the DMA but also the entire nuclear defence community. The purpose is to enhance our understanding of the strategic environment, its developments, and its implications for our deterrence capabilities.

Secondly, it supports research and education on strategic and deterrence issues. Unlike the United States or the United Kingdom, there is no equivalent of “War Studies” in French universities. This absence represents a significant gap, especially for a nuclear-armed state. For nearly a decade, there has been a concerted effort to structure and support a field of strategic studies. The Directorate of Strategic Affairs at the DMA actively contributes to this effort, particularly through its cooperation with the Interdisciplinary Centre on Strategic Issues, which was established at the *École Normale Supérieure*.

Finally, the Directorate of Strategic Affairs also contributes to the public debate on nuclear deterrence and strategic issues. This is a key element in a democracy like ours, where defence policy must be closely linked to a shared defence mindset. This mindset has to be supported by an informed, rational, and open debate on defence matters.

I stepped into this position after a career as a diplomat, dedicated in part to political military issues, as well as to strategic anticipation and forecasting. Until recently, I served as the Deputy Director of Strategic Affairs at the Ministry of Foreign Affairs. There, I was responsible for European defence issues, as well as policymaking aspects for the North Atlantic Treaty Organization (NATO). I also prepared defence and national security council briefings for the French Ministry of Europe and Foreign Affairs (MEFA). Over the past two years, I primarily worked on coordinating our actions with our Allies and partners for the war in Ukraine. Furthermore, during my tenure in our embassies in Washington and Berlin, I focused on strengthening bilateral relations with these two key partners. It is with this diverse experience that I have joined the DMA, firmly convinced that the evolving strategic context requires us to reinvest in nuclear deterrence.

How did the bombing of Hiroshima and Nagasaki mark the start of a revolution in strategic affairs and international relations? The political nature of the weapon was a concept that only became apparent gradually. General MacArthur, for example, wanted to drop between 30 and 50 atomic bombs on the Communist forces at a time when he was facing a violent Chinese counter-offensive during the Korean War. He thought he could end the war in 10 days. How did this domination of politics triumph in practice? Is it true everywhere today?

Initially, nuclear weapons were not immediately associated with the concept of deterrence. Instead, they were first and foremost viewed as weapons of use, essentially an extension of the aerial bombardments carried out by the Allied forces during the Second World War. For instance, the bombing of Dresden in 1945 resulted in around 25,000 deaths, primarily civilians. Similarly, the bombing of Tokyo in the first half of 1945 likely resulted in almost 100,000 deaths, once again civilians. The bombings of Hiroshima and Nagasaki were part of a vast campaign of massive bombings conducted by the United States against Japan. In this broader context, the atomic bomb was initially perceived as a conventional super-weapon, a strategic breakthrough intended to bring the Second World War to a definitive end.

Yet, the rupture caused by the destructive power of the atomic bomb led to a profound shift in strategic thinking. You are likely familiar with the famous phrase by U.S. strategist Bernard Brodie in his work *The Absolute Weapon* (1946): “*Thus far, the chief purpose of our military establishment has been to win wars. From now on, its chief purpose must be to avert them.*”¹ It is important to note that, in October 1945, French Admiral Raoul Castex had already outlined the precursors to what would eventually become deterrence theory in an article published in the *Revue de Défense nationale* (National Defence Review), titled “*Aperçus sur la bombe atomique* (Insights on the Atomic Bomb).”²

However, it was not until the first Soviet nuclear test in 1949 that U.S. strategists began to link the nuclear weapon more closely to a doctrine of deterrence. It was only then that they gradually began building a deterrent relationship with the USSR. Thus, when General MacArthur proposed the use of the nuclear bomb in the Korean War, he was still thinking as the commander of the Pacific forces during the end of World War II. Regardless, a new strategic era had begun with the Cold War and the USSR’s acquisition of nuclear weapons. This was also a fact well understood by President Harry Truman.

The primacy of politics over the military was then expressed in the simplest and most explicit manner: the dismissal of General MacArthur by President Truman in April 1951, despite his great popularity with the U.S. public. MacArthur’s statements had, in addition, caused concern beyond the United States, evidenced by British Prime Minister Clement Attlee’s visit to Truman in December 1950 to plead against the unilateral use of nuclear weapons. Their unique power therefore reinforced the necessity of political primacy over the military. This is not a weapon like any other whose decision to use could be made by anyone other than the executive power. This fundamental principle still holds true for today’s nuclear powers.

1. B. Brodie (eds.), *The Absolute Weapon: Atomic Power and World Order* (New York: Brace and Company, 1946): 80-81.

2. R. Castex, “[*Aperçus sur la bombe atomique*](#),” *Revue de Défense Nationale*, vol. 11, no. 17 (1945): 466-473.

The nuclear age is sometimes divided into three periods. The Cold War roughly corresponds to the first of these nuclear periods. Could you tell us more about its foundations? Two major diplomatic crises punctuated this first period: the Cuban Missile Crisis in 1962 and the Euromissile Crisis in the early 1980s. What were their consequences?

Historical classifications are evidently simplistic, even if they have the merit of making the sequence of events more intelligible. For the sake of convenience, we can distinguish three nuclear periods. The first period is indeed the Cold War, which was when deterrence doctrines were developed. After successive crises, these doctrines aimed to achieve “strategic stability” between the U.S.-Soviet relationship.

The nuclear weapon essentially structured and determined the intense competition between the two great powers. The USSR and the United States engaged in fierce competition over power and access to the thermonuclear weapon, the number of warheads, the amount of delivery systems and anti-missile defences, and, finally, missile defence systems. Both great powers were obsessed with avoiding a decapitating first strike and with ensuring the survivability of their forces for a second-strike capability. However, the resulting increase in arsenals magnified the fear of a preemptive strike from the adversary. This is the classic circle of the security dilemma, pushed to the extreme – and even to the absurd – by the very nature of the nuclear weapon: in 1986, the global arsenal included nearly 70,000 deployed nuclear warheads.

In the early decades of the Cold War, there was still neither a shared grammar nor a stabilised deterrence relationship. This lack of stability made the Berlin (1958-1961) and Cuban (1962) crises particularly dangerous. Nevertheless, in both cases, the very existence of the nuclear weapon forced leaders to show restraint in a context of extreme uncertainty. The end of these crises led them to establish a minimal space for cooperation to avoid the risks of uncontrolled escalation.

The Cuban Missile Crisis laid the foundational groundwork for the main nuclear deconfliction mechanisms that would develop and persist until the end of the Cold War. It underscored the critical necessity of having direct communication lines between Washington and Moscow in the event of an emergency. This was in order to avoid misunderstanding the adversary’s intentions that could escalate into a nuclear conflict due to a lack of dialogue. It also marked the crucial realisation of the need to regulate the nuclear arms race. This eventually led to the signing of the Partial Test Ban Treaty in August 1963 between the United States, the United Kingdom, and the USSR.

A new phase of tensions then occurred in the late 1970s and early 1980s with the deployment of the Soviet SS-20 intermediate-range missiles in Europe. The intention was to force a decoupling between the United States and Europe, which subsequently launched another arms race. Immense competition grew in an attempt to restore the prior strategic balance, and increase the pressure on the USSR (following NA-

TO's 1979 "double-track" decision³). It was only after this phase that negotiations finally began with Gorbachev. With the signing of the Intermediate-Range Nuclear Forces Treaty (1987), the United States and the USSR expressed their dissatisfaction of simply limiting each other's weapons systems. This led to the unanimous approval of the first treaty in history to eliminate an entire category of weapons in its own right. This treaty represented the culmination of the Cold War arms control process and it is this legacy that Russia has decided to violate since the early 2010s.

The main nuclear doctrines emerged during this period. What are the principles that underpin them, not including that of France's?

The predominant fear shared by U.S. and Soviet strategists at the time was the potential for a disarming first strike that would eliminate their nuclear capabilities. For deterrence to remain credible, it became necessary to develop a dependable second-strike capability. This would make it clear to the adversary that any first strike would be followed by an inevitable nuclear retaliation. Such a doctrinal evolution, which was closely tied to the technological advancements of the time, was central to the concept of mutually assured destruction that existed between the United States and the USSR.

Between the two great powers, another crucial issue was evidently the European theatre. For the United States, the question was how to make the security guarantee that they provided through the Washington Treaty in 1949 – including and specifically in its nuclear dimension – credible enough to dissuade Moscow. The challenge was how to prove that they would genuinely be willing to risk an all-out nuclear war to protect third-party countries that were allies of the United States. Conversely, Moscow's constant objective (which has not significantly changed today) was to bring about a "decoupling" of transatlantic security. Russians aimed to create dilemmas for Washington, demonstrating that the United States would not be willing to risk its own security to protect Europe's.

It was in order to address this credibility issue of extended deterrence that the U.S. eventually abandoned the doctrine of massive retaliation, which had been adopted since 1954. It was no longer credible once the USSR had the means to strike the U.S. territory directly. As such, they developed the famous doctrine of flexible response in 1962. This new doctrine, in fact, provided for the transformation of the European territory into a nuclear battlefield, without necessarily leading to a nuclear exchange targeting the central systems on the territory of the two great powers.

The Soviet doctrine, on the other hand, is more difficult to interpret. This is due in part to a deliberate emphasis on ambiguity, or even concealment. After maintaining that the objective was to win a war in Europe by giving it a complete and immediate

3. In response to the deployment of Soviet SS-20s, NATO representatives decided in December 1979 (1) to deploy U.S. *Pershing* and ground-to-ground cruise missiles in Western Europe; (2) to adopt a set of measures to strengthen arms control and confidence-building mechanisms to improve mutual security and cooperation throughout Europe. See "[1979](#)," *NATO Update*, n.d.

nuclear dimension, Soviet doctrine and planning seemed to have moved towards use in the European theatre. This thus mirrored the U.S.'s graduated response. In a sense, it can be interpreted that the two great powers had converged on the same notion that nuclear arms could be used as weapons to confront each other on European territory, but also as weapons of deterrence to protect their own respective territories.

It was during this period that the major concepts of deterrence were developed. These concepts are still referenced today to understand the current strategic situation, with its notable similarities and differences from earlier periods.

The second nuclear period extends from the end of the Cold War to the return of great power rivalry. During this time, deterrence seemed to have fallen out of favour. This was primarily because precision conventional missiles could apparently neutralise or destroy strategic targets by limiting the scale of force used. Can these missiles be seriously considered as a legitimate alternative?

It is usually considered that the end of the Cold War marked the beginning of a second nuclear period, which was notably characterised by both fear and aspiration. The predominant fear was of unchecked nuclear proliferation. The major concern in the early 1990s was that the collapse of the USSR would lead to the unintended dispersion of Soviet nuclear capabilities and know-how. The aspiration, conversely, was to reduce the role and the pervasive fear of nuclear weapons. This ambition for nuclear abolition was first articulated by U.S. presidents Jimmy Carter and Ronald Reagan during the 1970s and 1980s, amidst the escalating tensions of the Euromissile crisis.

This dread and ambition were closely intertwined. At the end of the Cold War, Western nuclear states aimed to set an example by significantly increasing their disarmament efforts, hoping to limit the risks associated with proliferation. France made substantial progress during the 1990s, leading by example. President François Mitterrand's decision to implement a nuclear test moratorium, concurrent with joining the (Treaty on the Non-Proliferation of Nuclear Weapons) (NPT) in 1992, followed this line of reasoning. Similarly, President Jacques Chirac's signing of the Comprehensive Nuclear-Test-Ban Treaty, after conducting a final round of tests, also aligned with this approach. These French presidents took significant actions by closing fissile material production sites for nuclear weapons – the first being at Marcoule and subsequently at Pierrelatte. Furthermore, France actively advocated for an international treaty banning the production of fissile material, referred to more commonly as the "Cut-off Treaty".

The primary goal was to strengthen the NPT, which France joined in 1992 and whose indefinite extension was agreed upon by its parties in 1995. Paris's aim was to bolster the credibility of the NPT's foundational compromise. This was the commitment made by nuclear States to pursue negotiations in good faith on both nuclear and generalised disarmament, while non-nuclear states pledged not to proliferate.

The United States and Russia also moved in this direction, although they did not abandon the parity logic that remains central to their deterrence relationship. The

first Strategic Arms Reduction Treaty (START), signed in 1991, initiated a substantial reduction in the number of warheads deployed. This was followed by a sequence of other disarmament treaties, the latest of which being the New START Treaty in 2010. However, this effort must be viewed within its proper context: both parties retained more deployed warheads than all the other nuclear states combined. Strategic stability was also consolidated via a series of agreements that not only banned certain categories of weapons – such as biological and chemical weapons, but also limited conventional forces, and promoted transparency and predictability in Europe through measures, including, most notably, the 1990 Vienna Document and the 1992 Open Skies Treaty.

Even in considering all these steps undertaken by nuclear states towards nuclear disarmament, deterrence remains nonetheless the cornerstone of their defence policies, with no other weapon systems being able to replace it. The development of advanced conventional capabilities, particularly in terms of range and precision, has historically been linked to the evolution of nuclear deterrence. While certain nuclear states have placed greater emphasis on conventional capabilities since the end of the Cold War, this shift was an adaptation to evolving threats – particularly through the use of high-tech conventional weapons, rather than a substitution for nuclear deterrence. Since 1991, no NPT nuclear weapon state has renounced nuclear weapons in favour of relying solely on conventional tools. The real question today revolves around dual-use missiles, which are capable of carrying both conventional and nuclear warheads, thereby potentially causing confusion about intentions during their deployment.

As such, despite numerous nuclear disarmament efforts, proliferation persisted. In 1992, following the Gulf War, the International Atomic Energy Agency (IAEA) uncovered the extent of Iraq's clandestine military nuclear programme, before its forced dismantling. This was in complete breach of its status as a signatory to the NPT. Similarly, in 1994, North Korea's nuclear programme was exposed, leading to Pyongyang's withdrawal from the NPT. This consequently made it the only state to do so thus far. Since then, North Korea has persisted in its nuclear efforts, despite various offers of negotiation and pressure from sanctions, and has conducted its first nuclear test in 2006.

Moreover, in 1998, two states that had never joined the NPT, Pakistan and India, conducted their own nuclear tests. Considering that they were not parties to the Treaty, these tests did not directly challenge the NPT's normative framework. Regardless, Pakistan's programme significantly fuelled the dynamics of proliferation through Abdul Qadeer Khan's networks. Finally, in 2002, Iran's clandestine uranium enrichment activities were revealed, marking a prolonged and ongoing effort to prevent it from acquiring nuclear weapons, which is a challenge that persists to this day.

We are currently living through a third nuclear period. What are its defining characteristics? Is this period essentially a return to Cold War deterrence strategies, or are there significant differences?

Thérèse Delpéch characterises the third nuclear period as an era of “*strategic piracy*.”⁴ This period marks a return to a logic of unconstrained competition, effectively dismantling the normative frameworks that were established to regulate and contain it. This change has given free rein to revisionist ambitions, including those of certain nuclear powers. One can mark the beginning of this era with Vladimir Putin’s speech at the Munich Security Conference in February 2007, where he clearly revealed his intentions: to restore Russian imperialism by challenging the European and international order that had been established since the end of the Cold War, by force if necessary. The following year, Russia invaded and occupied northern Georgia. What followed is well known: the annexation of Crimea in 2014 and the continued aggression today against Ukraine since 2022.

This challenge to the international order is leading to a general disinhibition in the use of force and a return to competition in the nuclear dimension. The main difference is that this competition was no longer driven solely by the U.S.-Soviet strategic relationship, as it was during the first nuclear period. Rather, the U.S.-China relationship is becoming more of a priority but it is not occurring in isolation from the U.S.-Russia deterrence relationship. This is what the U.S. refers to as the “two-peer problem”. Nuclear tensions in Asia and the Middle East are increasing, each with its own dynamics. These trends accumulate towards a nuclear multipolarity, which is inherently more unstable than the bipolar equilibrium of the Cold War, shared between the two blocs.

A second difference is the proliferation of non-nuclear capabilities, capable of producing strategic effects, in particular ballistic missiles and cruise missiles. These capabilities have now been mastered by certain non-state actors, such as the Houthis and Hezbollah, who possess considerable capacities at their disposal. As a result, the world is witnessing an entanglement of escalation risks amongst actors at the local, regional, and strategic levels, making them even more difficult to contain.

Does the ongoing war in Ukraine already raise new questions, and do they, for example, serve to reinforce the importance of signalling?

The war in Ukraine is being conducted by Russia under the threatening shadow of highly explicit nuclear signalling, starting when Vladimir Putin announced the initiation of his “special operation” on the night of 24 February 2022. These threats are clearly directed at the West with the aim of deterring any direct intervention in the conflict. As a result, this invasion is backed by explicit and repeated nuclear threats, a tactic now referred to as “aggressive sanctuarisation”. Here, the nuclear weapon does not serve a purely defensive role but supports aggressive actions.

4. T. Delpéch, *La Dissuasion nucléaire au XXI^e siècle. Comment aborder une nouvelle ère de piraterie stratégique [Nuclear Deterrence in the 21st Century: How to Approach A New Era of Strategic Piracy]*? (Paris, Odile Jacob: 2013): 304.

Nuclear deterrence, in this context, has become an offensive tool used for territorial conquest and coercion. This is an extremely worrying development because of the dangerous precedent it could set. We could be entering a world where the nuclear weapon turns into a tool of destabilisation. Therefore, it is crucial for France to thwart Russia's strategy. However, the challenge is not only to avoid escalation, but also to make sure we are not overestimating Russia's intimidation manoeuvre.

The Russian threats have undeniably had an effect as Western states have, to this point, refrained from directly intervening in the war, to avoid a direct confrontation with Russia. On its side, Moscow has also demonstrated some restraint, maintaining a distance from Allied territories. Both sides are attempting to prevent the war in Ukraine from evolving into a conflict between NATO and Russia.

Nevertheless, the Russian nuclear intimidation effort has also failed in that it has not prevented massive Western military support for Ukraine. Such a situation is one that Russia must endure unless it wants to enter into a confrontation with NATO. One of the important lessons learnt from the last two years is that the Atlantic Alliance's nuclear deterrent is working. Formulated in terms of the nuclear dimension, the ultimate goal should be to lead Russia into recognising that nuclear intimidation has not worked, without calling into question the nuclear deterrence relationship between NATO and Russia. It is necessary to bring Russia back to a strictly defensive use of deterrence and away from an aggressive and destabilising use of it.

In France, the initial doctrine was conceived by the military, namely by those commonly known as the “*Four Generals of the Apocalypse*.”⁵ However, the military now appears more withdrawn by primarily focusing on ensuring the implementation of the nuclear weapon. Today, who participates in doctrinal reflection, and in what forums? What are the fundamental principles of French deterrence, and how has it evolved since the 1960s? Finally, how does the French doctrine differ from other foreign doctrines?

France's nuclear deterrence doctrine falls directly under the responsibility of the President of the Republic. The most recent speech was given by Emmanuel Macron at the *École de Guerre* (War School) on 7 February 2020, detailing his strategy for defence and nuclear deterrence.

The French nuclear doctrine rests on a number of key constants that not only ensure the coherence and credibility of deterrence, but also preserve the necessary flexibility to adapt to changes in the strategic context. These fundamentals were laid down very early on, even if the wording has changed over time.

In 1945, well before the development of the French nuclear programme, Admiral Castex laid down the groundwork for the concept of deterrence from the weak to the strong and the “*equalising power of the atom*.” These key formulas were set to evolve into the notions of strict sufficiency and unacceptable damage, which are central to our current posture. This is one of the major differences between the U.S.

5. Generals Charles Ailleret, Pierre Marie Gallois, André Beaufre, and Lucien Poirier.

and Soviet approaches: the consistent refusal to engage in an arms race by basing our strategy on a rationale of minimal deterrence. The aim is to inflict unacceptable damage (Charles de Gaulle spoke of “*appalling destruction*”), but one that is not linked to the opponent’s arsenal. It is a doctrine of pure deterrence, which rejects the prospect of nuclear war, unlike the one between the U.S. and the USSR, which sought to convince their adversaries that they were in a position to prevail in a nuclear confrontation.

The French nuclear deterrence doctrine is thus characterised by the refusal to consider nuclear weapons as battlefield weapons. Unlike Russia, we do not distinguish between “strategic” and “tactical” nuclear weapons, which we believe deviates from a defensive conception of deterrence. Moreover, France has not adopted a no-first-use policy, as, for example, India has done so. It also does not possess a “sole purpose” doctrine, where nuclear weapons are intended exclusively to deter nuclear aggression. This is due to the consideration that such a stance would open the possibility of massive conventional aggression or an attack with radiological, biological, or chemical weapons. Furthermore, France’s position is distinguished by its exemplary role towards the disarmament objectives under the NPT. This model stance includes reducing our arsenal, putting a definitive stop to nuclear testing, and halting the production of fissile materials for military purposes.

The other key element is, of course, the notion of vital interests. Nuclear deterrence is not aimed at a specific threat or adversary but rather at any form of attack on our vital interests coming from a State. These interests are not precisely defined, and the responsibility for them lies with the President. The core of vital interests is nevertheless outlined. This namely includes the protection of territory and populations, as well as the preservation of France’s sovereignty and independence. However, there is deliberate ambiguity about their scope, in order to avoid creating an overly legible threshold below which an adversary might feel free to carry out an attack.

The French nuclear deterrence has shown remarkable continuity since acquiring our strike force in 1960. It enjoys a consensus that transcends political alternations. Adjustments have been made concerning the principle of strict sufficiency of the nuclear arsenal, as required by the international environment. This was illustrated by President Chirac’s decision to eliminate the ground-based component.

Another major development is the recognition of the European dimension of our vital interests. France’s nuclear deterrent contributes to the Atlantic Alliance’s nuclear deterrent and to Europe’s security, as confirmed by President Macron’s speech on 7 February 2020. This does not contradict the principle of independence. General de Gaulle had rejected any form of integration of nuclear deterrence into a multilateral framework, as proposed by U.S. President John F. Kennedy, and therefore made nuclear deterrence the pillar of France’s strategic autonomy. The challenge then was, and remains today, not to subordinate the French deterrent to any forum that might constrain our choices. Nonetheless, from the outset, it has also been clear that the French nuclear deterrent contributes to the security of the European continent. Successive presidents have progressively emphasised and reaffirmed this.

There are those who fear that substantial financial investments in military nuclear capabilities will come at the expense of conventional resources. What is your view on this? In this regard, the President declared in 2020 that our defence strategy is a coherent whole, and that conventional forces and nuclear forces constantly support each other. How should these remarks be interpreted?

Nuclear deterrence, as the cornerstone of our defence policy, represents a major budgetary commitment, reinforced by the passage of the 2024-2030 *Loi de programmation militaire* (Military Programming Law). It is incorrect to think that this essential investment for our independence and sovereignty should come at the expense of conventional resources. Nuclear deterrence accounts for an average of 11 to 13% of our annual defence spending. It therefore in no way impedes the development of other components of our defence policy. Rather, it helps to elevate all other resources upwards through its high standards.

The unique nature of the nuclear weapon demands that it be treated differently from conventional issues. However, this does not equate to the fact there is a perfect watertight seal between the two. The 2022 *Revue Nationale Stratégique* (National Strategic Review) points out to us that current conflicts involve “*the return of the nuclear reality, high intensity and hybridity*.”⁶ In the face of multiple threats, conventional forces reinforce nuclear deterrence by preventing it from being circumvented from below (such as limited, hybrid, ambiguous aggression). Thus, the shoulder-to-shoulder positioning between conventional and nuclear forces only strengthens even more the President’s freedom of action in the event of a threat or aggression.

At the end of the Cold War, France abandoned its strategic ground-based missile component, which was operated by the French Air Force and based on the Albion Plateau. Why was such a decision made? How do the current two components fulfil the role it previously held?

This decision corresponds to a dual evolution.

On the one hand, with the disintegration of the Soviet bloc and the end of the Cold War, the European strategic environment was profoundly altered. This, by evidence, meant that France’s nuclear posture required an adaptation. It became particularly important to set an example in terms of disarmament. On the other hand, the French nuclear program also reached several key milestones. After his election, President Chirac launched the final nuclear test campaign, which gave the AEC and DMA the capacity to guarantee the operation of smaller nuclear warheads and to ensure their renewal through simulation.

Currently, the airborne and oceanic components are capable of sharing the operational and political functionalities previously provided by the Albion Plateau. This includes the permanence at sea of the oceanic component with the *Force océanique stratégique* (FOST, or in English, Strategic Oceanic Force), as well as the invol-

6. Secrétariat général de la défense et de la sécurité nationale (*General Secretariat for Defence and National Security*), “[National strategic review 2022](#)” (28 November 2022): 11.

nerability of nuclear-powered ballistic missile submarines (SSBNs). Moreover, the number of warheads they can deploy in the face of anti-missile defences took over some of the capabilities that had been previously provided by the ground-based component of the Albion plateau. The ability to make a power build-up visible from a permanent position and an anchoring on national soil are the other historical operational capabilities of the Albion plateau. These can now be fully provided for by the *Forces aériennes stratégiques* (Strategic Air Forces).

When President Chirac deemed that the Albion site had become vulnerable, maintaining the ground-based component was no longer suited to the threat assessment and the principle of strict sufficiency of our nuclear arsenal. In the context of the end of the Cold War, this decision, which eliminated redundancies and replaced them with a more genuine complementarity between the remaining two components, was a very practical application in the principle of strict sufficiency. This also became a part of France's determination towards its nuclear disarmament efforts.

France is the only European country with an independent and sovereign nuclear capability. Can it play a more significant role in deterrence in Europe?

The French nuclear deterrence has always been linked to the security of the European continent. This is not contradictory to the principle of independence. Since the Ottawa Declaration of 1974, the contribution of French (and British) nuclear forces to NATO's overall deterrence has been formally recognised, even though we do not participate in the Alliance's nuclear planning. Moreover, the European dimension of our vital interests has been progressively affirmed by successive heads of our state, which naturally leads us to play a key role in Europe's defence. Within this framework, the President of the French Republic has proposed a dialogue with our European allies on the role of France's nuclear deterrent in our security strategy to our European allies who wish for it.

As for our last question, considering that deterring an adversary is primarily a psychological process, how can misunderstandings with an adversary be avoided?

First and foremost, we must consistently demonstrate our resolve to defend our vital interests. Deterrence depends on the political, operational, and technical credibility of our commitment to this defence. The clarity of our message in this area is essential to ensure that an adversary does not misunderstand our intentions and our ability to respond to a threat. More broadly, strategic dialogue, which includes strategic signalling, as well as the various arms control and non-proliferation frameworks, should reduce the risk of misunderstandings between adversaries. However, today, through its methodical destruction of the European and international security architecture, Russia is reducing the possibility of exchanges aimed at reducing these risks.



Exchange between General Jérôme Bellanger and young operators from a ground-to-air defence squadron during a trip in January 2024. A time of closeness highlighting the leader's recognition and support for his men.

Interview with General Jérôme Bellanger, commander of the Strategic Air Forces

Jean-Christophe Noël



General Jérôme Bellanger had been in command of the French Strategic Air Forces since 2021. During the Council of Ministers meeting on 26 June 2024, he was appointed Chief of Staff of the French Air and Space Forces (Chef d'état-major de l'armée de l'air et de l'espace, or CEMAEE), effective starting from 16 September 2024.

Could you briefly summarise your career for us?

I joined the French Air Force when I was 20 years old, with the 1989 “Clément Ader” class in Salon-de-Provence. Following extensive military and academic training, I qualified as a fighter pilot in 1993, and was subsequently assigned to the 1/5 “Vendée” fighter squadron on the *Mirage 2000 RDI* nearby Orange city. Trained in air combat by my seniors with the vigorous and highly effective methods of the time, I was deployed on external operations in Bosnia and Iraq between 1995 and 1999. I also maintained the aerial permanent security posture (PSP), and regularly held the alert statuses required for such missions. To date, I have logged 2,400 flight hours with 59 war missions completed.

Following this extensive operational period, I fulfilled a variety of staff positions, notably at the Air Operational Centre of the French Air Defence and Air Operations Command (*Commandement de la défense aérienne et des opérations aériennes*) and at the Employment Division for the Inspectorate of our Air and Space Forces (FASF). I also served as Vice-Chairman of the Permanent Air Safety Council, a responsibility that now helps me to be particularly vigilant on air security, which is so crucial to our duties. Furthermore, a wealth of cabinet experience has broadened my horizons in

strategic decision-making. This began initially with working alongside the Minister of Defence, then in 2020, as the head to the cabinet of the Chief of Defence.

Last but not least, the most invigorating part of our profession lies in the immense responsibilities entrusted to us. For that, I have had the great honour of commanding four distinct entities in my career: the 1/2 “*Cigognes*” fighter group, which is the heir of the First World War aces squadron; Saint-Dizier nuclear air base, when the *Rafale* was gaining ground; the Air and Space Force Academy (*École de l’Air et de l’Espace*) during its significant transition into the status of a public establishment; and finally, the Strategic Air Forces (*Forces aériennes stratégiques*), which continue their comprehensive transformation today, as nuclear rhetoric gains renewed momentum not only in Europe, but also elsewhere in the world.

You had not been assigned to the Strategic Air Forces before taking command. What surprised and impressed you the most in this command?

I had indeed never served in the Strategic Air Forces Command (SAFC). Nevertheless, as you can imagine, commanding a nuclear air base fully integrated me into the Strategic Air Forces (SAF) community from that point onwards. Organised and equipped to conduct a nuclear build-up, the nuclear air base is daily connected to the SAFC. Its heart beats to the rhythm of numerous deterrence exercises and manoeuvres, including the famous nuclear security exercises, which put the base commander on the front line with the departmental authorities.

What particularly impressed me when I arrived at Saint-Dizier was the rigour, discipline, and logical reasoning with which the staff carried out their responsibilities. While being fully aware that they were performing an exceptional mission, they served every day with remarkable professionalism and upstanding presence.

I found these qualities again, when I took command of the SAF. Two points have particularly struck me since 2021. First and foremost is the versatility of the SAF, which I understood quite well at Saint-Dizier. This was developed even further with the arrival of the *Airbus A330* multi-role tanker transport (MRTT). As a result, all our capabilities are now omni-purpose in their area of use. This means that there has been a significant change of pace in operational activity, consequently demanding extraordinary agility from our personnel.

The second striking point is the omnipresence of change and the ability of SAF personnel to embrace its pace. The past three years have seen significant milestones for the SAFC as a whole. The modernisation of the *Rafale* and the upgrade of its improved medium-range air-to-ground missile (*air-sol moyenne portée amélioré*, or ASMPA), the build-up of the 31st Wing at Istres and its infrastructures, as well as the regrouping of the headquarters at Taverny are just a few examples. Contrary to what some might be tempted to think, routine is not part of the SAFC’s vocabulary. This command is by no means an outdated fossil!

What are your relationships with France's highest military and political authorities?

The relationship I have with our political and military authorities in my two main areas of responsibility is both based on trust and regular consistency. My first major responsibility is to oversee the execution of the nuclear raid. I am the nuclear force commander and report to the Chief of Defence Staff. My second major responsibility is to the Chief of the Air Staff, who is responsible for the readiness of the forces assigned to me, the training and education of SAF personnel and the maintenance of their assets. I am not only in close contact with the Chief of the Defence Staff and the Chief of the Air Staff, but I also interact with the Minister for the Armed Forces, the President's Chief of Staff, as well as the President himself. While this is always the case, it has particularly been so since 24 February 2022 – for reasons you can easily imagine.

Despite the very political and sovereign aspects of your mission, do you maintain relations with foreign airborne nuclear component commanders? If so, then in what way and what benefits do you gain from these interactions?

Our vital interests extend far beyond national borders, as stated by the President of the Republic, and our capacity for action is undoubtedly global. Preparing for and carrying out the deterrence mission requires extensive exchanges with our allies, most notably the U.S., who remains our only partner in possession of a sovereign airborne component. On this note, I would like to pay tribute to General Anthony J. Cotton, Commander of the U.S. Strategic Command, whom I have met on several occasions, and to General Thomas A. Bussiere, Commander of the Global Strike Command of the U.S. Air Force, whom I recently met in Paris and at Saint-Dizier air base. I have fond memories of my last visit to the United States, when I was offered the chance to fly on the famous *B-52 "Memphis Belle"*, named after the legendary *B-17*.

These interactions grant us a better understanding of not only what we have in common, but also what makes us different. Similarities prevail, even if our air forces differ in their proportions, as our U.S. counterparts have more than 200 bombers and more than 40,000 aviators dedicated to this strategic mission. Nonetheless, beyond the differences in format and doctrine, we share the same conviction in our mission and in the absolute necessity of the operational and technical credibility of our forces.

What is it like to experience a *Poker* exercise as the General commanding the Strategic Air Forces?

Each edition represents a new challenge, as the teams responsible for preparing the operation come up with demanding and realistic scenarios that are different each time. Multi-domain operations are already a reality in our operational preparations. As such, we integrate cyber, electronic warfare, as well as nuclear, radiological, biological, and chemical (NRBC) exercises together. We also continuously take into account the rapid technological advances in areas such as space intelligence. In addition to this tactically structured aspect – which remains extremely crucial, air security remains my top priority. *Poker* involves several dozen aircraft, with some flying at very low altitudes, at night, and sometimes in marginal weather conditions. Few missions involve such a high level of technical skill and complexity.

In truth, each edition of *Poker* is a “strategic” operation for three reasons. Firstly, the exceptional quality of the high-intensity scenarios enhances the adaptability of our teams and strengthens their overall effectiveness. Secondly, the sheer number and diversity of the assets involved means that they are vastly interoperable. It is our ability to conduct *Poker* exercises that ultimately enables us to carry out complex operations like the *Hamilton* raid or the PEGASE (*Projection d’un dispositif aérien d’Envergure en Asie du Sud-Est*, or in English: Projection of a large air force in Southeast Asia) power projection. Finally, the regularity of our training consistently sends a strong signal beyond our borders, and thus contributes to the overall credibility of our deterrent force.

The personnel of the SAF must always be ready to accomplish their unique mission, though it never reaches an end – something everyone can be thankful for. How do you maintain the motivation of your men and women in such a context?

Training is part of the DNA of aviators. After three years at the head of the SAF, I can confidently attest that everyone knows their role very well and fully understands the strength they derive from the group. This is the result of constant conditioning, and it is precisely the reason why nearly 70 exercises and operations are conducted on average each year. With a quarterly edition, *Poker* is, in reality, just the tip of the iceberg.

The other activities cover the rest of the segments of the mission, from the most obvious to the less apparent, including signalling, the Command and Control (C2) chain, and even infrastructure. Ultimately, every member of the SAF recognises that they are not only essential to the mission, but also 100% integrated into the overall manoeuvre.

Finally, it is worth pointing out that we conduct build-up phases that involve the handling of real warheads during *Banco* exercises. These simulations, which are ordered by headquarters following thorough risk analyses, allow our operators to fully recognise that not only our procedures work well, but that they can also rely on them, and with complete confidence in the chain of command.

From my point of view, I think the question is whether you would juggle foam balls in the same way as glass ones. As far as we are concerned, we juggle with glass balls even in training by consistently applying real procedures. It is a matter of credibility, and that justifies our strong ambition in terms of conditioning.

Given the current geopolitical situation, what were your major areas of focus over the past three years?

The deterrence mission shapes the structure of the air fleets in terms of both their type and number. While the *Rafales* of the 4th Wing and the tankers of the 31st Wing carry out conventional missions on a daily basis – and their versatility is certainly something to be commended – nuclear deterrence remains *the* mission of interest.

As the commander of the SAF, I contribute to defining future requirements by anticipating new threats that may arise 20 years into the future. The *Rafale* F5 and the

4th generation nuclear air-to-ground (*Quatrième Génération Air-Sol Nucléaire*, or ASN4G) hypervelocity will embody this future in 2035, as we await the eventual arrival of the future aerial combat system (*Système de Combat Aérien du Futur*, or SCAF).

I also closely monitor the availability of the SAF's assets, which is essential for guaranteeing our posture and the conduct of our training.

What were the key events that occurred during your command?

There have been many significant events worth noting, but since I cannot mention them all, I will simply highlight three that stood out.

On 22 May 2024, the French armed forces reached a major milestone with the execution of Operation *Durandal*. This operation involved the evaluation firing of the renovated improved medium-range air-to-ground (*air-sol moyenne portée amélioré – rénové*, or ASMPA-R) missile from a *Rafale B*, following a strategic raid training mission.

Additionally, as I mentioned earlier, each Poker operation is a special occasion, taking place in a different political, operational, and even meteorological context. A summer Poker at 30°C/86°F faces different challenges than the ones conducted in the middle of winter, at night, and under windy and rainy conditions.

Lastly, I would emphasise the “equalising power” of the atom. There are few nuclear powers in the world, and when they do engage in dialogue, it is on an equal footing. In this regard, I was particularly struck by the remarkable welcome I received during my visit to the United States last year. The consistency of our doctrine since its inception and the professionalism of those involved in nuclear deterrence lend credibility to our position in the eyes of our competitors. We are a “nuclear” air and space forces that contribute fully to the posture of stability and firmness that France wishes to defend.

The SAF are celebrating 60 years of existence this year since its conception. What is the significance of history in this command and how does it manifest?

As one of the two permanent nuclear commands (alongside the Strategic Oceanic Force – FOST), the SAFC is a major command within the Air and Space Forces, both operational and organic, which has never ceased its modernisation efforts since its creation. Two dates mark its birth. On 14 January 1964, General de Gaulle signed a decree establishing the SAFC, outlining its responsibilities and organisational principles. A few months later, on 8 October, a *Mirage IV* armed with its AN-11 bomb and a *C-135* took the first nuclear alert at Mont-de-Marsan air base. Since that day, this alert has been maintained without interruption. For 60 years, three generations of weapon systems have successively produced: from the *Mirage IV*/AN-11 to the *Rafale B*/ASMPA and the *Mirage 2000N*/ASMP.

In 2024, the organisation of the SAF is no longer quite the same, much like the procedures that were forced to evolve over time. However, as intergenerational exchanges reveal, the pioneers and their distant successors have shared the same

belief in the mission, however unique it may be. The SAF's insignia is highly symbolic. Red is the colour of the bombing. Yet, the dove signifies the hope that these forces will never be used. An iron glove unsheathing a sword communicates that the Strategic Air Forces, if necessary, are nevertheless ready to carry out their mission of destruction.

For 60 years, this badge has been a cord linking these men and women who have been serving the same mission of peace.



Patrick Space Force Base, Fla. – Gen. Anthony J. Cotton, commander of U.S. Strategic Command, briefs members of the Air Force Technical Applications Center during his visit to Florida’s Space Coast Nov. 16, 2023. Cotton, accompanied by Command Senior Enlisted Leader Sgt. Maj. Howard Kreamer, came to the nuclear treaty monitoring center to get an update on emerging threats and nuclear deterrence operations.
(U.S. Air Force photo by Susan A. Romano)

Interview with Anthony J. Cotton

By Colonel David Pappalardo, French Air and Space Attaché in the US



DR

Gen. Anthony J. Cotton is the Commander, United States Strategic Command, Offutt Air Force Base, Nebraska. He is responsible for one of 11 Unified Commands under the Department of Defense. USSTRATCOM is responsible for strategic deterrence, nuclear operations, global strike, missile defense, joint electromagnetic spectrum operations, analysis and targeting, and missile threat assessment. USSTRATCOM is comprised of 150,000 Soldiers, Sailors, Airmen, Marines, Guardians, and civilians who operate globally performing the command's missions. The command also provides the Secretary of Defense and President a range of options to deter adversaries and assure allies.

Please tell us a bit about you and your background.

I am serving because my father served. He joined in 1942 and served in World War II in the Army Air Corps. He later made the transition to the United States Air Force and retired as a Chief Master Sergeant in 1974. He encouraged me to go to college and become an officer, so I joined the Air Force through the ROTC program in 1986 through North Carolina State University in Raleigh. Since that decision, I have commanded at the squadron, group, wing, and major command levels, most recently as the commander of Air Force Global Strike Command, where I had oversight over two legs of the U.S. nuclear triad. In 2023, I assumed command of United

States Strategic Command and all three legs of the nuclear triad. I am responsible for strategic deterrence and providing the Secretary of Defense and President with a range of options, including nuclear weapons, to deter adversaries and assure allies.

The concept of “integrated deterrence” is central to the U.S. *National Defense Strategy* published by the Biden administration at the end of 2022. What is new about it, and where are you two years after its implementation?

I see our strategy deterrence maturing, evolving, and blending how we have approached deterrence in the past, by increasing resilience, and synchronizing different levers of power within our governments and across our alliances. That level of partnership is a strategic shift. It is weaving together cutting-edge technology, operational concepts, and state-of-the-art capabilities alongside interagency counterparts, allies, and partners to dissuade aggression. The strategy involves working across domains, theaters, and the spectrum of conflict to ensure each military service, government department or agency, or an ally and partner contributes comparative advantage in deterring threats.

More specifically, what is the place of nuclear weapons in such a deterrence strategy?

Nuclear weapons remain the ultimate deterrent against existential threats and continue to act as the bedrock, the failsafe that compels any adversary to think twice before attacking the U.S. or our allies. The nuclear posture review examined the role of nuclear weapons in the integrated deterrence framework, noting that U.S. nuclear forces continue to play a unique position given their ability to achieve deterrence effects that other elements of U.S. power cannot. The *Nuclear Posture Review* concluded that a pragmatic approach to integrated strategic deterrence is identifying ways to leverage non-nuclear capabilities to complement the unique attributes of nuclear weapons when developing tailored deterrence approaches.

Integrated deterrence entails working seamlessly across a U.S.’s unmatched network of Alliances and partnerships. What does “integration” really mean for Allies and partners? To what extent can they be integrated strategically, for instance?

The weaving of our combined and joint abilities are realized by integrating joint planning, intelligence sharing, and exercising interoperability of our collective force. Integration recognizes the unique strength of each nation and synchronizing them for maximum deterrent effect. This requires us to have a common understanding of the threats and a united approach to address them.

What is your assessment of the quantitative and qualitative modernization of the Chinese triad? What is the impact on your posture and your force model?

PRC’s unprecedented strategic forces expansion provides China with substantially greater capabilities than would be necessary for a strategy of minimal deterrence. The PRC continues to grow its nuclear arsenal, and has increasingly become less transparent in their objective. This increased threat will require greater coordination with our allies and partners to bolster our collective security.

Most recently, Russia has engaged in nuclear saber-rattling over its invasion of Ukraine, raising fears that it could be setting the stage for actually using a nuclear weapon. What is your assessment of this issue?

While countries from around the world and across Europe have condemned Russia's aggression, NATO and the European Union remain united in standing up to Russia and defending shared values. Clearly Russia's nuclear saber-rattling raises serious concerns and is irresponsible. Our unwavering focus is on ensuring they never doubt the will and credibility of the United States and NATO. This means maintaining a highly ready and reliable nuclear force, clear communication, and steadfast resolve as an unbreakable alliance.

Most generally, how are you re-writing your deterrence theory facing a nuclear three-body problem? Do you think Russia and China could synchronize their military activities to complicate your calculus?

This complex environment requires adaptability, flexibility, and close collaboration with allies to ensure our deterrence remains robust and credible and accounts for a range of potential scenarios. We must mobilize and foster the intellectual capital of the U.S. and our allies to meet this challenge. In the face of these evolving threats, we are confident that our existing nuclear force posture is sufficient to deter and, if necessary, respond. At the same time, the Department is closely monitoring the security environment and, if necessary, examining whether nuclear strategy or force adjustments are needed to ensure our ability to deter, assure, and meet our national security objectives.

Please tell us more about U.S. plans to modernize its nuclear triad.

Modernizing our nuclear triad is required to maintain a safe, secure, and effective deterrent. It's not just about platforms; it's about the command, control, and communications systems that ensure their reliability and effectiveness. This investment safeguards our security and global stability, deterring aggression and preventing the unthinkable. The advocacy of the modernization of the nuclear triad, the modernization of the weapons complex, the modernization of infrastructure are critical to the security of our nation and our allies and partners. To ensure our continued ability to serve as a bedrock of integrated deterrence, we're recapitalizing every leg of the nuclear triad and the nuclear command control and communications spectrum and addressing the electromagnetic spectrum. These long-term investments will ensure we have a predictable, stable, and efficient nuclear force for generations to come.

Last, French Strategic Air Forces celebrate their 60th anniversary this year, and France is continuously modernizing its air-to-ground nuclear missile. A new version of the current missile will soon be operational. France is also moving towards hypersonics, developing a fourth-generation air-to-ground nuclear missile (ASN-4G) to guarantee the credibility of the French deterrent's airborne component beyond 2040. What are your views on the French nuclear deterrent?

France's commitment to modernizing its nuclear forces aligns with our shared vision for global security. On my recent visit to France I met with General Burkhard,

Admiral Vandier, and Lieutenant General Bellanger and have hosted both Lt. Gen. Bellanger and Vice Admiral Fayard (ALFOST) at USSTRATCOM. I was able to observe and learn about the French nuclear deterrent and how they provide their nation with a safe, secure, and effective deterrence. Their ability to have an open exchange of views regarding the common threats our countries face is critical. As we look to the future, I welcome continued engagement with our French allies as we refine our common understanding of the threat environment, as well as how our respective strategic forces might contribute to our collective security.

AIR NUCLEAR COMPONENTS
France

Nuclear weapons, a different kind of weapon

Benoît Cornu

A French Air Force officer in mechanical engineering, Colonel Benoît Cornu graduated from the École de l'Air in 1999. Having mainly served in operational units equipped with Mirage 2000s, he notably commanded the 15.002 aeronautical technical support squadron at Luxeuil air base 116, and took part in the Harmattan, Chammal and Barkhane external campaigns.

At the end of World War II, a handful of visionaries considered equipping France with a nuclear strike force. On October 18, 1945, General de Gaulle, on the advice of Raoul Dautry, created the Commissariat à l'énergie atomique (CEA) to continue the work begun in this field before 1939.¹ The CEA was officially tasked with conducting scientific and technical researches “*with a view to the use of atomic energy in the various fields of science, industry and national defense.*” In addition to developing a nuclear energy production branch, the aim of this initiative was to join the very small club of countries capable of deploying nuclear weapons. This project became reality on October 8, 1964, when the Strategic Air Forces went on nuclear alert for the first time.

Since 1945 and the Hiroshima and Nagasaki blasts, numerous international crises have rocked the planet, but the development of nuclear stockpiles and the associated doctrines of deterrence have so far helped to avoid armed confrontations on a regional or global scale. After the period of relative calm that followed the end of the Cold War, the Russian-Ukrainian war is rekindling fears because of its nuclear dimension. Russia is a state with a nuclear arsenal.

With weapons numbering in the thousands. The United States, the United Kingdom and France, also nuclear-armed countries, support Ukraine without intervening directly. These fears, today as in the past, are based on the potential power of nuclear

1. CEA, “From the pioneering era to the Simulation program.”

weapons, which are, by virtue of their intrinsic capabilities, weapons of a “*different kind*,” uniquely capable of causing unacceptable damage to an adversary.

The purpose of this article is to clarify the difference between these weapons and conventional explosives. To fully grasp this subject, we need to look back at the scientific discoveries made at the beginning of the 20th century – to which French researchers made significant contributions. They were fundamental to the development of the various types of nuclear armament. France’s scientific contribution, was relatively dormant during the Second World War, so we will pick the story up from there. This gave France the opportunity to successfully implement its nuclear program and carry out its first nuclear test in 1960. Finally, the effects of these nuclear weapons were described, demonstrating their incomparable power. It is this destructive power that led to the emergence of doctrines of nuclear deterrence.

Pioneers of nuclear fission

Christopher Nolan’s film *Oppenheimer*, released on July 19, 2023, gave the general public the opportunity to discover the history of nuclear weapons and, thanks to a captivating storyline,² to understand that, because of their power, they were weapons of “*a different kind*.”

A huge box-office success, described by some critics as the biggest “biopic” since *Lawrence of Arabia* (1962), this grippingly realistic three-hour biography, with its steady pace and excellent cast, recounts part of the life of Robert Oppenheimer (1904-1967), who went down in history as the “*father of the atomic bomb*.”

A renowned physicist and university professor at Berkeley and the California Institute of Technology, in 1942 he was appointed director of the Los Alamos laboratory, whose aim was to design an atomic bomb for the Manhattan Project headed by General Leslie Groves.³ Over the course of the film, we meet other brilliant physicists such as Einstein, Fermi, Bohr, Heisenberg, Teller and many others... But none of them are French. And yet there were many French contributions!

French scientists at the end of the 19th and beginning of the 20th century made major contributions to the fundamental discoveries and work on radioactivity that were essential in learning how to harness the nuclear energy produced in reactors (first derivative of Fermi’s experimental nuclear pile on December 2, 1942) or weapons (*Trinity* test on July 16, 1945). The pioneers of radioactivity were Henri Becquerel (1852-1908), Marie Curie (1867-1934) and Pierre Curie (1859-1906).

H. Becquerel discovered natural radioactivity in 1896, when he accidentally observed that uranium salts emitted “*uranic*” rays that left a trace on an undeveloped photographic plate.⁴ His discovery paved the way for the more systematic study of

2. Notably by *Le Point*, in an August 07, 2023 article entitled “*Oppenheimer: does Christopher Nolan respect scientific truth?*”

3. General Leslie Richard Groves (1896-1970) had previously supervised the construction of the Pentagon.

4. “*Uranic rays*” was the old name for the radiation emitted by uranium at the time it was discovered by Henri Becquerel in 1896.

radioactivity, in which French scientists Marie and Pierre Curie played a key role, discovering two major radioactive elements in 1898: polonium and radium. In 1903, Marie Curie became the first woman to win a Nobel Prize, along with her husband and H. Becquerel, for their work on radioactivity. She was awarded a second Nobel Prize in Chemistry in 1911 for her discoveries of radium and polonium.

A few years later, New Zealand physicist Ernest Rutherford (1871-1937) made a fundamental contribution to our understanding of radioactivity, proposing in 1909 the concept of an atom with a central nucleus. This revolutionized our vision of atomic structure. Rutherford also identified three types of radioactive radiation: “alpha”, “beta” and “gamma”. Based on Rutherford’s work, Danish physicist Niels Bohr (1885-1962) developed his theory of atomic structure. His model of the atom, known as the “*Bohr model*”, posits that the electrons in an atom are characterized by discrete levels of energy. This was the foundation of quantum mechanics.

Enrico Fermi (1901-1954) was another physicist who made a direct contribution to the Manhattan Project. He worked on artificial radioactivity and the transmutation of elements. Known for having designed the aforementioned Fermi pile, this Italian scientist bombarded uranium atoms with neutrons in 1934, paving the way for the discovery of nuclear fission, an essential process to the development of the atomic bomb.⁵ Two years earlier, in 1932, Rutherford’s assistant, the Englishman James Chadwick (1891-1974), had discovered the neutron while expanding on the research of Irène and Frédéric Joliot-Curie, who were trying to explain the origin of radiation capable of ejecting protons from a hydrogenated substance. Armed with this knowledge, Chadwick headed the British delegation working on the Manhattan Project at Los Alamos between 1943 and 1945.

And last but not least, Albert Einstein (1879-1955).⁶ Although he is best known for his theory of relativity, he also made important contributions to our understanding of radioactivity.⁷ In 1905, he described the photoelectric effect, helping to establish the quantum nature of light and open the way for the subsequent exploration of subatomic particles.

Along with many others, these researchers of widely differing nationalities, many of them European, laid the foundations of modern nuclear physics. They paved the way for many applications, including the first atomic bomb, of course, but also nuclear medicine, radiation detection and electronuclear energy.

French scientists and the explosion of the first French nuclear bomb

In France between the two world wars, Irène Curie (1897-1956), daughter of Pierre and Marie Curie, followed in her parents’ scientific footsteps.⁸ Married to

5. “[Frédéric Joliot-Curie](#),” *France Archives*.

6. In 1905, the theory of special relativity founded the notion of space-time and established a link between mass and energy ($E=MC^2$). This theory also posited the speed of light as an invariant in a vacuum. In 1915, Einstein extended these principles and developed general relativity, based on the principle of equivalence between gravitation and acceleration.

7. In physics, the photoelectric effect refers to the emission of electrons by a material under the effect of light.

8. Says Frédéric Joliot-Curie.

Frédéric Joliot (1900-1958), also a physicist and chemist, she and her husband were awarded the Nobel Prize in Chemistry in 1935 for their work on artificial radioactivity, discovered a year earlier.

On December 12, 1935, Frédéric Joliot unveiled his thoughts on nuclear fission in a speech accompanying the award ceremony: *“If we look back at the progress made by science at an ever-increasing pace, we are entitled to think that researchers, building or breaking elements at will, will be able to achieve explosive transmutations, veritable chemical chain reactions. If such transmutations are able to propagate through matter, we can imagine the enormous release of usable energy that will take place. But, alas, if contagion occurs to all elements on our planet, we must foresee with apprehension the consequences of unleashing such a cataclysm.”*⁹ This fear, which is also evoked in the *Oppenheimer* film, already augured that nuclear energy would be of a very different nature from other types of energy then available.¹⁰

While it was the Austrians Otto Frisch (1904-1979) and Lise Meitner (1878-1968) who proved that uranium is fissile through neutrons bombardment, Frédéric Joliot and his team at the *Collège de France* (including Hans Halban, Lew Kowarski and Francis Perrin) demonstrated experimentally in March 1939 that a chain reaction can occur through the emission of secondary neutrons when uranium fissions.



Frédéric Joliot-Curie (1900-1958).

© Musée Curie

At the time, the many exchanges between scientists prompted Albert Einstein to write his famous letter to President Roosevelt on August 2, 1939: *“In the course of the last four months it has been made probable – through the work of Joliot in France as well as Fermi and Szilard in America – that it may be possible to set up a nuclear chain reaction in a large mass of uranium, by which vast amounts of power and large*

9. [“Frédéric Joliot-Curie,”](#) *op. cit.*

10. [“Frédéric Joliot-Curie,”](#) CNRS.

quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future. This new phenomenon would also lead to the construction of bombs, and it is conceivable – though much less certain – that extremely powerful bombs of this type may thus be constructed.”

Shortly before, alarmed by the German threat, Joliot and his team filed three “secret patents” in May 1939 relating to the possible applications of their recent work. One of them, entitled “*Perfecting explosive loads*,” suggested the possibility of releasing very large quantities of energy from nuclear fission, thus justifying how sensitive the matter was. The second patent was entitled “*Energy production device*,” and the third “*Processes for stabilizing an energy production device*.”

Frédéric Joliot also alerted the French government to the importance of uranium oxide (a large stock of which was recovered from the Belgian Congo), the raw material needed for his research, and heavy water (deuterium), which can be used as a neutron moderator. In March 1940, France acquired the world’s entire stock of heavy water, produced and stored in Norway. But Germany’s invasion of the country changed everything. The French were forced to evacuate these reserves in Great Britain. Collaboration with British teams having been authorized by Raoul Dautry, then Minister of Armaments, Hans Halban and Lew Kowarski returned to Great Britain to continue their work. The French scientists’ research had indeed shifted to a military dimension.¹¹

Halban and Kowarski initially met with the scepticism of their hosts, but succeeded in demonstrating the value of the natural uranium route to the bomb. They thus anticipated the plutonium route, which would not be discovered by the American Glenn Seaborg (1912-1999) until December 1940. Halban and Kowarski were later joined by Pierre Auger, Jules Guéron and Bertrand Goldschmidt.¹²

Although these French researchers shared their work with the British and Canadians, they were never included in Groves and Oppenheimer’s Manhattan Project. However, their knowledge was not lost.¹³ The Commissariat à l’énergie atomique (CEA) was created in October 1945 with the mission of pursuing research “*with a view to the use of atomic energy in the various fields of science, industry and national defense*.” This was the first stage of wide-ranging plans, with the nuclear field identified as one of the key areas for the country’s reconstruction.¹⁴ From a military point of view, this organization ultimately gave rise to what is known today as

11. CEA, “Résistance et Dissuasion,” *op. cit.*

12. With the exception of Bertrand Goldschmidt, who worked for a few months in the United States with Glenn Seaborg, in 1942 and 1943. However, the fundamental contribution of the French discoveries was *subsequently* recognized by the British and contributed to the resumption of French work in the immediate post-war period, culminating in our first nuclear test in 1960. France became the fourth nation in the world to possess the bomb, after the United States, the Soviet Union and the United Kingdom.

13. CEA, “Résistance et Dissuasion,” *op. cit.*

14. The terms and conditions of the French military atomic program were laid down in a decision by the Prime Minister on June 13, 1961, specifying that its implementation was a “joint undertaking” of the Ministry of Defense and the CEA. CEA, “De l’ère des pionniers au programme Simulation.”

“l’Euvre commune”, bringing together, right up to the highest level of government, the scientific, technical, military and political resources and commitment that underpin our policy of deterrence.

France’s post-war efforts enabled it to carry out its first nuclear test, dubbed the “*Gerboise Bleue*”, on February 13, 1960, in the Algerian desert. A plutonium A-bomb with an approximate yield of 70 kilotons (kt), three to four times that of Hiroshima, was successfully detonated.¹⁵ Positioned at a height of around 100 meters on a tower, it vitrified the sandy soil within a 300-metre radius. An essential step was thus taken towards becoming an independent nuclear power.

Atomic bombs

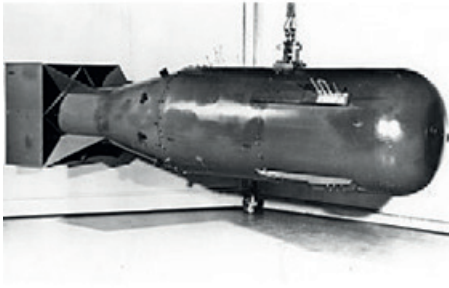
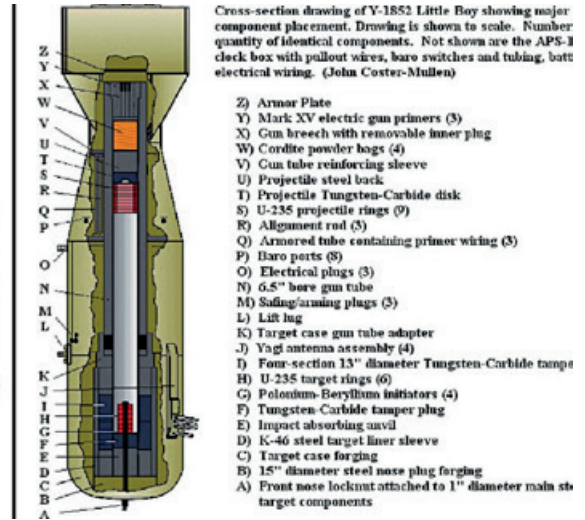
The A-bomb, a fission weapon, was the first type of nuclear weapon to be developed using uranium 235 or plutonium 239.¹⁶ The principle involved using various methods to exceed the critical mass of fissile material required to trigger a neutron chain reaction that can diverge, *i.e.* grow exponentially, within this critical mass. Each uranium or plutonium nucleus hit by a neutron releases several others as it fissions, each fission resulting in a release of energy. The new neutrons produced in turn strike other nuclei, sustaining the phenomenon. When this reaction is controlled and stabilized, the nuclear energy released can be harnessed: this is what happens at the core of a nuclear reactor. If the chain reaction is allowed to diverge, to get out of control, the result is a nuclear explosion, as long as the fissile material is appropriately shaped beforehand.

Two main principles were used to trigger this chain reaction: the gun-type “close-in” weapon and the compression type “implosion” weapon.¹⁷ In the close-in weapon concept, two subcritical sets of fissile material are brought together by an explosive to form a sufficient critical mass in which the chain reaction is triggered. *Little Boy*, the atomic bomb dropped on Hiroshima on August 6, 1945, was the first example of a close-in weapon, using uranium 235. It was designed to be both relatively simple to manufacture and functional. It was, however, less efficient in terms of energy yield than the implosion weapons (*Gadget* and *Fat Man*). Its energy is estimated at 15 kt. Exploding 580 meters above the city, it immediately killed around 70,000 inhabitants. But tens of thousands of Japanese died from injuries, severe burns or the effects of radiation.

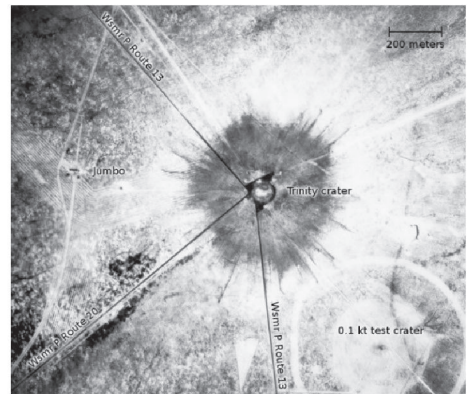
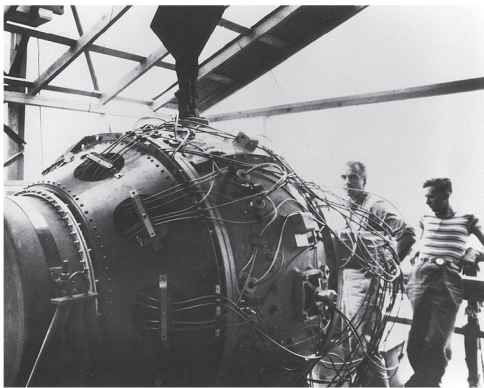
15. “February 13, 1960, first French nuclear test in the Sahara,” *INA* (10 February 2020).

16. In other words, matter whose nuclei can break apart under the impact of neutrons, releasing energy and other neutrons, enabling a chain reaction.

17. “[A Meta Implosion Weapon of Mass Destruction](#),” *Geopoliticatus* (14 April 2018).

Post-war replica of *Little Boy*.*Little Boy*'s schematic diagram.

On the other hand, implosion weapons are a more technologically advanced concept, since the critical mass is no longer exceeded by adding material, but by increasing its density. This involves compressing the fissile material, which is in the metal state, by means of conventional explosives arranged symmetrically around it. Achieving criticality depends on a number of technological criteria, and in particular on the perfect synchronization of all the detonators firing these peripheral explosives.¹⁸ The *Gadget* explosion on July 16, 1945, the *Trinity* test bomb positioned on a test tower, was a plutonium 239 fission implosion weapon. It delivered an energy of around 20 kt.

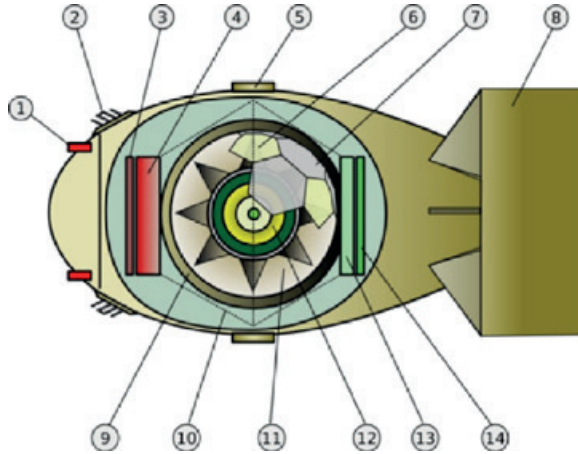
*Gadget* on standby in the test tower at the *Trinity* site. Aerial photograph of the site after the trial *Trinity*.

This concept allows for much higher energy yields than gun-type weapons, potentially reducing their volume. The atomic bomb dropped on Nagasaki on August 9, 1945, named "*Fat Man*", was also an implosion weapon, using plutonium 239. Exploding at an altitude of 550 meters and releasing around 20 kt, it killed almost 35,000 people.

¹⁸. This is the bomb shown in the *Oppenheimer* film.

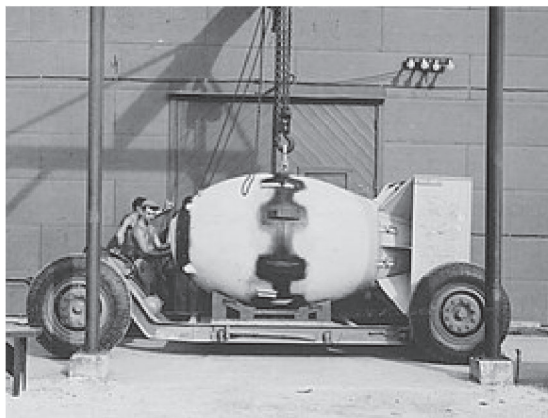
Nuclear weapons, a different kind of weapon

ple, half as many as the less powerful *Little Boy*. This difference is explained by the hillier nature of Nagasaki, which reduced the effects of the weapon.



Fat Man's schematic diagram.

1. Fuse AN219.
2. Archie radar antennas.
3. Plates with explosion-initiating batteries.
4. Firing unit located near conventional explosives.
5. Chain 1 for securing the hull's two ellipsoidal pallets.
6. Pentagonal explosive lens (12 units with layers of slow and fast explosives).
7. Hexagonal explosive lens (20 units with layers of slow and fast explosives).
8. "California parachute", aluminum bomb tail.
9. 140 cm diameter spherical envelope.
10. Cones containing the weapon.
11. Explosive lens envelope.
12. Stacking of fissile material layers (neutron initiator, reflector, buffer, boron/aluminum layer).
13. Instrumentation plate (radars, barometers and timers).
14. Collector for barometer tubes.



Fat Man shortly before loading.

Nuclear weapons operate sequentially, but extremely fast. From an electrical impulse of a few joules, detonators are fired, triggering more powerful conventional explosives which, by compressing and densifying the fissile material, enable it to exceed its critical mass. At the end of the almost instantaneous chain reaction, a gigantic amount of energy is released in a very short space of time, resulting in very high power output.

In fact, this power was so great that a new unit of measurement had to be invented to describe it: the kiloton of TNT equivalent (kt). One kiloton is equivalent to the energy released by a thousand tons of trinitrotoluene, a conventional explosive already common at the time.

Several examples can be taken to try to picture the effects of such energy. In 2017, Donald Trump authorized U.S. forces in Afghanistan to use the most powerful bomb in their conventional arsenal, the Massive Ordnance Air Blast Bomb (MOAB), often referred to as the “*Mother Of All Bombs*”.



A GBU-43/B Massive Ordnance Air Blast Bomb.

This 9-meter-long GBU-43/B type bomb contains around 8 tons of explosives with a power equivalent to 11 tons of TNT, or 0.011 kt – in other words, a ratio of around 1:1000 with *Little Boy* and *Fat Man*. It is so large that it was dropped from a *C-130 Hercules* transport aircraft. Yet it releases only a tiny fraction of the energy of a nuclear weapon.

As a further illustration, the Oklahoma City bombing, carried out in 1995 using a vehicle bomb, killed 168 people and injured 680 others, and was estimated to have a yield of “only” 0.0023 kt (2,300 kilos of TNT).



Damage caused by the Oklahoma City bombing, April 19, 1995.

More recently, the explosion in the port of Beirut on August 4, 2020 caused a shockwave felt over 10 km from the grain silo (center of the explosion), shattering windows at this distance, although most of the damage was localized on the port.¹⁹ Researchers at the University of Sheffield have estimated, from videos and photos of the disaster, that this explosion caused by ammonium nitrate (2,750 tons) was equivalent to around 1,000 to 1,500 tons of TNT – *i.e.* between 1 and 1.5 kt.



Aerial view of damage in the port of Beirut on August 4, 2020.²⁰

19. P. Breteau, “[Compared with other disasters, how powerful was the explosion in Beirut?](#),” *Le Monde* (7 August 2020).

20. A more powerful explosion was the one in Halifax, Canada. Estimated at 2.9 kt, it took place on December 6, 1917, when a Norwegian ship collided with a French cargo ship loaded with munitions. This was the most powerful conventional explosion to date.

These few examples show that it is inconceivable with today's technologies to create conventional weapons whose power could rival that of a nuclear weapon. And even if a state were to possess hundreds or thousands of MOAB-type bombs, it would have to launch them all at the same time and detonate them in the same place simultaneously to achieve power levels comparable to those of a nuclear weapon optimized for its military effects.

In addition, nuclear weapons, which are becoming increasingly powerful and precise, can release energies equivalent to hundreds of kilotons. An even larger unit of measurement, the megaton (Mt, *i.e.* 1,000 kt or the equivalent of one million tons of TNT), is needed to describe the power of these weapons. The French *Canopus* test of August 24, 1968 is said to have reached 2.6 Mt. The record is held by an experimental Russian weapon, the *Tsar Bomba*, which released 57 megatons in 1962, according to American estimates (although it was designed to reach 100 Mt). The bomb was detonated 4,000 meters above its target. The flash of the explosion was visible 1,000 km away, the heat felt 300 km away, and the destruction was total within a radius of 30 km. Such high power levels were achieved using special nuclear weapons known as H-bombs (or hydrogen bombs).

These are based on reactions similar to those occurring inside the sun.

Devastating effects not limited to ground zero

The *Oppenheimer* film not only shed light on the scientific adventure leading up to history's first nuclear test. It also revived the memory of its effects on the environment and human beings in the short, medium and long term.²¹ According to a study published on July 20, 2023 by Princeton University, radiological fallout from *Trinity* would have reached forty-six American states, Canada and Mexico at the time.

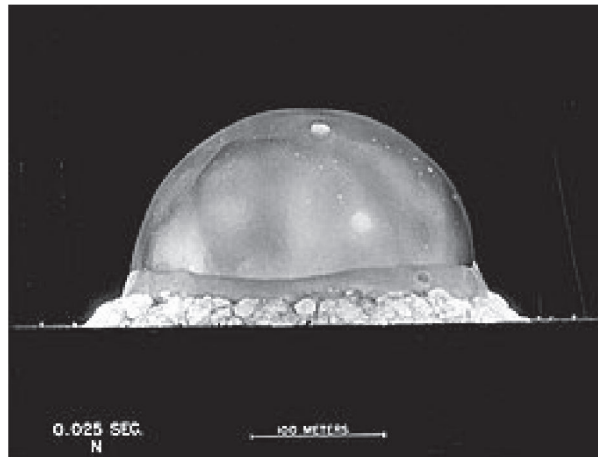


Photo of *Trinity* used by G. I. Taylor to estimate bomb power.

21. L. M. M. Blume, "[Des retombées radioactives jusqu'au Canada](#)," *La Presse* (5 August 2023).

In the absence of sufficient prior experimental data, Oppenheimer's team could not accurately anticipate the power of these weapons. They did, however, foresee that the explosion of a nuclear weapon would generate a blast effect accompanied by an intense flash of light and a lethal heat wave. These effects would extend far beyond the position of the characteristic fireball that gave rise to the famous mushroom cloud.²²

Since then, all nations with nuclear programs have coupled their tests (first atmospheric, then underground) with measures to quantify and control the effects of weapons, in particular the risks associated with radioactive fallout. A nuclear weapon generates a number of direct effects on the environment around the point of detonation, which vary according to conditions. For example, as the Hiroshima and Nagasaki cases show, the configuration of the terrain has a significant influence.

Thermal radiation is one of the most deadly effects, due to the difficulty of protecting against it. The ambient air is then heated to extreme temperatures.

Whatever the power of the weapon, the temperature generated at the heart of the explosion – several thousand degrees – can cause third-degree burns in a matter of seconds to living beings several kilometers away from the center of the blast. People exposed to this intense heat suffer serious, often fatal, injuries instantly. Others die later as a result of their burns. The intensity of the thermal radiation is also the cause of infrastructure fires. At the very heart of the explosion, the fireball is obviously highly destructive, but it is also accompanied by an intense flash of light that can cause partial or total blindness, adding to the long list of casualties. This flash is the first observable effect.



A visitor at the Hiroshima Peace Memorial Museum.

® Carl Court/Getty Images.

22. W. F. Mulley, "What would be the effects of a nuclear war?," *Le Monde diplomatique* (December 1962).

This radiation is also accompanied by a shock wave that spreads rapidly from the point of detonation, generating a devastating overpressure effect, followed by a violent blast in the opposite direction that naturally rebalances the pressure. Overpressure and blast generate severe structural damage several kilometers away from the center of the explosion. Buildings are blown up, windows shattered and debris hurled at high speed, further increasing the damage and the number of casualties.

Temperature and shock effects account for a large proportion of the energy released. Their combination over a distance of several kilometers would be responsible for most of the immediate victims of a nuclear weapon, particularly in densely populated areas.

The nuclear radiation emitted during the explosion and the dreaded radioactive fallout also varies according to the altitude at which the weapon is detonated. Close to the surface, the radioactive material produced by the explosion mixes with the ground.

At higher altitudes, radioactive materials are much less numerous, but more widely dispersed.



Hiroshima after the explosion.

® Maarten Heerlien / Flickr, CC BY-SA²³

23. On July 9, 1962, the American *Starfish Prime* 1.4 Mt nuclear test, carried out at an altitude of around 400 km, generated an electromagnetic pulse whose effects on power lines and equipment were felt up to 1,500 km away. Damage to property was limited, however, as the test area over the Pacific was sparsely populated. The particle streams emitted by the high-altitude explosion did, however, damage or destroy a third of the 24 satellites in orbit at the time.

But a nuclear explosion can also damage or destroy electronic and electrical systems over vast areas, both through the nuclear radiation emitted and through the generation of an electromagnetic pulse. The operation of communications, power grids, satellites, vehicles and critical infrastructures would be severely disrupted.

All these effects have been widely documented since the first test on July 16, 1945, and the atomic bomb explosions in Hiroshima and Nagasaki.²⁴ More than 2,400 nuclear tests in all, including 543 atmospheric tests, have enriched the knowledge held by the USA, Russia, Great Britain, France and China, to mention only these five countries.

The effects of nuclear weapons continue to be studied theoretically, particularly outside military circles, to estimate the response capabilities that a nation or the international community could provide in the event of a nuclear strike or terrorist attack. This is the case, for example, of a study by American researchers and published in May 2023. Using a set of simulation tools, they modeled the results of a purely theoretical nuclear exchange between Iran (which today would not have nuclear weapons) and Israel (which still maintains ambiguity about its possession of a nuclear arsenal). They have taken into account as many parameters as possible: type, yield and power of weapons, single or multiple explosions, population densities, types of construction, topology of the environment, meteorology and even seasons (the population may be outdoors or indoors).²⁵

Estimating that the energy of a weapon is divided between the thermal effect (30-50%), shock and associated winds (40-60%), radiation (5%) and fallout (5-10%), the study arrives at the theoretical loss results presented in the table below.

24. "Atmospheric nuclear testing," *Institut de radioprotection et de sûreté nucléaire*.

25. C. E. Dallas, W. C. Bell, F. Burkle, D. J. Stewart, A. Caruso, "Nuclear war between Israel and Iran: lethality beyond the pale," *Conflict and Health*, vol. 7, n° 10 (10 May 2013).

Table 4: Total casualties for all scenarios

Scenario/City	Weapon yield (kt)	Estimated population*	Total* fatalities	Total* injuries
Israeli Cities				
Beer Sheva	15	206,770	105,510	35,090
Haifa	15	323,390	69,420	50,400
Tel Aviv (double strike)	Dual 15	1,372,440	229,330	147,340
Iranian SingleStrike cities				
Arak	250	424,270	387,600	32,240
Ardabil	500	456,500	428,120	22,240
Hamadan	250	386,130	362,400	35,250
Karaj	15	1,125,360	157,960	130,960
Karaj	50	1,125,360	325,860	199,270
Karaj	100	1,125,360	506,030	219,070
Karaj	250	1,125,360	744,100	210,460
Karaj	500	1,125,360	891,190	164,770
Kerman	500	560,320	510,850	36,110
Qazvin	100	460,250	423,200	38,190
Rasht	500	503,140	482,940	46,450
Reza Iyeh	500	582,820	545,450	44,170
Yazd	250	435,120	326,610	48,930
Zahedan	500	602,530	578,950	23,330
Iranian Multiple-Strike cities	Yield/Number of weapons			
Ahvaz	500+250	1,050,530	852,140	74,330
Bandar Abbas	100x3	467,510	438,240	22,160
Esfahan	500x2	1,836,920	1,510,050	199,640
Kermanshah	250x3	751,710	718,480	33,020
Mashad	500x3	2,242,760	2,178,020	59,250
Shiraz	500x2	1,227,320	1,037,170	133,190
Tabriz	500x2	1,264,550	1,220,250	73,760
Tehran	100x5	8,317,080	3,615,350	1,622,360
Tehran	250x5	8,317,080	5,594,200	1,577,220
Tehran	500x5	8,317,080	7,127,300	791,060

Total casualties plus uninjured do not equal estimated population, as direct blast effects and fallout plumes typically extend beyond the areas of highest population density and may include other communities.

Theoretical results of a nuclear exchange between Iran and Israel, according to a study published in *Conflict and Health*.

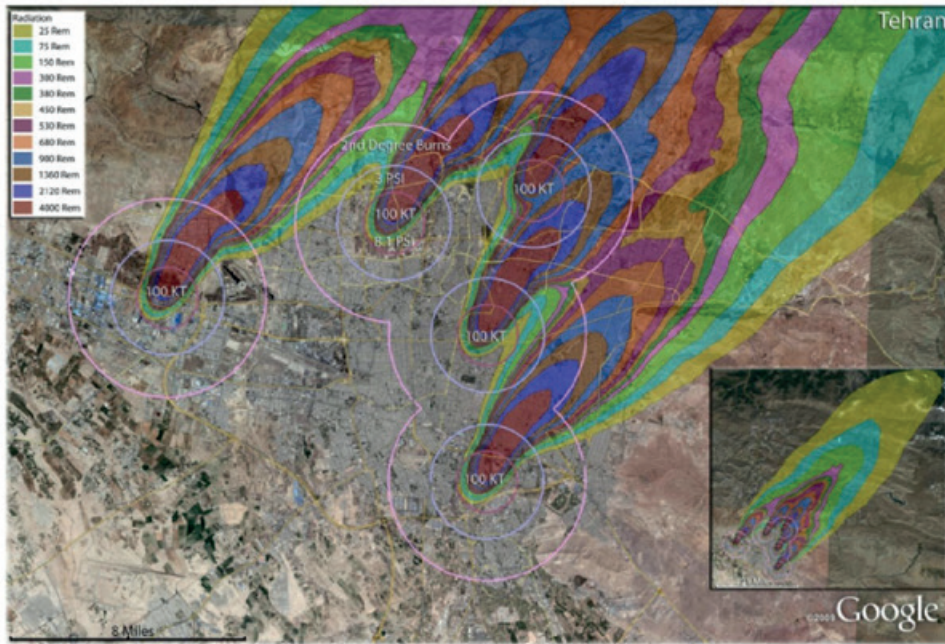


Figure 20 Multiple detonation casualties for five 100 Kt nuclear weapons for Tehran, Iran. Rings display trauma casualties for 8.1 and 3.0 psi, and 2nd degree burns. Radiation exposures are delineated by color in the dispersion plume.

Simulation example²⁶ from the study published in *Conflict and Health*.

Beyond the direct effects previously mentioned, one or more nuclear explosions in the same country would have indirect repercussions that would be difficult to fully predict today, and which would not be comparable with those of the two explosions in Japan in 1945. Indeed, with populations increasingly concentrated in cities (up to 43,000 inhabitants per km in Manila or 20,000 in Paris), the number of deaths, both immediate and delayed, could be much higher than in 1945.

But concentration does not involve only human beings. It also concerns the tools that contribute to the life of a country: governmental, financial, economic, cultural and industrial bodies, *etc.* The same logic applies to telecommunications hubs or energy infrastructures. The social and economic disruption that would probably follow for years after nuclear strikes on a country's main cities could undoubtedly lead to its partial or total collapse, without even requiring numerous explosions.

The most advanced medical services are also often grouped together in large cities. If they are hit, as are part of the healthcare infrastructure,²⁷ the chances of survival for the seriously injured would be drastically reduced, further increasing the

26. This study considers different levels of overpressure, resulting from explosions, with all the effects of a shock wave (collapse of structures, projection of debris, *etc.*). Ratios of injuries and fatalities correspond to these levels.

27. C. Dallas, "Let's not forget what a nuclear war would actually mean," *Asia Times* (15 August 2023).

number of victims.²⁸ This tragic situation is exacerbated by the fact that there is no international response capability to assist a country in such a situation. This was the case in Hiroshima, where the health services, concentrated in the city, were hard hit and unable to provide rapid assistance to the injured (polytrauma victims, severely burned or irradiated). What's more, only a very small proportion of medical staff are trained and able to intervene in such extreme situations, adding to the toll of indirect consequences of such explosions.

Finally, the effects in terms of radioactive pollution, on both nature and people, would exacerbate these social and economic disruptions. Deaths could occur months or even years after the explosion of nuclear weapons. The initial death toll in Hiroshima and Nagasaki almost doubled over the following five years, reaching an estimated total of 300,000.

Faced with this risk, population movements out of the contaminated zones are likely, adding to the general chaos. The affected country could find it extremely difficult to handle such internal migration if its main centers of economic, political or military power were to be destroyed.

Nuclear weapons have left an everlasting mark on humanity, starting with the only two operational explosions at Hiroshima and Nagasaki. Their capabilities have subsequently been progressively enhanced to create ever more powerful and precise weapons. The tests carried out, particularly in above-ground testing, have demonstrated the increase in their destructive power, which has no temporal or spatial limits. This power can extend over years, and some nuclear missiles have an intercontinental range the explosion from which could not be contained locally.

From scientific object to strategic doctrine

It is this incomparable power that makes nuclear weapons a different kind of weapon, one on which various deterrent strategies have been built. What all these strategies have in common is their reliance on the threat to use this destructive force, underlining its willingness and ability to inflict “*unacceptable damage*” or “*massive retaliation*” – depending on the vocabulary used.

In his February 19, 2015 speech at Istres, France, President Hollande chose to illustrate this strategy in different terms, even if the message remains the same: “*Nuclear deterrence aims to protect our country from any state-sponsored aggression against its vital interests, wherever it comes from, and whatever form it takes. Let me add that for France, nuclear weapons are not intended to gain any advantage in a conflict. Because of the devastating effects of nuclear weapons, they have no place in an offensive strategy, and are only conceived as part of a defensive strategy.*”

Previously, the existence of nuclear threat had attracted the attention of many French strategists during the 20th century. One of the first to comment on the doctrinal consequences of Hiroshima and Nagasaki was Admiral Raoul Castex (1878-

28. “[Nuclear weapons](#),” *International Committee of the Red Cross*.

1968).²⁹ Barely two months after the explosions, he asserted that “*the weak nation, just as much as the strong nation, will possess atomic bombs, in lesser quantities perhaps, but this consideration of numbers weighs little when it comes to devices of such great individual power.*”

A few years later, airman Pierre Marie Gallois, then a colonel in the French Air Force, made a significant contribution to the development of the French deterrence doctrine, publishing *Stratégie de l'âge nucléaire* (Strategy for the Nuclear Age) in 1960. In particular, he argued that the atom creates a new military hierarchy between nations, namely “*those who protect themselves by nuclear means and those who do not.*” He also declared that the decision to use nuclear weapons, which involved the survival of the nation, could only be taken in the supreme interest, and must remain absolutely national.

While we cannot mention all of them, in particular Generals Beaufre, Poirier and Ailleret, it is worth noting that thinkers from all three services (Army, Navy and Air Force) were working very early on in developing the French nuclear deterrence doctrine. It is characterized by the use of specific vocabulary and grammar that continue to determine France's singular stance in this area: use in defense, vital interests, credibility – political, technological and operational –, national independence, strict sufficiency, permanence and unacceptable damage. These precise terms structure all presidential speeches on deterrence.

In 2001, speaking at the *Institut des Hautes Études de Défense Nationale*, J. Chirac asserted that “*if they had hostile intentions towards us, the leaders of these states must know that they would be exposing themselves to damage that would be absolutely unacceptable to them.*” N. Sarkozy echoed the same idea in Cherbourg in 2008: “*All those who threaten to attack our vital interests will expose themselves to a severe response from France, resulting in unacceptable damage for them, out of proportion with their objectives.*”

F. Hollande did the same at Istres in 2015: “*Our nuclear forces must be capable of inflicting absolutely unacceptable damage on the adversary.*” President E. Macron finally confirmed the words of his predecessors, reminding at the *École Militaire* in 2020 that “*if, by any chance, a State leader were to underestimate France's visceral attachment to its freedom and consider attacking our vital interests, whatever they may be, he must know that our nuclear forces are capable of inflicting absolutely unacceptable damage on his centers of power, i.e. on his political, economic and military nerve centers.*”

29. R. Castex, “Aperçus sur la bombe atomique,” *Revue de défense nationale* (10/1945).

Conclusion

Nuclear deterrence has protected us from any existential threat for 60 years, and more broadly has helped to avoid a major direct confrontation between nuclear-armed powers.

While it is impossible to determine just how many bombs, shells and munitions of all types have been fired since the Second World War, it is clear that only two nuclear bombs have been used to date – on August 6 and 9, 1945 – because of their very special nature.

The threat of unacceptable damage – sometimes referred to as the “*balance of terror*,” as part of the deterrence dialogue between two states with comparable arsenals – may not therefore be the most reassuring option for some, when one imagines the potential damage that would be inflicted. But it has proved its effectiveness to date. Having credible nuclear forces is undoubtedly a vital resource in an increasingly conflict-ridden world.

An ever-so-sharp blade:

60 years of airborne nuclear deterrence

Jean-Patrice Le Saint

Brigadier-General Le Saint is the Chief of Staff of the Strategic Air Forces. A navigator by trade, he headed the SPA 102 “Soleil de Rhodes” escadrille of 2/3 “Champagne” FS, then 1/4 “Dauphiné” FS and Luxeuil Air Force Base. He served in the Air Staff, as the speechwriter to the Chief of Defense, as an exchange officer in the U.S. Air Force Chief of Staff Strategic Studies Group (Pentagon) and in the General Directorate for International Relations and Strategy.

“Should France have a sword, it has to be her own.”
(Charles de Gaulle¹)

On October 8, 1964, the *Mirage IV* of the “*Gascogne*” Bombing Squadron are put on nuclear alert on Mont-de-Marsan Air Base (AB), just over four years after the first detonation of a French nuclear weapon in Reggane, Western Sahara. On October 8, 2024, the *Rafale* succeeded the *Mirage 2000N* that had replaced the first-generation bomber aircraft. And the “*Gascogne*” Bombing Squadron remains on alert, ready to carry out the mission ordered by the President of the Republic.

It is clear that there has been a major shift in the geostrategic context since the first alert of the Strategic Air Forces (*Forces aériennes stratégiques* – FAS), but the aims of the nuclear deterrence mission remain unchanged: protecting our vital interests against any state threat, whoever it may come from and whatever it may be, securing our freedom of assessment and decision *vis-à-vis* any blackmail threat, and contribute to the defense of Europe. In this regard, France has never let her guard down. To date, it is still a fully sovereign military nuclear power, whose technical and operational expertise secures a top-notch level of credibility for its forces. The sixtieth FAS anniversary is an opportunity to restate it, by emphasizing their key role in this essential task, backbone of our defense and security strategy.

The epitomizing word of these first 60 years of FAS existence is consistency. A consistency forged by all the civilian and military stakeholders, which is referred to as the common effort. Policy consistency, in the driving force behind all the presidents of the 5th Republic, in a rhetoric invariably adapted to the strategic environment, and the coherence between the doctrine and the capabilities selected to embody it.

1. Excerpt from the 21 October 1950 speech during the Rally of the French People (RPF) National Council meeting in the *Vélodrome d'Hiver*, Paris.

Technical consistency also, as an ongoing endeavor to design, deploy and sustain the capability, a vital steadiness in support of the production time, the complexity and lifespan of the programs.

Operational consistency, ultimately, in the alignment of the organization, procedures and operational readiness with the goals and constraints relevant to the mission. As we will see, the FAS are fit for their primary mission, they are organized to ensure its effectiveness and, subsequently, always more versatile and congruent with the pace of the military operations.

A continuously sharp blade based on the principle of strict sufficiency

In sixty years, the rationale behind the FAS has never changed: building confidence in France's ability to cause irrevocable damage to any state threat posed to its vital interests and being able to do so in a timely fashion, by order of the President of the Republic. The FAS' assets and courses of action (COAs) have however evolved steadily over time. The changing international circumstances and threats, technical progress, the upgrading of our nuclear forces and the doctrinal shifts stemming from it or requiring it have led to practical effects on the FAS in the field of intelligence, planning, equipment, operational readiness and implementation.



Mirage IV crew alert take-off.

Only three years after the *Mirage IV* was introduced into service, the development of the Soviet missiles and interceptor aircraft in the 1960s forced the high-altitude Mach-2 bombers into a very low-altitude flight course while carrying a weapon slightly adapted to these new flight conditions. The entry into service of the 1st Strategic Missile Group's (*Groupeement de missiles stratégiques* – GMS) firing unit on the Albion Plateau in 1971, and of the first nuclear ballistic missile submarines (SSBN) in 1972, completes the French nuclear triad and allows adapting the *Mirage IV*'s response timeliness. In 1988, the introduction of the *Mirage 2000N* results in the replacement of 5 *Jaguar A* and *Mirage III E* squadrons that had been ensuring tactical nuclear missions since the mid-1970s by three *Mirage 2000N* squadrons.

The end of the Cold War marks the break-up of the existential threat that had deeply influenced our nuclear triad's build-up. The fading prospect of a sizeable military confrontation in the heart of Europe and the widely perceived opportunity to enjoy "peace dividends" led us to reassess our posture and withdraw from "tactical" nuclear. In 1991, the *Mirage 2000N* thereupon took on the strategic nuclear mission with their integration into the FAS as their second-generation carriers. In 1996, the *Mirage IV* relinquishes the nuclear mission with the dismantling of the Albion Plateau. The latest significant change, disclosed in the 2008 *White Paper*, pertains to the development of the FAS towards their current format that no longer comprises three, but two combat squadrons designed to accommodate the *Rafale*, a third generation carrier.

As part of a strict sufficiency approach, namely tailoring our arsenal to the assessment of the geostrategic context and the evolution of the enemy defenses in a bid to ensure our ability to cause irrevocable damage, this curtailment was offset by the continuous enhancement of the FAS' overall performance. The range, precision and ability of the ASMPA² to avoid threats are no match for the obsolete AN-11 bomb. This missile, which no longer requires target overflight or proximity firing, offers a range of several hundred kilometers enabling the targeting of command centers by foiling the most advanced threats. The *Mirage 2000N* weapon system is significantly more intelligent and reliable than that of the *Mirage IV*. The one used by the *Rafale* allows for outstanding penetration readiness and self-defense capability in the conduct of the nuclear raid. With the introduction of the *Airbus A330 MRTT Phénix* that supersedes the *Boeing KC-135*, the potential reach of a raid was also significantly boosted: carrying out missions twice longer than the ones considered at the time of the *Mirage IV/KC-135* duo is now commonplace.

Unique assets specific to air power

Since the relinquishment of its surface-to-surface ballistic nuclear capability in 1996, France has often reiterated the option to entrust its deterrence strategy to two components. Two substantially different types of penetration methods identify the latter: air-breathing for the Airborne Nuclear Component (*Composante nucléaire aéroportée* – CNA), and ballistic for the Seaborne Nuclear Component (*Compo-*

2. Improved medium-range air-to-surface missile.

sante nucléaire océanique – CNO). It is a matter of featuring a wide enough range of COAs and reducing the impact of a technical circumvention of either of them. In other words, it is crucial not to “*put all our eggs in one basket*.”

France’s FAS and Strategic Oceanic Force (*Force océanique stratégique* – FOST) supplement each other and are nonhierarchical in form. They are both capable of responding to all possible scenarios, from nuclear warning³ to larger-scale strikes. Additionally, they both have common features such as permanent availability, reliability and resilience.

The permanence of the FAS arises from the “combat-readiness pact”, which ensures that they are able to build up on a timely basis as set out by the President and penetrate enemy territory to strike the targets specified by him. This pact is relentlessly maintained by the Operational Center for Strategic Air Forces (*Centre d’opérations des Forces aériennes stratégiques* – COFAS), monitoring in real time the positioning and readiness of the FAS’ assets wherever they may be, in France or abroad, whether they are conducting training, drills or operations. The COFAS may thus order their return to their bases, their redeployment or repair in a preemptive fashion so that the combat-readiness pact is never broken, or even jeopardized.

The reliability of the FAS relates to their unremitting operational training efforts in real world conditions. The training scenarios recreate realistic situations that are constantly reassessed, the training procedures in peacetime are identical in every aspect to those of actual commitment, and the personnel is conditioned by handling highly sensitive military hardware, including nuclear weapons, whose implementation is to be brought under firm control.

Ultimately, their resilience can be ascribed to several factors: the redundancy of the command structures and the transmissions, the ability of the forces to spread out when ramping up, the ruggedization of the infrastructure and their protection against any foreseeable threats, ranging from the most limited (intrusion) to the most severe threats (massive aggression in CBRN environment⁴).

The FAS can however rely on innate strengths involving lightning speed, responsiveness and the flexibility of use of air power. Four of them have not wavered in the slightest since their first alert.

First and foremost, the FAS operate from air bases, whose activity can be inherently identified. This allows translating into reality the different stages of their build-up in the opponent’s mind, hence giving credence to the deterrent engagement of the political authorities. As a fixed infrastructure, the air base can also act as a “picket goat”, a role once entrusted to the Albion Plateau by President Mitterrand: any attack targeting it unambiguously reflects the intent of the attacker.

Then, the FAS provide a comprehensive scale of COAs, enabling the President of the Republic to adjust his deterrent engagement. Several steps comprised between

3. Strike intended to mark the line of our vital interests and, in so doing, re-establish deterrence.

4. Chemical, Biological, Radiological and Nuclear.

putting training at a standstill and launching a raid may lead the adversary to reconsider their plan.

Moreover, they also provide a wide array of options to the Chief of Defense (CHOD) for the possible preparation of commitment plans and operational directives, as the airborne nuclear raid primarily remains an air maneuver whose design, on very short notice if need be, is tailored to the tactical situation at hand.

Finally, they show considerable reversibility, for each of the build-up landmarks can be immediately interrupted. It is even possible to launch a raid towards its targets and call it home, insofar as the crew members have not received the president's order to carry out their task.⁵ The range of the modern communication systems enables retaining this possibility even hours after the raid took off. The associated political stake is undeniable.

The current generation of the FAS' weapon systems also features three additional assets. The first one lies in the performance of the ASMPA missile. Delivered several hundred kilometers away from its target with various possible trajectories, it is highly supersonic and maneuverable, thus hard to intercept. Besides, its world-class precision testifies our ability to strike the opposing centers of power. As a second asset, the *Rafale*, an omnirole fighter aircraft boasting a formidable air-to-air capability and an all-weather very low-altitude penetration capability, can hold off air threats more than a hundred kilometers away while slipping past the enemy surface-to-air systems. Its third asset, the MRTT, provides the *Rafale* and its ASMPA missile with a reach dwarfing that of the previous *Boeing C-135* while remaining ahead of the pack in the area of communications and operations command.

This way, the nuclear raid's reach, penetration, resilience and precision are unprecedented in the history of the FAS. This tanker/fighter-bomber/nuclear weapon triptych is all the more outstanding for our force model in that it builds upon valuable dual capabilities. The *Rafale* and the MRTT are fully committed to the whole conventional missions of the French Air and Space Force (FASF). The technical features of the strategic nuclear force are now limited to the nuclear-based capabilities and their specific implementation environment. The FAS are remarkably efficient.

Thus, the complementarity of the two permanent French components fights on all fronts. At the strategic level, there exist "*the one that can be seen, and the one that cannot*," to quote the words of President François Hollande.⁶ This visibility – the one that can be seen, displaying itself – not just lends credibility to the FAS, but to the whole nuclear forces. It also helps demonstrate the FASF's conventional capabilities, just as the commitment of the FAS to the conventional missions contributes towards their credibility in their nuclear endeavor. Everything is connected. At the

5. Upon receipt of the president's order, the mission is to be completed, it can no longer be interrupted.

6. "[President François Hollande's statement on nuclear deterrence in Istres, on 19 FEB 2015](#)," *Discours, Vie publique* (19 February 2015). However, this overview ought to be qualified. The one component *that can be seen* may also operate with stealth, and the one *that cannot* is capable of doing the opposite.

operational level, the military effects yielded by the FAS and the FOST complement each other. At the technological level, the combination of two distinct penetration methods buffers the adverse consequences of a technological breakthrough in the field of detection (SSBN) and missile interception (M51 and ASMPA), or of a failure of either component. It also forces the enemy into a balancing act, as the features of the air-breathing and ballistic missiles are so different that the development of relevant antimissile systems poses a technological and financial challenge that only a few countries – if any – can address.

An efficiency-oriented organization governed by the mission

The credibility of the nuclear mission hinges on four key requirements: government control, ensuring the President of the Republic that he and he alone has access, at all times, to the means necessary to the mission; nuclear safety and security, to ensure control of the nuclear activities; and permanent presence and responsiveness, as prerequisites for carrying out a commitment order of the nuclear forces.

The prime minister is held responsible by the President of the Republic for government control, which relies on an efficient structure and the implementation of measures providing assurance to the president that: he and he alone, at any time, can deploy the nuclear forces; the posture of the nuclear forces is compliant to the presidential guidelines; and that the deterrents, including the fissile materials, are unimpaired and safe against acts of malevolence, hostile acts, or any threat to national defense secrets.

Overseen by the Nuclear Weapons Inspector (*Inspecteur des armements nucléaires* – IAN), the commanding officer ensuring conformity of the procedures and their efficient implementation, government control is based on a distinction between the implementation chain and the safety chain. While implementation falls under the armed forces, namely the FASF for the FAS, safety is partly provided by the Nuclear Weapons Security Gendarmerie (*Gendarmerie de la sécurité des armements nucléaires* – GSAN), a special gendarmerie unit created simultaneously with the FAS in 1964 and responsible to the French Ministry for Armed Forces. GSAN detachments operate in all the operational facilities of the FAS and are involved in the whole spectrum of their sensitive activities in a fully independent fashion.

Nuclear safety and security, which are not so different from the civil norms in that field, guarantee practices enabling realistic operational air training on a daily basis while mitigating risks. They encompass four areas, for which the Strategic Air Forces Command (*Commandement des Forces aériennes stratégiques* – CFAS) and the FASF report to the French Defense Nuclear Safety Authority (*Autorité de sûreté nucléaire défense* – ASND): nuclear safety and security, preventing and combating malevolent acts, radioprotection and civil defense activities in the event of accidents. Near-actual commitment conditions are vitally important for a mission involving nothing less than a hundred percent success rate. Against this backdrop, staff qualifications and ramp-ups lead to the handling of real weapons. This is how staff is prepared

and gets into condition, performing the same procedures as those of the mission that may otherwise be seen as abstract. It does so by learning how to control natural apprehension safely with a view to securing the acceptability of nuclear activities in a sustainable way, whether towards the political authorities or our fellow citizens. Together with government control, nuclear safety and security are pivotal in deterrence credibility. They require a stringent framework aiming to reduce the risk as close as possible to a nil rate by combining security requirements and operational credibility. Out of that absolute discipline and within these coordinates comes a well-known principle strongly associated with the FAS: *what is not specified is prohibited*.

Unfailingly meeting his responsibilities under government control and nuclear safety and security, ensuring the continuance of the posture and the build-up within statutory time frames imply the necessity for the Officer General Commanding the Strategic Air Forces (*Général commandant les Forces aériennes stratégiques* – GC-FAS) to own the fullest requisite capacity to the mission. His responsibilities are both operational and organic to ensure his ability to carry out the mission fully, from situational assessment to Lessons Learned (LL) through operational training, mission planning and command.

As the operation commander, the GCFAS, overseeing a nuclear force, ensures the operational command (OPCON) of the assets to be committed to a mission. He reports to the CHOD for the maintenance of the FAS' posture and the monitoring of their mission implementation. To this end, he can rely on a Brigade of Operations (*Brigade des opérations* – BOPS) supported by its operations centers in Taverny (primary COFAS) and Lyon-Mont-Verdun (auxiliary COFAS). This brigade brings together the appropriate skills for situational assessment, nuclear planning and the conduct of the Airborne Nuclear Component-led operations. The introduction of the MRTT *Phénix*, and the fact that the FAS are wholly accountable for strategic air transport, enabled the creation of a division in charge of coordinating the commitment and the employment of these assets along with the domestic and international joint bodies likely to turn to them.

As the commander-in-chief of the FAS, the GCFAS reports to the Chief of the French Air and Space Force for the operational readiness of the FAS. He undertakes this responsibility with the aid of an Activity-Support Brigade (*Brigade de soutien à l'activité* – BSA). Coordinating with all other major FASF's commands and directorates, along with several joint bodies, this brigade ensures that the resources provided to the FAS are consistently kept in line with their missions. It develops the standards pertaining to capability employment and support while managing personnel training, whether technical or operational. It also contributes to the use of the ASMPA according to nuclear safety standards and to development activities related to future readiness together with the French General Staff, Defense Procurement Agency and various joint directorates overseeing infrastructure and information systems. Established on Villacoublay AB, the BSA is to be integrated into the BOPS in Taverny alongside the GCFAS in June 2024. The collation of these two Air Staff mainstays will facilitate the command of the FAS and provide the latter with greater outside clarity. Its overall consistency will be further improved.

Aside from the Air Staff and operations centers, three nuclear air bases (*Base aérienne à vocation nucléaire* – BAVN) harbor the FAS’ operational assets. Forming part of the command, implementation and security chains, the BAVN are fitted with specific facilities entitling them to engage in nuclear buildup: buried command posts, quick reaction alert (QRA) areas, nuclear weapon storage sites, communications, as well as enhanced protection and defense assets to face any type of threat. They notably accommodate surface-to-air defense squadrons (*Crotale-NG* and *Mamba* systems) and considerable Counter-Unmanned Aircraft Systems (C-UAS) capabilities. Dedicated infrastructure and communications, meshed and redundant, are fully integrated components of the overall weapon system in the same way as the weapon and its delivery vehicle, the bomber fighter carrying it, and the tanker providing the latter with the required reach.

Saint-Dizier AB (Haute-Marne) is the home base of the whole FAS’ fighter bombers, where two combat squadrons supported by an aeronautical technical squadron are established. Istres AB (Bouches-du-Rhône) is that of the air refueling and strategic transport squadrons and their maintenance units providing for the build-up of the *Phénix*. With time and upon removal of the remaining *KC-135*, it is to accommodate 15 MRTTs. Finally, Avord AB (Cher) comprises more specific capabilities to support all our nuclear forces.

With the location of *Rafale B* and tankers on two dedicated sites, peacetime organization reflects the rationalization approach of capability employment and support at the operational, technical and logistical levels. However, upon acknowledgment of the build-up order, which attests to the FAS’ change of stage, the assets are deployed on the bases allocated to them. As nuclear air bases, Saint-Dizier, Istres and Avord are capable of housing *Rafale*, weaponizing them and taking nuclear alert, constantly interacting with their mandating authorities. Nevertheless, there are other bases assisting in accommodating the FAS’ aircraft and contributing towards build-up of the conventional assets meant to support the raid. This dilution is instrumental in the resilience of the layout, without weakening its overall consistency.

Whether they serve in the Staff, the operations centers or the BAVN, the 2,200 FAS aviators operate within a compact and clear organization, structured around the mission requirements. Another consequence of the permanence and responsiveness obligations, the top down command method of a “human-size” apparatus promotes the immediate transmission of orders and reports while bolstering staff compliance to the mission. Being aware of serving an existential mission for the Nation is a widespread point of pride.

A well-developed and established expertise, battle-hardened forces

The conduct of the nuclear mission entails the implementation of a wide range of skills involving a particularly high level of qualification and readiness. The operational credibility of the entire FAS staff is at stake: there can be no doubt that it is capable of maintaining the combat-readiness pact no matter the circumstances,

namely building-up in a timely fashion, and firing nuclear weapons to produce the effects called for by the President of the Republic.

This credibility is reflected daily, at all the command and execution levels, through realistic training comprising all or part of the capabilities needed for the mission. These capabilities encompass all the know-how, from situational assessment to firing practice along with mission planning, weaponry operation, readiness, order and report issuance, *etc.* Relentless LL allows drawing experience and ensuring its integration.

Seventy dedicated drills and operations are hence carried out throughout the year, but expertise is put to the test and assessed every day. Most of these activities transpire with minimal publicity out of the units' operations centers, QRA and "restricted areas", though some of them are purposely visible due to the necessity to assert credibility through show of force. This applies to extended and complex missions called Firing Force Assessments (*Tir d'évaluation des forces* – TEF). They comprise several in-flight refueling operations and penetrative missions in a simulated hostile territory ending with an ASMPA live-fire exercise – without any nuclear warhead – in the Atlantic, in close cooperation with the test centers located in the French Landes. More than twenty firing tests and assessments have thus been conducted since this missile was brought into service, all successfully: the control of the expertise chain is self-evident, whether for our potential adversaries or our allies and strategic partners.

This expertise is most notably represented during iconic Operation *Poker*, hallmark of our national Airborne Nuclear Component: France is the sole nuclear power in the world to conduct exercises at such a large scale, with such frequency (at least four drills a year).

As it would on D-day, *Poker* raid is the culmination of the FAS' ramp-up, enabling to confirm the full spectrum of their capabilities, from the presidential build-up directive to the aircraft takeoff. Twice a year, this build-up comes into play with actual weapons, all the way to the crews being put on alert with armed aircraft. At the conclusion of this ground stage, which puts the whole command and implementation chains to the test (responsiveness assessment with various occurrences), the weapons are removed and the raid takes off, which also confirms the quality of aircraft readying.

Upon receipt of the take-off order, fighter-bombers, tankers, escort fighters and AWACS depart from their bases across the national territory and fly to Brittany, where they gather in holding patterns, fuel-staging areas located in "friendly territory". The deployment arrays before heading to the enemy territory mock-up while keeping close to our Atlantic coastline then to the Pyrenees towards Corsica. Thereupon, it crosses "allied" or "neutral" airspace, exposing itself to the curiosity, and even aggressiveness, of interceptors and other anti-aircraft systems. Near the end of their transit and after performing several in-flight refueling, the fighter bombers split up from their tankers, soon ready to operate at very low altitude and very high speed.

They fly towards the Massif Central and their weapon release point, which they are to reach despite an extraordinary dense air-to-air and surface-to-air opposition. After launch, the fighter bombers leave the “enemy” territory to join their tankers before returning to their home bases.

As a night-time mission,⁷ *Poker* is deemed “equivalent” since it reflects the real mission in its phasing (take-off, transit, penetration, release and return), its profile (hi-lo-hi) and scenario (very high intensity threat). Besides, a variety of occurrences can be added from the COFAS where the GCFAS oversees the maneuver and manages the forces’ operational readiness. After switching to the *Rafale*/MRTT duo, *Poker* is however no longer truly indicative of the strength of a raid in terms of duration. The possibility for longer flights is now established, as shown repeatedly with non-stop flights to strongpoints located in the other hemisphere.

“*Poker is the war of the French Air and Space Force as a whole,*” as the saying goes, is more than a tagline. The operation commits over forty aircraft, whether they belong to the FAS, support the raid or act as opponents, both in the air or on the ground for that matter, due to the standard deployment of anti-aircraft systems. It also involves the FASF’s space capabilities, its entire air control and simulation assets, and all its airfields available, not to mention those pertaining to Search and Rescue (SAR), or the joint directorates and support services and the complete involvement of their personnel.

The *Rafale M* of the Nuclear Naval Air Force (*Force aérienne nucléaire – FANu*) are sometimes comprised in *Poker* to test their nuclear capability from Aircraft carrier FS *Charles de Gaulle*. The Air and Navy assets either gather in Brittany, where the *Rafale M* join the tankers and fighters “train”, or just before crossing the enemy line when they directly join them from the aircraft carrier. In any case, Air and Navy *Rafale* simultaneously cross the lines to reduce the amount of time spent in hostile territory and make it more difficult for the defenses. This is referred to as “combined” raid, for the GCFAS becomes the Navy *Rafale*’s operation commander upon take-off.

Each *Poker* edition entails specific aims in a bid to train our crews to face any given hostile environment, including CBRN and Cyber. In any event, *Poker* is invariably a show a force, a “tactical testing ground” whose secondary concern is to harden and qualify FAS personnel to sustain a crew contract pool empowered with nuclear readiness. *Poker* also embodies an exercise where these crews can witness the efficiency of the chain of command, the procedures that they learn daily and that of asset implementation. Thus, they maintain confidence in their

7. With a view, from a tactical perspective, to fully drawing on the raid’s stealth, but also for practical purposes. The amount of air assets secured for Operation *Poker* is sizeable, and the arrangements with the French Civil Aviation Authority (*Direction générale de l’aviation civile – DGAC*) require many months’ notice in an effort to coordinate the flight paths of the raid with the other users of our airspace as far ahead of time as possible. *Poker* however transpired once as a day-time operation, in May 2020, during the COVID-19 lockdown. The meaning was clear: the FAS will perform at all times, including in extreme environments.

weapon system and their ability to perform the mission. Internally, *Poker* adds to the credibility of our capability.

A driving force for the entire French Air and Space Force

Four elements underpin a nuclear deterrence policy: rhetoric, posture, high-readiness forces and both the technical and operational reliability of the system overall. The FAS lend credibility to all of them. Achieving such performance is the result of the sizeable commitment of the FASF over the past sixty years, but its endeavor has been beneficial to all its components, from a cultural, technical and operational standpoint.

As with the establishment of the air defense command,⁸ the FAS helped develop the FASF's cultivation of alert, considering that the response timeliness expected from the air bases called for permanent monitoring and command capabilities, in addition to intervening within moments. Building up also required anticipation in the understanding of the threat, coupled to the ability to plan with strong time constraints as well as an extremely high level of readiness among the forces. The FAS mindset, characterized by a stringent procedural implementation, has expanded to other areas, including flight safety.

Furthermore, the strike force's delivery vehicles have catalyzed countless technological developments applied to other weapon systems. The *Mirage IV* was the first French air-to-air refuellable combat aircraft featuring Inertial Navigation Systems (INS) and Electronic Counter Measures (ECM). These capabilities then became in standard use throughout the whole combat fleets, and even in tactical transport. The ASMP was the first cruise missile operated by the French Air Force, paving the way for APACHE⁹ then SCALP¹⁰.

From an operational standpoint, in-flight refueling of conventional *F-100* fighters in the late 1960s enabled French Air Force deployments to its areas of interest in Africa, swiftly and without any stop over. Since Operation *Lamantin* (Mauritania, 1977), the tanker has not only been used for combat aircraft escorting. It is fully integrated into their maneuver, increasing their reach or endurance, at the very heart of the action. The *Boeing C-135*, procured within the FAS to allow the *Mirage IV* to reach their targets, extended the range of the FASF's aircraft, reshaping the rationale behind force and power projection by turning it into a highly coveted tool for the political authorities.

The need to penetrate particularly hostile positions day and night, in all weather conditions, led to the development of systems and techniques for very low-altitude blind flight. The basic – though effective – *Mirage IV* system was replaced by that of

8. Formerly in charge of domestic air defense before the Air-Defense and Air Operations Command (*Commandement de la défense aérienne et des opérations aériennes* – CDAOA) took over, this command body was established by decree on June 10, 1961.

9. *Arme propulsée à charges éjectables*. It is a cruise missile delivered by the *Mirage 2000 D* and containing 10 antirunway sub-munitions in its central section.

10. *Système de croisière autonome à longue portée*. It is an APACHE variant with conventional payload first launched by the *Mirage 2000 D* then the *Rafale*.

the *Mirage 2000N*, a deeply reliable automatic Terrain Following (TF) system, took up and refined on the conventional *Mirage 2000 D*. Nowadays, every single- and two-seat *Rafale* is fitted with this capability.



KC-135 and Mirage 2000N.

Finally, because the mission of FAS requires it, high intensity combat has always been a priority for the FASF. When external operations involved the FASF in asymmetric conflicts characterized by a low air-to-air threat, FAS focused on maintaining their know-how in the face of modern air weapon systems and ground-to-air threats.

The *Poker* edition has always been an opportunity to test original modes of action for all participants, members or not of FAS.

This operational memory is an asset on which the FASF relies. Whether nuclear or conventional, the strategic raid proceeds from the same logic.

That is why the FAS played a major role in the operational missions where the SCALP missile was deployed, whether during Operation *Harmattan* in Libya, the aborted summer 2013 raid in reprisal for the use of chemical weapons by the Syrian regime, or finally during Operation *Hamilton* on 13 April 2018.

A growing and now complete versatility

Each generation of nuclear-capable aircraft hailed a significant milestone towards increased versatility. Solely designed to release AN-11 then AN-21 and AN-22 bombs, hence bereft of any conventional fire capability, the *Mirage IV* was fitted with a CT.52 reconnaissance pod in the late 60s. Used for the first time in 1974 as part of an out-of-area mission in Chad, this strategic reconnaissance asset was mobi-

lized until the withdrawal of the *Mirage IV* in 2005. Its shots were highly valued by our allies during the 1999 air campaign above Kosovo. Besides, the *Mirage IV* was the first French combat aircraft to overfly Afghanistan as of October 2001. It then operated from the United Arab Emirates in early 2003 to overfly Iraq in an attempt to settle the issue pertaining to its alleged weapons of mass destruction.

The entry into service of the *Mirage 2000N* turned the tide, as the aircraft is also designed to release 250-kilogram dumb bombs, BAP100 anti-runway bombs, BAT120 tactical support bombs, 68-millimeter rockets and a MAGIC II infrared-guided missile used for self protection. This capability allowed it to take part in conventional combined drills, including *Red Flag* in the United States from 1992. In 1994, the FAS' *Mirage 2000N* were also part of the first NATO bombing mission in Udbina (Croatia). Still, the "N" designation of the aircraft explicitly refers to its core purpose, causing the political authorities and the military high command to exercise caution in its overseas commitment... Operation *Harmattan* (2001) in Libya broke this taboo once and for all. Through this protracted mission that challenges the French Air Force's offensive capabilities, needs must. In July 2001, the *Mirage 2000N* were deployed on La Sude base (Crete) to support the *Mirage 2000 D*, joining them in mixed patrols. Despite falling short of the latest operational standards,¹¹ they fulfilled their role in the operation and were committed anew in the Levant from H5 base (Jordan) between August 2015 and February 2016, still alongside the *Mirage 2000 D*, then in the Sahel for their final operational detachments.

The introduction of the *Rafale* as an omnirole combat aircraft gave further thrust to this momentum. Achieved in technical terms, complete versatility was even inevitable due to the aircraft shrinkage. In 2011, the French Air Force Staff determined the need for every crew member to be able to harness the *Rafale*'s versatility, regardless of the missions entrusted to their parent unit. By the same token as the other combat squadrons, the FAS *Rafale* units are to acquire a foundation of expertise in all the air-to-air and air-to-surface missions enabled by the system, while developing more extensive skills in a specific field. In the case of Saint-Dizier squadrons, it comprises allweather penetration and cruise missile firing.

With the strategic reconnaissance mission, the *Mirage IV* crew diversified its tasks beyond deterrence. The *Mirage 2000N* crew implemented a convention-capable weapon system, culminating by the end of its operational employment in the release of four 250 kilogram laser guided bombs. The *Rafale B* crew must be able to carry out all the combat aviation duties. The FAS fighter squadrons, formerly regarded as the highest level of specialization, are now the most versatile.

While maintaining the nuclear deterrence posture, they also contribute to missions assigned to conventional squadrons such as air policing over national territory, exercises and overseas operations. The 4th Fighter Wing operating with *Rafale B*

11. The *Mirage 2000N* is not fitted with any laser-guided or encrypted radio capabilities, deemed necessary in modern-day operations. The *Mirage 2000 D* provided these capabilities during joint flights in Libya.

and the 30th Fighter Wing operating with *Rafale C* are put on duty as the H5 base fighter detachment to ensure reassurance missions on Europe's eastern flank.

The transition from *C-135* to MRTT marked a similar shift. The new aircraft is no longer a mere tanker with limited transportation capacity. In addition to a significantly greater offload fuel capacity, it benefits from a 272-seat room. Moreover, it is fitted with the MORPHEE module, allowing the professional evacuation of intensive care patients in a military plane. The standard 2 of the MRTT will initially provide connectivity capabilities pending the introduction of self-protection capabilities, which is unusual for this type of aircraft. In Istres, the implementation of the whole 15 *A330*, including 12 delivered in the MRTT standard, has contributed to a highly beneficial cultural melting-pot for the 31st Air Refueling and Transport Wing (*Escadre Aérienne de Ravitaillement et de Transport Stratégique* – EARTS) staff.

Until recently, some crews were exclusively dedicated to inflight refueling or strategic transport missions. The 31st EARTS now takes on both missions on its own and more, such as noncombatant evacuation operations (NEO) or medical evacuation (MEDEVAC), whether for the FAS or, more broadly, all our armed forces.

Such diversification is virtuous. It bolsters the staff's experience by expanding its requisite expertise for the core deterrence mission: conducting any tactical flight, in-flight refueling or aerial combat training provides useful insight into nuclear raid preparedness. It lays down other staff standards. Achieving and maintaining such a level of versatility implies sustained and diversified air activities, ones that are representative of real-world conditions of employment. This requires a technical availability of the aircraft and their equipment¹² equal to the task, but also that of most advanced aeronautical platforms, training areas designed to match the performance of the weapon systems, high-performance simulation tools, *etc.* While the fighter crews ultimately epitomizes the very high standard of combat aviation and those of MRTT the fullness of transport and strategic refueling, it is all the personnel of the FASF that allows this.

Continuous maintenance of a forward-looking steadiness

The FAS have always been steadily maintaining a forward-looking stance. To this end, they constantly seek to anticipate the world's development, the evolution of the threats and conflicts, the technological improvements and breakthroughs, and so forth. Ensuring the ability to penetrate enemy defenses to cause irrevocable damage requires being one step ahead at all times.

Indeed, operational credibility, driving force of the FAS, can never be secured. As a perennial search, it entails building on LL daily while looking as far as possible to address looming threats in the most suitable way. As for nuclear deterrence, the

12. Sensors and weaponry for the *Rafale*, in-flight refueling pods for the MRTT.

complex development of critical capabilities calls for the necessity to schedule their implementation within the forces twenty years ahead. Thus, there are multiple timescales involved in the challenges faced by the FAS.

The continuing challenge at hand is to meet the whole set of requirements while controlling their activities. Nuclear safety and security, along with government control compliance, involve staff safety and the confidence of the political authorities and our fellow citizens. Aviation security ensures the safeguarding of the FAS' human and technical bases. Their compliance is unfailing, whether in training or operation. It is a recurring feature suffused by the command day after day. Protecting the deterrence facilities, whose sustained integrity is compulsory, also encompasses adaptation to a multifaceted, ever-changing threat. Currently intrusive and likely to become more destructive, the small Unmanned Aircraft Systems (sUAS) require continuously adapting hardware, organization and procedures.

Owing to the standards of the core mission and the diversity of the others, it also entails ensuring a very high level of preparedness among the staff. Continuous and varied air activities, in the sky or in a simulator, are essential for an omnirole *Rafale* crew to be fully operational.

The programming laws, namely the ongoing military programming law (*Loi de programmation militaire* – LPM) and the forthcoming one, govern the medium-term challenges and draw the FAS' evolutionary path. The current period is that of a comprehensive equipment modernization. The ASMPA missile overhaul is underway: the ASMPA-R version, operational as of December 2023, considerably increases its precision and penetration capacity. The *Rafale* fleet is on its way to the F4 standard, which further improves its sensor performance and connectivity. The three remaining *A330* will be converted into MRTT by 2025. The Standard 2 will then have to be qualified for improved connectivity and the acquisition of a self protection capability, which will yet again change the employment concept of this weapon system whose considerable potential is merely hinted at. The infrastructure pertaining to the implementation and maintenance of the tankers will be completed in spring 2024 with the development of a modern stopover providing for the annual transit of 100,000 passengers and 9,000 t of cargo to Istres. Outside the nuclear deterrence mission, the “army hub” is taking on a full scale and benefits for all armies in particular and the state in general, as during the airlift to New Caledonia in 2024. On other bases, adaptation works are being undertaken for parking areas so they can accommodate the MRTT during build-ups. As regards specialized communications, they are also to be modernized at mid-decade.

Alongside these technical milestones jointly led by the common effort and the armed forces, staff training, which underpins the overall effectiveness, continues. Due to the associated human resource strain, training is very demanding: in Istres for instance, the *C-135* conversion to MRTT is to be carried out at constant staffing level, hence calling for a fine process against the backdrop of an ever growing operational pressure.

More broadly, this favorable capability development falls within the framework of Multi Domain Operations (MDO). Indeed, the sustainment of the build-up and penetration capabilities of the Airborne Nuclear Component requires drawing great benefit from the achievements in the area of intelligence, cyber, spatial, electronic warfare (EW) and joint cooperation. The FAS are already firmly committed to this synergetic approach, at both the technical and operational levels.

In the longer run, the challenge lies in transiting towards tomorrow's nuclear system. By 2035, ASN-4G hypersonic missiles will equip the F5-standard *Rafale* pending the Future Combat Air System (FCAS) some ten years later. The FAS, on the grounds of their vision of the field enriched by sixty years of experience and through the integration of an action-oriented approach of the implementational constraints, are instrumental in defining military requirements. These items ought to be pondered on and considered at the earliest possible stage, since the introduction of these systems will affect every facet of the “doctrine, organization, human resources, equipment, support and training” (*Doctrine, organisation, ressources humaines, équipement, soutien, entraînement* – DORESE) process, including the overall organization of the force system, *e.g.* with the establishment of the future nuclear air bases.

Contrary to the widely-held belief that they form part of a major “shadow” command, the FAS are essentially forces constantly operating and deployed on the front-line, forces that epitomize the operational excellence of the FASF and our armed forces, for all of us to be proud of.



Rafale fitted with ASMPA pending refueling.

The French Air Force and the Atom: A Prosperous Encounter

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France's nuclear aspirations began to take shape during its Fourth Republic and gained momentum with the rise to power of General de Gaulle in 1958. Shortly after, he issued directives to establish a national atomic capability. This, however, was driven more by the objective of solidifying the country's international standing than by an articulated strategic reflection. Consequently, toward the end of 1958, the Minister for the Armed Forces tasked the Air Force with developing an atomic strike capability centred on piloted delivery systems.¹ Yet, the doctrine of “*deterrence of the strong by the weak*” – later becoming the cornerstone of French military doctrine – had not yet been articulated, nor were there the means to operationalise it.

It was not until the Defense Council meeting of 2 May 1963, that the roadmap for French deterrence was drawn out. The decisions made by the Head of State at this juncture detailed a nuclear capacity anchored on a first-generation made of a fleet of fifty *Mirage IV* supersonic bombers (later expanded by an additional twelve), followed by a second-generation contingent leveraging maritime assets. Bridging these generations, an “interim” ground-based ballistic missile force was slated for the period between 1968 and 1972. Its implementation was then entrusted to the French Air Force in 1959. This subsequently outlined the original vision of France's nuclear deterrent forces by its political authorities. Notably, a long-term, exclusively submarine-based component was conceived, coupled with an intermediary arrangement comprising airborne and ground-to-ground components, of which both were to be overseen by the Air Force.

1. General and permanent directive of 21 November 1958.

The French Air Force and the Atom: A Prosperous Encounter

Today, the disparity between the initial vision and the reality of France's nuclear deterrence strategy is evident. The "first generation" of deterrence, embodied by the airborne component, has persisted beyond the *Mirage IV* era and remains operational to this day. Conversely, the ground-based component did not simply serve as a transitional measure between the different generations. Rather, it played a strong pivotal role. For more than twenty-five years, it ensured the nation's capability to respond instantaneously from its territory and at any moment's time to a nuclear attack. Until the oceanic component achieved minimal operational readiness in 1976, the "*diamond tip of deterrence*" – to quote a former French President – was indeed stationed at the French Air Force's nuclear bases, as well as buried under the Albion plateau in Vaucluse.

The discrepancy between this reality and the government's initial projections was undoubtedly due to the acknowledgement – based on empirical evidence rather than theoretical conjecture – of the indispensable role played by both the airborne and ground-based components within a deterrent system. While the latter neither survived the French military's budgetary constraints at the end of the Cold War, nor the diplomatic pressure exerted on France when its nuclear testing resumed in 1995, the airborne component, on the other hand, has persevered and successfully underwent modernisation efforts.

For the Air Force, taking into account the nuclear responsibilities, either at the strategic or tactical level in a sovereign employment rationale, or within a NATO context at the tactical level – as it has briefly been the case in the early 1960s, subsequently catalysed a series of favourable developments. The impact has been manifold, and profoundly shaped what the French Air and Space Forces have come to be today. Indeed, it has transcended far beyond what a simple glance at the airborne nuclear component might suggest. Enhanced personnel morale, bolstered operational capabilities and credibility, increased budgetary allocations, and expanded influence exemplify the tangible benefits derived from the robust engagement of the Air Force – now the Air and Space Forces – in the nuclear deterrence mission.

The Benefits of a National Nuclear Ambition for the French Air Force

In January 1954, United States Secretary of State Foster Dulles unveiled the concept of "massive retaliation" as the cornerstone of his government's deterrence strategy. This announcement triggered a shift towards nuclearisation within the tactical air forces operating under NATO, which were then entrusted with nuclear strike missions. As an inevitable result, tactical air units lacking atomic weaponry found themselves pushed to the sidelines in favour of their nuclear-equipped counterparts. As expressed by Pierre Marie Gallois in his May 1955 article "*Défense aéro-nucléaire*", "*limited to conventional means, these forces would lack the teeth to bite.*"²

2. P. M. Gallois, "Défense aéro-nucléaire," *Revue de Défense Nationale*, 125 (06/1955): 603-613.

Thus, it was only logical that in 1955 the French government approached the U.S. with a request to add nuclear capabilities to its Air Force's *F-84* fighters assigned to NATO, in addition to the *Vautour* bombers that were due to enter into service the following year. Washington did not initially accede to this request, which was potentially driven by the French atomic ambition at a time when Paris had just begun to openly pursue military nuclear energy.



The *F-84* of the 1/4 “*Dauphiné*” at Bremgarten.
Source: “[Assaut sur F-84F à la quatre](#),” *Escadrilles*.

The concept of “massive retaliation” became operational within NATO in 1957. A staunch Atlanticist, General Jouhaud, Air Force Chief of Staff between 1958 and 1960, feared that it would lead to a loss of influence for a non-nuclear France within the Alliance. Apprehensive that French units would be relegated to “*footman missions in the event of a conflict*,”³ Jouhaud set out to convince Washington to entrust the French Air Force with nuclear strike missions. He endeavoured to acculturate French personnel to the use of nuclear weapons, while addressing his government’s concern of a British-U.S. hegemony within the Atlantic Alliance. Accordingly, from 1957 onwards, the French Air Force intensified its efforts to enhance the operational credibility of its units deployed within NATO. Military build-up and deployment exercises culminating in a massive raid were regularly carried out to test the readiness, responsiveness, and fighting spirit of the personnel. Designed to be realistic and demanding, these exercises, known as “*Rebecca*”, punctuated – not without its share of harshness – the life of the French fighter squadrons of the First Tactical Air Command (*Commandement aérien tactique* or CATac)⁴ at the time.

3. Quoted in P. Façon, *Histoire de l’armée de l’Air* (Paris: La Documentation française, 2009): 401.

4. Created in 1953, this command based at Lahr in Germany was subordinate to NATO’s 4th ATAF. At the time, it comprised three fighter wings and a reconnaissance wing, as well as their support resources.

However, this new approach alone could not be attributed as the sole justification behind the U.S. change in position – which was not without its own political motivations. Washington ultimately agreed in early 1962 to authorise two French fighter squadrons, equipped with *F-100 Super Sabres* and based in Germany, to take on a tactical nuclear strike capability. General de Gaulle, ever so attentive about nuclear weaponry's impact on national independence, readily acquiesced. This was no doubt after seeing its advantages towards an exclusively national nuclear force he had envisioned. By May 1963, the third and fourth Fighter wings were qualified for conducting nuclear strike missions within NATO with the U.S. MK 43 nuclear bomb. Needless to say, to have accomplished this, the First CATac units had to undergo rigorous operational training and sharpen their fighting spirit. Ultimately, French influence within NATO was preserved. This achievement was a clear result of France's nuclear ambitions at the time, which created a positive ripple throughout the organic, operational, and, of course, political spheres.

In parallel to this development in NATO, France pursued a strictly national and sovereign project to establish itself as a nuclear power. In an address given at the Military School (*École Militaire*) on 3 November 1959 – a few months after his return to power, General de Gaulle declared his intentions, unequivocally stating that “*the defence of France must be French*” and that “*it is essential for France to defend itself by itself, for itself and in its own way.*” After distancing himself from the Atlantic Alliance, which ultimately led to France's withdrawal from the integrated military structure in 1966, General de Gaulle began to wholly focus on the nuclear field. Specifically, he expressed that France “*must have what is known as a strike force that can be deployed at any time and anywhere. It goes without saying that the basis of this force will be atomic weapons.*” As the French Air Force had been entrusted with the deployment of this new force as previously mentioned, answering the presidential statement meant creating and maintaining nuclear units that were to be both responsive and capable of a long reach.

The concept of deterrence, particularly that of “*deterrence of the strong by the weak*,” which France formalised shortly afterwards, incorporated additional imperatives of determination and operational credibility. As General de Gaulle articulated, “*deterrence exists as soon as you have what it takes to mortally wound your potential aggressor, that you are very determined to do so and that he himself is convinced of this.*”⁵ Thus, from their inception, the fundamental tenets of the Air Force units, which had then been entrusted with the nuclear deterrence mission, were established and could be encapsulated into a single formula: unwavering resolve and credibility to act anywhere without delay. The strength of these requirements can be better gauged when contextualised against the backdrop of the time when 60% of the Air Force's resources are devoted to the Algerian crisis, whose rationale was largely divorced from nuclear deterrence.

5. C. de Gaulle, *Discours et messages – Tome IV – Pour l'effort – Août 1952-Décembre 1965* (Paris: Plon, 1970).

The state of the French Air Force during the late 1950s and early 1960s was precarious to say the least. It was beset by the dual challenges of its commitment to the other side of the Mediterranean and its collective defence duties in Europe. Moreover, this all occurred during a time of tightening budgetary constraints. General Gélée, its Chief of Staff in 1958, described it as being “*in a position of survival, which prevented it from effectively carrying out any mission other than maintaining order in Algeria.*”⁶ In April 1961, the Algiers putsch, led by air force generals Jouhaud and Challe, further exacerbated the Air Force’s predicament. This was not only vis-à-vis the French government, but also itself. Namely, fighter units were given the order to stand ready to open fire on military transport aircrafts if they were transporting seditious troops to mainland France. Under this context, the possibility of rebuilding itself upon new foundations based on the nuclear deterrence mission appeared to the Air Force as a unique opportunity. After the period of the Alger putsch, the government expressed its mistrust towards the Air Force, considering that there were “*extremely serious shortcomings which had not been detected by the ‘hierarchy’.*”⁷ It then appeared very comforting to the Air Force to receive from the same government the mission of setting up the deterrence forces. This served as a pivotal opportunity to overcome the crisis, which the Air Force seized without fail.

The French government’s pursuit of a nuclear power status resulted in the establishment of a multi-year legislative framework for the armed forces. This defined the requisite capabilities and the corresponding budgetary allocations needed to achieve such a purpose. The first Military Programming Law (*Loi de programmation militaire* or LPM) was passed in 1960, stretching over a five-year period. The Air Force particularly benefited from this, having been apportioned 26% of the funding, compared to 14% for the Army and 7% for the Navy. This high percentage can be simply explained by the new responsibilities entrusted to the Air Force, which were notably reflected in an order placed for 50 *Mirage IV* bombers, 12 *C-135F* refuellers, and 76 *Mirage III* fighters. This latter procurement was made in order to provide air cover for the bases where the future atomic force was to be deployed. A dozen air bases were also being prepared to house the future nuclear units. Multiple transmission networks were set up to ensure that orders to engage could be broadcasted to these units under any circumstances. Modern and resilient, these infrastructures would subsequently bring the Air Force up to the best standards of the time.

In 1962, alongside the influx of credits for its equipment, a sweeping reorganisation of the Air Force began. The nuclear deterrence mission necessitated the need for organisational requirements of permanence and reactivity. This led to the institutionalisation of major operational commands that would then possess their own support resources needed for their missions. Having been integrated into NATO, the aforementioned First CATac prefigured these newly emerged and substantially large specialised commands. The Strategic Air Forces Command (*Commandement des forces aériennes stratégiques* or CFAS) and the Air Defence Forces Command (*Commandement air des forces de*

6. P. Facon, *op. cit.*, 373.

7. Pierre Messmer, Minister for the Armed Forces, in July 1961, quoted in *ibidem*, 379.

défense aérienne or CAFDA), officially created in January and July 1964 respectively, were part of the new entities making up the reconfigured Air Force. From their inception, these two commands were closely associated with each other, even with their headquarters co-located. The latter provided the former with an assessment of the threat level in the air and provided air cover for its bases on its behalf. In this manner, the increase in the CFAS's capabilities went hand in hand with that of CAFDA's, as mandated by the first LPM. This coupling yielded improvements in terms of capabilities, for not only the Air Force but also the national aeronautics industry. With the notion of sovereignty lying at the heart of the deterrence mission, a dynamic move to replace U.S. aircraft with indigenous counterparts thus began within the French Air Force.⁸

Beyond these major commands, another essential element of the Air Force's new organisation was the reform of its air bases. These were transferred into genuine operational units, then streamlined under the command of a single authority. This reorganisation gave the Air Force a radically new face. In hindsight, this seems all too evident, given the longevity of the decisions taken at the time (some thirty years). All in all, it is fair to conclude that the Air Force, as a whole, operated with great efficiency over the long term. This was especially made possible by the organisation put in place to accommodate its new nuclear deterrence mission – an achievement often overlooked.

In the sixties and seventies, the Air Force reaped substantial benefits from its entry into the nuclear age, both in terms of resource allocation and deployed capabilities and operations. Yet, its most notable gain was arguably in its political influence. The exorbitant and eminently political nature of the deterrence mission, entrusted solely to the Air Force, was clearly the reason behind this. Namely, the Commander of the FAS was accorded an unprecedented level of working intimacy with the Head of State and the Minister for the Armed Forces. The decree that had established the FAS⁹ stipulated that its commander was to report directly to the President of the Republic for the employment of their forces and directly to the Minister of the Armed Forces for matters on organisation, management, conditioning, and infrastructure. His status within the military apparatus therefore rose to a highly exceptional level.

On 8 October 1964, France took an operational turn vis-à-vis its status as a nuclear power, when a *Mirage IV* armed with an AN-11 bomb, and a *C-135F* were put for the first time on QRA (Quick Reaction Alert) status. This marked the beginning of a new chapter in the history of the French Air Force.

The Nuclear Deterrence Mission Practice “Lifts Off” the Entire Air Force

The first commander of the FAS was General Philippe Maurin. This was but a logical choice, given that he previously commanded the First CATac. Thus, he had

8. In 1949, more than half the aircraft in service with the French Air Force were of foreign origin (mainly from Great Britain and the United States). Their replacement by French models reduced the proportion of foreign equipment to almost 20% in 1977. Data provided in C. Christienne, P. Lissarrague (eds.), *Histoire de l'aviation militaire française* (Paris: Charles-Lavauzelle, 1980): 524.

9. Decree no. 64-46 of 14 January 1964.

already acculturated himself to the nuclear mission within the framework of NATO. In his own words, nuclear alerts received under the orders of SHAPE¹⁰ had “*familiarised him with the seriousness and precision of everything to do with nuclear power.*” It was this mentality that he imported into the Air Force, which left a far-reaching impact.

In terms of practice, the deterrence mission demands exacting standards of permanence, responsiveness, and operational readiness. It is clear that these requirements have enriched the French Air Force over time. Indeed, permanence and responsiveness were once the strengths of the ground-based missile force operated by the FAS. This had now granted, for instance, air bases and command and control centres their current ability to switch instantly from peacetime to crisis mode, and to seamlessly work within a network. Moreover, the nuclear mission also allowed the Air Force to develop a high expertise in targeting, as well as in intelligence gathering and fusion.

The capacity for long-range strikes on short notice, intrinsic to the DNA of the FAS since its inception, was also passed on to all echelons of Air Force crews. Recent operations, such as Operation *Excalibur* in 2019, bear witness to this shared proficiency, as the FAS continues to showcase its know-how in this area. This was namely exemplified during *Excalibur*. Specifically, a *Rafale* successfully fired an inert nuclear missile at the end of a mission within a very dense operational scenario that not only lasted nearly twelve hours, but also required numerous in-flight refueling operations.



Firing an ASMPA during the *Excalibur* Exercise of 2019.

Source: “[L’armée de l’Air met en œuvre les missiles nucléaires depuis des Rafale](#),” *Dailymotion* (2020).

10. SHAPE: Supreme Headquarters Allied Powers Europe.

Furthermore, be it during the liberation of Benghazi from Gaddafi's regime in 2011, during the counter-offensives against armed jihadist groups in Mali in 2013, or in the destruction of the Syrian regime's chemical weapons production facilities in 2018, the Air Force has carried out air raids, combining considerable elongation and firepower. This was explicitly executed with the technical and operational aspects reflective of a nuclear raid. The requirements were thus very similar in terms of responsiveness, the ability of being the first to independently enter hostile territory, the capability to strike from very long distances, and the capacity to engage in a manner that answered to the political manoeuvres taking place in parallel. These were all competencies that the FAS had imparted to the Air Force as a whole, which the latter has now fully mastered.

On a technical point of view as well, the deterrence mission was the catalyst for significant advancements across the entirety of the Air Force. In 1964, the Air Force, which had just barely emerged from the decolonisation conflicts, was veritably propelled into the modern age with the arrival of the *Mirage IV*. This aircraft incorporated a host of high-performance features that represented considerable developments on those already in service. Such was the case of its navigation and bombing system, which was run by the most powerful computer yet to be installed on a European combat aircraft. This bomber, equipped with electronic countermeasures also drove the French Air Force into the world of defensive electronic warfare. Designed around the ability to navigate autonomously and accurately in hostile environments, the blueprint of the *Mirage IV* weapons system was subsequently adapted for use on the *Mirage III* and *Jaguar* conventional tactical fighter-bombers.

In addition, the *DC-8s* acquired to link up with the Pacific Experimental Centre from the late 1960s onwards – albeit not assigned to the FAS – were also justified in terms of deterrence. It thus brought military air transport into the era of the long-haul jet. The *Mirage 2000N*, successor to the *Mirage IV* in nuclear bombing missions, marked another leap forward necessitated by the deterrence mission. In order to be able to penetrate hostile territory at very low altitudes, day and night, whatever the weather conditions, the French industry produced an automatic terrain-following system to meet the requirements of the general staff. This possessed a level of performance that eventually set the benchmark for years to come. Finally, it was also used on the *Mirage 2000 D*, an evolution of the *Mirage 2000N* adapted to conventional air-to-ground missions.

Nevertheless, FAS bombers were not the only ones to add technical and operational value to the Air Force's conventional units. The entry into service of the air-to-ground medium-range (*air-sol moyenne portée* or ASMP) supersonic nuclear missile in 1986 marked another significant advancement. The know-how gained from the FAS in the complex process of mission planning and preparation, associated with the use of a cruise missile subsequently proved invaluable. This was especially so when the Apache conventional missile entered into service in 2001, followed by the Scalp in 2005. It is thus of no coincidence that FAS crews played a central role in the 2018 *Hamilton* mission against Syria, during which nine airborne cruise missiles

were fired. From an industrial point of view, it is thanks to the airborne component of the deterrence force that a French air-to-ground cruise missile industry was born. Today, it constitutes a centre of excellence. As ramjet missiles, the ASMP and its evolved descendant, the ASMPA, have placed France in a leading position in the field of supersonic cruise propulsion, one that is undeniably conducive to further developments towards hyper velocity.

These synergistic dynamics continue to shape the present landscape. The arrival of the *Phénix* in the FAS marks a considerable leap forward in capabilities, compared with the *C-135*. It can deliver three times as much fuel over a distance of 2,000 km, and carry almost twice as much freight over a distance of 7,000 km. This makes projection missions, such as *Pegasus* possible, producing substantial benefits in terms of air diplomacy.



A Boeing C-135FR Stratotanker and an Airbus A330 multi-role tanker transport at the Istres-Le Tubé 125 Air Base (2019).

The *Meteor* air-to-air missile also marks a major step forward. While this ramjet-powered missile considerably increases the survivability of nuclear raids, it also introduces a new approach to air-to-air combat for the entire French Air Force. Namely, its performance in terms of range represents a significant breakthrough. Looking forward, from 2040 onwards, the new carrier chosen to carry the ASN 4G¹¹ will have a major impact on combat aviation. It will be part of a system designed to penetrate the most robust defences. Ultimately, the deterrence mission plays a major role in determining the operational performance level of the Air Force's Futur Combat Air System.

11. Fourth-generation nuclear air-to-ground missiles.

The FAS Assets: A Direct, Significant Contribution to French Air Force's Conventional Operations

Throughout their long and rich history, the Strategic Air Forces have not only served as a nuclear deterrent. Their assets have also been deployed, at times in very particular ways, for conventional operations, thereby providing considerably added value. This dual functionality underscores one of their predominant strengths and distinguishes them from the deterrent's oceanic component.

Furthermore, in-flight refuelling immediately springs to mind when this point is raised, which is quite logical insofar as, since their creation, the FAS have concentrated the bulk of this key operational capability within the Air Force. A review of nearly fifty years of military operations in foreign theatres reveals that almost all of France's air power projection operations have been made possible solely through the FAS's fleet of refuelling aircraft. With the introduction of the *Phénix*, the FAS also took on a new mission – that of strategic transport, which they now carry out on behalf of the entire armed forces. The FAS now plays a central role in forces and air power projection and strength of our country, with the *A400M* being another facet of this capability.

The successive nuclear-capable aircraft of the FAS also highly contributed to conventional missions. In fact, it was with the *Mirage IV* that the FAS first became involved in conventional missions. Owing to the exceptional performance of this aircraft, strategic reconnaissance missions – although often kept secret – were performed at a time when France was still lacking military space imagery. For instance, some of these missions were carried out in Africa in the 1970s and 1980s. One of them, carried out in 1986, lasted eleven hours, including thirty minutes at supersonic speed. This remains a remarkable performance even today.

Subsequent strategic reconnaissance missions were later carried out over Afghanistan in 2001 – just after the September 11 attacks – in a very reactive manner, even before the Navy's Carrier Battle Group and Air Force tactical aircraft were deployed. This was also the case over Iraq in 2003, when France expressly chose not to join the British-U.S. offensive. In addition, FAS aviators have also contributed to offensive missions. The Balkans, Libya, Mali, the Central African Republic, and the Levant were all theatres in which they have exhibited their mastery of the most complex air combat missions. This, they continue to do today. The versatility of the *Rafale*, equipping its combat squadrons, has thus enabled the FAS to broaden its remit to cover the entire spectrum of air power missions. Sixty years after the FAS's creation, their *Rafale* and tanker crews even participate in the permanent security posture by taking on air defence alert missions.

When we look at the record, it is clear that the nuclear deterrence mission has helped shape today's French Air and Space Force, its command structures, air bases, capabilities and identity. Thanks to this mission, numerous avenues have been opened up for the benefit of the country's air forces and more. These include in-flight

refuelling and very long-range combat air missions; the implementation of electronic countermeasures; the use of cruise missiles; certain very long-range transmission techniques; large-scale operational exercises; the hardening of infrastructures, as well as many other areas.

Representing today a substantially half of the FASF's *Rafale* fleet, the FAS now assume an unprecedented role in their conventional combat capabilities. Moreover, they continue to fulfil the nuclear posture contract assigned to them by the President of the Republic and participate in a permanent security posture. Far from the hyperspecialisation of their early years, the Strategic Air Forces now fulfil the three fundamental missions of defence: deter, first and foremost, but also protect and intervene.

The French Nuclear Naval Aviation Force (FANU), the story of a unique deterrent force

Didier Chastel

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Little-known to the general public and rarely mentioned in the media, the French Nuclear Naval Aviation Force (*Force Aéronavale Nucléaire* – FANU) remains quite unique alongside the other two French deterrent forces. Brought into being with the advent of tactical nuclear weapons, it survived after the fall of the USSR. It has no equivalent in the world since the U.S. Navy gave up this capability just after the end of the Cold War. However, since the adoption of a single-carrier navy (*CVN Charles de Gaulle*) in the late 90s, the FANU doesn't provide a permanent alert service.

Yet it is neither obsolete nor anachronistic, and its relevance is regularly reiterated at the highest levels of government. In 2015, for example, French President François Hollande declared that “*the airborne component also ensures the permanence of deterrence through the Strategic Air Forces. Alongside them, the Nuclear Naval Aviation Force, deployed from the Charles de Gaulle aircraft carrier, offers other modes of action.*”¹ Even today, recent developments in the geopolitical context confirm the importance of adding a nuclear dimension to the power-projection capability of the aircraft carrier.

1. Speech by French President François Hollande in Istres on February 19, 2015.

Some see its obvious strategic value, while others see it as a throwback to an historical anomaly, but in any case, the FANU is certainly not well known. It is therefore appropriate to look back at the reasons behind its creation, and its continued existence; at the difficulties it has had to overcome in order to maintain its credibility; and at its current strengths and weaknesses. All these aspects will be addressed in succession in this article.

The slow rise to maturity of the concept of a nuclear naval aviation capability

The Second World War saw at least two major strategic changes. The first was the rise of naval aviation. By demonstrating the superiority of air power, the Pacific War profoundly altered the principles of naval strategy. This was demonstrated first by the Japanese at Pearl Harbor on December 7, 1941, before the Americans retaliated twice in 1942 at the battles of the Coral Sea and Midway. The aircraft carrier became the capital ship. The second change was the introduction of nuclear weapons. On August 6, 1945, an American *B-29 Superfortress* bomber named “*Enola Gay*” took off from North Field in the Marianas. After a six-hour flight, it dropped the first nuclear bomb on Hiroshima. The long-range heavy bomber carrying a nuclear warhead became the most destructive weapon of all time.

After 1945, however, the combination of nuclear weapons and aircraft carriers was not an obvious strategic choice. The U.S. Navy had to overcome complex technical difficulties² and unfavorable capability choices in the field of naval aviation. In 1949, General Eisenhower’s proposal for a navy with just four aircraft carriers was adopted. The Korean War demonstrated the value of light attack aircraft deployed from the sea, and called into question the wisdom of this decision. The U.S. Navy force structure of more than ten aircraft carriers was adopted, and has not been challenged since. From a technical point of view, the success of the first thermonuclear test in 1952, essential for weapon miniaturization, and the commissioning in 1955 of the aircraft carrier *USS Forrestal*, with its angled landing deck, steam catapult and optical landing system, launched the development of a nuclear naval aviation force. The latter became operational in the early 60s. From then on, the Americans had a capability based on three guiding principles: the “*omnidirectional*” nature of deterrence, the political and military value of this capability, and the dual use of the carrier.

The process was slower in France. Post-war industrial and budgetary conditions prevented the construction of a new aircraft carrier. Paris, therefore, had to turn to its allies to find expedients, especially as it lacked the means to halt Viet Minh’s expansion in Indochina. The Navy successively acquired the *Dixmude* and *Arromanches* from the British, then the *La Fayette* and *Bois Belleau* from the Americans between 1945 and 1954. The war in the Far East significantly increased the experience acquired navy aviation pilots in sea-to-land projection and bombardment. It also gave

2. It took the U.S. Navy almost fifteen years to succeed in deploying heavy aircraft with sufficient payload and range from undersized aircraft carriers.

rise to the first reflections on the aircraft carrier, which, as a power projection tool, could become a political instrument.

Nevertheless, it was the Suez crisis in 1956 that to some extent constituted the “*founding myth*” of French deterrence. Politically, it accelerated decisions to develop nuclear energy for military purposes. From an operational point of view, it confirmed the obsolescence of the aircraft carriers still in service, and the urgent need to replace them. In 1958, therefore, it was decided to build two 24,000-ton-class French aircraft carriers, equipped with two fifty-meter-long catapults and capable of operating fifteen-ton aircraft. The third aircraft carrier, the *Verdun*, would never see the light of day.

Significant progress was thus made in France, with the emergence of capabilities based on the three guiding principles of the American nuclear naval aviation fleet. However, the idea of equipping this force with a nuclear capability was just a seed in 1958. It would be another twenty years before it bore fruit. The doctrine of “*omnidirectional*” deterrence would serve as the foundation, and tactical nuclear weapons as the accelerator.

“*Omnidirectional*” deterrence

This doctrine of nuclear deterrence was rooted in France’s perception of the limits of NATO integration and the political disconnect between Paris and Washington. France, through General de Gaulle, aware that the notion of a preferential, or even unique, enemy no longer held sway, and that the guarantee of Europe’s protection by the American nuclear umbrella was not absolute, asserted that its doctrine had to be “*omnidirectional*”.

On November 3, 1959, General de Gaulle gave a speech at the *École Militaire* that clearly set forth his intentions for the independence of our national defense. He hinted at the departure from NATO’s integrated command, the need for a sovereign strike force, and the beginnings of a doctrine of “*omnidirectional*” deterrence:

“The defense of France must be French [...]. If a country like France has to go to war, it has to be its own war. Its effort must be its own effort [...]. Naturally, French defense would, if necessary, be combined with that of other countries. That is in the nature of things. But it is essential that it be our own, that France defends itself by itself, for itself, and in its own way [...]. The idea of a war, and even of a battle, in which France would no longer be itself, and would no longer act on its own behalf, with its own share and according to its own wishes, is unacceptable. The system known as “integration”, which was inaugurated and even, to a certain extent, practiced after the great ordeals when it seemed that the free world faced an imminent and unlimited threat, and when we had not yet recovered our national personality, this system of integration belongs to the past [...].

It goes without saying that this force will be based on atomic weapons – whether we make them or buy them – but they must be our own. And since France can po-

*tentially be destroyed from anywhere in the world, our force must be designed to act anywhere on Earth. The obvious consequence of this is that, over the next few years, we need to equip ourselves with a force capable of acting on our behalf, a so-called “strike force” that can be deployed at any time and to any place.”*³

In the General’s speech at the Naval Academy on February 15, 1965, he emphasized the importance attached to the Navy in a particular way:

*“As far as the nation is concerned, we need a Navy that can strike hard. To strike as is its nature, on the sea and from the sea, any enemy of France. To strike them with the most powerful weapons available, and to strike them, if necessary, unreservedly and unconditionally.”*⁴

Because the time was ripe for the creation of a nuclear triad, this speech is often read “from below the surface”. It seems to concern mainly submariners. But “*striking ON the sea*” is not the exclusive reserve of submarines. Implicitly, it can be understood that the “*most powerful weapons*” will rely above the surface on the triptych of capabilities of nuclear naval aviation: naval power (the aircraft carrier), air power (the fighter-bomber) and nuclear power (the atomic weapon).

Although Charles de Gaulle is credited with inventing the concept, in the end experts on deterrence attributed it to “*another Charles*”. In December 1967, Army General Charles Ailleret, French Chief of Defense, published an article in the *Revue de défense nationale* (RDN) entitled “*Défense dirigée ou défense tous azimuts*” (“*Directed defense or omnidirectional defense*”). In his view, omnidirectional defense rested on two conditions: access to thermonuclear technology for the strategic triad, and the development of “*our air-land and air-sea battle forces in forms that will correspond to operational conditions in the atomic age, battle forces that will necessarily have to be equipped with nuclear weapons and possess the necessary capabilities to act offensively even beyond our borders should we be attacked.*”

This was the first public mention of the relevance of a nuclear naval aviation force. From then on, the creation of carrier-borne nuclear aviation was closely linked to the question of tactical nuclear weapons.

Tactical nuclear weapons and the tactical age (1978-1996)

When General de Gaulle returned to power in 1958, France was in the process of developing military applications of atomic energy. As head of state, he committed the funds needed to build a coherent defense system based on three pillars: a deterrent force (or strategic nuclear force), a maneuver and intervention force (equipped with tactical nuclear weapons) and an operational homeland defense force.

On March 7, 1966, General de Gaulle informed President Lyndon B. Johnson of his decision to leave NATO’s integrated military command. This decision, effective July 1, 1967, obviously had far-reaching consequences. Tactical nuclear weapons

3. Speech on “*Vision de défense de la France*” available on the [INA website](#).

4. “*De Gaulle et la Marine. Des FNFL à la Marine du XXI^e siècle,*” *Cols bleus*, n°3088 (07/2020):26.

became an urgent issue. For French forces in Germany, withdrawal from NATO's integrated command meant the loss of American support in this area.

France therefore embarked on the development of tactical nuclear weapons for land and air forces. The Tactical Air Force (FATAC) was equipped with AN-52 bombs in October 1972, the year of the first *White Paper*, which clearly established the main principles of our defense policy and confirmed the value of tactical nuclear weapons. Everything was then in place to give the Navy a tactical nuclear strike capability from the sea. In 1974, the decision was taken to equip the naval air arm with the same airborne bomb as the one also in service within the French Air Force (FAF).

On December 10, 1978, the combination of the *Clemenceau* aircraft carrier, *Super-Étendard* aircraft and AN-52 bomb marked the creation of a nuclear naval aviation capability. To this end, each of these assets underwent varying degrees of modification. For example, the fins on the AN-52 carried under the *Super-Étendard* were adapted to avoid any risk of contact with the flight deck. The weapon was stored on a special rack to guarantee its endurance in the event of an underwater explosion. As for the weapon platform, Avions Dassault-Breguet Aviation was commissioned in 1973 to improve the *Étendard* and adapt it to the requirements of nuclear specifications, following unsuccessful tests on the *Jaguar*. For the first time in naval aviation, the weapon was carried in an asymmetrical underwing configuration.⁵ Lastly, the *Clemenceau* aircraft carrier's storage and handling facilities were modified, as were its command and control (C2) capabilities, which included a new tactical nuclear cell.

As the last force to receive nuclear weapons, the FANU had to immediately comply with the same nuclear implementation and safety requirements as the other forces. Planning, build-up and engagement procedures differed little, if at all, from those of other forces, while compliance with the three pillars of government control⁶ was clearly essential. This requirement necessitated adaptation of the chain of command and transmission capacities, at a time when the first *Syracuse* constellation was not yet in orbit.⁷ It also required the presence of *gendarmes* from the *Groupeement Spécial de Sécurité* on board the aircraft carrier.⁸ Their presence indirectly contributed to the development of carrier-based nuclear aviation as a legitimate force of deterrence.

In the Cold War era, the missions allocated to carrier strike groups directly supported those of the FATAC, bypassing the Russian fleet in the Mediterranean on its southern flank to strike targets north of the Black Sea. They could also be intended to attack a naval force at sea, thanks to the exclusive know-how of carrier-based naval aviation. Even if the FANU held its own, there was still room for improvements in certain areas. As with other nuclear forces, the concept of tactical employment

5. In other words, the weapon was not carried under the fuselage, but under one of the wings.

6. Governmental control of commitment, governmental control of conformity of use and governmental control of integrity of means.

7. The first *Syracuse* constellation was deployed between 1985 and 1987.

8. In 1993, the *Groupeement Spécial de Sécurité* became the *Gendarmerie de la Sécurité des Armements Nucléaires* (GSAN).

alongside that of deterrence was still a source of confusion, particularly regarding ends and means. Whether nuclear weapons were tactical or pre-strategic, the purpose of the mission was still deterrence, which was indeed a strategic mission.⁹

The modernization of the two aircraft carriers, first the *Clemenceau*, then the *Foch* in 1981, nevertheless proved decisive in enabling surface forces to maintain a permanent nuclear standby for almost two decades. In fact, an aircraft carrier is at least on 72-hour alert. The force also gained in effectiveness in 1990 with the operational admission of the supersonic *Air-Sol Moyenne Portée* (ASMP) missile and the arrival of the *Super-Étendard Modernisé* (SEM). Finally, political declarations validated doctrinal changes heralding the concept of the final warning. The transformation of tactical forces into “*pre-strategic*” forces in 1984 confirmed the overall maturity of the tool. For five years, the FANU enjoyed a golden age, with a force structured around the SEM/ASMP combination, which ensured that an aircraft carrier and its carrier air group were always on the alert.¹⁰ But history was about to change.

The geopolitical and strategic consequences of the collapse of the Soviet bloc were numerous. One of them, as we have seen, was the giving-up of the U.S. nuclear naval aviation capability in 1991. The post-1989 “*new world disorder*” led to profound changes in France’s deterrent forces. Nevertheless, it confirmed the relevance of our doctrine. In terms of nuclear geopolitics, three salient facts characterize this period.

First of all, the number of would-be nuclear powers increased: Pakistan and North Korea, but also Iraq, Syria, Libya and Iran, closer to us geographically, showed serious proclivities in this area. The atomic threat also spread. It was no longer just a European security problem. It also undermined regional balances in Asia and the Middle East. Nuclear confrontations multiplied. Last but not least, the build-up of missile defense meant that air forces of modest size had to possess top-end technologies if they were to remain credible in the context of “*weak-to-strong*” deterrence.

In this new context, “*omnidirectional*” deterrence retained its relevance, albeit for different reasons. The ambiguity surrounding our vital interests, defined according to their nature or geography, remained. What’s more, we had to contend with new, uninhibited players, with a different or less sophisticated interpretation of our deterrence grammar. In this context, nuclear warning became a cornerstone of our doctrine. If necessary, it could be sent far from the homeland, into the depths of the enemy system, to re-establish deterrence. The greater likelihood of escalation meant that, to keep things under control, conventional and nuclear forces needed to be much more closely linked, as defined today by the term “*helping each other*”, while refusing to accept a continuum between the two. Thus, despite President Jacques Chirac’s announcement of the end of pre-strategic nuclear weapons, it was essential

9. See F. Mitterrand’s 1986 speech: “*It is the force of deterrence that comes into play once the pre-strategic force is involved.*”

10. Commissioned in 1961, the *Clemenceau* was decommissioned on September 25, 1997.

for France to have a nuclear naval aviation capability to deal with these new threats. Deterrence, therefore, became the cardinal mission of the carrier strike group.

The FANU as a strategic force: organization, strengths and weaknesses

Following a decision by the French President, the FANU became a *de facto* strategic force. This formal genesis led to changes in the chain of command. In 2002, the Nuclear Naval Aviation Force was entrusted to the Surface fleet Commander¹¹ (ALFAN), who from then on assumed the responsibilities of nuclear force commander. By decision of the political authority and following a model identical to the other two nuclear forces, the Commander of the FANU (ALFAN/CFANU) exercises operational control of the FANU, under the operational command of the Chief of Defense (CEMA). ALFAN/CFANU has a dedicated operations center, COFANU, which replaces the planning cells that previously existed within the squadron commands, now operational-level theater commands (CECLANT and CECMED). At sea, tactical command is entrusted to ALFAN's tactical deputy rear admiral, who in 2005 became commander of the Air-Sea high readiness force (FRMARFOR). The latter has a nuclear planning cell (CNP) on board the aircraft carrier, manned by his staff.

The 2000s revealed a number of the force's weaknesses, which we will discuss below. The need to modernize the single aging aircraft carrier and to upgrade the SEM/ASMP duo became apparent. Moreover, the terrorist attacks of 2001 and the changing geopolitical context were likely to place even greater demands on the use of the carrier battle group in conventional operations. The instrument remained dual-purpose, but the general trend leaned heavily towards conventional missions. Nonetheless, the nuclear naval aviation capability was preserved, in line with the strategic analysis outlined above. The return of nuclear weapons to the limelight demonstrated, if proof were needed, the value of having such a powerful tool at one's disposal.

However, it was only in the 2010s that a new dynamic began, definitively establishing the credibility and coherence of this tool. This was based firstly on the commissioning of all the components of the new triptych: the nuclear aircraft carrier¹² *Charles de Gaulle*, which was commissioned in May 2001; the *Rafale* omnirole fighter in its "naval" version;¹³ and finally, the upgraded ASMPA missile. On July 1, 2010, the modernization of carrier-based nuclear aviation was completed with the initial operational capability of the *Rafale M*/ASMP-A duo within Air fleet unit 11F. This was confirmed by an evaluation firing in November 2012, carried out by an aircraft from Air fleet unit 12F.

11. ALFAN: Admiral commanding the "Naval Action" force (surface navy, as opposed to submarines, carrier-based aircraft, fusiliers marins and commandos).

12. In the sense of nuclear propulsion, unrelated to the existence of the FANU.

13. Naval aviation switched to "*all Rafale*" in 2016, with all three Air fleet units fully qualified by 2018.



DR

Rafale M equipped with ASMPA missile on the Charles de Gaulle aircraft carrier.

The other major change was the creation within the Naval Action Force (NAF) headquarters of a division dedicated to the force. All FANU-related issues were centralized within this division. CFANU now had a permanent organic staff, the main objective of which was to ensure that trained sailors and resources were available for the mission. Finally, COFANU underwent a complete overhaul¹⁴ to provide the force commander with a command tool meeting the demanding requirements inherent in any operational command of a nuclear force.

Today, whatever the situation of the aircraft carrier, all FANU sailors are properly trained. Of course, the 3,000 or so sailors who would contribute to an FANU nuclear operation are mainly trained during the conventional operational readiness cycle. This is true in particular for the crews of frigates, nuclear attack submarines and maritime patrol aircraft. The level of performance achieved through training planned by the various organic authorities, operational deployments and, finally, high-intensity operational readiness (POHI) training¹⁵ guarantees optimum preparation for a nuclear operation, delivering the message of credibility that underpins effective deterrence.

It is also clear that certain naval personnel need specific skills to carry out nuclear missions. *Rafale M* crews are trained for this, of course, but they are not the only ones. Members of tactical and operational staffs, the soldiers who operate the information and communications systems specific to nuclear deterrence, and the naval aviation technicians, who prepare ASMPA-armed aircraft, are also trained. Joint training with the French Strategic Air Forces (FAS) is also essential to the continued development of the force's skills. The two planning and command staffs work together. On a regular basis, the FANU takes part in Operation *Poker*, whose name

14. The new facilities were delivered at the end of 2019.

15. POHI's ambition is to prepare military personnel to fight even in the high-end scenarios.

is, in this case, changed to Operation *Yass*.¹⁶ These training sessions are essential for sharing experience across the entire planning, implementation and command chain. They demonstrate the credibility of the entire airborne nuclear component (CNA) and guarantee the necessary interoperability between the two forces.

In addition, the FANU has maintained its expertise in the field of striking a force at sea, such as a carrier battle group, a unique capability that may suggest “*other modes of action*.” Finally, the last stone to be laid on the edifice is perfect control of the conventional-nuclear interface. When the President so decides, the carrier battle group will be placed under the operational control of CFANU, and the nuclear mission will then take priority. To achieve this smoothly, dedicated training programs are organized. They form the core of operational readiness for the FANU. It is a key activity and an essential demonstration, comparable to Operation *Poker* for the FAS: the FANU plans, it prepares for the mission, the CFANU takes operational control of the tool and the carrier battle group, commanded by a tactical staff trained for this mission, and launches the nuclear attack.

Today, the qualities of the FANU are widely recognized. The quality of the military assets deployed, the experience acquired by naval personnel in operations, the efforts made to prepare the French Navy for tomorrow’s battles and to provide the FANU with the manpower it needs for its missions, all guarantee the coherence and credibility of the organization.

Nevertheless, the FANU also suffers from certain weaknesses. These may be historical, or the result of long-term capability choices.

First of all, it suffers from a lack of recognition, which may seem paradoxical for an actor whose visibility should be an asset. The first explanation for this situation is doctrinal. It is up to the political authorities, and them alone, to draw attention to the force when they decide to do so. By its very nature, the FANU is in direct competition with the aircraft carrier, which is more closely associated with the resolution of conventional crises. The second reason is historical. Initial capability was acquired in 1978, so the FANU was the last force to be equipped with nuclear weapons, fourteen years after the French Air Force. It also entered the nuclear arena by the back door – that of tactical nuclear power – with all the ambiguities that this concept encompasses and the limitations of such a weapon. Things changed with the end of the Cold War. But this birthmark of a force “*from the ranks*” is still reflected in its designation: the air and oceanic forces are “strategic”, while the naval aviation force is ‘*only*’ “nuclear”. Let us hope, however, that this lack of recognition in France, even within our own armed forces, has no impact on our competitors’ view of the capabilities of an aircraft carrier with such potential.

The second fragility lies in the choice of non-permanence, *de facto* entailed by the fact that France has a single aircraft carrier since the decommissioning of the *Clemenceau* from active service in 1997. As we have seen, despite its dedicated

16. Like *Poker*, *Yass* is a card game. This operation involves joint training between the FAS and the FANU.

staff and permanently trained personnel, the FANU nevertheless offers only options with “*blackouts*,” to use Admiral Païtard’s expression.¹⁷ These blackouts correspond to periods of major overhaul to replace the nuclear core of the carrier’s reactor, *i.e.* around eighteen months every ten years.

From a strategic point of view, the possession of a single aircraft carrier offers a number of advantages. With a supersonic air-breathing missile carried on an omni-role aircraft and deployed from a nuclear aircraft carrier, France has an operational capability that is unique in the world. And the ambitions of our strategic competitors show us that, to exist, one needs nuclear weapons and aircraft carriers. The FANU is a capability that marks our difference; it is both differentiating and invaluable in enabling France to assert its interests in the legal and power context of the third nuclear age. Being both unique and nuclear, its deployment allows us to materialize the nuclear threshold and re-establish the dialogue of nuclear deterrence.

In the end, since the blackouts can be tolerated thanks to the permanence of the other two forces, the FANU is making progress towards greater recognition (to which this article will perhaps contribute), which is an asset for the deterrence dialogue. The reappearance of war on European soil, major geopolitical developments on other continents, and operations in an increasingly contested and uncertain environment mean that we cannot be satisfied with the current situation, and must prepare for future challenges.



DR

A Rafale M equipped with an ASMPA is launched during exercise Poker 2023-1.

17. Expression taken from Admiral Païtard’s discussions with *Capitaine de vaisseau* (OF-5) Emmanuel Caillat during the latter’s work on his dissertation written at the War College: “*L’aviation nucléaire embarquée, une mise en perspective historique*.”

Conclusion

The French Nuclear Naval Aviation Force will evolve in a stabilized format for the next fifteen years, before undergoing another generation change. It can draw on a strong identity and a wealth of experience built up over the last few decades. Nevertheless, it will have to continue to accept the fact that its activities are based on a single aircraft carrier. This format, which has lasted for twenty years, should continue for at least as long. Deterrence can be strengthened by it. It could be an incentive to explore even further the complementarities between the two land- and carrier-based facets of the airborne component. What is an opportunity today will be a necessity tomorrow.

The FANU will also have to anticipate the limits of the duality between manned aircraft and UAVs. Man has a key role to play in the deterrence mission. This role is perhaps more diffuse in conventional missions, and the FCAS will bring together manned aircraft and drone systems. We therefore need to start thinking right now about the right mix of human and robotic resources for the ultimate mission.

Finally, we must remain faithful to the virtues of weapon system differentiation. Arms control is weakening, the nuclear threshold is eroding, dual-use technologies are fueling ambiguity around the conditions of their use; “*military nuclear power is back, less orderly than ever.*”¹⁸ Against this backdrop, we need to stick to the basics, supporting a strategy based on deterrence, the essential aim of which is to prevent war. France has no alternative but to be virtuous in order to re-establish the conditions for stable deterrence. We must accept the risk of inferiority in the conventional sphere, always seek superiority in the nuclear sphere, and refrain from ensuring continuity between the two spheres, a *sine qua non* if we are to avoid the pitfalls of tactical nuclear weapons.

The history of the FANU has not been a smooth one, as doctrinal and capability developments have taken their toll. The recent and brutal return of nuclear reality sheds a little more light on the most misunderstood force in the French arsenal, which has nonetheless managed to guarantee its credibility and coherence. The “*shadow cast by deterrence*” is all the clearer and greater. Of course, when the aircraft carrier is docked, French deterrence is still guaranteed. On the other hand, when the aircraft carrier is at sea, or when it is simply available dockside, the President has an additional tool of deterrence at his disposal, which is useful in the context of the “*disorderly return of military nuclear power.*” While deterrence is not, strictly speaking, more strongly guaranteed, it has greater endurance, and can count on an extra layer of subtlety. To end with an analogy and flatter the Strategic Air Forces’ taste for card games like poker, the FANU is an “*oudler*” in the tarot deck. The cleverest ones will immediately cry out that it’s the “*Little One*”. Well, perhaps... It’s true that it can rarely win a trick or triumph on its own. But along with other cards, used with skill and cunning, it can help seal victory.

18. G.-H. Soutou, *Le retour du nucléaire militaire* (Paris: Éditions Hermann, 2019): 99.

The French Nuclear Naval Aviation Force (FANU)...



Gendarmerie for Nuclear Weapons Security, a decisive choice in turbulent times

Gendarmerie for Nuclear Weapons Security

In acquiring the capability to deploy nuclear weapons, France demonstrated its strategic resolve in a complex international and national context. Against this background, the creation of a highly specialized gendarmerie was a carefully considered choice in a France that had to rebuild itself in a geopolitical environment marked by the Cold War.

A few weeks after the American strategic bombardment of Japan in August 1945, General de Gaulle, aware of the military and civil sovereignty implications of nuclear power, decided to create the *Commissariat à l'énergie atomique* (CEA – Atomic Energy Commission)¹ on the following October 18th. Subsequently, and despite the difficulties of the Fourth Republic in establishing clear political majorities, the launch of France's military nuclear program enjoyed a remarkable multi-party consensus. Thus, on November 4th, 1954, under the impetus of French Prime Minister Pierre Mendès France, a secret decree was signed establishing the *Comité des explosifs nucléaires* (Nuclear Explosives Committee). It was headed by General Jean Crépin who was given the task of “*guiding, coordinating and monitoring the activities of civilian, military and joint bodies involved in implementing the program decided by the government, with respect to projects to design and build nuclear explosive devices.*”²

The early development of French atomic weapons was also marked by international technical and political events. In October 1957, the Soviets launched *Sputnik* into orbit, which – in addition to being a scientific feat – heralded the imminent arrival of intercontinental ballistic missiles (ICBMs) in the arsenals of the two great powers. A few years later, the commissioning of the first nuclear-powered ballistic missile submarine, the *USS George Washington*, and its launch of a Polaris missile in July 1960, officialized the creation of oceanic deterrence. At the same time, the political consensus concerning the French program was reinforced by the way in which the Suez crisis was resolved in 1956. According to Yves Rocard, a scientist involved in the development of the French weapon, French Prime Minister Guy

1. Renamed in 2010 *Commissariat à l'énergie atomique et aux énergies alternatives* (Atomic Energy and Alternative Energies Commission).

2. B. Faïlles, “[Pierre Mendès France et la construction de l'arme atomique. Une responsabilité collective, un défi personnel](#),” *Matériaux pour l'histoire de notre temps*, n°63-64 (2001): 136-147 (141).

Mollet declared: “Ah! if I’d had the bomb, it wouldn’t have been the Russian threat or the pressure from Eden that would have stopped me.”³

It was not until General de Gaulle returned to power at the end of the 1950s that the military nuclear program was set in stone with the first Defense Spending Law (*Loi de Programmation Militaire* – LPM) 1960-1964. The President of the new Fifth Republic confirmed the order to carry out tests on atomic weapons, while the LPM organized the development of the first delivery platform, the *Mirage IV*.

Once again, current events interfered with the smooth running of the nuclear program. Involved in a war on Algerian soil since 1954, some French army officers were opposed to the planned independence of Algeria. On April 21st, 1961, four general officers attempted to reverse the course of events and staged a *coup d’État*.⁴ Faced with the risk of the plotters seizing one of the experimental atomic devices stored at the Reggane Saharan military test center, the French government decided to bring the detonation of the *Gerboise verte* forward to April 25th, 1961. This episode dramatically underlined the issue of security and protection of atomic weapons and raised awareness of the need to tighten control over strategic military assets.

This did not, however, prevent them from being put into service by the Forces. In 1963, the Taverny military site became Air Force Base 921, containing the buildings destined to accommodate the command of the *Forces aériennes stratégiques* (FAS – Strategic Air Forces). On February 17th, 1964, the first *Mirage IV* was delivered to the French Air Force. On the following October 8th, a nuclear alert was triggered at the Mont-de-Marsan base. Based on the triad *Mirage IV/C-135* tanker/AN-11 bomb, the French deterrent was operational.

Coinciding with these events, and drawing lessons from the 1961 putsch, the Defense Council meeting of February 4th, 1964 decided to entrust the gendarmerie with the mission of *contrôle gouvernemental* (CG – government control), the main aim of which was to prevent the use of weapons without a legitimate order from the President of the Republic. This was a new prerogative for the gendarmes, who adapted perfectly and made proposals to the political authorities in order to satisfy the requirements imposed by CG in terms of security.

Initially, the resources and manpower allocated to this mission would be based on those of the Air Force Gendarmerie. Already responsible for security at Air Force bases,⁵ it now also had to guarantee the key stages in the use of a nuclear weapon. On May 22nd, 1964, it carried out an initial test of secure communications between the Taverny and Mont-de-Marsan bases, to evaluate their autonomy and robustness.

3. Y. Rocard, “La naissance de la bombe atomique française,” *La Recherche*, n°141 (February 1983). During the crisis, British Prime Minister Anthony Eden came under pressure from U.S. President Eisenhower to put an immediate end to Western intervention in Egypt.

4. They were army generals Maurice Challe, Edmond Jouhaud, Raoul Salan and André Zeller.

5. Created in September 1943 by decree of the French Committee for National Liberation. For its history, see “[La gendarmerie de l’Air fête ses 80 ans](#),” *Gendinfo*, Ministry of the Interior and Overseas (1 June 2023).

Developing the regulatory framework

Early days: the birth of the Groupement Spécial de Sécurité de l'arme nucléaire (Nuclear Weapons Special Security Group)

On July 15th, 1964, the Gendarmes in charge of the CG mission split off from the Air Force Gendarmerie. They were organized around a command group in Courbevoie (barracks at La Défense) and a central section in Taverny. On August 13th, a decree signed by the Minister for the Armed Forces, Pierre Messmer, officially created the *Groupement Spécial de Sécurité* (GSS – Special Security Group) for nuclear weapons. *Lieutenant-Colonel* Girault was appointed as the first GSS commander.



Special Security Group pennant.

The GSS reported directly to the Minister for the Armed Forces. Although administratively it was attached to the Directorate of Gendarmerie and Military Justice (DGJM – the future Directorate General of the National Gendarmerie), which provided it with the necessary resources, the DGJM did not have the authority to monitor its activities.

Its missions were fourfold. The GSS had to: 1) be able to prevent any movement outside special ammunition depots and workshops (DAMS) of real cores, whether isolated or incorporated into a weapon, without prior authorization from the government; 2) transmit authorizations for movement outside DAMS; 3) know the location of real cores at all times, and be able to report to the relevant government authorities at any time; and 4) exercise constant surveillance and control over nuclear weapons at three critical moments: their transport on national territory, their storage on strategic forces bases and their installation on aircraft or on board nuclear-powered ballistic missile submarines (SSBNs). Military personnel were even absent from certain assembly stages, carried out solely by CEA and GSS teams.

In short, the GSS's *raison d'être* was to keep a constant eye on the nuclear weapon, whatever its state of assembly, until the departure of the delivery platform on an operational mission.

How the mission evolved and adapted during the Cold War

Based on feedback from the early years of the continuous airborne nuclear mission, and in response to the executive power's desire to strengthen CG, the original decree of August 1964 was repealed by the decree of February 28th, 1972.⁶ This new regulatory framework extended the scope of the GSS's missions to take account of developments in the weapons systems inspection systems available to the "engagement" section of CG.

First and foremost, this framework took into account the new security requirements generated by the entry into service of the strategic ground-to-ground ballistic missile component at Albion, and the ocean-going component.⁷ This update of the 1964 decree also guaranteed the President of the Republic the ability to commit – whenever and wherever – the nation's nuclear air, land and sea forces, and, *a contrario*, to make it impossible to launch them without an order from him. Here, we find a fundamental trend: as soon as a new weapon system was approved and entered service in the forces, it was accompanied by an adaptation and reinforcement of the missions of the GSS/GSAN (Gendarmerie for Nuclear Weapons Security).⁸

A new version of the decree was issued on February 7th, 1990, covering, among other things, transportation of nuclear weapons, their sensitive components and experimental devices. For the first time, the issue of costs was clarified, with ongoing operating and equipment expenses for the GSS to be borne by the National Gendarmerie. Expenditure specific to nuclear forces, particular to certain sites or linked to barracks, remained the responsibility of the services that deployed nuclear systems, *i.e.* the French Air Force and Navy.⁹

However, post-Cold War geopolitical realignments and a succession of political decisions led to new adaptations of the GSS's prerogatives. With the disappearance of the threat from the East, France gave up its nuclear ground-to-ground component. It dismantled its Pluton and Hadès systems, as well as the facilities on the Albion plateau. It then rationalized its strategic air and oceanic forces, reducing the number of bomber squadrons from 9 to 2 (1/4 "Gascogne" and 2/4 "La Fayette") and the number of SSBNs from 6 to 4. Finally, the number of nuclear warheads was reduced from 500 to less than 300.

In 1993, a new decree was issued. It changed the name of the GSS to the more explicit *Gendarmerie de la Sécurité des Armements Nucléaires* (Gendarmerie for the

6. In the same year, oceanic deterrence was declared permanent.

7. The first S2 strategic ground-to-ground ballistic missiles were declared operational on August 2nd, 1971, while the SSBN *Le Redoutable* began its first patrol on November 18th, 1972.

8. In this respect, the arrival of the 4th generation air-to-ground nuclear missile (ASN4G) by 2035 is likely to introduce specific oversight systems that will certainly differ from the upgraded medium-range air-to-ground missile currently in service. The introduction of the new airborne nuclear warhead will therefore require an adaptation of GSAN's procedures and working methods. This will be formalized and specified in a new regulatory framework.

9. The French Air Force and Navy each have three "nuclear" sites: the three nuclear air bases (BAVN) at Istres, Avord and Saint-Dizier, and the ports of Cherbourg, Brest and Toulon.

Security of Nuclear Weapons). It also updated the unit's mission statement to reflect the many changes to France's nuclear capabilities in the 1990s.



Tricolor shield, with a stylized rocket embroidered with a gold atom.

This badge was intended for organic units only.

The major reform of 2009

The last major overhaul of the GSAN took place in 2009. Firstly, under the law of August 3rd, 2009, the National Gendarmerie was attached to the Ministry of the Interior, both organically and operationally. The text also recalls the GSAN's essential role in France's nuclear deterrent, stating that "*it also participates in the defense of the homeland and the nation's higher interests, notably in the control and security of nuclear weapons.*"¹⁰

The following month, decree n°2009-1118 of September 17th, 2009 on government control of nuclear deterrence redefined the general organization of deterrence. In particular, it addressed the respective roles of the various authorities involved. For example, the division of responsibilities between the President of the Republic, the Prime Minister, the Defense Minister and the Chief of Staff of the Armed Forces was described in detail.¹¹

With regard to government control, it stated that the CEA's resources were the responsibility of the Defense Minister. Given the "*integrity*" aspect of CG for nuclear systems involved in deterrence¹² and under the responsibility of the Commissariat, the chain of implementation of these systems was entrusted to the

10. Law n° 2009-971 dated August 3rd, 2009 on the National Gendarmerie – "Rattachement de la gendarmerie nationale au ministère de l'Intérieur."

11. [Decree n° 2009-1118 dated September 17th, 2009 on the government control of the nuclear deterrent](#), Journal officiel de la République française n°0216 dated 18 September 2009.

12. The French [Defense Code](#) (article R*1411-8) stipulates that the CG of nuclear deterrence is exercised in three areas (which are "*complementary and inseparable*"): 1) the commitment of nuclear forces, 2) the conformity of employment and 3) the integrity of nuclear deterrence systems", which, according to the Code, "*includes nuclear materials, the oversight of which is designed to give the President of the Republic the assurance that all these systems are protected at all times against malicious or hostile acts, and against breaches of national defense classified information.*"

General Administrator of the CEA, while the security chain was the responsibility of the High Commissioner for Atomic Energy.¹³ In this way, the CEA became a fully-fledged player in CG.

This clarification was part of a wider legal overhaul, since a decree issued on the same day (n°2009-1120) revised the rules governing the control and protection of civil nuclear materials. The decree defined civil nuclear materials as those “*not assigned to systems necessary for the implementation of deterrence policy.*”¹⁴ The importance of the military nuclear sector can be gauged by the semantics used here to differentiate between the civil and military nature of the nuclear materials under consideration. The distinction was made according to whether or not they were used as part of “deterrence policy”. However, this choice remained inversely proportional to the quantities of civilian nuclear materials¹⁵ and to the size of the industrial and human resources that used them.

Following the introduction of this new legal framework into the *French Defense Code*, all texts relating to deterrence would be reviewed, and would only increase the scope of GSAN’s missions.

GSAN, the permanent shadow of French nuclear weapons

As new nuclear systems have been introduced into the forces – but also withdrawn from service – the GSS has adapted to meet the demands of ever-tighter oversight while respecting the need to protect classified information.

This entanglement between the history of the GSS and that of French nuclear weapons has led the GSS to learn to work in close collaboration with the strategic forces. This link between the Armed Forces and the GSS was amply spelled out in a document signed by former Defense Minister Jean-Pierre Chevènement (1988-1991): “*The chain of government control represented by the GSS is independent of the Forces’ government chain of command and control, but this duality does not impede the Forces’ rapid and effective response.*”

Supporting the build-up of strategic nuclear forces

- The air component

The Air Force was the first to acquire nuclear weapons and ensure continuous nuclear deterrence in 1964, and until 1987 it used the AN series of bombs: AN-11, AN-21 and AN-22. They were deployed at the Mont-de-Marsan, Saint-Dizier, Ca-

13. The CEA is a public research organization of a scientific, technical and industrial nature (EPIC). As such, it is headed by a Director General. The High Commissioner (who is seen as a scientific authority of reference) does not belong to the CEA. In this way, by giving him a directorship of the CG, it was possible to guarantee the independence of the Commissariat’s activities.

14. Decree n° 2009-1120 of September 17th, 2009 on the protection and oversight of nuclear materials, their installations and transportation. These materials are used, for example, by EDF and Orano.

15. To give an order of magnitude, the annual consumption of EDF’s nuclear power plants was 8,000 tons of natural uranium in 2017.

zaux, Creil, Cambrai, Orange, Istres, Avord and Luxeuil air bases. These bases became operational between 1964 and 1966. At the same time, the number of Mobile Gendarmerie Squadrons (EGM) stationed in the vicinity of these bases was increased to form *Pelotons Spéciaux de Sécurité* (PSS – Special Security Platoons), which acted as relays for the main GSS section at Taverny.¹⁶

- The ground-to-ground ballistic component

In 1967, the 1st strategic missile group (GMS) was created in Albion, Vaucluse. Occupation of the plateau began in 1968, leading to the construction of air base 200 Apt-Saint-Christol. On June 15th, 1969, in parallel with this change, the *Antenne Spéciale de Sécurité d'Apt* (Apt Special Security Unit) began operations. The following year, given the vast area to be covered (almost 800 km² for the entire system), the unit was reinforced by mobile gendarmerie units and became the *Escadron Spécial de Sécurité d'Apt* (Apt Special Security Squadron).



Transporting a missile towards the Plateau d'Albion, escorted by two Gendarmerie vehicles.

Source: " Histoire de missiles... Le 1^{er} GMS du Plateau d'Albion," *CAPCOM Espace*.

16. It was not until January 29th, 1973, that the Nuclear Weapons GSS received its first emergency command post. It was located within the underground facilities at Lyon-Mont-Verdun air base 942.

Due to the extensive nature of the work to be carried out on air base 200, the first launch unit (nine S2-type strategic ground-to-ground ballistic missiles) was not declared operational until August 2nd, 1971. In the end, with the announcement of its closure by President Jacques Chirac in 1996, the site was completely denuclearized in February 1998.

- The oceanic component

In the late 1960s, President de Gaulle confirmed the construction of the Île Longue naval base in the Finistère department. It was to be the base for the SSBNs of the *Force océanique stratégique* (FOST – Strategic Oceanic Force). On January 15th, 1971, just as construction was nearing completion, a *Peloton Spécial de Sécurité* (Special Security Platoon) was created. Its mission was to carry out CG missions for the first strategic sea-land ballistic missiles to be carried by the six *Le Redoutable* class submarines.¹⁷ GSS teams are also involved in all nuclear qualification operations for these vessels, prior to their admission to active service.

Finally, in December 1979, the decision was taken to create an *Antenne Spéciale de Sécurité de l'Île Longue* (ASSILO – Special Île Longue Security Unit) on January 1st, 1984. This decision reflected a desire to expand the mission of the unit, which was organically attached to the GSS. It could also count on reinforcements from the Brest EGM, notably for transport operations in Finistère.

Ensuring security of tactical nuclear weapons

In August and December 1973, at the Saint-Dizier and Luxeuil air bases, the French Air Force took delivery of the AN-52, the first French-designed “tactical” nuclear weapon. Compared with the AN-22 and AN-11 before it, the external appearance was identical, but the yield was different: between 60 and 70 kilotons for the AN-22 and -11 versus 25 kilotons for the AN-52.

Mounted on aircraft of the *Forces aériennes tactiques* (FATac – Tactical Air Forces), these weapons necessitated nuclear qualification of the *Mystère 20* designed to transport them, as well as the establishment of non-permanent detachments at the Colmar, Toul-Rosières, Cognac, Bordeaux-Mérignac and Solenzara air bases. These detachments were equipped with *Mirage III E* and *Jaguar* combat aircraft for the French Air Force, and *Super-Étendard* for French Naval Aviation.

The introduction of this new weapon required a further adaptation of the GSS, which played a full part in weapon qualification. For example, a CG detachment was set up at the Pacific Experimental Center during Operation *Tamara*, which involved an AN-52 released from *Mirage III* n°617 on August 28th, 1973.

17. Class comprising six SSBNs: *Le Redoutable* (1971), *Le Terrible* (1973), *Le Foudroyant* (1974), *L'Indomptable* (1976), *Le Tonnant* (1980) and *L'Inflexible* (1985). Today, oceanic deterrence is based on four *Le Triomphant* class submarines: *Le Triomphant* (1997), *Le Téméraire* (1999), *Le Vigilant* (2004) and *Le Terrible* (2010). They will be replaced by third-generation nuclear-powered ballistic missile submarines (known as “SNLE 3G”) at the turn of the 2030s.

With regard to the development of a *Force aérienne nucléaire* (FANU – Nuclear Naval Aviation Force), the AN-52 had to be tested from the *Clemenceau* and *Foch* aircraft carriers before it could be put into service. Studies were carried out in December 1979, with a view to taking gendarmes on board – an essential step due to the presence of nuclear weapons and the need for CG continuity.

In this respect, particularly in terms of operational processes, the presence of a nuclear warhead on an aircraft carrier can be likened to the actions that gendarmes would have to perform on an air base. Whether on the tarmac of a base or on the flight deck of an aircraft carrier, it must be ensured that the weapon can be stored safely, removed from storage, attached and deployed on a *Rafale* – whether *M* (“*Marine*” – Navy) or *B* (“*Biplace*” – two-seater) – on the orders of the President... The gendarmes must be able to validate all the key stages in preparing for a nuclear mission.

Nuclear qualification operations for the Hyères naval air station, the *SA.330* helicopter in charge of air transport, the *Super-Étendard* armed with an *AN-52* and the *Clemenceau* aircraft carrier began on May 18th, 1980, and were subsequently also carried out from Toulon. The first embarkation of gendarmes from the *Unité Spéciale de Sécurité Embarquée* (USSE – Special Onboard Security Unit) took place on February 27th, 1981 aboard the *Clemenceau* and on April 26th, 1982 for the *Foch*. These operations – with a change of teams at dockside or at sea – would follow one another without interruption for several years, sometimes over long distances. In July 1987, for example, the USSE was airlifted aboard the *Clemenceau* anchored off Djibouti. The team being relieved returned home by the same means. These long-distance changeovers would be carried out regularly for almost one year.

Finally, during the Cold War, land forces implemented the AN-51 (the land and tactical counterpart to the AN-52) with the *Pluton* ground-to-ground system. This system was gradually put into service between 1974 and 1977 in nuclear artillery regiments. Once again, to take account of the arrival of the AN-51, *Pelotons Spéciaux de Sécurité* (PSS – Special Security Platoons) were created at Mailly-le-Camp, Laon-Couvron, Oberhoffen, Suippes and Belfort.

However, the end of the Cold War led to the abandonment of so-called “tactical” nuclear weapons. The *Pluton* and its successor *Hadès* were withdrawn in 1993 and 1996, respectively. This of course meant the closure of the PSSs designed to guarantee their security.

Transportation of nuclear weapons

According to the initial decree creating the GSS in 1964¹⁸, the latter was responsible for transporting nuclear weapons. Two squadrons were designated to perform in turns this highly sensitive mission covering all aspects of the secure transport of

18. Instruction n°02709 concerning the special security group for nuclear weapons, dated December 16th, 1965.

weapons and weapon components, and the anticipation of potential threats, whether on the road or in the air. As of January 1st, 1965, this mission was carried out by EGM 2/10 in Châteauroux and EGM 3/10 in Blois.

In 1964, the GSS's nuclear weapons transport mission was limited to escorting convoys. Then, in 1981, a *Transports sensibles nucléaires* (TSN – Sensitive Nuclear Transport) section was created within the GSS to take responsibility for the different facets of the mission, from planning to operational tracking of the convoys. Over time, the providers of these missions became diversified. In 1983, TSN was given responsibility for transport missions on behalf of the management of the nuclear test centers, then, in 1985, of the CEA.¹⁹ Finally, since 1992, TSN has also handled the transport of spent fuel elements.

GSAN at a time of post-Cold War upheaval

Adapting to changes in strategic nuclear forces

The year 1988 was mainly devoted to the final nuclear qualification operations for the *Air-Sol Moyenne Portée* (ASMP – medium range air-to-surface) missile for the FAS and the Nuclear Naval Aviation Force, on board the *Foch* aircraft carrier. On the latter, squadrons *IIF* and *I7F* were scheduled to deploy the system.²⁰ The *Clemenceau*, meanwhile, would continue to carry AN-52s until 1991, and would not receive its first ASMPs until 1992.

For the French armed forces, the final years of the Cold War also saw the arrival of new deterrence weapon platforms. In 1986, the *Super-Étendard* was replaced by the *Modernized Super-Étendard* (SEM), later replaced by the *Rafale Marine* in 2002. The following year, it was the Air Force's turn to declare the entry into operational service of the *Mirage 2000N*, the new ASMP missile platform that would eventually replace the *Mirage IV*.

In 1990, on December 18th and 19th, the validation of air transport of nuclear weapons (AN-52 and ASMP) became effective between Air Force bases and the Atlantic coast. Throughout this process, the GSS accompanied the deployment of these weapons in the forces, guaranteeing security.

For the French forces, the 1990s marked the beginning of a period of major reforms and reorganization. As far as the GSAN was concerned, with the exception of the oceanic component whose sites remain unchanged, only the special security platoons at Avord, Istres, Luxeuil, Saint-Dizier and Valduc remained. In 2011, the Mont-de-Marsan base would lose its nuclear status, as would Luxeuil in 2012.

19. On this date, the Valduc special security platoon was created. It was responsible for government control of nuclear weapons components delivered to the Forces, dismantling retired weapons systems, and carrying out certain operations at nuclear air bases.

20. In the same year, gendarmes for the aircraft carrier's Special Onboard Security Unit (USSE), previously provided by the Saint-Dizier PSS, would be drawn from the Istres PSS. In the event of an emergency, the USSE would also be able to call on personnel from the Mont-de-Marsan PSS.

Already a member of the select “club” of nations with aircraft carriers, France acquired a nuclear-powered vessel, the *Charles de Gaulle*, in 2000. GSAN was once again involved in the many qualification operations for this ship in the field of government control and the transport of nuclear weapons onboard.²¹

Finally, in addition to the regulatory redefinitions of GSAN’s missions that took place at the same time, 2009 and 2010 were also marked by the commissioning (and related qualifications) of the new *Tête Nucléaire Aéroportée* (TNA – airborne nuclear warhead) – the “improved” ASMP – at all Air Force sites. For the Valduc PSS, this process involved managing reception and delivery of the new missile to Air Force sites.

The ocean-going component also underwent a number of changes in the post-Cold War period. Its size was re-evaluated with the transition from first-generation SSBNs to the “new generation” of *Le Triomphant*-class SSBNs: their number was reduced from 6 to 4 units – the minimum size to maintain continuous oceanic patrols.

There were also developments in the missile sector, with the arrival of the M51.1 in 2010 – replacing the old M45s – with improved versions still in development today. The commissioning of a new warhead was accompanied by a test phase that began in 2003, with real launches using inert warheads, with a heavy involvement of GSAN (particularly in the event of failure, as in the case of the 2013 test launch from the submarine *Le Vigilant*). The latest development: from 2016, the M51.1 TN75 was replaced by the M51.2 *Tête Nucléaire “Océanique”* (TNO – “Oceanic” Nuclear Warhead) delivered by the CEA. Since then, there has been a steady stream of improvements, with preparatory work currently underway for the development of the M51.4.

As in the field of airborne nuclear warheads, the TNO warheads start their “career” when they are picked up at the Valduc CEA by GSAN gendarmes. At every stage of the warheads’ operational life, the gendarmes guarantee the three complementary and inseparable aspects of government control, as laid down in the French *Defense Code*: the deployment of nuclear forces,²² the conformity of use²³ and the integrity of nuclear deterrence systems.²⁴

Finally, the GSAN monitors and works with all players (military and civilian) involved in deterrence, under the authority of the President of the Republic and the

21. On this subject, see A. Faure, “[Des gendarmes à bord du “Grand Charles”](#),” *Gendinfo*, Ministry of the Interior and Overseas (2 June 2021).

22. “[...] the oversight of which is designed to ensure that the President of the Republic has the ability to engage nuclear forces at any time, and to make it impossible to activate nuclear weapons without an order from him.”

23. “[...] the oversight of which is designed to give the President of the Republic the assurance that the operational posture of the nuclear forces complies with his directives.”

24. “[...] including nuclear materials, the oversight of which is designed to give the President of the Republic the assurance that all these systems are protected at all times against malicious or hostile acts and against breaches of national defense classified information.”

government. It is committed to fulfilling the missions entrusted to it since the promulgation of its founding decree in 1964, in the spirit of the fundamental text *L'Œuvre Commune* for deterrence.²⁵

The evolution of transportation systems

New, highly complex systems for transporting weapons components are being delivered. Keeping pace with these developments requires close cooperation with the GSAN. These systems also require a number of qualification operations, combining safety and security requirements, for which the role of the gendarmes is decisive – much more so than on a military base.

With these new systems, military nuclear transport has taken on a new dimension, one in which the National Gendarmerie has demonstrated its expertise through the concept of “defense in depth”. This concept is based on three pillars: the technical performance of the packaging (containment of contents, robustness of packaging, shielding, *etc.*), the reliability of the transport system and the prevention or management of incidents and accidents.²⁶

Thus a sensitive transportation operation benefits from the action and vigilance of all the gendarmerie units geographically involved in the route. The whole system constitutes a series of homogeneous, coordinated layers of security to guarantee a protective bubble around the convoy.

This level of excellence also involves international exchanges with a view to benchmarking. For example, GSAN was involved in the Franco-American Accident Working Response Group. In addition to these working groups, exercises on American soil have generated a wealth of feedback. In this respect, GSAN's expertise is recognized by its American counterparts. The testimony of former FAS Commander (2012-2014) Patrick Charaix, during a hearing before the Committee on National Defense and Armed Forces, offers a glimpse of this. Referring to the two major nuclear incidents experienced by U.S. forces in 2006 and 2007,²⁷ he concluded: “*These serious incidents involving nuclear weapons, which escaped all government control for 36 hours, led a commission of inquiry to recommend the creation of a specific*

25. *The Œuvre Commune Armées-CEA* defines, by decision of the Prime Minister, the project management missions delegated to the CEA for nuclear defense programs, and how the CEA reports on these missions. This text dates from June 13th, 1961, and is updated every 5 years or so, in particular to take account of changes in the scope of CEA/DAM's responsibilities. See here V. Salvetto (DAM), “[Répondre aux enjeux de la dissuasion de demain](#),” *Le Jaune et Le Rouge*, Magazine n°769 (November 2021).

26. On the concept of “defense in depth”, see “[Savoir et comprendre: le transport de matières radioactives](#),” *Institut de radioprotection et de sûreté nucléaire* (March 2018).

27. In 2006, an incorrect delivery of *Minuteman III* intercontinental missile components. The following year, during an exercise, a *B-52H* took off from Minot AFB (North Dakota) on a flight to Barksdale AFB (Louisiana) carrying six AGM-129 cruise missiles armed with nuclear warheads – in violation of current safety protocols. On these two episodes, see J. Patterson, “[Taiwan Fuse Shipment Reveals Nuclear Security Gaps](#),” *Arms Control Association* (8 November 2008); P. Grier, “[Misplaced Nukes](#),” *Air&Space Forces Magazine* (26 June 2017).

command [...]. In 2009, a command dedicated to the airborne nuclear component was re-created, and since then the FAS have had regular contact – twice a year – with Air Force Global Strike Command, whose first action was to come and see us so that we could explain to them how our system of government control and nuclear security and our specialized gendarmerie work.”²⁸

Close cooperation with Forces training and exercises

In order to maintain a high level of competence and resilience, and to keep up with the elevated tempo of Forces training operations, GSAN personnel²⁹ are involved in a large number of exercises testing the different phases in the buildup to launch our defense systems. Of course, GSAN works and trains in the same way with the FOST and the FANU. Our gendarmes on the other side of the world can thus embark on a French Navy vessel.

A first difficulty then arises. While the FAS have a clear demonstrative dimension – regularly referred to as “*the one that can be seen*” – the positioning of GSAN’s gendarmes during exercises must remain invisible so as not to reveal the secrets of our procedures and working methods. Nevertheless, we invite the curious reader to consult the book by General Bruno Maigret – former commander of the FAS from 2018 to 2021 – where a particularly vivid account takes us behind the scenes of one (of many) of these major exercises.³⁰ He also talks about the importance of the *tirs d’évaluation des Forces* (TEF – Forces Evaluation Launches). To demonstrate the high security levels within our organizations, he briefly mentions the role of the GSAN: “*Present at every stage of raid preparation, the gendarmes – who are not part of the FAS – are a full-fledged part of nuclear operations.*”³¹

The details of his account show the wide range of situations to which the gendarmes have to adapt, without ever slowing down the speed of the Forces’ action. This applies throughout France, while constantly anticipating non-compliant situations, such as the emergency landing of an aircraft... Finally, we’ll borrow from this book a phrase full of meaning, and equally applicable to the GSAN: “*The culture of the alert is inseparable from maintaining the posture.*”³²

28. *Loi de finances pour 2015. Tome VIII – Sécurité. Gendarmerie nationale*, op. cit., 51.

29. In 2019, according to a report by the *Cour des Comptes* (French general accounting office), there were 54 gendarmes reporting to the GSAN; “Bilan du rattachement de la gendarmerie nationale au ministère de l’Intérieur,” report requested by the Senate Finance Committee (June 2021): 265. Including these units and support staff, the number of personnel involved in GSAN missions can rise to around 300; *Loi de finances pour 2015. Tome VIII – Sécurité. Gendarmerie nationale*, op. cit.

30. B. Maigret, A. Colcombet, *Opération Poker. Au cœur de la dissuasion nucléaire française* (Paris: Éditions Tallandier, 2021): 256 p.

31. *Ibidem*, 136.

32. *Ibidem*, 132.

Conclusion

The implementation of deterrence policy involves many players, including political authorities, civilian and military industrial players, oversight and inspection bodies, and other protagonists, such as the *Gendarmerie de la Sécurité des Armements Nucléaires* (GSAN). A specialized unit of the French National Gendarmerie, in the same way as the other specialized Gendarmerie units working alongside the armed forces,³³ the GSAN reports to the Director General of the National Gendarmerie and, since its creation, has been placed under the authority of the Minister for the Armed Forces.

Its history is inseparable from that of deterrence: born of deterrence, it cannot exist without it. Committed to the Forces since 1964, the GSAN still contributes today to the credibility of our deterrent. This unique unit, composed entirely of gendarmes (officers and NCOs), has constantly adapted its regional presence and organization to keep pace with the evolution of deterrence systems, and has always succeeded in adapting to meet the requirements of the nation's highest authorities.

33. For example, the *Gendarmerie Maritime* (GMAR – Naval Gendarmerie), the *Gendarmerie de l’Air* (GAIR – Air Gendarmerie) and the *Gendarmerie de l’Armement* (GARM – Armaments Gendarmerie).

AIR NUCLEAR COMPONENTS
Abroad

Nuclear Deterrence in Theory and Practice: Understanding the USAF Nuclear Deterrent Posture

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Introduction

In 2024, the current United States Air Force nuclear forces are more important than ever. Or, put differently, they are just as important as they always have been, but new and emerging threats have once again brought their importance to the forefront of our attention. According to the U.S. Air Force Nuclear Weapons Center, “*nuclear deterrence is the #1 priority mission of the Department of Defense. The nuclear deterrent underwrites every U.S. military operation on the globe – it is the backstop and foundation of our national defense and that of our allies.*”¹

After decades of focusing on irregular warfare, the United States finds itself once again facing issues of great power rivalry such as it has not seen since the Cold War. This time, however, there are two nuclear armed near peer threats in the form of China and Russia as well as threats from other actors such as North Korea and Iran. While the U.S. focused on preventing terrorism in the Middle East for the past twenty odd years, both near peer threats have watched, learned, and focused on their own nuclear arsenals.

1. “[Sentinel ICBM](#),” *Air Force Nuclear Weapons Center*.

The United States faces an incredibly contested strategic environment that raises significant, unanswered questions about the role that nuclear weapons will play in U.S. national security strategy going forward, and the forces that will be required to deter –and if necessary, defeat – its adversaries. The next decade may be among the most strategically challenging in U.S. history.

As the 2022 *National Defense Strategy* (NDS) points out, we find ourselves in the midst of a “‘decisive decade,’ one stamped by dramatic changes in geopolitics, technology, economics, and our environment. The defense strategy that the United States pursues will set the Department’s course for decades to come.”² The NDS calls out China as the pacing threat for the United States, with Secretary of Defense Lloyd Austin noting that the “PRC remains our most consequential strategic competitor for the coming decades... Meanwhile, Russia’s unprovoked, unjust, and reckless invasion of Ukraine underscores its irresponsible behavior... In these times, business as usual at the Department is not acceptable.”³ So what is to be done differently, and why does it matter? How can understanding U.S. thinking on deterrence better help us assess these questions? Further, and perhaps most importantly, is the United States currently postured to deter two peer nuclear adversaries simultaneously? Can it do so while also deterring other conflicts or opportunistic aggression from other actors such as North Korea or Iran?

This article will explore these questions by first discussing how the United States views nuclear deterrence and how its views have been shaped over time. Next it will offer an overview of how its nuclear forces are organized, offering strengths and limitations to the current force. Finally, the article concludes with a frank discussion of current and future challenges that the U.S. faces for maintaining a credible nuclear deterrent.

Nuclear Deterrence in Theory

The predominant intellectual history of nuclear deterrence in the United States is borne out of the Cold War and the years immediately prior. From the dawn of the nuclear age, nuclear deterrence has concurrently operated in theory and practice, as strategy and policy. There are pros and cons to this symbiotic relationship. On the one hand, leaders and policymakers directly engaged leading scholars during the Cold War, and we saw a truly iterative process of the refining of ideas and shaping of policy. On the other hand, “deterrence” has become almost meaningless as we have blurred the lines between theory, strategy, and policy over time and used the word as a catchall for anything that isn’t brute force.

In order to better understand how the United States views nuclear deterrence today, it is useful to first briefly summarize the trajectory of scholarship on the subject, which are best thought of as four “waves” of deterrence thinking. Next, a short description of how this scholarship has influenced presidential administrations’ *Nuclear*

2. “[2022 National Defense Strategy](#),” U.S. Department of Defense (27 October 2022): iii.

3. *Ibidem*.

Posture Reviews is useful to connect scholarship on nuclear deterrence to U.S. national strategy. This section will end with a discussion of the latest NPR and where we can expect the U.S. to go from here.

“Deterrence” as a concept has been around since at least the advent of the social contract, in which individuals in a state were deterred from criminal activity based on their belief that the state would punish such behavior. Arguably though, deterrence has existed as long as humans have been alive and seeking to influence the behavior of one another. To “deter” comes from the Latin *deterreere*, which literally translates, “to frighten from or discourage from [taking some action].” The advent of the nuclear age led to a renewed interest in and focus on deterrence. The Department of Defense defines deterrence in *Joint Publication 3.0* as “the prevention of action by the existence of a credible threat of unacceptable counteraction and/or belief that the cost of action outweighs the perceived benefits,”⁴ though a more illustrative conception comes from Dr. Strangelove, when he said that deterrence is “the art of producing in the mind of the enemy the fear to attack.” Note that deterrence happens *cognitively* – its success or failure is dependent on an adversary’s belief that a deterrent threat is credible.

Though there are some quibbles that more exist, typically, we bucket scholarship on nuclear deterrence into four distinct waves.⁵ The first wave of nuclear scholarship came after World War II, and is characterized by a response to a problem occurring in real time: the advent of the atom bomb. This wave is epitomized by Bernard Brodie and his writing on *Strategy in the Missile Age*.

The second wave emerged between the 1950s and 1960s, characterized by the rational actor model and employing tools like game theory to better understand the logic of nuclear deterrence. It coincided with a general trend in the social sciences known as the “behavioral revolution”, in which various disciplines in the social sciences, particularly political science and economics, took a positivist approach to research – attempting to extract normative beliefs out of research and conduct a rigorous scientific method to human behavior as in the hard sciences.⁶ This second wave can really be considered the “heyday” for scholarship on nuclear deterrence, it was during this period that conventional wisdom about the principles of nuclear deterrence were generated. Scholars such as Thomas Schelling and Hermann Kahn epitomize this period of scholarship, and their competing views on escalation and risk tied directly to political leaders deterrent policies.

The third wave of nuclear scholarship represents a pushback against the assumptions of rational choice, coming to fruition in the 1970s and 1980s. This scholarship is epitomized by work from Robert Jervis and Janis Stein and questions assumptions about the rational actor model: is there a unitary actor in the form of a state? Do

4. “[Air Force Doctrine Publication \(AFDP\) 3-72 Nuclear Operations](#),” Curtis E. Lemay Center (18 December 2020).

5. For instance, see: S. Monaghan, “[Deterring hybrid threats: Towards a fifth wave of deterrence theory and practice](#),” *The European Centre of Excellence for Countering Hybrid Threats* (March 2022).

6. E. Hafner-Burton, S. Haggard, D. Lake, D. Victor, “[The Behavioral Revolution and International Relations](#),” *International Organization*, Vol. 71 (2017): 1-31.

individuals act “rationally” as proscribed by this model – do they have perfect information, time, and even enough sleep to make decisions in the ideal laid out? If not, how does this affect our understandings of deterrence? This wave of scholarship also sought to empirically test the largely theoretical work put forth previously, predominately through case study work on conventional deterrence.⁷

The final and fourth wave of scholarship is similar to the first in that it was a response to changing real world events rather than a refinement of ideas. The fourth wave is tied to the collapse of the Soviet Union, and fears over what were deemed “loose nukes” in the former Soviet Republics Kazakhstan, Belarus, and Ukraine. Were the nuclear weapons safeguarded effectively? Would terrorists be able to gain access to them? Interestingly, this wave is the first wave of scholarship that considered what it meant to deter an actor other than a state. Though this scholarship really began in the early 1990s, after the September 11, 2001 terrorist attacks against the United States, a stronger impetus to reexamine what deterrence meant in light of non state actors arose.⁸ The fourth wave both builds on the previous waves, taking many of the same assumptions about assurances, escalation, and how to effectively deter against different actions and actors, and generates new thinking that seeks to take deterrence beyond a nuclear-conventional divide to better understand how the precepts of deterrence will function in domains such as space and cyber and in situations that do not involve interstate rivalries.⁹

After fears of loose nukes tamped down in the early 2000s, the West saw a decline in serious thinking on nuclear deterrence – with the collapse of the Soviet Union and the safe transfer of nuclear weapons out of the former Soviet Republics, fear over nuclear war took a backseat to eradicating terrorism in the Middle East. At the time, the North Korean bomb was a still little more than a pipe dream; China had a fledgling nuclear arsenal while it appeared to be embracing the liberal world order; Russia was no longer considered a threat; South Africa peacefully gave up its nuclear weapons program; and India and Pakistan were fledgling regional nuclear powers at best.

This lack of deep thinking on nuclear issues took place across both policy and military circles and in academia, with thought shifting to how to win a war against an ideology. As a personal anecdote, I received my Ph.D. in Political Science during this time period, and was told by almost every one of my professors that I needed to rethink my dissertation topic – which focused on why leaders sought nuclear weapons and what tools policymakers had to leverage nuclear reversal¹⁰ – because “*no one cares about nuclear weapons anymore.*” The implication being of course that I would not be able to find employment. Luckily for me, but perhaps not so luckily for international stability, the threat of nuclear war is still real, and is once again

7. J. Knopf, “The Fourth Wave in Deterrence Research,” *Contemporary Security Policy*, Vol. 31, n°1 (2010): 1-33.

8. *Ibidem*.

9. *Ibidem*, 2.

10. P. P. Cone, “Leaders in Search of the Bomb: Institutional Incentives for Going Nuclear,” *Thesis*, Doctor of Philosophy, Political Science. University of South Carolina (May 2016).

at the forefront of U.S. strategy, policy, and scholarship. As Jervis noted in 1979, deterrence theory is “*probably the most influential school of thought in the American study of international relations*.”¹¹ This scholarship has had direct bearing on U.S. policymaking, particularly when it comes to presidential administrations setting out their nuclear deterrence postures. This then trickles down and informs joint military strategy and doctrine and has direct implications for how the USAF postures its nuclear forces.

While the objectives of United States’ foreign policy tend to change with each incoming presidential administration, one constant has been a focus on preventing the proliferation of nuclear weapons to nonnuclear states and ensuring that the United States maintains a credible nuclear deterrent.¹² There have certainly been shifts in deterrent policy over time, for instance the shift from “Massive Retaliation” under the Eisenhower Administration to “Flexible Response” under the Kennedy Administration, or more recently to “Tailored Deterrence” in the early 2000s and most recently to a policy of “Integrated Deterrence” in the most recent iteration of the NPR.¹³ Each U.S. president has a unique focus on certain policies of deterrence. For instance, Eisenhower’s policy of massive retaliation focused on the principles of mutually assured destruction – a state convinces another that if it were to attack, the response would be so catastrophic that it is better to not act. When Kennedy came into office, his administration shifted from this guarantee of massive response to a more flexible posture. The shift was meant to politically separate him from his predecessor domestically, better reassure allies abroad, and respond to scholars of the day who saw Eisenhower’s policy as implausible. The policy outcome of flexible response focused on selective strategic strikes that were more limited in nature, where a state could focus on ensuring a counter attack at any level of escalation (not just nuclear). Put differently, a greater focus was placed on increasing strength in conventional operations as a means of raising the threshold for an adversary to go nuclear.¹⁴ This first shift set the stage for other changes in U.S. deterrent policy under multiple administrations.

Of more recent note are the policies of tailored deterrence and integrated deterrence, which built on each other and their predecessors. After the Soviet Union broke apart and the Cold War ended, the focus of the United States shifted. Tailored Deterrence was borne out of the unipolar moment and grew over time from Bush Senior to Obama. Tailored deterrence was meant to give the U.S. the most options possible in a shifting international system in which it found itself the sole superpower. Policy planners over these two decades had many focal points – how to deter

11. R. Jervis, “Review: Deterrence Theory Revisited,” *World Politics*, Vol. 31, n°2 (1979): 289-324.

12. P. Price, “Continuity and Change in American Nonproliferation Policy toward North Korea,” in S.-M. Lee, T. Roehrig, *Negotiation Dynamics to Denuclearize North Korea* (New York: State University of New York, 2023): Chapter 5.

13. M. Doughty, “[Integrated Deterrence for the 21st Century: More Threats, Many Options](#),” *Thesis*, School of Advanced Air and Space Studies, Air University, Maxwell AFB (June 2023): 108 p.

14. R. McNamara, *Blundering into Disaster: Surviving the First Century of the Nuclear Age* (New York: Pantheon Books, 1986).

small states newly armed with WMDs, how to deter against the potential of non state terrorist organizations gaining nuclear weapons, and how to navigate its growing alliance network. Tailored deterrence was meant to demonstrate that there is not a one size fits all policy for dealing with multiple actors of varying sizes and threats.

Finally, integrated deterrence, the current policy of U.S. deterrence builds on shifts in tailored deterrence and flexible response and is meant to highlight again a changing international system in which the U.S. must adjust to. For the first time in its history, the U.S. concurrently faces to nuclear armed near peer competitors in the form of Russia and China. In order to effectively deter threats, it must have a strategy that spans domains, sects of government, allies, and types of weapons systems – it must integrate across these spectrums.

However, these shifts in many ways represent continuity as much as they do change. The goal has been, and remains, determining how the United States can best posture itself to prevent nuclear war. What constitutes a credible nuclear deterrent for the United States and does this credibility change depending on context of the threat faced? Articles in this series focus on the USAF's historic nuclear deterrent, specifically focusing on the years of Strategic Air Command when nuclear awareness was arguably at its highest. This article will focus on current nuclear forces, paying particular attention to the two legs of the nuclear triad that the Air Force owns. The next section will highlight how the nuclear triad (air, land, and sea launched) functions today, the role of air power in nuclear deterrence, and strengths and limitations to the U.S. nuclear forces.

U.S. Nuclear Forces in Practice

Like scholarship and policy on nuclear deterrence, U.S. nuclear force structure has developed over time, with changes occurring in response to the international threat environment. At the end of the Cold War, the U.S. nuclear arsenal was reduced by eighty five percent. While these changes are significant numerically, structurally, changes to the U.S. nuclear forces have occurred only on the margins, for as General Mark A. Milley, former chairman of the Joint Chiefs of Staff noted, *“The nuclear Triad has kept the peace since nuclear weapons were introduced and has sustained the test of time.”*¹⁵ Doctrine and strategy documents that outline nuclear force structure for the United States shows much continuity in objectives: to maintain a credibly nuclear deterrent that assures allies and partners, deters adversaries, and achieves objectives if deterrence is to fail. These objectives were true at the height of the Cold War and they still hold today.

The United States utilizes a nuclear triad – forces that operate from land, sea, and sky – to meet these objectives. The USAF holds two legs of the triad, the air and land and the U.S. Navy holds the sea-based leg.

15. [“The Importance of the Nuclear Triad,”](#) OSD Nuclear and Missile Defense Policy (November 2020).



© Congressional Budget Office, “[Projected Costs of U.S. Nuclear Forces, 2021 to 2030.](#)”

Today, the nuclear triad consists of 400 land-based intercontinental ballistic missiles (ICBMs); 14 ballistic missile submarines (SSBNs) that are armed with 240 submarine-launched ballistic missiles, and 60 nuclear-capable heavy bomber aircraft that are equipped to deliver gravity bombs and cruise missiles. The U.S. nuclear triad is setup in such a way to provide the most robust capability possible for credible deterrence: each leg has unique capabilities, these capabilities complement one another, and collectively, *“the Triad is intended to ensure that no adversary believes it could launch a strategic attack under any circumstances that eliminates the U.S. ability to respond and inflict unacceptable damage.”*¹⁶

From the sea, SSBNs are the most survivable leg of the triad. This is because some portion of the fleet is perpetually on patrol, which is intended to make it difficult to track the entire fleet. Currently, the SSBNs are an *Ohio*-class that began patrol in 1982. SSBNs are both quite mobile, with multiple launch points available and offer a continuous presence, with each patrol occurring for months at a time. The *Ohio*-class submarines carry 20 Trident II D5 submarine-launched ballistic missiles (SLBMs).¹⁷ Similar to the Minuteman III, the Trident II can carry multiple nuclear warheads, which gives diverse response options. Currently the Trident II D5 missiles

16. *Ibidem.*

17. U.S. Department of Defense, “[2016 Nuclear Matters Handbook – New Revised Edition, Authoritative Guide to American Atomic Weapons, History, Testing, Safety, Security, Delivery Systems, Physics and Bomb Designs, Terror Threats,](#)” (2017): 302 p.

are low-yield – the W76-2 warhead is designed to be a deterrent against a limited strike by an adversary. These SLBMs will be supplemented with Nuclear-Armed-Sea-Launched Cruise Missiles (SLCM-Ns) that are meant to deter a strategic attack, including limited nuclear strikes from an adversary.¹⁸



© USNI News, "[Ohio-Class Subs Approaching Several Firsts As Navy Prepares Them To Reach 42 Years of Service.](#)"

The land-based ICBMs, meanwhile, are designed to be responsive, with a command and control structure that assures connectivity to the U.S. President allowing a rapid response to an attack. They are deployed in hundreds of missile silos around the United States and are capable of reaching targets within minutes of being launched, which takes away crucial decision making time for an adversary and making it nearly impossible for them to target. Currently, the ICBMs are Minuteman III missiles, which were first deployed in 1970.¹⁹ Due to their dispersed and hardened nature, adversaries would have to launch a massive attack on the U.S. homeland to attempt to disable all of the ICBMs, operating as a deterrent by denial, sending the signal to any potential adversary that they will be unable to meet their objectives. U.S. nuclear plans have accounted for a massive first strike from an adversary by either absorbing the first strike and responding effectively (known as second strike capability), or, if deemed necessary to launch ICBMs while under attack to ensure the systems are not disabled.²⁰ Retaining this option forces the adversary to consider that it might very well “waste” hundreds of nuclear warheads on empty silo targets. ICBMs provide

18. "[The Importance of the Nuclear Triad](#)," *art. cit.*

19. U.S. Department of Defense, "[2016 Nuclear Matters Handbook...](#)," *art cit.*

20. "[The Importance of the Nuclear Triad](#)," *art. cit.*

many options and capabilities to the U.S. president in the face of a nuclear attack. They have the capability to upload additional warheads, the Minuteman III can carry up to three at a time, though each is loaded with only one missile to provide targeting flexibility.²¹ Additionally, because ICBMs are on constant alert, it takes some of the burden off of the bombers, which allows them to be more flexible in their postures.



© Military.com, "[LGM-30 Minuteman III](#)."

Finally, in the air, bombers are designed to be flexible. The Air Force currently has both bomber aircraft, the *B-52H* heavy bomber and the *B-2* bomber and dual capable aircraft (DCA), the *F-15E* and most recently, the *F-35A* is designated to carry the *B61-12*.²² The *F-35A* is set to replace the *F-16 Fighting Falcon*, a highly maneuverable aircraft that flew a variety of missions from suppressing enemy air defense to forward air controller missions and the *A-10 Thunderbolt II*'s, which have been the primary fighters over several decades.²³ The spokesman for the *F-35* Joint Program Office, Russ Goemaere, noted that the *F-35A* "*achieved Nuclear Certification ahead of schedule, providing U.S. and NATO with a critical capability that supports U.S. extended deterrence commitments earlier than anticipated.*"²⁴ These American

21. *Ibidem*.

22. *Ibidem*.

23. "F-35A Lightning II – Fact Sheets," *website* of the U.S. Air Force.

24. M. Marrow, "[Exclusive: F-35A officially certified to carry nuclear bomb](#)," *Breaking Defense* (8 March 2024).

fighters add an element of deterrence to the traditional bombers when we think of nuclear deterrence. Particularly for NATO allies in Europe, the dual capable fighters are seen as a key component of deterring Russian aggression.

The *B-2 Spirit* is set to be replaced by a *B-21* stealth bomber, though other articles in this series will discuss this new bomber's importance. Bombers are arguably the clearest signal of U.S. deterrence – providing a visible indicator of resolve both to adversaries and allies alike. Once bombers are placed on alert, there are a variety of yield and deployment options available, making them the most flexible option of the triad.²⁵ The bombers have an almost unlimited range because they can be refueled while in the air, they can be tailored to carry multiple nuclear and/or conventional weapons depending on mission-set, and can be forward deployed to allied and partner nations.



© U.S. Air Force, "[Air Force Photos.](#)"

(*B-52 Stratofortress, F-35 A Lightning II, B-2 Spirit*)

While the U.S. nuclear triad has worked well since its introduction in the 1960s, the majority of systems that compose it are outdated, operating well beyond the intended lifecycle they were designed for. One current issue that the U.S. faces is the need to modernize the systems that comprise the nuclear triad or risk losing them. This is crucial to maintaining a credible nuclear deterrent. The average age of a

25. *Ibidem.*

nuclear warhead is just under thirty years. For instance, the Minuteman III missiles have been operating for over fifty years, with an expected service life of ten while the *Ohio*-class SSBNs that began patrol in 1982 were intended to have a thirty year service life, but have been extended for over forty years.

Both have undergone multiple life extensions and are set to be replaced. The Minuteman III will be replaced by a new weapons system beginning in 2029 that is meant to be both more cost effective and more survivable.²⁶ This new system is known as the LGM-35A Sentinel (or Sentinel for short), though in early stages of development was known as the Ground Based Strategic Deterrent (GBSD). The Sentinel is meant to extend the land-based leg's capabilities through 2075 and is deemed the most cost effective option.²⁷ The *Ohio*-class SSBNs are set to be replaced with twelve *Columbia*-class SSBNs, with their first patrol scheduled for 2030. These modernization efforts are crucial to maintaining the credibility and effectiveness of the U.S. nuclear deterrent.

Beyond issues of modernization, the U.S. faces several more challenges to near and mid-term nuclear deterrence, including a population who largely has no living memory of the Cold War, and a general lack of interest in nuclear matters, continued budget constraints for modernization challenges, coming to terms with what integrated deterrence means for U.S. strategy and the threat of opportunistic aggression from several nuclear adversaries. The final section highlights these challenges and reiterates why U.S. nuclear deterrence remains so important.

Future Challenges

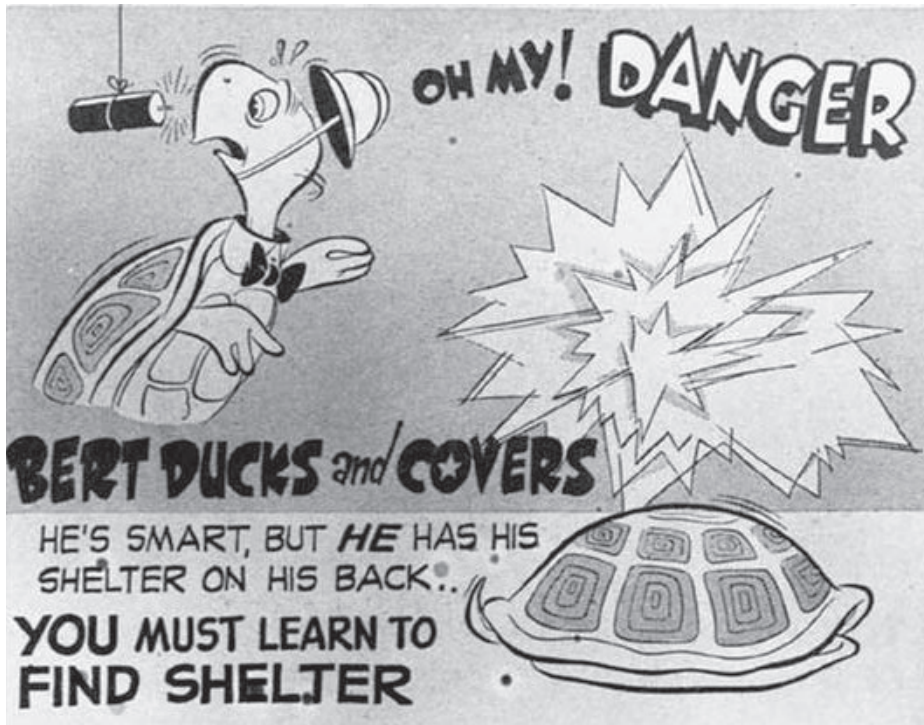
Challenges to maintaining a credible nuclear deterrent come in many forms. For most in the policy and planning community, modernization of nuclear capabilities is top of mind – and for good reason. The Department of Defense currently faces budget constraints in Congress and competing needs across all of its services. Many of the triad's systems are set to be modernized in the next decade and must contend with changing administrations, budget constraints, and growing needs across the branches of the military.

However, there is a more insidious threat to nuclear deterrence, one that is less explored but still no less relevant. In 2024, the United States population looks much different than it did during the Cold War, with most Americans having little to no knowledge or care about nuclear concerns, though the threats to its population are no less serious. Gone are the days of “duck and cover” drills, with the majority of American citizens having no memory of “Bert the Turtle” or experiencing what it meant to prepare as a population to find shelter during a nuclear attack.²⁸

26. “Defense Primer: LGM-35A Sentinel Intercontinental Ballistic Missile,” *Congressional Research Service* (10 January 2023).

27. “[Sentinel ICBM](#),” *art. cit.*

28. “[Film/Video. Duck and cover. Civil defense for school: duck and cover](#),” *Library of Congress*.



© Military.com, "[Civil defense: More Than Duck and Cover.](#)"

Population dynamics have real impact for the credibility of deterrence: a joint survey between the Chicago Council on Global Affairs and the Carnegie Corporation shows that only among Americans over age of 45 does a majority say that the U.S. nuclear arsenal makes the country safer; younger Americans say they don't make a difference to safety.²⁹ Most respondents report to not knowing much about U.S. nuclear policy, with only 30% reporting familiarity with policy and targets of U.S. nuclear weapons and only 20% with understanding the costs of nuclear weapons.³⁰ If citizens do not know or care about nuclear weapons, how can we expect Congress to fund modernization efforts?

It's not all doom and gloom, however. Of those surveyed, 88% reported that they are interested in learning more about nuclear weapons policy.³¹ This is important because those who were familiar with nuclear deterrence were far more likely to believe that United States nuclear weapons makes the homeland safer. We should work diligently to make nuclear knowledge more accessible and less esoteric. Efforts are under way to do this, with the Bulletin of Atomic Scientists being a prime example, translating archaic nuclear matters into more accessible prose for younger genera-

29. "Majority in the US Interested in Boosting Their Nuclear Knowledge," *Carnegie Corporation of New York* (July 2023).

30. *Ibidem*.

31. *Ibidem*.

tions in outlets such as Teen Vogue.³² These efforts should be replicated in multiple fashions, with the idea being to educate the public as shared experiences of the Cold War dwindle.

Other concerns lie in how the United States should seek to handle the role of opportunistic aggression and what integrated deterrence means. For the first time in its history, it faces threats from two major nuclear powers, often referred to as the “two-near peer” challenge. How should the U.S. mitigate risks from facing two nuclear adversaries simultaneously? What challenges arise with opportunistic aggression?

As the 2022 NPR points out, *“opportunistic aggression could create deterrence challenges. Should we find ourselves in a large-scale military confrontation with a major power or regional adversary, the Joint Force will need to be postured with military capabilities – including nuclear weapons – that can deter and defeat other actors who may seek to take advantage of this scenario to engage in opportunistic aggression.”*³³ While the NPR and NDS calls out a broad force planning construct focused on “integrated deterrence”, in which it plans to coordinate and seek contributions from allies, have nuclear weapons as a backstop, leverage capabilities not “solely engaged in the primary war fight” such as cyber and space, respond to both small-scale crises and enduring campaigning activities, and draw on all efforts of the diplomatic, intelligence, military, and economic (DIME) strengths of the U.S.³⁴ While the concerns have been made clear, there is less evidence that the United States is prepared for such a scenario, with today’s Joint Force not being sized or shaped to address two high-end conflicts at once. The Congressional Strategic Posture Commission found that *“the new partnership between Russian and Chinese leaders poses qualitatively new threats of potential opportunistic aggression and/or the risk of future cooperative two theater aggression.”* Ostensibly, addressing opportunistic aggression in a second theater may require greater optimization of U.S. and Allied conventional forces, improved nuclear capabilities for the U.S. and increased Allied contributions. This issue will define the next decade for U.S. strategy. Together, these concerns highlight the continued importance of U.S. nuclear deterrence.

32. S. Squassoni, “[What You Should Know About North Korea and Their Nuclear Weapons Threats](#),” *Teen Vogue* (14 February 2024).

33. “[National Defense Strategy](#),” U.S. Department of Defense.

34. M. R. Creedon, J. L. Kyl (eds.), “[America’s Strategic Posture](#),” *Final Report*, Congressional Commission on the Strategic Posture of the United States (October 2023): 160 p.

Cost-effective Deterrence for a Multi-polar World: The *B-21 Bomber*

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America's ability to deter, and if necessary, prevail, over threats to its vital security interests has greatly eroded since the end of the Cold War. This erosion is the result of a series of policy decisions over the last 30 years that reduced the U.S. military's size and delayed modernization of its most critical forces, especially the conventional and nuclear capabilities of the U.S. Air Force.

According to the 2022 *National Defense Strategy*, the Department of Defense's (DoD) highest priorities are to defend the U.S. homeland, deter nuclear attacks, deter and remain prepared to defeat a peer aggressor, and increase the resiliency of its forces.¹ The strategy also reaffirmed DoD's 2018 decision to use China as a pacing threat for sizing its forces and relegated Russia to a lesser, "acute" threat status.²

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1. U.S. Department of Defense (DoD), "[2022 National Defense Strategy of the United States](#)," DoD (October 2022): 1.
 2. In 2021, then-Undersecretary of Defense for Policy Colin Kahl explained that declaring China as a pacing threat means that it is "the only country that can pose a systemic challenge to the United States in the sense of challenging us, economically, technologically, politically and militarily," in J. Garamone, "[Official Talks DOD Policy Role in Chinese Pacing Threat, Integrated Deterrence](#)," *DOD News* (2 June 2021).

While DoD's 2018 shift toward planning for great power conflict was timely, it also abandoned its long-standing requirement to size the U.S. military for two major regional conflicts. The Air Force, Space Force, Army, Navy, and Marine Corps are now required to organize, train, and equip their conventional forces to defeat aggression by a single peer adversary and deter – but not defeat – a lesser aggressor in another region. DoD's adoption of this one-war planning policy was motivated more by its desire to avoid the cost of growing its forces than addressing emerging strategic realities. DoD's force planning policies also downplay the continuing proliferation of nuclear weapons. DoD continues to size its triad of nuclear-capable bombers, intercontinental ballistic missiles (ICBMs), and ballistic missile submarines to deter a single nuclear competitor – Russia – despite the rise of China as a nuclear power.³ Baselining the U.S. triad on a Cold War-era duopoly that no longer exists is the result of the Biden administration's desire to constrain defense spending and reduce reliance on nuclear weapons for deterrence.

Real-world events are now proving the folly of sizing America's conventional and nuclear forces for a single pacing threat. The war in Ukraine and spiraling conflict in the Levant demonstrate the risks created by DoD's attempt to “park” requirements to deter in Europe and the Middle East in favor of shifting its resources toward the Indo-Pacific. The United States must remain ready to counter aggression from multiple regional bad actors and terrorist groups that have obtained guided missiles, drones, and other modern capabilities that allow them to wage asymmetric warfare. At the same time, China is in a nuclear breakout, meaning it is rapidly increasing the size of its nuclear-capable forces with the intent to reach parity with the United States. Russia has almost completed its triad modernization program.⁴ Growing cooperation between these adversaries increases the need for a U.S. triad that has the capabilities and capacity to deter multiple threats concurrently instead of sequentially and in isolation.⁵ Moreover, North Korea is developing the ability to launch nuclear strikes at intercontinental ranges, and Iran may soon become the world's next nuclear power.

China and Russia took advantage of DoD's decades-long modernization pause after the Cold War to field advanced air defense systems, long-range missiles, anti-satellite weapons, and other counter-intervention capabilities. These will make U.S. military operations in all domains far more challenging than in past conflicts. DoD's failure to reset its nuclear triad since the Cold War has also caused many of

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3. According to DoD, the U.S. triad remains “*the backbone of America's national security*,” in U.S. Department of Defense, “[America's Nuclear Triad](#).”
 4. According to Russian President Vladimir Putin, the percentage of Russia's nuclear forces that have been modernized “*has been brought to 95% and in the naval component almost 100%*,” in “[Putin says Russia's nuclear arsenal is near fully modernized](#),” *Japan Times* (20 December 2023).
 5. According to General Anthony Cotton, Commander of the U.S. Strategic Command, these adversaries are “*increasing their level of coordination and cooperation with one another. This threat environment raises the possibility of near-simultaneous conflicts with multiple nuclear-armed, opportunistic adversaries*,” in “[Statement of Anthony J. Cotton, Commander United States Strategic Command Before The United States Senate Committee on Armed Services](#),” *Armed Services Senate* (29 February 2024).

its weapon systems to exceed their planned service lives, calling into question their continued credibility as a deterrent.⁶ The triad is at risk of losing additional capacity if its modernization programs are further delayed or receive insufficient funding.

There is a growing awareness that these force planning policies have eroded America's capacity to deter both conventional and nuclear threats. DoD's priorities must change to address today's multi-polar security environment. In 2018, the congressionally mandated National Defense Strategy Commission called for returning to a two-war U.S. force sizing construct.⁷ In late 2023, the Congressional Commission on the Strategic Posture of the United States followed suit by recommending DoD rebuild its capacity to deter and defeat "*simultaneous aggression in Europe and Asia using conventional forces*" and ensure the size and force mix of its nuclear triad "*account for the possibility of combined aggression from Russia and China.*"⁸ According to General Anthony Cotton, Commander of the U.S. Strategic Command, the potential for "*near-simultaneous conflicts with multiple nuclear-armed, opportunistic adversaries*" is now a very real possibility.⁹

Rebuilding a force to deter this unprecedented array of threats will not be without cost. However, there is a *cost-effective* option that would greatly enhance the U.S. military's multi-theater deterrence credibility: acquire a robust force of nuclear and conventional-capable *B-21 Raider* bombers. The need to acquire at least 200 dual-capable stealthy *B-21s* is borne of the need to rebuild an Air Force that has been hollowed out by 30 years of force cuts. And while similar force cuts affected the U.S. Army and Navy, only the Air Force has an opportunity to create a force that has the long ranges, survivability, weapons payload capacity, and mission flexibility to decisively deter nuclear and conventional threats in multiple theaters.

The Hollowing of the U.S. Air Force

Today's smallest, oldest, and least ready U.S. Air Force is the product of decades of force cuts and delayed or cancelled modernization programs.¹⁰ The service is now marginally prepared to defend America's vital interests due to its decreased readiness, the advanced ages of many of its aircraft, and insufficient budgets that require it to retire aircraft faster than it can buy new.¹¹ For instance, the Air Force's Fiscal

6. For a DoD description of its current nuclear triad, see U.S. Department of Defense, "[America's Nuclear Triad](#)."
7. The Honorable Eric Edelman, Admiral Gary Roughead (US Navy, ret.), *et al.*, "[Providing for the Common Defense: The Assessments and Recommendations of the National Defense Strategy Commission](#)," *United States Institute of Peace* (13 November 2018).
8. M. R. Crendon, *et al.*, "[America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States](#)," *Congressional Commission on the Strategic Posture of the United States* (October 2023): viii.
9. "Statement of Anthony J. Cotton..." *art. cit.*
10. D. A. Deptula, M. A. Gunzinger, "[Decades of Air Force Underfunding Threaten America's Ability to Win Mitchell](#)," *Mitchell Institute for Aerospace Studies* (September 2022).
11. According to Secretary of the Air Force Frank Kendall, keeping the Air Force's "*force structure small is required to build the right kind of Air Force for the China challenge, because the service*

Year 2023 budget request proposed divesting 250 of its older aircraft and buying only 82 new jets.¹² This long-standing practice, which DoD calls trading current force capacity for future capabilities, is no longer sustainable.

DoD's post-Cold War force planning policies increased the risk of failure in a peer conflict. The slide toward a hollow Air Force began after Operation *Desert Storm* in 1991. Following this stunning victory, DoD's civilian leadership believed it was feasible to reduce defense expenditures by cutting forces that would not be required for two *Desert Storm*-like major regional conflicts. Additional cuts were periodically levied on the Air Force over the next 20 years, accompanied by delays to nuclear and conventional force modernization programs. For instance, in 1992 President George H. W. Bush announced his decision to acquire only 20 of the 132 nuclear and conventional capable *B-2* stealthy bombers required by the Air Force to keep pace with emerging threats. One year later, the Secretary of Defense determined that roughly 40 percent of the Air Force's fighter wing equivalents and 31 percent of its bombers were no longer needed and could be phased out of the force by 1999.¹³

Subsequent DoD strategic reviews further throttled the Air Force's modernization plans. This included a decision to cap stealthy *F-22* fighter acquisition at 187 aircraft – far short of the Air Force's requirement for 381 – partly based on the short-sighted assumption that an adversary would not be capable of challenging U.S. air superiority before the *F-35* was fully fielded. Overall, budget and policy decisions forced the Air Force to abandon its Cold War practice of fielding a new combat aircraft approximately every two years to keep pace with emerging threats and technological advances. Since 1989, the service has only had the resources to acquire an average of *one* new fighter or bomber design about every *ten* years.

DoD's post-Cold War force planning policies have proven myopic, given the growing threat from Chinese and Russian advanced integrated air defense systems (IADS) and other anti-access/area-denial (A2/AD) systems. Today, the Air Force's small *F-22* force cannot generate enough sorties to achieve the degree of air superiority needed to ensure the success of joint force operations in a peer conflict. Overall, the Air Force's fighter inventory is now less than half the size of the force it could call on to fight Operation *Desert Storm*. And after applying the percentage of total time an aircraft can perform at least one of its assigned combat missions – its mission capable rate – across the fleet, the Air Force has fewer than 1,000 fighters available to support America's combatant commanders. Many of these fighters consist of *A-10s* with an average age of 41 years and *F-16s*, *F-15C/Ds*, and *F-15Es* that exceed 30 years in service. This force is wholly inadequate to simultaneously defeat peer aggression, defend the United States, and deter – much less defeat – threats in a second theater.

must free up funding for the development of future, higher-end platforms.” A. Mahshie, “[Kendall: Air Force Has and ‘Affordability Problem’ As It Tries to Meet Capability Gaps](#),” *Air & Space Forces Magazine* (1 June 2022).

12. J. A. Tirpak, “[Divestitures and Purchases: USAF’s 2023 Aircraft Plans](#),” *Air & Space Force’s Magazine* (29 April 2022).

13. The Air Force defined a “fighter wing equivalent” at the time as 72 combat-coded fighter aircraft.

The same is true for the U.S. bomber force. The Air Force operates the free world's only bomber force that can strike dozens of targets per sortie over global ranges, including moving targets at sea. Despite these unique advantages, force cuts and insufficient budgets caused the Air Force to reduce its bomber inventory by two-thirds since 1989. After accounting for mission capable rates and subtracting test and training aircraft, today's force of 19 *B-2s*, 45 *B-1Bs*, and 76 *B-52Hs* might generate fewer than 55 combat ready bombers on a day-to-day basis. Operationally, this means only about 15 bombers could be engaging targets in *one* theater at a time while other bombers are en route to target areas, regenerating at bases for their next sortie, or, in the case of *B-52s* and *B-2s*, standing alert in the United States to deter nuclear attacks.

Moreover, not all bomber sorties are equal. Nineteen *B-2s* are now the U.S. military's only combat aircraft that have the range, survivability, payload capacity, and other attributes needed to strike scores of targets that are located deep in highly contested environments.¹⁴ Cold War-era non-stealthy *B-52Hs* and *B-1Bs* are limited to launching "stand-off" strikes from areas that cannot be reached by long-range Chinese or Russian air defenses. And unlike "stand-in" strikes conducted by stealthy bombers that can penetrate contested environments, stand-off attacks are less effective against targets that are highly mobile or hardened/deeply buried.¹⁵ The Air Force's bomber inventory falls short of its stated requirement for 225 total aircraft and remain short until operational *B-21s* are fielded in significant numbers sometime in the 2030s. There are now no excess bombers to compensate for attrition in war or even bombers that are in long-term maintenance. In fact, the Air Force has indicated its operational bomber force will further decrease this decade as it retires its *B-1* and *B-2* inventories and cycles *B-52s* through depot level maintenance for upgrades.

The Air Force's chronic inability to recapitalize and modernize means it must continue to operate air superiority, strike, surveillance, and other aircraft that have exceeded their planned design lives. Advanced ages and hard use over the years are why the service must soon retire its *F-15C* fighters, *B-1B* bombers, and other aircraft. Worse yet, the diminished capabilities of this aging force cannot be offset by the too-small inventories of *B-2* bombers, *F-22* air superiority fighters, and multi-mission *F-35As*. While they remain the best stealthy aircraft in the world, their numbers are insufficient to prevail over a peer adversary plus credibly deter other threats. A viable joint force fundamentally depends on the capabilities and capacity afforded by U.S. Air Force combat airpower – anyone questioning this should look at the scenario now playing out in Ukraine. An Air Force with too few modern jets, too few highly trained aircrews, and a force mix that is better suited for threat environments of the past *encourages* the kind of aggression the *National Defense Strategy* seeks to deter. In 2004, then-Secretary of Defense Donald Rumsfeld said, "*You go to war with the*

14. An inventory of 19 *B-2* bombers does not include the aircraft that was damaged as it made an emergency landing at Whiteman AFB in late 2022.

15. For an analysis of the effectiveness of long-range stand-in and stand-off strike capabilities against different target classes, see M. Gunzinger, "[Long-Range Strike: Resetting the Balance of Stand-in and Stand-off Forces](#)," *Mitchell Institute for Aerospace Studies* (18 June 2020).

*army you have, not the army you might want or wish to have at a later time.”*¹⁶ Today, going to war with China with the Air Force we have could result in unsustainable loss rates for *all* U.S. forces and possibly of a defeat that would irrevocably disrupt the international order.

The aging U.S. nuclear triad. The ability to launch retaliatory strikes in response to nuclear aggression has long been the foundation of America’s nuclear deterrence strategy. Since the 1960s, a triad of ICBMs, nuclear-capable bombers, and submarines carrying submarine-launched ballistic missiles (SLBM) underpinned this strategy. While each “leg” of the triad has unique advantages that enhance deterrence, its current systems were designed during the Cold War for a quite different threat environment than exists today. In some cases, triad systems like the Minuteman III ICBM and Air-Launched Cruise Missile (ALCM) have exceeded their planned service lives and must be replaced as quickly as possible.

The Air Force has maintained ICBMs on alert status for the last 65 years to give U.S. national command authorities options to respond within minutes of receiving warning of a nuclear attack on the United States. This land leg of the triad now consists of 400 Minuteman III missiles deployed across the Air Force’s 450 operational ICBM silos. These silos and their launch control facilities are dispersed over 30,000 square miles in five U.S. northern tier states to make it difficult for an adversary to launch a preemptive nuclear strike with high confidence that it will destroy the U.S. ICBM force. The Air Force modified its Minuteman III missiles to carry a single warhead to comply with the New START Treaty.¹⁷

The three-stage, solid-fuel Minuteman III was designed in the 1960s with a planned service life of ten years. A series of upgrades and service life extensions have sustained Minuteman III and their infrastructure since then, but the Air Force has hit a hard stop in what it can do to keep this force combat ready. Without a replacement ICBM, the Air Force will not be able to meet its requirement to maintain 400 operationally deployed missiles in the field shortly after 2030. New ICBMs are the only viable option to meet future triad requirements since Minuteman III have been out of production for decades and many of their components are no longer

16. Wolf Blitzer Reports staff, “[Troops put Rumsfeld in the hot seat](#),” *CNN* (8 December 2004).

17. The New START Treaty limits the U.S. and Russian Federation’s deployed intercontinental range nuclear weapons to: “700 deployed intercontinental ballistic missiles (ICBMs), deployed submarine-launched ballistic missiles (SLBMs), and deployed heavy bombers equipped for nuclear armaments; 1,550 nuclear warheads on deployed ICBMs, deployed SLBMs, and deployed heavy bombers equipped for nuclear armaments (each such heavy bomber is counted as one warhead toward this limit);” and “800 deployed and non-deployed ICBM launchers, SLBM launchers, and heavy bombers equipped for nuclear armaments.” The United States and Russia have agreed to extend the Treaty to February 4, 2026. In February 2023, Russian President Vladimir Putin announced that Russia would suspend – but not withdraw – from New START. U.S. Department of State, “[New START Treaty](#)” (1 June 2023).

manufactured.¹⁸ Minuteman III modernization is essential and must not be delayed, deferred, or curtailed.

The Air Force also operates the air-breathing leg of the triad, comprising 46 nuclear-capable *B-52s* and 19 *B-2s*. Non-stealthy *B-52s* originally designed in the 1950s cannot penetrate contested areas with an acceptable degree of risk. The Air Force sought to acquire stealthy *B-2s* in the 1990s capable of penetrating increasingly advanced integrated air defense systems (IADS) fielded by Russia. *B-2s* have flying wing shapes that are coated with materials that deflect and absorb radar energy, advanced mission systems to detect and avoid threats, and other capabilities that greatly reduce their potential to be tracked by active and passive sensors. Both *B-52s* and *B-2s* can deliver nuclear “gravity” bombs, and the *B-52H* can also carry up to 20 subsonic nuclear ALCMs to strike over long ranges without penetrating enemy air defenses.



B-52 Stratofortress (left) and B-2 Spirit (right).

© “[B-2 Spirit](#),” Strategic Bureau of Informations on Defense Systems.

The bomber force is considered the most flexible leg of the triad because it can be placed on alert to signal national resolve in a crisis, dispersed to remote locations to enhance their survivability, or directed to attack any target on the face of the Earth. The U.S. bomber force is also the only leg of the triad that can launch, remain in a survivable airborne alert status, and then either strike or stand down and be recalled.

18. House Armed Services Committee Chairman Mike Rogers has said that new Sentinels must “replace the current ICBMs before they reach the end of their lives. Failure is not an option,” in “[Rogers: Sentinel ICBM Program Needs to Get Back On Track](#),” House Armed Services Committee (19 January 2024).

Like the Minuteman III enterprise, the Air Force must modernize its bomber forces. The Air Force accepted its final *B-2* almost 28 years ago, and the youngest of its remaining *B-52s* is 62 years old. While the *B-2* remains the best operational stealthy bomber in the world, its main drawback is the small size of its inventory – only 19 aircraft. Moreover, *B-52s* rely on ALCMs to strike targets located in contested areas during a nuclear exchange. Designed in the 1970s with a projected service life of 10 years, ALCMs are subsonic missiles designed to evade Soviet-era missile defenses at range, not Russia and China’s current IADS. ALCMs will soon not be able to penetrate highly contested environments, which means *B-52s* would have to use very short-range nuclear gravity bombs to attack targets. This weapons-based limitation alone would greatly increase operational risk and reduce the credibility of the bomber leg of the triad.

The U.S. Navy operates the sea-based leg of the triad which now consists of 14 *Ohio*-class SSBNs. Each SSBN can carry up to 20 Trident II D5 sea-launched ballistic missiles (SLBMs) with multiple independent reentry vehicles (MIRV) that can each deliver a nuclear warhead on a separate target. SSBNs are considered the most survivable leg of the triad – when they have sortied from their U.S. ports – and help assure the United States will have a second-strike capability after a nuclear attack. In peacetime, each SSBN averages approximately 77 days at sea interspersed with 35 days at their home ports, excluding boats that are in long-term maintenance status. Like the other two legs of the triad, the Navy designed its *Ohio*-class SSBNs in the 1970s for a planned service life of 30 years, which has since been extended to 42 years. The service lives of earlier model *Ohio*-class SSBNs will begin to expire in 2027.

The nuclear triad has been a billpayer. The main reason for the U.S. triad’s creeping obsolescence is no secret: DoD used its nuclear enterprise as a billpayer for decades after the Cold War. This means that DoD deferred recapitalizing its triad in favor of reducing defense expenditures and sustaining its other forces. All three legs must now be modernized – simultaneously – without further delay. As reported by the U.S. Government Accountability Office, “*as a result of delaying the recapitalization of the nuclear triad repeatedly, there is now little-to-no margin for further delaying U.S. nuclear modernization programs and upgrading of the nuclear weapons infrastructure without harming the nation’s deterrent.*”¹⁹

The good news is the U.S. Congress and DoD now agree the triad must be modernized. In fact, it is one of the United States’ most constant bipartisan defense priorities. Multiple presidential administrations – regardless of party – have validated the need to modernize the triad since DoD initiated programs to do so roughly a decade ago. The Air Force will begin replacing its *B-2s* with *B-21s* in the next few years with the intent to field at least 100 of these advanced stealthy aircraft. To ensure *B-52s* remain combat credible until at least 2060, they will receive new engines, an active electronically scanned array (AESA) radar, upgraded avionics and communication

19. U.S. Government Accountability Office (GAO), “[Nuclear Triad: DOD and DOE Face Challenges Mitigating Risks to US Deterrence Efforts](#),” GAO (May 2021): 2.

systems, and new nuclear-capable Long-Range Standoff Weapons (LRSO) that are designed to penetrate contested environments.²⁰ At the same time, the Air Force's Sentinel program will replace its 1970-era Minuteman III missiles, silos, launch facilities, and command and control systems, and the Navy will recapitalize its leg of the triad beginning in the 2030s with new *Columbia*-class SSBNs.

These programs must proceed on their planned schedules to avoid further degradation to the credibility of the U.S. triad. This said, modernizing the triad without increasing its *capacity* will not create a force capable of deterring two nuclear peer competitors as recommended by the U.S. Strategic Posture Commission. And while growing the size of the triad would not be without cost, there is a *cost-effective* option to attain this objective – acquiring a larger force of dual-capable *B-21* bombers. Compared to ICBMs and SSBNs, only the *B-21* is a true multi-mission capability that can swing between nuclear and conventional operations to meet U.S. combatant commander requirements. This “two-for-one” dual capability would make *B-21s* the most cost-effective means to simultaneously enhance both nuclear and conventional deterrence.

The *B-21*: A Cost-effective Deterrent for a Multi-Polar World

In January 2024, Dr. William LaPlante, DoD's Under Secretary of Defense for Acquisition and Sustainment, announced he had approved low-rate production for the *B-21* “based on the results of ground and flight tests and the team's mature plans for manufacturing” the new bomber.²¹ One of the most important facts to understand about the *B-21* is the Air Force designed it to perform as the lead component of a long-range strike family of systems. This family will likely include uninhabited aircraft equipped with sensors, electromagnetic warfare capabilities, and other mission systems that will, in combination, ensure U.S. warfighters can strike any target over long ranges in a peer conflict.²² The ability to strike targets at scale – potentially 100,000 or more aimpoints – in highly contested environments is a foundational requirement for deterring and defeating Chinese or Russian aggression.

The *B-21* will provide affordable mass to deny a Chinese or Russian *fait accompli*. Defeating a Chinese or Russian *fait accompli* military campaign is the U.S. National Defense Strategy's key force planning challenge. According to Dr. Colin Kahl, DoD's Undersecretary of Defense for Policy in 2021, the U.S. joint force must have the credible capability to deny “the type of rapid *fait accompli* scenarios that we know potential adversaries are contemplating, so they can't make a rapid lunge

20. “RTX delivers first B-52 AESA radar to Boeing,” RTX (12 September 2023).

21. Z. Rosenberg, “Northrop Grumman B-21 enters low-rate initial production,” *Janes* (24 January 2024).

22. The *B-21* force will be the foundation “of a larger family of systems that will deliver intelligence, surveillance and reconnaissance, electronic attack and multi-domain networking capabilities” for penetrating strikes, in “B-21 Raider,” *Fact Sheet*, U.S. Air Force. This long-range strike system-of-systems will also include advanced munitions with low-observable technologies and other capabilities to ensure they can penetrate advanced air and missile defenses.

at our partners and allies before they believe the United States can show up.”²³ This is a far more stressing requirement for sizing and shaping U.S. forces compared to the *Desert Storm*-centered template that DoD embraced after the Cold War.

In 2022, Secretary of the Air Force Frank Kendall acknowledged the Air Force was stretched thin to meet this and other defense strategy requirements with an “*aging and costly-to-maintain capital structure with average aircraft ages of approximately 30 years and operational availability rates that are lower than we desire.*”²⁴ Kendall established seven operational imperatives to address these shortfalls and develop capabilities “*the Department of the Air Force must invest in to protect the United States’ ability to deter conflict and project power against pacing challenges.*”²⁵ Operational imperative number 6 is focused on fielding a family of systems for global strike that would be anchored by stealthy *B-21* bombers. This family of systems – including munitions designed to penetrate IADS and UAVs equipped with sensors and other capabilities – will provide the affordable mass needed to rapidly blunt a Chinese invasion of Taiwan or Russian invasion in the Baltics.²⁶



Artistic view of the *B-21 Raider* escorted by unmanned aircraft.

© “[What Could Be Part of the B-21 ‘Family of Systems’? New Report Offers Some Insight](#),” *Air & Space Forces Magazine* (8 February 2022).

23. C. Kahl (Undersecretary of Defense), “[Concept of Integrated Deterrence Will Be Key to National Defense Strategy](#),” *DoD* (December 2021).
24. “[Kendall details ‘Seven Operational Imperatives’ & how they forge the Future Force](#),” *Secretary of the Air Force Public Affairs* (3 March 2022).
25. “[Department of the Air Force Operational Imperatives](#),” *U.S. Air Force* (2023).
26. Other critical elements of the Air Force’s future force design include the NGAD family of systems, CCA for counter-air operations, lower-cost munitions that can be acquired at the scale required for peer conflict, and capabilities to enable long-range air-to-air and air-to-ground kill chains.

The Air Force uses the term “affordable mass” to describe a future force capable of delivering a sufficient density of sensors and weapons over long ranges to create decisive effects against the most difficult target sets in a peer conflict. This force must be *affordable* in the sense that the Air Force will be able to acquire with its constrained budget new long-range strike capabilities at the scale needed to defeat a *fait accompli* campaign. This would include striking forces that are essential to a peer adversary’s offensive operations, like the PLA’s long-range coastal air defenses, surface action groups (SAGs) arrayed around Taiwan to shield China’s offensive operations, and airbases generating PLA fighter sorties. Defeating a Chinese assault on Taiwan or Russian invasion of one or more of the Baltic states could require allied air forces to strike 100,000 or more aimpoints over long ranges. This is a conservative estimate, considering U.S. air forces alone attacked about 40,000 aimpoints during Operation *Desert Storm* in 1991 in a much smaller geographic region. It will also require stealthy aircraft that can operate in battlespaces that will remain highly contested throughout a *fait accompli* defeat campaign. This is a major departure from conflicts since the Cold War where U.S. forces were able to quickly establish air and sea dominance to open the way for non-stealthy forces to operate with acceptable risk.

Furthermore, some targets critical to defeating a Chinese or Russian offensive, such as mobile ballistic missile launchers and anti-satellite weapons, could be located deep in their interiors. Only stealthy *B-21s* – and *B-2s* while they remain in the force – will have the range, survivability, persistence, and payloads to strike across these immense battlespaces. The need to execute attacks deep into an adversary’s interior will be a policy decision, but failing to develop the capability to do so will eliminate this option and a key means to deter peer aggression.

Designed to provide affordable mass. “Affordability” is a critical attribute for next-generation capabilities that must be acquired at the scale needed to defeat a Chinese or Russian *fait accompli*. This is why the Air Force adopted a family of systems approach to designing the *B-21*: it would create opportunities to offload some capabilities needed to close kill chains from the new bomber to other crewed and uncrewed aircraft in the family of systems. Distributing functionalities in this way would help reduce the *B-21*’s cost and possibly free some of its on-board capacity for lethal payloads.

Adopting a family-of-systems approach will also increase the survivability and lethality of the Air Force’s penetrating long-range strike operations. There are obvious advantages to designing the *B-21* with all-aspect, broadband stealth, which is a product of its advanced low-observable shape, exterior coatings that absorb radar energy, in-cockpit information fusion, and smart mission planning tools that help pilots avoid high-risk threats. *B-21* survivability will be further enhanced by operating them with other systems in ways that present adversaries with a far more difficult defensive challenge. Instead of concentrating on finding and tracking penetrating *B-21s*, an adversary will need to characterize an attacking force that could include multiple crewed and uninhabited aircraft, jammers, and other systems that are part of

the Air Force's strike packages. This can complicate an adversary's ability to prioritize threats and force it to expend its defenses against decoys and other lower-value systems instead of *B-21s*.

The Unique Capabilities of *B-21s* Will Enhance Deterrence

B-21s will enhance deterrence by reducing a peer adversary's ability to use its vast interior as a sanctuary to generate its long-range power-projection forces. With a range and stealthy attributes unmatched by any other combat aircraft, *B-21s* will hold at risk mobile and other high-value targets located deep in China and Russia's territory and do so, if required, without cues from off-board command, control, intelligence, surveillance, and reconnaissance (C2ISR) networks that are susceptible to countermeasures. No other existing or planned U.S. strike system will provide a similar unilateral capacity to strike dynamic targets at the same scale and tempo in highly contested operational environments.

Eliminating operational "sanctuaries" created by precision strike countermeasures. China and Russia have fielded a wide range of active and passive countermeasures to offset the United States' precision strike advantage. Passive countermeasures – like distributing high-value military capabilities deep in areas covered by advanced IADS and mobilizing ballistic missile launchers at risk of attack – and active defense systems to disrupt C2ISR networks are designed to break U.S. find, fix, or track, target, and engage kill chains. The capability to close kill chains against targets that adversaries value most dearly without first establishing domain dominance is essential to maintaining a credible U.S. deterrent. It is also a baseline requirement for the *B-21*.

When *B-21s* are fielded at scale, no other precision strike force in the U.S. military will match their ability to penetrate deep into contested areas to strike dozens of high-value mobile targets per sortie. Fighter aircraft carry fewer weapons and typically have a combat mission radius of 650-700 nm or less. This means that, in best-case scenarios, U.S. and allied fighters operating from their Pacific bases would be able to reach targets along parts of China's coastline, but not many hundreds of miles inland. Other strike platforms, like the Navy's aircraft carriers, may have to stand off 1,000 to 1,500 nm from China to reduce the risk they will be attacked by anti-ship missiles. These distances significantly exceed the combat radius of their embarked fighters and would greatly reduce their potential to strike PLA forces in the Taiwan Strait. Moreover, many carrier fighters would be dedicated to outer air battle operations to defend their carrier battle groups against PLA Air Force bombers carrying long-range anti-ship cruise missiles.

Unmatched ability to penetrate areas covered by advanced IADS. *B-21s* are also designed with all-aspect, broadband signature control to greatly reduce the probability they will be detected and tracked by multi-spectral sensor networks. The *B-21* is considered an extremely advanced bomber because its low observability is far more advanced than early stealthy aircraft that primarily depended on their shapes (planforms) and radar-absorbing coatings to avoid detection. Most contemporary

stealth fighters are designed in ways that optimize their frontal aspect signatures to counter ground and airborne radars operating in a narrow part of the electromagnetic spectrum (EMS). In contrast, the *B-21*'s flying wing shape gives it 360-degree low observability across a much broader part of the EMS.



The *Raider* during its unveiling ceremony at Palmdale facility (California).

© "[B-21 Raider – Fact Sheets](#)," U.S. Air Force.

The *Raider* also benefits from next-generation radar-absorbing materials, more advanced computing power, the ability to automatically fuse information from multiple sensors, and software that optimizes its flight path to avoid threats. According to U.S. Secretary of Defense Lloyd Austin, the combined effect of these design features means "*even the most sophisticated air-defense systems will struggle to detect a B-21 in the sky.*"²⁷

Unmatched capacity to engage moving targets at scale. The Air Force's diminished combat forces now lack sufficient capacity to kill large numbers of moving targets at range, which is why Secretary Kendall established engaging ground mobile and moving sea surface targets as one of his operational imperatives.²⁸ U.S. Air Force sources have estimated that up to 90 percent of the targets that must be at-

27. "[The B-21 Raider, the Air Force's new nuclear stealth bomber, takes flight for first time](#)," *CBS News* (10 November 2023).

28. L. Blinde, "[Air Force releases OI #4 RFI \[Request for Information\]](#)," *Intelligence Community News* (31 January 2022).

tacked during a campaign to blunt a peer adversary's *fait accompli* will be mobile.²⁹ China will rely on its mobile SAGs, amphibious ships, and surface-to-surface missile launchers to assault Taiwan. Similarly, a Russian force invading NATO's eastern frontier would largely consist of mobile artillery, rocket launchers, armored vehicles, and other massed fires capabilities. These are challenging targets to strike with a high degree of precision since their mobility increases the need for U.S. and allied forces to receive real-time information on thousands of aimpoints.

B-21s will have significant advantages over stand-off weapon launchers against these dynamic targets. The time needed for cruise missiles to fly hundreds of miles after they are launched by surface and airborne stand-off strike platforms – even at hypersonic speeds – creates opportunities for an adversary to detect attacks and relocate likely targets. Unlike non-stealthy aircraft, *B-2s* and *B-21s* can avoid detection in defended areas, persist to locate mobile and moving targets, and then attack them with or without off-board target cues. Using penetrating bombers to rapidly concentrate offensive mass at range to strike moving, mobile, and relocatable targets translates directly to meeting timelines to blunt a Chinese or Russian assault, which is why *B-21s* are the centerpiece of the Air Force's global strike operational imperative.

Improve resiliency of U.S. long-range kill chains in highly contested environments. Improving the resiliency of the Air Force's long-range strike kill chains is another priority for its future force design. Maintaining a credible nuclear and conventional deterrence force will depend on the service's ability to complete thousands of kill chains in hundreds of hours. This will require long-range strike forces that can find and engage targets despite Chinese or Russian efforts to disrupt the U.S. military's C2ISR networks. Stand-off conventional and nuclear weapons with datalinks may be able to receive target updates while in flight *if* their supporting networks have the required degree of connectivity. *B-21* aircrews, conversely, will be able to update or change their targeting priorities while in flight without support from off-board C2ISR. The value of using aircrews to determine operational priorities on the fly without relying on remote air battle managers has not diminished in an era of drone warfare. In communications denied environments, only human aircrews will have the ability to determine if they should launch or withhold a conventional or nuclear strike depending on mission priorities and rules of engagement.

In summary, the Air Force currently lacks enough combat aircraft with long ranges, weapons payload capacity, and all-aspect, broadband stealth to conduct decisive operations at scale in highly contested environments. Only the Air Force's *B-2s* can presently meet these requirements with an acceptable degree of risk, and the operational demand for penetrating bombers in a peer conflict will clearly exceed what can be delivered by 19 of these stealthy bombers. The solution to this shortfall is now available – next-generation penetrating *B-21 Raiders*. Importantly, DoD must acquire them in sufficient numbers to credibly deter and respond to aggression in multiple theaters.

29. C. Buckley (Colonel, U.S. Air Force Chief of Weapons Development & Requirements), "[The End of the Kill Chain: The Weapons We Need to Arm the Air Force the Nation Needs](#)," Briefing to Weapons Pitch Day Conference (July 2022): slide 4.

Final Thoughts: Toward a Two-War Deterrent

Maintaining a military with the capacity to fight two wars was considered critical to U.S. national defense for more than 25 years after the Cold War. This changed in 2018 when DoD abandoned its two-war force planning requirement in favor of fighting a single peer conflict and deterring a second, lesser aggressor such as North Korea or Iran. This shift was based on a belief that DoD could not afford to increase the size of all its services to meet requirements for two theaters of war.

Rebuilding a two-war U.S. military will not be inexpensive, but failing to do so will greatly increase the risk and costs of operational failures. This is why it is important for DoD to prioritize cost-effective capabilities – agnostic of service – that have the greatest potential to deter opportunistic aggressors and reduce the cost of a two-war force. DoD as a whole should have the capacity to fight two wars, every service does not need to have that capacity.

Determining the right size and capabilities mix of this force should be informed by the nature of potential peer conflicts. Since a major conflict with China in the Indo-Pacific will be sea, air, space, and cyberspace domain dominant, it should be the pacing threat for sizing the Department of the Navy and Department of the Air Force. And since a major operation to defend NATO against Russian aggression would be ground, air, space, and cyberspace domain dominant, it should be the pacing threat for the Department of the Army and Department of the Air Force.

This means that both China and Russia should be pacing threats for sizing the Air Force. Only the Air Force can respond over thousands of miles to go on the offensive in both theaters within hours of the start of conflict. Response timing will be critical, since Russian and Chinese *fait accompli* campaigns may reach their decisive points within days, a timeframe that is well outside the weeks required for many Army and Navy forces to deploy from their U.S. bases and join the fight. And only Air Force bombers have the range to launch strike sorties directly from the United States and then return or recover at forward locations to generate additional sorties. Bombers can rapidly swing between theaters and missions to meet changing operational requirements, including deterring nuclear attacks. Unlike the other two legs of the triad, the nuclear-capable bomber force provides options to “dial up” the size of the U.S. nuclear deterrent force, again, within hours if necessary. Because of this unmatched mission flexibility, the Air Force’s bomber force will be one of DoD’s most cost-effective means to deter peer aggression in multiple theaters.

Sizing the U.S. bomber force for a multi-polar world. Sizing the U.S. bomber force for two wars reduces the risk that a second regional crisis will escalate to a conflict with China or Russia – one that could have existential consequences for the United States and its allies. DoD should also size its bomber force to deter two nuclear peer adversaries. Nuclear threats now facing the United States exceed the deterrence potential of its current triad. DoD projects that China will “*have over 1,000 operational nuclear warheads by 2030,*” and Russia never stopped modernizing its

nuclear forces after the Cold War.³⁰ Russia also maintains an inventory of at least 2,000 shorter-range nuclear systems that are not limited by the New START Treaty. These are the weapons that Russia would most likely use should it decide to back up its recent threats of nuclear strikes against NATO.

Acquiring at least 200 *B-21s* would be a major step toward a joint force capable of deterring both Chinese and Russian aggression. The Air Force's Global Strike Command has stated it requires 225 total bombers including 76 remaining *B-52s* for nuclear deterrence and one peer conflict.³¹ While this would be a significant improvement over today's force, multiple independent studies that were not bounded by DoD's budget minimization requirements have recommended rebuilding an even larger bomber force to hedge against peer conflicts. One analysis required by the U.S. Congress recommended the Air Force field up to 24 bomber squadrons (383 total bombers) as part of a two-war force.³² Other studies led by independent think tanks and retired Air Force general officers recommended DoD field a similar number of *B-21s* to meet multi-polar deterrence and warfighting requirements.³³

It is worth stressing that while conflict scenarios and operational assumptions underlying these assessments were not uniform, they all concluded the Air Force's bomber inventory should be significantly larger and more capable of operating in highly contested environments. To place these assessments in context, the bomber inventories they recommend are still smaller than the force the Air Force maintained during the Cold War to deter a single peer adversary.

No Time to Waste

America's bombers provide options for global strike and other missions that no other U.S. military capability can provide. These options will not be available if DoD fails to grow its bomber inventory by acquiring *B-21s* in quantity over the next decade. The future bomber force must be sized to simultaneously deter and decisively respond to Chinese aggression and a second threat in another theater while deter-

30. US Department of Defense, "[Military and Security Developments Involving the People's Republic of China 2023](#)," *DoD* (October 2023): viii.

31. In 2020, Chief of Staff of the Air Force General David Goldfein testified to Congress that "*our assessment – and that's been backed up by independent assessments – that a moderate risk force is 220 bombers of which 145 would be B-21s.*" Goldfein's comment is from a recording of a U.S. Senate Armed Services Committee hearing "[Posture of the Department of the Air Force](#)" in March 3, 2020. Nuclear deterrence is an additive requirement for the Air Force, which means that some of its nuclear-capable bombers may be withheld in the United States and not deployed to fight a conventional conflict.

32. The independent study recommended the Air Force field 383 bombers consisting of 20 *B-2s*, 75 *B-52Hs*, and 288 *B-21s*, which translates to 266 combat-coded bombers that are fully resourced to support combat missions. M. Gunzinger, *et al.*, "[An Air Force for an Era of Great Power Competition](#)," *Center for Strategic and Budgetary Assessments* (2019).

33. "[US Air Force Aircraft Inventory Study Executive Summary](#)," *MITRE* (2019); D. A. Deptula, D. A. Birkey, "[Building the Future Bomber Force America Needs: The Bomber Re-Vector](#)," *Mitchell Institute for Aerospace Studies* (September 2018); and M. R. Moeller, "[US Bomber Force: Sized to Sustain an Asymmetric Advantage for America](#)," *Mitchell Institute for Aerospace Studies* (2015).

ring nuclear attacks. This force should include at least 200 penetrating *B-21s*, the most cost-effective means of quickly increasing the U.S. military's capacity to deter conventional and nuclear threats. Other options to grow the U.S. triad, like expanding the Air Force's ICBM fields or acquiring additional *Columbia*-class submarines sometime in the 2040s, will not enhance nuclear deterrence this decade when the threat of peer aggression may reach a new high. *B-21s* will be daily fliers that can be tasked to support global operational requirements or placed on nuclear alert in the event of a crisis. No other alternative offers the "two-for-one" advantage or has the same potential to hedge against the uncertainty that spans the spectrum of conflict. As U.S. Senator Mitch McConnell recently asked, "*Will we give those who crave our leadership more reason to wonder if it's in decline, or will we invest in the credibility that underpins our entire way of life?*"³⁴ This is the key question now facing the United States, and a robust force of *B-21 Raiders* is part of the answer.

34. "[McConnell: Senate Faces Test of American Leadership](#)," *The Newsroom* (11 February 2024).

NATO's Airborne Nuclear Component

André Dumoulin

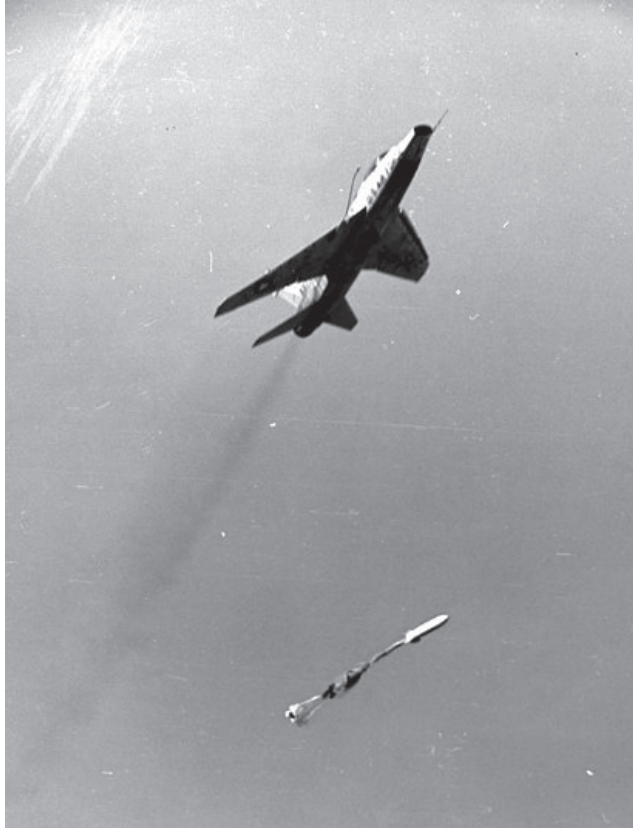
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The Atlantic Alliance's strategy has consistently relied on the combination of both nuclear and conventional components. During the 1950s, the potential use of the nuclear component fell under the doctrine of massive retaliation,¹ outlined in *Military Committee* (MC) 48 of 1954. Due to the strategic and highly confidential nature of the designated targets, restrictions were imposed on the dissemination of information. According to MC 48, “the Supreme Allied Commander Europe (SACEUR) is not authorised to disclose the nuclear aspect of his campaign plans, the identified targets, or the potential rate of fire to European leaders.”²

In subsequent years, the United States entered into bilateral agreements with several nations, including the United Kingdom, France (along with its Moroccan protectorate), Greece, Italy, and Germany. These agreements allowed for the deployment of U.S. *B-36*, *B-47*, *B-50*, and *B-52* bombers from their respective territories. These aircrafts were equipped to launch nuclear strikes against population centres or economic targets situated east of the Iron Curtain. Additionally, Washington supplied its Allies, particularly France, with *F-84G Thunderjet* and *F-100D Super Sabre* fighters capable of carrying low-altitude gravity nuclear bombs. These weapons then remained under U.S. control through the “dual-key” principle, ensuring the United States to retain its decision-making autonomy without being constrained by regional commitments.

1. The doctrine of Massive Retaliation involved responding with massive intercontinental nuclear strikes to a victorious Soviet offensive in Europe using conventional forces. For a history on U.S. nuclear warheads, see C. Hansen, *U.S. Nuclear Weapons: The Secret History* (New York: Aerofax and Oron Books, 1988). For a history on the introduction of U.S. nuclear weapons in France, see O. Pottier, *Les bases américaines en France (1950-1967)* (Paris: L'Harmattan, 2003).

2. Editor's translation from F. David, “La genèse doctrinale du nucléaire tactique”, in T. Meszaros (ed.), *Repenser les stratégies nucléaires: Continuités et ruptures* (Brussels: Peter Lang, 2019): 231.



A United States Air Force (USAF) *F-100* drops a test nuclear bomb.

Source: [Air & Space Forces Magazine](#)

In the 1960s, the nuclear doctrine underwent a shift towards “Flexible Response”,³ with two successive models proposed. The first model, outlined in MC 14/3 of 1967, advocated for a cautious and rational deployment of nuclear weapons, specifically for the purpose of battlefield interdiction. The objective was to exercise control over escalation by initially targeting strictly military objectives with tactical nuclear weapons (TNW), following a selective or demonstrative logic. The second model, presented in MC 48/3 of 1969, emphasised the rapid deployment of conventional forces equipped with non-nuclear armaments. This deployment was aimed at impeding or halting a Soviet offensive before contemplating the potential use of tactical nuclear weapons.

3. The flexible response implies, according to L. Poirier, a willingness for moderation, demonstrated firstly through political restraint by avoiding reckless commitments to agitated Allies; then through a strict moderation of military forces on the theatres of operations. See L. Poirier, *Des stratégies nucléaires* (Paris: Hachette, 1977): 95. This strategy of limited war was thus made possible by the technical emergence of tactical nuclear weapons (TNWs), their monopoly being, at that time, in the hands of the United States.

During the Cold War, the objective of the Allies, particularly the U.S., was to foster solidarity amongst the Member States of the Atlantic Alliance within the framework of containing the Communist threat. Additionally, there was a commitment to ensure nuclear non-proliferation in Europe through extensive consultation and acculturation of the Allies, facilitated by the establishment of the Nuclear Planning Group (NPG) in 1966. Lastly, this then entailed granting specific countries the authority to possess dual-keys⁴ for U.S. nuclear weapons systems deployed in Europe (refer to Table 1).

Doctrines have been a subject of debate, especially in the context of a battlefield potentially involving nuclear salvos,⁵ given the abundance of nuclear stockpiles. This led to an opposition against the French doctrine, which had favoured the idea of a warning shot or a final warning for a single, specific, and politically motivated use. During the Cold War, these doctrinal disagreements were further complicated by political disputes with Bonn, regarding the potential use of U.S. and French TNWs⁶ on German territory⁷ and across Central Europe.⁸ These tensions persisted throughout the 1980s, notably during the Euromissile crisis.⁹ In the end, any anticipated debates on the modernisation of the U.S.'s TNWs (such as the short-range nuclear forces (SNF)'s tactical air-to-surface missiles) did not materialise and dissipated with the fall of the Berlin Wall.¹⁰

4. The United States retains the activation codes for nuclear weapons, while European Allies have control over their weapon delivery systems, allowing them to exercise their national veto regarding their use.

5. The objective was also to curb the over-rapid use of U.S. nuclear weapons in Europe by scaling the only conventional "rungs": an orientation that would avoid being drawn into a strategic intercontinental conflict with the Soviet Union. In other words, it was to not lose New York to save Hamburg. See R. Lukic, *Conflit et coopération dans les relations franco-américaines* (Montréal: Presses universitaires de l'Université Laval, 2009): 51-53.

6. Namely, Pluton and then Hadès "stillborn" ground-to-ground missiles, as well as *Jaguar A*, *Mirage IIIE*, and *Super-Étendard* fighter-bombers and their AN-52 bombs. The *Mirage 2000N* / ASMP and the *Super-Étendard / air-sol moyenne portée* ("medium-range air to surface missile" or ASMP) continue its use in pre-strategic missions outside the narrow framework of tactical weapons for technical, operational, and doctrinal reasons.

7. See D. Cumin, J.-P. Joubert, *L'Allemagne et le nucléaire* (Paris: L'Harmattan, 2013).

8. For an analysis on the history of French military nuclear power, see A. Dumoulin, *La dissuasion. Histoire du nucléaire militaire français* (Merignac: Argos Éditions, 2013).

9. See M. Tatu, *La bataille des euromissiles* (Paris: Éditions du Seuil, 1983). Euromissiles could link U.S. with European defences as long as the nuclear systems (Pershing-2 and the ground-launched cruise missiles *Gryphon*) were deployed in Europe under exclusive U.S. control (single key). Targeting them could trigger a response from the U.S. central systems. Conversely, Euromissiles could facilitate a decoupling as they were based in Europe and could be deployed from the Old Continent without affecting the North American continent and a risk of Soviet retaliation. From the Kremlin's point of view, the U.S. Euromissiles responding to the Red Army's SS-20, SS-4, and SS-5 theatre missiles were perceived as a threat, given the short notice, which could result in a response targeting Europe but also its U.S. sponsor. Decoupling and coupling were therefore put forward in many debates at the time, with strong technical, strategic, political and ideological arguments (see D. Lutz, *La guerre mondiale malgré nous? La controverse des euromissiles* (Paris: La Découverte-Maspero, 1983); and M. Manel, *L'Europe face aux SS 20* (Paris: Berger-Levrault/Boréal Express, 1983)).

10. In reference to the mechanism provided for in document MC 70 of 1967. See A. Dumoulin, "Armes nucléaires stand-off: L'avènement des missiles de théâtre," *Avianews international*, no. 10 (1990): 34.

The presence of U.S. nuclear weapons in Europe has consistently triggered a range of diplomatic, military, and doctrinal discussions and disputes. Today, the U.S. airborne nuclear component within the North Atlantic Treaty Organisation (NATO) continues to face scrutiny from its Members in light of the evolving geostrategic landscape of the Old Continent and the influence of certain ideologies.

This article, using open sources, seeks to provide a summary of the historical development of the Atlantic Alliance's nuclear component, specifically of the Nuclear Planning Group (NPG)'s. It also examines the repercussions of new operational challenges, such as cyber threats, and geopolitical turbulence, including the possible resurgence of high-intensity warfare with the Russian annexation of Crimea in 2014 and the invasion of Ukraine in 2022. Lastly, the article explores the potential for a new nuclear discourse emerging between Russia and NATO, with some Member States reaffirming the Organisation's primary identity as a "nuclear Alliance."¹¹

The History of Strategic Postures

Managing the End of the Cold War: The Nuclear Aspects of the Rome Document (1991)

As the Cold War came to an end, the signing of the Conventional Forces in Europe (CFE) Treaty in 1990 – albeit temporary – sought to establish a balance of conventional forces in Europe. The aim was to prevent any surprise conventional attacks. In parallel, NATO also initiated a redefinition of its defence doctrine, prompting reconsiderations of nuclear weapons.

As early as 1988, the term "*sub-strategic weapons*" was adopted in place of "*tactical weapons*,"¹² as the latter fell out of popularity.¹³ This marked a renewed politicisation of the nuclear strategy within the Alliance. Subsequently, beginning from October 1989, numerous studies were carried out to solidify the roles, missions, and characteristics of NATO's nuclear systems,¹⁴ further intensifying this trend.

In July 1990, the Alliance, excluding France, declared nuclear weapons to be "*weapons of last resort*"¹⁵ in the final statement of the London Summit. The complete withdrawal of Soviet forces from Europe and the implementation of the CFE agreement enabled the concerned Allies to reduce their reliance on nuclear weapons. This seemingly had allowed them to adopt a different NATO strategy in the newly "transformed" Europe, where nuclear forces were to be genuinely considered as a

11. Le Figaro TV, "[Poutine doit comprendre ” que l’OTAN “ est une alliance nucléaire ”, lance Le Drian](#),” *Le Figaro* (16 May 2022).

12. In regard to the difficulty of defining "tactical" nuclear weapons, see T. de Champchesnel, "The Return of Tactical Nuclear Weapons?," *IRSEM*, report no. 105 (April 2023): 17-30.

13. C. G. Fricaud-Chagnaud and J.-J. Patry, *Mourir pour le roi de Prusse ? Choix politiques et défense de la France* (Paris: Publisud, 1994): 107.

14. Editor's translation of B. Tertrais, *L'arme nucléaire après la guerre froide* (Paris: Economica, 1994): 119.

15. P. Boniface, "L'avenir de la dissuasion," *La revue Internationale et Stratégique (IRIS)*, no. 6 (Summer 1992): 64.

last-resort option. In essence, the Alliance, at that time, had already recognised how profoundly transformed the nature of post-Cold War Europe had become.¹⁶

This in-depth review led to the publication of the Alliance's new *Strategic Concept*, approved by the Heads of State and Government at the Atlantic Council meeting in Rome on 8 November 1991. In specific regard to the topic of nuclear weapons, the document remained cautious and reiterated that it would be necessary to maintain in Europe an appropriate combination of nuclear and conventional forces. This had directly reflected President Bush's decision in September 1991 to unilaterally withdraw ground-to-ground, ground-to-air, and naval TNWs. The 1991 *Concept* had also taken into account the Nuclear Planning Committee's decision in Taormina the following month to halve the theatre of air-to-ground weapons.¹⁷ Essentially, the text had stressed the importance of deterrence against any threat to the territory of a NATO Member State and the preservation of the strategic balance in Europe.¹⁸

Similarly, paragraph 54 of the 1991 *Strategic Concept* stated that the "*supreme guarantee of the security of the Allies [was to be] provided by the strategic nuclear forces of the Alliance, particularly those of the United States.*" Reflecting the Ottawa Declaration of 1974,¹⁹ it also noted that the independent nuclear forces of the United Kingdom and France were to contribute to the overall deterrence and security of the Allies, despite having "*a deterrent role of their own.*" The following paragraph 55 then stated that the nuclear forces "*based in Europe and committed to NATO [were to] provide an essential political and military link between the European and the North American members of the Alliance.*"

This cohesion can be further witnessed in collective defence planning, the peacetime stationing of nuclear forces on Allied territories, as well as within associated command, control, and consultation arrangements. As such, the Alliance was to "*maintain adequate nuclear forces in Europe. They need[ed] to have the necessary characteristics and appropriate flexibility and survivability, to be perceived as a credible and effective element of the Allies' strategy in preventing war. They [were to] be maintained at the minimum level sufficient to preserve peace and stability.*"

Paragraph 56 then addressed the question of which delivery systems to use to carry the nuclear warheads. The primacy of dual-carrier aircrafts was affirmed. While it stated that these means "*could, if necessary, be supplemented by offshore*

16. R. Hyppia, *L'OTAN dans l'après-guerre froide* (Montreal: L'Harmattan, 1997): 45.

17. T. van Vlijmen, "Alliance Security: New Context, New Challenges," in *Reports / North Atlantic Assembly; Defence and Security Committee* (Brussels: North Atlantic Assembly, International Secretariat, 1992): 6.

18. According to paragraph 13 of the 1991 *Strategic Concept*, "*Soviet military capability and build-up potential, including its nuclear dimension, still constitute the most significant factor of which the Alliance has to take account in maintaining the strategic balance in Europe.*" See Collectif, *Demain, l'ombre portée de l'arme nucléaire... L'arme nucléaire française en question* (Paris: CREST/La Documentation française, 1996).

19. The Declaration on Atlantic Relations, approved by the North Atlantic Council in Ottawa on 19 June 1974 and signed by NATO Heads of Government in Brussels on 26 June, recognised the contribution of British and French nuclear forces to NATO's overall deterrence.

systems,” it was nevertheless specified that “*in normal circumstances,*” sub-strategic nuclear weapons were not to be deployed on surface vessels and attack submarines. As for “*nuclear artillery or ground-launched short-range nuclear missiles,*” there would be no requirement for their use and were to be eliminated gradually.

Table 1: Evolution of NATO's Tactical and Sub-strategic Nuclear Potential in Europe

Estimated Number of Nuclear Warheads						
Systems ¹	1965	1981	1988	1991	1993	2023
SNF ² Lance	0	692	692	692	0	0
SRINF ³ Pershing-1A	200	293	100	0	0	0
SAM ⁴ Nike Hercules	990	686	100	75	0	0
Charges ASM ⁵ B-57	0	192	192	192	0	0
Mines ADM ⁶	340	372	0	0	0	0
INF ⁷ Pershing-2	0	0	234	0	0	0
INF GLCM ⁸	0	0	443	0	0	0
SNF Honest John	1.900	198	0	0	0	0
SNF Sergeant	300	0	0	0	0	0
Bombes aéroportées	1.240	1.729	1.400	1.400	<800	≤100
Obus 203 mm	975	938	738	240	0	0
Obus 155 mm	0	732	732	732	0	0
Total	5.905	5.792	4.631	3.331	<800	≤100
<ol style="list-style-type: none"> 1. This table does not take into account the French and British nuclear forces, but only the U.S. arsenal deployed in Europe under the dual-key or single-key procedure. All TNWs withdrawn from Europe during these years but still stored in the United States were destroyed from 1999 onwards. 2. Short-range Nuclear Force. 3. Short-range Intermediate Nuclear Force. 4. Sol-air missile. 5. Anti-submarine. 6. Atomic Demolition Munition. 7. Intermediate Nuclear Force. 8. Ground-launched Cruise Missile (Gryphon). 						

Sources: Successive editions of the *SIPRI Yearbook*, the *Military Balance* (from the International Institute for Strategic Studies) and the *Nuclear Notebook* of the *Bulletin of the Atomic Scientists*.

The concept of “last resort”, as was outlined in the London Declaration, no longer appeared in the Rome Declaration. The Alliance had wished to reaffirm the principle of a possible “first use” without causing too much discomfort to Paris. Indeed, the notion of “last resort” was rejected by France. The country’s doctrine of final warning, contrary to the Alliance’s, considered an early resort to nuclear weapons as a warning shot to prevent a widespread nuclear battle. Therefore, Paris did not endorse

the aforementioned paragraphs of 55 and 56, which specifically addressed operational aspects of deterrence.²⁰

In juxtaposition with the French perspective,²¹ NATO then considered nuclear weapons to be too extreme and lacking in credibility as a tool for crisis management. While the idea of response and escalation remained, the definition of “thresholds” – the risk of reaching extremes or deliberate escalation – was no longer coherent with the withdrawal of a large number of TNWs and the new U.S. conventional remote strike capabilities into a theatre. Although no longer enshrined in the Rome Declaration, the principle of “last resort” is still very much present in the minds of NATO military personnel and officials.²² The Rome decision is, above all, a symbol of the Alliance’s desire to reduce dependence on nuclear weapons, be it in its force structure, policy, or planning.²³

Acknowledging A New Strategic Context

The 1991 *Strategic Concept* became grossly “outdated” in just a few years, with the dissolution of the Warsaw Pact, the demise of the Soviet Union, the Gulf War, and the explosion of nationalism in the Balkans. Against this backdrop, the NPG decided, as early as November 1994, to reduce TNWs and update consultations and planning procedures. The end of the Cold War provided an opportunity to develop more flexible directives with a case-by-case definition of conduct.

In February 1996, the NATO Military Committee completed a new version of the MC 400 (the MC 400/1) by incorporating an analysis of risks and threats, including weapons of mass destruction. Subsequently approved in June 1996, the study addressed issues of nuclear policy adaptation and readiness, sub-strategic nuclear weapons stockpile levels, availability for intra-regional deployments, security measures, as well as nuclear planning, training and consultation procedures.

After this, discussions on nuclear issues became rather modest. A case in point is the communiqué issued on 17 December 1998 at the end of the ministerial meeting of NATO’s Defence Planning and Nuclear Planning Committee. It recognised that “*in the current security environment, the circumstances in which any use of nuclear weapons might have to be contemplated [were] extremely remote.*”

The shift towards potentially assigning tactical nuclear missions to conventional forces aligned with the insights drawn from the Kosovo war and the broader context of the Revolution in Military Affairs (RMA).²⁴ Notably, increases in the range and

20. B. Tertrais, *op. cit.*, 124.

21. F. Bozo, *La France et l’OTAN. De la guerre froide au nouvel ordre européen* (Paris: IFRI/Masson, 1991): 173-174.

22. A. Dumoulin, “OTAN. Quel rôle face la nouvelle Europe ?,” in P. Buffotot (ed.), *La défense en Europe. De la guerre du Golfe au conflit yougoslave* (Paris: La Documentation française, 1995).

23. G. L. Schulte, *Les forces nucléaires de l’OTAN dans un monde en mutation* (Bruxelles: Revue de l’OTAN, février 1993): 17.

24. The Revolution of Military Affairs involves technological change, doctrinal innovation, and organisational/operational adaptation. It is reflected, amongst other things, in the emergence of the “systems of

precision of conventional capabilities had allowed for the neutralisation of critical targets on a global scale. In addition, the delicate nature of setting up a political, diplomatic, and military think-tank on nuclear issues within NATO, elucidated the Alliance's increasing reluctance to initiate a debate on this issue.

Nevertheless, three main themes emerged before the discussions on the new *Strategic Concept* of 1999. Firstly, NATO's stance on counter-proliferation was addressed. Secondly, focus turned towards the issue of no-first-use.²⁵ Finally, the nuclear posture was studied under the context of the Alliance's enlargement to include former Soviet satellites.

Counter-proliferation

The desire of NATO's neighbouring states to choose the path of obtaining military nuclear power became evident during the 1980s and 1990s. Whether it was the Islamic Republic of Iran, pre-1991 Iraq under Saddam Hussein, or Colonel Gaddafi's Libya, these Muslim-majority countries could rely on the existence of clandestine proliferation networks, including that of Pakistan's Dr. Khan.

Nevertheless, NATO did not dare leverage the U.S.'s remaining nuclear presence to develop a preventive, pre-emptive, or coercive counter-proliferation strategy. A particularly sensitive subject, its interpretations remained partially divergent between the two coasts of the Atlantic. In France, for instance, there was a fairly significant but now stillborn debate on the concept of the "*fort au fou* (madman with a bomb)".²⁶

Moreover, the debate at the time revolved around the difficulty of making deterrence credible in the face of leaders, who were deemed unstable and capable of unleashing nuclear fire. It soon became evident that the "madman" could not truly be "mad", given their presumed desire to stay in power. Despite an adversary's capacity to retaliate, they would refuse to commit suicide. North Korea is often cited as an example to illustrate such a scenario. Notwithstanding their nuclear gesticulations, every dictator is first and foremost driven by the need to ensure their own survival.

Ultimately, irrespective of the scenarios and actors involved, the goal was to demonstrate that the Alliance remained determined and capable of deterring any aggression, regardless of where it came from.

systems" concept regarding the C4ISR domain (command, control, communications, computers, along with intelligence, surveillance, and reconnaissance). The objective is to increase the capacity to detect, identify, and track a much larger number of targets, in a much larger space, and within a much shorter time span than in the past, e.g. Observe, Orient, Decide, Act (OODA) loop tested during the Gulf War.

25. D. S. Yost, *The US and Nuclear Deterrence in Europe* (London: Adelphi Paper 326, IISS, 1999): 64-67.

26. A. Dumoulin, "Inflexions autour de la dissuasion nucléaire française: De l'influence de la conceptualisation et de l'outillage américain," *Stratégique*, vol. 86-87, no. 1-2 (2006): 181-194; J.-D. Merchet, "[Les 'fous' ciblés par le nucléaire français](#)," *Libération* (27 October 2003); P. Boniface, *Contre le révisionnisme nucléaire* (Paris: Éditions, 1994); B. Tertrais, "La dissuasion nucléaire française après la guerre froide : Continuité, ruptures, interrogations," *Annuaire français de relations internationales*, vol. I (2000).

No First Use

The deterrent role of nuclear weapons primarily hinges on the threat posed by other nuclear weapons and weapons of mass destruction (radiological, biological, and chemical). Weighing the latter against the former then became necessary. The complexity of their use and the uncertainty surrounding their immediate or delayed effects proved to be a challenge in comparison to thermonuclear devices.

Beyond the notion of uncertainty as a guarantee of deterrence and the ability to bring into play a European Allied legitimacy through NATO, certain circles envisioned a pre-emptive U.S. strike from European bases. This was to be followed by a counter-proliferation scenario against nations in the South, namely, Iran, Iraq, or Libya. The question of maintaining a possible “first-use” in the context of deterrence/retaliation under the context of a nuclear, biological, or, incidentally, chemical threat outside the zone had been raised.

This debate took place after 1993 when Russia renounced²⁷ the principle of no-first-use, in order to regain freedom of action and to respond fully to the logic of deterrence. Concurrently, it psychologically restored the geostrategic balance through the use of nuclear weapons. For Moscow, the weapon had become a tool of prestige that compensated for its conventional inferiority against U.S. power, amidst a back-drop of tensions on NATO’s enlargement process.

At the NPG meeting on 17 December 1998, emphasis was put on “*ensuring uncertainty [...] about the nature of the Allies’ response to military aggression. They demonstrate[d] that aggression of any kind [was] not [to be] a rational option.*” The reluctance of a majority of NATO Member States to officially contemplate no-first-use could be attributed to the concern that the U.S. nuclear umbrella, itself, might be called into question. Moreover, many analysts viewed no-first-use as the very negation of deterrence.²⁸ They deemed that the notion offered no guarantees in terms of “disarmament” and did not serve the language of deterrence.

Nevertheless, the hypothesis of adopting the no-first-use principle to address purely conventional aggressions, may have been a prudent way of responding to the new post-Cold War geostrategy. This was to, in parallel, preserve the first-use message²⁹ in consideration of any nuclear, biological, and chemical threats.

27. Editor’s translation of Pavel Gratchev’s statement (then Russian Defence Minister) on 02 November 1993: “*The Russian Federation will not use nuclear weapons against any signatory of the Treaty on the Non-Proliferation of Nuclear Weapons that does not possess nuclear weapons, except in two cases: in the event of an attack by a (non-nuclear) state which has signed a military agreement with a nuclear power; in the event of a joint action (by a non-nuclear State with a State possessing nuclear weapons) aimed at carrying out or supporting an invasion or armed attack against the Russian Federation, its territory, its armed forces, its other troops, or its allies.*”

28. See for example P. Boniface, *Repenser la dissuasion nucléaire* (Paris: Éditions de l’Aube, 1997): 109-111.

29. K. Stoddart, “The Status of NATO’s non-strategic nuclear weapons in Europe,” in G. Bouthérin (eds.), *Europe facing nuclear weapons Challenges* (Brussels: Bruylant, 2008).

Responding to Enlargement

A myriad of questions regarding NATO's nuclear posture in the context of enlargement also surfaced well before the adoption of yet another *Strategic Concept*, which confirmed the progress made in this domain. Debates included considerations about deepening the relationship with Moscow through a clearer commitment to the non-deployment of U.S. nuclear weapons on the territory of new Member States and the consequences of a nuclear-free zone³⁰ in Central and Eastern Europe.

Initially, the September 1995 *Study on NATO Enlargement* emphasised that there had to be “no a priori requirement” in deploying nuclear weapons from the territories of new Member States. However, the possibility was not categorically ruled out. Rather, the document specified that these countries were to contribute “to the development and implementation of NATO's strategy, including its nuclear components.”³¹ In practice, the Alliance did not make any legally binding commitment not to deploy nuclear weapons in the East.³² All it had produced was a simple declaration of intent that could be revised unilaterally according to the circumstances. *De facto*, the notion of a special nuclear status for the Central European zone was thus present but without a legal basis.

Subsequently, at the foreign ministers' summit in April 2010, the issue of withdrawing U.S. nuclear weapons was put on the agenda at the request of several European NATO members, namely Belgium, Norway, and the Netherlands. This request reflected the spirit of the 2004 working paper submitted by these three countries to the Preparatory Committee for the 2005 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons. The main stated objective was the complete elimination of non-strategic nuclear weapons worldwide. This discussion,³³ however, did not lead to any U.S., Russian, or NATO decisions being made.³⁴

Moreover, these strategic and geographical reflections on the role of nuclear weapons within NATO unfolded at a time when new security issues began to emerge. Namely, this included the proliferation of weapons of mass destruction, the ballistic missile threat in the Middle East, the deployment of anti-ballistic missile systems in Eastern Europe and the Mediterranean (SM-2 Aegis Ashore missiles), terrorist

30. See J. Prawitz, “A Nuclear-Weapon-Free Zone in Central and Eastern Europe,” *Programme for Promoting Nuclear Non-Proliferation Issue Review*, no. 10 (February 1997).

31. At the OSCE meeting in Lisbon in December 1996, NATO announced that its Member States “have no intention, no plan, and no reason to deploy nuclear weapons on the territory of new members nor any need to change any aspect of NATO's nuclear posture or nuclear policy.”

32. In the Russia-NATO Founding Act, Part 4 states: “NATO has decided that it has no intention, no plan, and no reason to establish nuclear weapon storage sites on the territory of those members [editor's note: the three countries newly integrated into the Alliance at the time], whether through the construction of new nuclear storage facilities or the adaptation of old nuclear storage facilities”.

33. A. Dumoulin, “Positionnement des acteurs et “cartographie” de la Belgique en matière de dissuasion nucléaire substratégique,” in *Contribution to the study on Tactical Nuclear Weapons and Security In Europe* (Paris: FRS-DAS, March 2007).

34. E. Nexon, “Les armes nucléaires non-stratégiques en Europe,” *Observatoire de la non-prolifération*, no. 47 (March 2010): 3.

threats, strategic debates on the renewal of U.S., Russian, French, and British strategic components, the future of the Global Zero campaign, and more.

Within this context, NATO's *Strategic Concept* presented at the Lisbon Summit in 2010 established that the "*supreme guarantee of the security of the Allies [was to be] provided by the strategic nuclear forces of the Alliance.*" It also reiterated that deterrence was to be "*based on an appropriate mix of nuclear and conventional capabilities,*" in which missile defence had its rightful place.

In 2016,³⁵ NATO's emphasis on the link between a major cyber attack and the use of Article 5 of the Atlantic Alliance introduced a polymorphous vision of the threat, pointing towards the direction of a plural deterrence. This was then highlighted again at the Brussels Summit in 2021, which consequently made it possible to invoke Article 5 in response to "*attacks to, from or within space.*"³⁶

With the tensions arising from the crisis in Ukraine in 2014, coupled with Russia's invasion of Crimea in the same year,³⁷ as well as the country's aggressive sanction policies, these events ultimately led to further specifications³⁸ being made at the Warsaw Summit in July 2016. The Summit's conclusions thus stressed that nuclear resources were to remain a tool of deterrence, while naming Russia as a factor of instability. The Russian-Ukrainian crisis then led to statements from NATO, including further U.S. nuclear posturing.³⁹

Lastly, at the July 2018 Summit, NATO affirmed that as "*long as nuclear weapons exist, NATO will remain a nuclear alliance. The strategic forces of the Alliance, particularly those of the United States, are the supreme guarantee of the security of Allies. The independent strategic nuclear forces of the United Kingdom and France have a deterrent role of their own and contribute significantly to the overall security of the Alliance.*"

In parallel, through its spokespersons, its Secretary General, and certain national governments, NATO also regularly made note of the futility of mentioning or threatening against the use of nuclear weapons on any of its Members. This point was reiterated in the most recent *Strategic Concept* of 2022, which stated that the Alliance possessed "*the capabilities and resolve to impose costs on an adversary that would be unacceptable and far outweigh the benefits that any adversary could hope to achieve.*" This assurance reflected the uncertainties borne from the new international environment, while underscoring the importance of maintaining a U.S. nuclear component in Europe alongside its Allies.⁴⁰

35. "[Countering hybrid threats](#)," NATO (18 August 2023).

36. "[NATO's approach to space](#)," NATO (23 May 2023).

37. A. Dumoulin, "Crise russo-ukrainienne : Conséquences sur les politiques de défense OTAN, UE et de défense nationale," *Institut Royal Supérieur de Défense, Sécurité & Stratégie*, no. 125 (2016).

38. Belgium, Germany, Luxembourg, the Netherlands, and Norway.

39. For a list of nuclear demonstrations, see A. Dumoulin, "Crise russo-ukrainienne : Conséquences sur les politiques de défense OTAN, UE et de défense nationale," *Institut Royal Supérieur de Défense, Sécurité & Stratégie*, no. 125 (2016): 20-29.

40. A. Dumoulin, "Le "retour" des armes nucléaires non stratégiques," *Institut Royal Supérieur de Défense, Sécurité & Stratégie*, no. 144 (2020); and "Ce que la guerre d'Ukraine change," *Défense & Sécurité internationale*, HS, Areion, no. 88 (2 March 2023).

In this geostrategic environment, a number of issues concerning nuclear questions have already been pointed out. Certain include the replacement of the *F-16* by the *F-35*, which would be able to fulfil the function of the nuclear fighter-bomber certified in 2024. It also touched upon the scenario of a negotiation to withdraw nuclear weapons from the theatre by the two major nuclear powers. Notably, it points out the role of the French nuclear deterrent, which remains, in the narrow sense of the term (*cf.* the consequences of Brexit), as the only state in the European Union that is able to guarantee a deterrent.

Between the Virtuality and Continuity of Nuclear Vaults

Storing Airborne Bombs

According to open U.S. sources, the presence of nuclear weapons placed in special vaults under concrete aircraft hangars is currently estimated at around 100 U.S. B61 gravity bombs, namely Model 3, whose adjustable power is 0.3, 1.5, 60, and 170 Kt, and Model 4 with 0.3, 1.5, 10, and 45 Kt.⁴¹ Under the dual-key system, these bombs can be fitted on certain *Tornado*, *F-16*, or *F-35* fighter aircrafts from German, Belgian, Dutch, Italian, and Turkish fighter-bomber squadrons.⁴² They can also be mounted on the U.S. *F-16*, *F-15E*, and soon *F-35* fighter jets stationed in U.S. Air Force bases throughout Europe.



Interior of a hardened hangar of an unknown air base. A WS3 containing a B61 with an *F-16* is in the background.

Source: [Federation of American Scientists](#)

41. Model 10 (0.3, 1.5, 10, and 80 Kt) and Model 7 are not available in Europe.

42. Turkey is unable to buy an *F-35*, but will be able to take the B61 Model 12 with it, subject to a retrofit (unconfirmed). Ankara's uncertain diplomatic and military stance, along with U.S.-Turkish tensions seem to indicate that Turkey is abandoning the dual-key principle for its own *F-16* aircraft. Some sources point to the possible repatriation of all or part of the U.S. nuclear arsenal from Incirlik to the British base at Lakenheath.

Variable-charge thermonuclear capabilities can be adjusted before take-off, providing the opportunity to target hardened or non-hardened targets with “counterforce” precision. This encompasses strikes against priority military targets (command centres, logistical nodes, concentrations of strategic equipment, adversary nuclear weapons systems, etc). Its versatile modularity also allows the B61 to serve as either a tactical, sub-strategic, or strategic bomb. In-flight refuelling and low-altitude penetration capabilities of these fighter jets also allow them to increase their bombing range.

The new Model 12 version, set to replace B61 Models 3 and 4, incorporates nuclear materials from Model 4, and components from the older bombs of the B61 family. They will also possess new safety features that are to include an optional limited-penetration capability. Designed to have more accurate firing capabilities at a safe distance of 80km⁴³ (thanks to either an inertial navigation system, GPS, or digital-guided tailplane kit), it will be able to evade any ground-to-air threats. The *F-35s* acquired by certain European countries will receive this new bomb as soon as the Block 4 version is integrated.⁴⁴

Initiated in 1988, the NATO programme, known as the Weapons Storage and Security Systems, addressed the deployment of hardened underground vaults. An upgrade was then carried out between 1999 and 2005 to improve the safety and security of these vaults against intrusion and unauthorised use.⁴⁵ In 2021, a safety upgrade (command, control, and security) began and continued over the next four years. The aim was to “[install] double-fenced security perimeters, [...] having recently completed [modernisation of] the Weapon Storage and Security System (WS3) and Alarm Communication and Display (AC&D) system, [...] along with the new Secure Transportation and Maintenance System (STMS) trucks.”⁴⁶

While 437 storage vaults across 26 bases may have received bombs during the Cold War, the Senior Level Weapons Protection Group (SLOWPIG)⁴⁷ decided in

43. Instead of gravity release, it uses resource level and braking parachute (explosion delay also possible electronically).

44. For Belgium, the nuclear-ready version will be at Kleine Brogel (the only Belgian base where the WS3s are located) in 2027. For the 34 Belgian *F-35s*, the delivery of the first 8 devices is blocked due to the need to introduce a major hardware and software upgrade (Technology Refresh 3/TR3) required for the proper functioning of the Block 4 version of the device. A partial solution could be the adaptation of the first version of the TR3 software (truncated version) to unlock the delivery. The *F-35s* delivered will not have fully integrated all systems. Flight training for pilots would be scheduled for summer 2024 at Luke Air Force (Arizona) for a delayed IOC in summer 2025. The first *F-35s* delivered will operate from Florennes. On *F-35* block 4, cf. *Le Soir* (24 April 2024); *Air fan* (Octobre-Novembre 2022): 54 and seq.; J. Henrotin, “Le Block 4/C2D2 du F-35. Coûts, risques et opportunités,” *Défense & Sécurité internationale*, Areion, no. 148 (7 August 2020): 90. and seq.

45. The B61s stockpiled in Europe have Permissive Action Link (PAL) security keys with a code switch directly integrated into the bomb. The bomb is fully encapsulated in a protective casing (protective membranes) where any unauthorised penetration would result in the automatic implementation (thanks to electronic anti-intrusion circuits, a locking system, and rigid plastic covers with sensors) of a procedure designed to initiate the self-destruction a nuclear bomb’s vital elements.

46. H. M. Kristensen, “NATO Nuclear Weapons Exercise Over Southern Europe,” *FAS Strategic Security Blog* (20 October 2021).

47. This NATO committee was responsible for overseeing nuclear safety and security issues, as well as guaranteeing the survivability of these weapons. Supervised by the United States, it was replaced in 1999 by the NPG High Level Group.

1995 to reduce this number to 208 across 15 bases. With the decrease in the number of U.S. squadrons and the closure of various infrastructures in Europe, some of these vaults were already more or less empty during peacetimes (see Table 2). Moreover, they were only intended to receive B61 bombs in the event of a serious crisis or for strategic warning purposes. The bombs were then transported by the *C-17s* from the 4th Airlift Squadron at the Lewis-McChord Air Force Base in Washington, whose crews were specialised in the task.

The disparity between the number of WS3 vaults on NATO nuclear bases and the remaining number of B61 bombs still present on the continent,⁴⁸ has led to certain vaults being partially or even completely empty of weapons. Such is the case at Murted and Balikesir in Turkey, Araxos in Greece, as well as Memmingen, Ramstein (2005), and Norvenich in Germany (see Table 2). Furthermore, nuclear charges can be rotated between different vaults outside the routine of bomb maintenance. These changes also allowed for an intra-European exchange within the NATO zone to respond to certain crisis scenarios on the periphery of the Alliance (*e.g.* Turkey). In addition, such movements guaranteed the transfers of bombs from one storage vault to another for both security and safety reasons.

It should also be noted that, in absolute terms, measures to repatriate the B61 bombs to the United States would leave the vaults intact. They would thus remain fully capable of accommodating nuclear bombs for strategic signalling purposes.

Table 2: Location of U.S. Airborne Nuclear Bombs in Europe

Estimates of Empty ("cold") Vaults in Peacetime	Location of Nuclear Bases and Weapons Delivery Systems (1)	Host Countries	Estimated Number of Nuclear Bombs in 2023
	Büchel (<i>Tornado</i> to <i>F-35</i>)	Germany	15
11	Memmingen (<i>Tornado</i>)	Germany	0
11	Norvenich (<i>Tornado</i>)	Germany	0
55	Ramstein (<i>F-16C/D</i>)	Germany	0
	Kleine Brogel (<i>F-16A/B MLU</i> to <i>F-35</i>)	Belgium	15
11	Araxos (<i>A-7H, F-16</i>)	Greece	0
	Aviano (<i>F-16C/D</i> to <i>F-35</i>)	Italy	20
	Ghedi-Torre (<i>Tornado</i> to <i>F-35</i>)	Italy	15
	Volkel (<i>F-16 A/B</i> to <i>F-35</i>)	Netherlands	15
≤ 33	Lakenheath (<i>F-35</i>) (2)	Great Britain	After withdrawal around 2008, the process of re-nuclearisation is again underway

48. The presence of around 150 B61 bombs in these facilities remains conditional, as bilateral legal constraints meant that neither the number nor their location could be specified, and that some vaults may even be empty or partially occupied. Although a large number of declassified documents and other hearings before the U.S. Congress could provide a wealth of details, the primary indicator of the presence or otherwise of nuclear bombs is, in truth, the number of U.S. military personnel (Munitions Support Squadron/MUNSS) and their families in the vicinity of the host base, who are responsible for some of the maintenance and security of these weapons.

6	Balikesir (<i>F-16C/D</i>)	Turkey	0
	İncirlik (<i>F-16C/D</i>) to <i>F-35</i> (3)	Turkey	20
6	Murted (<i>F-16C/D</i>)	Turkey	0
24	Marham (<i>Tornado</i>)	Great Britain	0

NB:

(1) All data included in this table are estimates and are based on H. M. Kristensen, "U.S. Nuclear Weapons in Europe," *Natural Resources Defense Council* (February 2005) and the *Nuclear Notebook* (successive editions of the *Bulletin of the Atomic Scientist* and *Fas.org*).

(2) The airbases in italics (Ramstein, Aviano, Lakenheath, and Incirlik) are facilities under the U.S. Air Forces in Europe (USAFE)'s own control, where they have their own aircrafts.

(3) H. Kristensen, "Lakenheath Air Base Added To Nuclear Weapons Storage Site Upgrades," *Federation of American Scientists*, 11/04/2022; M. Korda, H. Kristensen, "Increasing Evidence That the US Air Force's Nuclear Mission May Be Returning to UK Soil," *Fas.org* (28 September 2023). The British base was denuclearised around 2008. One possibility would be the transfer of all or part of the nuclear weapons stored at Incirlik to Lakenheath.

(4) The base in Turkey does not permanently accommodate U.S. *F-16* aircrafts.

The Nuclear Grammar Needed Today

The future of the U.S. nuclear presence in Europe remains more as a question of political will than strategic necessity. The U.S. nuclear delivery systems (*B-2 Spirit* and its successor, the *B-21 Raider*) with their intercontinental autonomy, emphasises this point. Subject to Congressional approval, the Pentagon announced on 27 October 2023, its intention to introduce the new B61 Model 13 tactical bomb (with the 360 kt warhead of the B61-7 bomb, which will be withdrawn) with the purpose of hitting hardened targets. It will be intended for the *B-2* and *B-21 Raider* strategic bombers, rather than the European *F-35*.

In this context, the response to any debate on the future of NATO's nuclear weapons will be dependent on not only European perception of the French and British nuclear forces,⁴⁹ but also, and above all, on the geostrategic landscape of the Old Continent. Since February 2022, the Russian-Ukrainian war has provoked new and unstable geopolitical dynamics. The presence of U.S. nuclear weapons in Europe reinforces NATO's deterrent capabilities and guarantees the "attached goat" principle⁵⁰ for U.S. nuclear vaults at certain bases. Any attempt to neutralise or destroy the sites hosting U.S. weapons would result in a military response of "the same nature" against the aggressor. Now that trust between Russia and the U.S. has been broken, nuclear weapons are once again emerging as a measurement of power.

Today, for many NATO Member States, the purpose of nuclear weapons is to act as a general deterrent against uncertain risks, whether as a supreme guarantee against

49. On the U.S. nuclear presence in Europe, see D. Yost, "The US and Nuclear Deterrence in Europe," *IISS Adelphi Paper*, no. 326 (1999).

50. Expression used by President François Mitterrand regarding France's strategic ground-to-ground ballistic missiles. According to him, any attack on the missiles on the Albion plateau that require the use of nuclear weapons to destroy the silos in which they are placed, would have marked and revealed the true intentions of the aggressor.

Russian aggression, or against the possible threat of proliferation in the South, such as Iran. In other words, maintaining nuclear weapons is a means to avoid circumstances “*in which a state with a risk-taking leadership (or one feeling under special threat) might be tempted to gamble on a clandestine dash to seize advantage through a period of sole nuclear possession.*”⁵¹

At the July 2023 Vilnius Summit, NATO strengthened its deterrence posture, based on the *Euro-Atlantic Deterrence and Defence Concept* (EADC), adopted by various defence ministers in June 2020.⁵² The EADC grants nuclear weapons a unique place within the Alliance’s multi-domain architecture. It thus reflects the fruits of an improved operational readiness, capabilities modernisation, and strengthening of ties between different national military plans and those of NATO’s.⁵³

The Russian-Ukrainian crisis has therefore led the Alliance to retain the traditional principles guiding nuclear planning and consultations. In parallel, the conflict has marginally adjusted NATO’s nuclear deterrent to align with Russia’s own nuclear strategy. This notably involved codifying messages of reassurance, be it through verbal means (speeches, press releases, conclusions of NPG meetings or Alliance summits) or demonstrations (announced air exercises) for the benefit of European Allies. Likewise, Russian leaders are also reminded of the fundamentals of deterrence protecting NATO territories.

To implement this strategy, NPG Member States have been regularly conducting Steadfast Noon air exercises as part of NATO’s nuclear mission. These exercises, led by the United States in partnership with more than a dozen other Alliance Member States – officially “*non-nuclear-weapon states*” under the NPT⁵⁴ – fall into two categories.

The first category consists of the States involved in the “nuclear-sharing” mechanism, those being Germany, Belgium, Italy, the Netherlands, and Turkey. Their fighter-bombers take part in exercises and have the ability to carry the U.S. dual-keyed B61 bombs. The second category comprises the other NATO countries, whose aircrafts are limited to carrying out Support of Nuclear Operations with Conventional Air Tactics (SNOCAT) missions.⁵⁵

51. Sir M. Quinlan, “The Future of Nuclear Weapons: policy for Western possessors,” *International Affairs*, vol. 69, no. 3 (1993).

52. Approval by the Alliance’s Heads of State and Government in 2021.

53. S. R. Covington, “[NATO’s Concept for Deterrence and Defence of the Euro-Atlantic Area \(DDA\)](#),” *Belfer Center for Science and International Affairs, Harvard Kennedy School* (2 August 2023).

54. Regarding the interpretation of the NPT on the presence of U.S. nuclear weapons in Europe, see A. Dumoulin and Q. Michel, “La Belgique et les armes nucléaires,” *Courrier hebdomadaire du Centre de recherche et d’information socio-politiques*, no. 1871-1872 (2005).

55. C. Barbit and E. Maitre, “Discours de l’École de guerre : quelle intégration des partenaires européens à la dissuasion française ?,” *Observatoire de la dissuasion*, FRS (February 2020): 5; and “Nuclear Notebook, United States Nuclear weapons, 2022,” *Bulletin of the Atomic Scientists*, vol. 78, no. 3 (2022).

In October 2022, fourteen countries and up to 60 aircraft of various types took part in operations over Belgium, the North Sea, and the United Kingdom. The following year in October 2023, the exercise took place over the span of two weeks, starting in southern Europe, specifically, Italy, Croatia and the Mediterranean Sea. It involved nearly sixty aircrafts, including the U.S. *B-52s*, from thirteen NATO Member States.

Washington continues to maintain its nuclear doctrine aimed at ensuring the effectiveness of deterrence to defend its national interests and the integrity of Alliance Member States. Following their withdrawal in 2007-2008, discussions were reportedly underway for the redeployment of the B61 Model 12 bombs to be placed in WS3 underground vaults at Lakenheath Air Base in the UK, where U.S. *F-35s* operate. Additional measures in the same vein include: Germany's decision to acquire the *F-35s* (which are qualified to carry the B61 bomb) to replace their previous *Tornadoes*;⁵⁶ the continuation of the annual Steadfast Noon exercise in October 2023; maintaining the U.S.'s nuclear *status quo* through the *Nuclear Posture Review* (NPR); as well as upholding the Biden administration's integrated deterrent of October 2022 against the backdrop of the arms control crisis.



U.S. Air Force *F-35A* equipped with two B61 Model 12s.

Source: [War on the Rocks](#)

Beyond these decisions and actions of deterrence, senior leaders of NATO countries, including Stoltenberg, Biden, Blinken, Macron, and High Representative Bor-

56. The revival of the WS3s at Lakenheath, where the U.S. *F-35s* will be based, and the deployment of the B61 Model 12 were on the cards before Russia invaded Ukraine in 2022. The fact remains that these statements continue to maintain the principle of a well-known (future) deterrent visibility.

rell, have emphasised the extreme consequences that could follow Russian use of TNWs against Ukraine. This reiteration of the general principles of the dialectic nature of deterrence is crucial for the media, parliamentary, and political diatribes by Russian leaders on the use of nuclear weapons as a display of power. Moscow's aim is to instil a sense of dread in the West and potentially influence Europeans to reconsider their policies of support for Ukraine.

Dramatisation serves as another tool used to reassure Russian public opinion on the Kremlin's strategic choices. By portraying Moscow's military actions in Ukraine as sanctified, seeking concessions from Ukraine, and compensating for the image of failure of the Russian army,⁵⁷ Russian "influencers" can use these tactics as justification to inflate the performance of the Russian arsenal. However, in reality, Russia's use of nuclear weapons is borne from a strategic backdrop, where its vital interests of the country's survival are at stake.

Moreover, in 2023, Russian nuclear weapons were transferred to Belarus and put under the control of the Russian military personnel stationed there. The primary aim of this was to intimidate Poland.⁵⁸ As such, Warsaw has expressed its wish to receive U.S. B61s as vaults, following the example of what other Member States have done previously: either possessing the dual-key or accepting the presence of the USAF on their own bases (single key).

Regardless, the fact remains that discussions on the geographical extension of nuclear-sharing were not on NATO's agenda in 2023. Another absence were talks regarding changes in nuclear weapons. Such requests would not only have to be initiated by NATO, but also concurred by the United States and the respective host country. In addition, agreements would also have to be approved by the Nuclear Planning Group. It is thus likely that several Alliance countries that are members of the Nuclear Planning Group will oppose this scenario for diplomatic reasons. Their arguments would be in regard to either the proximity of the zone of tension,⁵⁹ or the refusal to respond to the Russian provocation with another provocation without necessarily providing a "surplus" deterrent.

Hence, any use of a Russian tactical nuclear warhead aimed at a symbolic target in Ukraine would likely not result in a nuclear exchange with NATO. Rather, it would most likely trigger a series of carefully measured conventional strikes that could greatly reduce Russia's conventional potential in either occupied Ukraine, a mixed zone (Black Sea fleet), or other locations beyond such zones (Russian installations in Syria).

57. I. Facon, "Guerre en Ukraine : le sens du signalement nucléaire russe," *Note de la FRS*, no. 30 (2022): 9.

58. Warsaw is already taking part in nuclear exercises as a support without having the dual-key nuclear expertise.

59. It should be noted that the recent return of B61s to the UK expresses, amongst other things, this desire for geographical distance. In addition, penetration flights from the north or south would be favoured.

Conclusion

For most of NATO Member States,⁶⁰ nuclear power is perceived as a factor contributing to transatlantic and political cohesion within the Alliance. It fosters a nuclear culture among Allies who do not possess nuclear codes.⁶¹ Consequently, there is a prevailing inclination among European NATO Members to remain under U.S. influence in terms of Allied nuclear policy, through concerted – but not shared – deterrence, as well as the dual-key principle.

Nonetheless, uncertainties about the future of nuclear power will continue to persist. Moreover, the NATO nuclear issue is an area exclusively tied to the evolution of U.S. power and objectives, along with Congressional policies in Washington. In other words, it will not be wholly dependent on the positions of European countries within the Alliance. Indeed, European states play a subsidiary role on this matter, with the key decision-making authority remaining in the hands of the United States. During the Cold War, this game of pretence was already enshrined in the doctrine of use and in the flexibility of the tools that could weaken any coupling. The credibility of the U.S. nuclear deterrent had been essentially understood as existing solely for the protection of the United States territory alone.

The notion of an automatic U.S. nuclear retaliation for the benefit of Europe was considered by some, namely, Henry Kissinger, “*as a reassuring fable of dubious credibility.*”⁶² Indeed, the prospect of a conventional NATO response outside of Article 5 raises significant challenges, should a non-NATO member (such as, Ukraine, which is not a member of NATO and is not affected by Article 5) were to suffer a tactical nuclear strike. Furthermore, the use of U.S. nuclear weapons in Europe would require the signature of order from Washington. This would potentially crack open the Pandora’s box of a generalised and uncontrollable confrontation in which U.S. territory could be hit. The stakes would be grossly disproportionate, and any posturing on the threshold for nuclear use would be undermined.

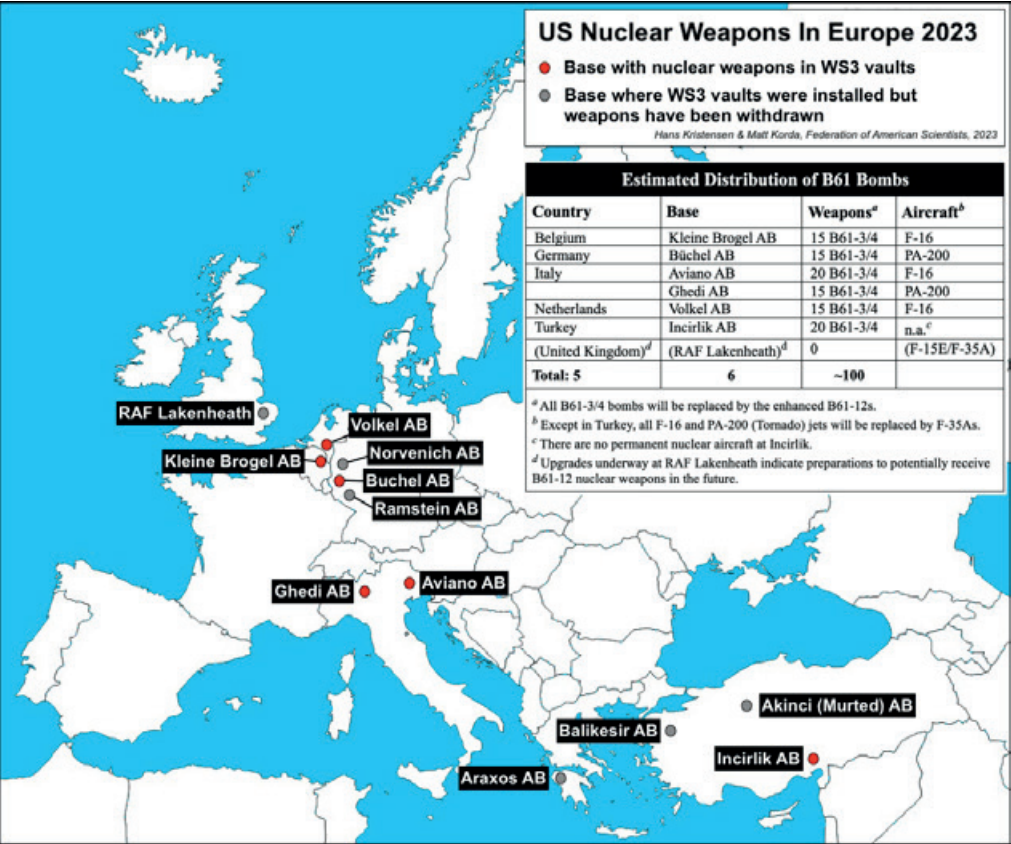
While there may be a perception in Europe that U.S. nuclear power is associated with a tactical or theatre confrontation space, its function has, in fact, long been of a strategic context of deterrence exercise. Admittedly, operational capabilities, the introduction of Model 12 on the B61, as well as exercises carried out by Allied air forces, all lead to a conviction that a “tactical” engagement competence is “more concrete”. Moreover, it could also respond to penetrations in the North, Centre, and South of Europe, as the case during the Cold War. However, from a political point of view, according to the White House, maintaining nuclear weapons in Europe depends first and foremost on the relevance of an existential deterrent based in the United States. At another level, U.S. conventional projection capabilities continue to serve as a deterrent through denial.

60. M. Marin-Bosch, “Europe’s nuclear family,” *Bulletin of the Atomic Scientists* (1 February 1998).

61. B. Warrington, in Collectif, *op. cit.*, 53.

62. R. Close, “La langue d’Esopo,” *La Libre Belgique* (2 May 1995).

Indeed, in light of the complex U.S. nuclear landscape in Europe, and the tangle of interests between European countries, the necessity to guarantee the durability of the French nuclear deterrent remains. Thus, the geographical proximity continues to guarantee its dialectical relevance.



Source: M. Korda, H. Kristensen, “Increasing Evidence That the US Air Force’s Nuclear Mission May Be Returning to UK Soil”, *Fas.org* (28 October 2023).

“For the final day...” Russia’s Airborne Nuclear Component

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Special thanks to Pascal Roche for monitoring the Russian air fleet.

On 12 August 2015, the chief of the Russian Aerospace Forces (*Voенно Космические Силы*, or VKS), General Viktor Bondarev, gave a speech that delineated the VKS’s three missions:¹

- 1) “*Repel air attacks [...].*”
- 2) *Destroy enemy targets and troops using both conventional and nuclear weapons;*
- 3) *Support ground operations from the air.”*

Of interest to this sentence is the VKS’s second priority: the nuclear airborne component. Indeed, it has not only been allocated privileged resources, but it also possesses operational aircraft and a variety of munitions. The primary air formation responsible for executing nuclear strikes is the Long-Range Aviation (LRA, and in French: *aviation à long rayon d’action*, or ALRA), which maintains approximately one hundred strategic and sub-strategic bombers in operational status.² Established in 1914, the LRA is one of the world’s oldest air forces and fulfils a dual role. From

1. “[С Днем Военно-воздушных сил России \[Happy Russian Air Force Day!\]](#),” *Pravda.ru* (12 October 2015).

2. The sub-strategic air fleet uses munitions with an operational or intermediate range (up to 3,000 km in theory, in practice 1,300 km with the Russian arsenal) and not weapons with intercontinental reach, reserved for strategic bombers.

the outset, it has carried out long-range conventional strikes, before acquiring the capability to launch nuclear weapons in 1954. As on-board weapons, these differ from intercontinental munitions fired from the ground or from naval launchers, which are exclusively nuclear. In addition to the substantial firepower deployed by the LRA, lighter combat aircraft from conventional bomber units – affiliated with both the VKS and the naval aviation – also possess dual capabilities to engage nuclear weapons. Adhering to the logic of deterrence, Moscow has emphasised and documented its airborne non-conventional strike capability in parallel to its modernisation plans. The theoretical framework for the use of atomic weapons thereby is articulated in the country’s doctrinal *communiqués*.

Considering its substantial relevance, this airborne nuclear weaponry deserves a closer examination. Indeed, it serves not only as an operative asset in the Ukrainian conflict – where operational process is constantly evolving, but also as a diplomatic instrument, showcasing Russia’s power during the *Tupolev* aircraft’s patrol of the oceans. This issue remains open to debate, as empirical feedback varies widely. To address them, it is essential to focus on the airborne assets used to launch nuclear weapons on ground targets. Other applications of nuclear weapons from the air, such as strikes against aircraft carriers, anti-submarine warfare,³ or even air defence,⁴ are indeed conceivable. However, these are not the conventional scenarios that necessitate a retaliatory approach. Barring these exceptions, this article sheds light on all nuclear ground strike capabilities, irrespective of the warhead size. Moscow does not make any normative or operational distinction between its most powerful weapons (herein referred to as “strategic” for practical purposes) and the smaller ones (termed “tactical” from here on), all of which constitute an arsenal dedicated to deterrence. This analysis will thus present Russia’s airborne nuclear capability in its first part, scrutinise its current and potential applications in its second section, and to end, explore projections for its evolution up to 2030.

I – A Deterrent with a Red Star: one Doctrine, many Resources

Concerted Management of the Strike Force in Peacetime

The air fleet capable of executing nuclear strikes falls under the administrative control of the VKS or the Russian naval aviation. These entities are responsible for their maintenance and combat management during conventional engagements. On the other hand, in the event of a nuclear engagement scenario, these aircraft constitute the air component of the Russian triad, alongside land and naval deterrent resources. The authority to decide whether they are to be used or not falls on the Federation’s President, regardless of the payload’s power. The terms of use are then determined by the General Staff in Moscow. All nuclear warheads – intended for ground, sea, and air launchers – are owned by the 12th Chief Directorate (12th

3. Nuclear depth charges can be deployed by the *Kamov Ka-27PL* helicopter, or by *Il-38*, *Tu-142MK*, and *MZ* maritime patrol aircraft.

4. There are nuclear warheads for R-33 air-to-air missiles.

GUMO⁵) of the Ministry of Defence. They are stored in depots near airbases, ensuring that munitions can be swiftly transferred to the units designated to use them in the event of a confrontation or exercise.

In Russia, nuclear weapons can be employed under specific situations. These are outlined in Presidential Decree (*Ukaze*) No. 355 of 2 June 2020, Article 17, of which states:

“The Russian Federation reserves the right to use nuclear force in the event of an attack using weapons of mass destruction against it and its allies, as well as in the event of aggression against the Russian Federation using conventional weapons, when the existence of the State is threatened.”

In other words, Russia is setting certain red lines here, albeit with some ambiguity surrounding the concept of “*existence of the State*.” This ambiguity is intentional as it provides a degree of flexibility in the weapon’s use and thereby enhancing the credibility of the deterrent. Article 14-b of the military doctrine of 25 December 2014 offers one of the best avenues for defining when this “*existence of the State is threatened*”:

“Any attack which impedes the governance and control of the armed forces and would prevent their use of nuclear forces, attacks against early warning systems,⁶ space activity systems,⁷ nuclear munitions depots, nuclear power stations and any structure involved in the nuclear, chemical and pharmaceutical industries.”⁸

This list is limited to constrain the risk of escalation. Only when “*the existence of the State is threatened*” will the door to a first strike be permitted to be opened. A notable example is the use of nuclear weapons by Russia without itself having suffered any attacks of such a nature.

Nonetheless, some Russian strategic sites listed are located in areas where exchange of fire are ongoing, linked to the conflict in Ukraine. Some include, for instance, the nuclear depot of Belgorod-22, bordering Ukraine, or the Engels airbase where LRA aircraft operate. Others are situated outside Russia, close to NATO powers (e.g., the VLF⁹ communications station in Vileika, Belarus, used to transmit messages to Russian submarines in the Atlantic). Maintaining the integrity of these sites significantly contributes to this *status quo*. The Russian airborne nuclear component is regulated by international agreements, primarily the U.S.-Russian New START Treaty, which came into force on 5 February 2011. Under this agreement, the *Tu-polev Tu-160* and *Tu-95MS* are the only strategic bombers authorised to carry nucle-

5. 12th *Glavnoye upravleniye Ministerstva oborony*. “12th GUMO”, *Encyclopedia.mil.ru* (24 Jun 2021).

6. Early warning systems include early warning satellites and anti-ballistic radars.

7. Space activity monitoring systems include systems for detecting opposing ballistic missiles. Russia’s aim here is to protect its anti-ballistic and over-the-horizon radars.

8. Presented as it is, the reference to pharmaceuticals includes bacteriological production.

9. VLF: Very Low Frequency, such as the channels used for long-distance exchanges with diving submarines.

ar-tipped cruise missiles.¹⁰ The number of warheads that can be carried on intercontinental strategic platforms – including bombers – is capped at 1,550.¹¹ Less is known about the number of low-power, more tactical warheads deployable from gravity bombs or non-strategic missiles, although their existence is of clear certainty.¹²

Overall, the weight of airpower has been reinforced, firstly by the 1987 U.S.-Russian Treaty on Intermediate Nuclear Forces (INF). This treaty bans ground-launched missiles with a range of between 500 and 5,500 km. To strike within these ranges, the Russian army must rely on strategic bombers and “heavy bombers” that lack the capacity to carry long-range cruise missiles. The number of *Tu-22M3* heavy bombers was restricted to 75 by the 1991 START I Treaty.¹³ The New START Treaty prohibits the co-location of these sub-strategic bombers on a strategic bomber base¹⁴ to limit ambiguities in posture interpretation. As a result, Russia cannot place its *Tu-22M3*s on its *Tu-95MS* and *Tu-160* platforms. An infrastructure point worth noting is the START I Treaty’s concerning provision, where strategic bombers must remain visible on their main bases without any concealing shelter. Protective construction is therefore only authorised on temporary deployment runways.¹⁵ While these texts – the key elements of which are preserved in Moscow and Washington – may have bolstered confidence between the two largest nuclear-weapon states, they also expose their equipment to third parties.



(CS) Featuring its propellers is a *Tu-95MS* strategic bomber at the Moscow Zhukovsky airfield.



(CS) This *Tu-160*, christened “*Alexander Novikov*”, took its flight to Venezuela in 2013.

10. “[Article IV-7](#),” *New START Treaty* (5 February 2011).

11. The *New Start Treaty* considers that a strategic bomber is equivalent to a strategic warhead, regardless of its payload capacity.

12. In his so-called “*presidential nuclear initiative*” of 1992, Russian President Boris Yeltsin announced that he wanted to destroy half of the nuclear warheads on aircraft and a third of those on naval vessels. Eleven years later, by Russia’s own admission, this objective had not been met. In April 2004, Anatoli Antonov, Director of Disarmament at the Russian Ministry of Foreign Affairs, declared that this work was “*virtually complete*,” while in October of the same year, Stephen Rademaker, Deputy Chief of the American diplomatic service, stated that “*his administration is concerned that the Russian commitments have not been fully met*.”

13. “[Strategic Arms Reduction Treaty](#),” *U.S. Department of Defense* (31 July 1991).

14. “[Article IV-3 paragraph 9](#),” *New START Treaty* (5 February 2011).

15. “[Article IX-3](#),” *START I Treaty* (31 July 1991). At the most, weather protection can be placed on the main bases provided that it is non-occluding.



(CS) *Tu-22M3* subsonic bomber, Moscow (2015).

The Decade of the 2010s: The Post-Cold War Surge

Russia's airborne nuclear capability has undergone significant restoration since its decline in the 1990s. It notably required a decade to revive. The aircraft that survived the arms reduction treaties¹⁶ have been refurbished since 2008.¹⁷ Each year, one *Tu-160* and two *Tu-95MS* have been overhauled at the Taganrog, Ryazan, and Kazan aviation plants.¹⁸ According to the U.S. Department of Defense, 21 *Tu-95MS* aircraft gained Kh-101 missile-carrying capabilities between 2015 and December 2019.¹⁹ Russian sources reported that this figure had risen to 29 *Tu-95MS* by the end of 2021.²⁰ The *Tu-160s* have also been adapted to carry this massive long-range weapon.²¹ For its sub-strategic component, the *Tu-22M3s* are being restored at the Ryazan factory, while the *MiG-31K/Is*, capable of carrying the Kinzhal ballistic missile, are being delivered by the Sokol plant in Nizhny Novgorod (see [Map 1](#)). Ten were operational at the beginning of March 2018.²² Additionally, twelve new *Su-34* bombers, capable of tactical nuclear strikes, joined the VKS that same year, with 117 delivered then since 2008.²³

16. Between 1981 and 1992, 35 *Tu-160s* and 88 *Tu-95MSs* were produced. Some of them were located on Ukrainian territory when the country gained independence in August 1991. Respectively 11 and 27 of these strategic bombers were destroyed as part of the Budapest Memoranda and the Nunn-Lugar initiatives, along with 483 Kh-55 nuclear-capable cruise missiles. Tactical nuclear capabilities were also reduced by the withdrawal of all *Su-7*, *Su-22* and *MiG-27* single-engine bombers.

17. A. Zatutchnii, R. Rigmant, P. Sineokii, *Strategicheskii raketonosiets bombardirovchik Tu-160* (Moscow: Poligon press, 2016): 505.

18. "[Aviation factory of Taganrog has given back modernised Tu-95MSs back to the VKS]," *OAK* (15 April 2019).

19. "Tu-95 Russian Strategic Bomber aircraft," *ODIN* (10 April 2024).

20. "Tu-95MC. Обновление на благо России. Что с ним не так. Часть 2 [Tu-95MS. Upgrade for the benefit of Russia. What's wrong with it. Part 2]," *Yandex* (28 February 2023).

21. A. Zatutchnii, R. Rigmant, P. Sineokii, *op. cit.*, 406

22. "Минобороны: на опытно-боевом дежурстве стоят 10 МиГ-31 с 'Кинжалом' [Ministry of Defense: 10 MiG-31s with 'Kinzhal' are on experimental combat duty]," *Tass* (5 May 2018).

23. "Поставки боевых самолетов в Вооруженные Силы России в 2020 году [Deliveries of combat aircraft to the Russian Armed Forces in 2020]," *BMPD* (20 January 2021).

Approximately one hundred LRA aircraft capable of carrying nuclear weapons survived the 1990s. In terms of missile payload, this force is ranked second in the Russian deterrent triad, behind ground-based launchers (around 330 launchers²⁴) but ahead the navy (fewer than 10 operational nuclear-powered ballistic missile submarines²⁵). As of February 2024, the fleet includes 19 *Tupolev Tu-160* supersonic bombers and around forty *Tu-95MS* quad-turboprop aircraft, albeit with varying degrees of availability. These platforms operate Kh-102 or Kh-55SM cruise missiles (with ranges of 5,000 and 3,500 km, respectively^{26, 27}), which have dual nuclear or conventional payload capabilities.²⁸ The sub-strategic capability is provided by Kh-22 and Kh-32 ballistic missiles, capable of striking land or naval targets, carried by approximately forty *Tu-22M3* bombers. Since 2018, these aircraft have been supported by *MiG-31Ks* and *MiG-31Is*. In January 2022, 14 of these aircraft were converted from former *MiG-31* fighter airframes to launch the dual Kinzhal missile.²⁹ Tactical bomber regiments are equipped with *Sukhoi Su-24M*, *Su-25*, *Su-30SM* (land-based naval aviation), and *Su-34* twin-engine aircraft. These are capable of deploying low-power nuclear warheads integrated into gravity bombs or certain tactical missiles.

All such resources are distributed across Russia. The strategic bombers have dedicated bases: the ten or so operational *Tu-160s* of the LRA are stationed at Engels (see [Map 1](#)), near Kazakhstan, while the *Tu-95MS* are split between Engels and Ukrainka in the Far East. The sub-strategic component, designed to strike protected ground or naval targets, is mainly deployed in Russia’s Western Military Region, at Shaykovka (12 *Tu-22M3s* were accounted for in February 2022), Olenegorsk (6 *Tu-22M3s* of the same period), and Savasleyka near Moscow (14 *MiG-31Ks* and *MiG-31Is* were observed in January 2022). The only eastern *Tu-22M3* base is at Belaya, near Mongolia. Several secondary airfields, equipped to occasionally accommodate these aircraft, are located at Soltsy and Vorkuta in the west and at Anadyr and Tiksi in the Far East. The geographical distribution of tactical nuclear capabilities is more challenging to describe. This is partly due to the fact that more airfields are being equipped with combat aircraft, capable of carrying these types of weapons. However, the *Su-34* crews at the Khurba base (Far East), the *Su-25* crews at Domna (Sibe-

24. “[Russian nuclear weapons 2024](#),” *Bulletin of Atomic Scientists* (7 March 2024).

25. With 16 intercontinental missiles on board each nuclear-powered ballistic missile submarine, the Russian Navy has the theoretical capacity to deploy up to 160 strategic munitions.

26. “[Стратегическая крылатая ракета Х-55 \(РКВ-500\) \[Strategic cruise missile Kh-55 \(RKV-500\)\]](#),” *Missilery.info* (May 2015).

27. “[Российские ученые создали лучшую крылатую ракету в мире \[Russian Scientists Create the World’s Best Cruise Missile\]](#),” *Pravda.ru* (28 May 2013).

28. A dual-purpose munition has a nuclear or conventional payload capability, with minor modifications (such as the introduction of lead casings to protect electronics from radiation and government control devices). The Kh-101 missile has a conventional explosive charge, while the Kh-102 has a nuclear charge. The older Kh-555 is armed with a conventional warhead, while the Kh-55SM is its nuclear counterpart.

29. The examples of *MiG-31K/I* identified visually during official communications or open days are numbers 30, 31, 36, 37, 38, 39 blues and 87, 89, 90, 92, 93 96, 97 and 99 reds. Amongst the modifications identified, the ‘90 red’ *MiG-31K* is based on the ‘83 blue’ *MiG-31* fighter based at Uglovaya. It was converted into a *Kinzhal* carrier in 2018.

ria), the *Su-34* crews at Morozovsk (near Ukraine), and the *Su-24M* and *Su-30SM* crews at Chernyakhovsk (Kaliningrad) have functional nuclear depots.³⁰

All these aeronautical sites linked to deterrence have been the foremost priority throughout the process of renovation,³¹ yet they remain predominantly ageing. Despite repairs to the tarmac, most aircraft³² – that is, strategic bombers, which should remain visible under the START I Treaty, as well as all other aircraft – are parked outside, and observable from satellites but exposed to hazards. The bases reflect the state of the airborne nuclear system as a whole: operational once again, compatible with the needs of symmetrical deterrence, and capable of deployment in the event of a major but brief conflict.



(PG) The four light grey pylons under the wing of this *Tu-95MS* indicate the carrying capacity of the Kh-101 missile.



(PG) Tandem of *Su-24M* tactical bombers, normally based at Gvardeïsk in Crimea.

30. “Fortress Kaliningrad”, *OSW* (October 2019); “[New satellite images suggest military buildup in Russia’s strategic Baltic enclave](#),” *CNN* (17 October 2018); “[Russian National-Level Nuclear Weapons Storage](#),” *Globalsecurity.org* (1 May 2018).

31. Five Russian air bases linked to airborne nuclear power are affected by the 2017 funding: two LRA bases (Engels and Ukraïнка) and three runways bordering a nuclear depot (Mozdok, Step, and Voronezh); “[В следующем году на аэродроме Украинка начнется ремонт ВПП \[Runway repairs to begin at Ukraïнка airfield next year\]](#),” *Amurskaya Pravda* (25 February 2017).

32. Khurba air base (Komsomolsk on Amur) is the only Russian base to have hangars housing some of the *Su-34* bombers in its fleet.

The Wings of Russian Airborne Nuclear Power

Carrier Type	Number of Airframes (March 2024)	Class of Nuclear Charges Carried	Ammunition Range with a Known Nuclear Charge
<i>Tupolev Tu-160 and 160M</i>	19;≈ 9 operational	Strategic	5,000 km ³³
<i>Tupolev Tu-95MS</i>	40 to 43;≈ 30 operational	Strategic	5,000 km
<i>Tupolev Tu-22M3</i>	38 to 40;≈ 30 operational	Sub-strategic	Up to 1,000 km (Kh-32 missiles)
<i>MiG-31K and 31I</i>	12	Sub-strategic	Up to 1,300 km ³⁴
<i>Sukhoi Su-24M, Su-34, Su-25</i>	Around 300 airframes	Tactics	Gravity bombs, dropped on the area to be hit

II – Operational: A Capacity Committed to the Long Term

Between Routine and Progression, Training, and Demonstrations until 2022

On 17 August 2007, two *Tu-160* strategic bombers flew from the Pacific to the coast of the United States. Concurrently, two *Tu-95MS* bombers crossed the North Atlantic before making a U-turn near the Faroe Islands. Although no airspace violations occurred, the scale of the event was unprecedented since 1992. On the same day, the Russian President declared that “*from now on, this type of mission will become a regular occurrence.*”³⁵ This statement has since led to the introduction of missions that have since become routine.³⁶ The strategic bombers undertake long flights of between 5 and 12 hours, which necessitate significant logistical support. The *Il-78* tankers refuel them mid-flight to extend their range,³⁷ while *A-50* early warning aircraft occasionally provide support to monitor air activity surrounding the bombers. Said bombers approach areas of activity in the West, as well as Japan

33. A. Kozachenko, “[Что за сверхдальние ракеты X-101 были применены на Украине \[What kind of X-101 super-long-range missiles were used in Ukraine\]?](#),” *Argumenti Fakti* (8 June 2022).

34. “[Почему реальная дальность “Кинжала” меньше общепринятой \[Why the real range of the Kinzhal is less than generally accepted\]](#),” *Dzen.ru* (7 July 2020).

35. “[Russia resumes Cold War nuke bomber patrols – accident potential high, say analysts.](#),” *Bellona* (20 August 2007).

36. There have been a few route alterations, such as a patrol of two *Tu-160s* in the Baltic Sea on 15 June 2017, after the flight of two American *B-52H* bombers in the same area on 10 June, or a rare *Tu-160* patrol in the Black Sea on 15 September 2020, after a *B-52H* flight in the same area on 4 September.

37. “[Страны НАТО подняли истребители из-за российских Ту-160 \[NATO countries scramble fighter jets over Russian Tu-160s\]](#),” *Gazeta.ru* (14 October 2020).

and South Korea in the Pacific region, but without penetrating their airspace.³⁸ The *Tu-95MS* and *Tu-160* both take off from the Olenegorsk base (for missions to the Atlantic) or from Ukrainka and Anadyr³⁹ (for missions in the Pacific). These aircraft are tracked by the radars of the countries they approach and are regularly escorted by their fighters.⁴⁰ The frequency of these activities does not correlate with the level of international tension. Rather, they have increased on the Pacific coast since the start of the war in Ukraine and decreased on the Western flank.



Moreover, testimonies from the crews of *Tu-95MS* and *Tu-160* bombers do not indicate any particular anti-Western tension at their level. Interviewed on 18 August 2019 by *Gazeta.ru* magazine, pilot Viktor Korotkov, a regular on these long-distance patrols, remarked:⁴¹

“As for the piloting and reliability [of the Tu-160], I don’t know of a single fault. Perhaps the army would have doubts about the radio electronic equipment. One day the crew is flying [on patrol], one of the members says ‘Guys, we’re coming over the Arctic’, and out of nowhere two friends [NATO fighters] are already standing to the left and right, even though you haven’t made any transmissions.”

The airborne component of the Russian deterrent, with its distinctive aircraft, also enables Moscow to support its diplomacy. The first pair of *Tupolev Tu-160* bombers arrived in Venezuela on 10 September 2008 to reassure Hugo Chavez of Russia’s

38. Of the 89 patrols considered since 2015, one border crossing was recorded on 13 July 2018, when two *Tu-95MS* flew over a South Korean island.

39. Monitorwar, “2х стратегічних бомбардувальників ТУ-95МС з в/ае “Олень”... [2 Tupolev TU-95MS strategic bombers from the Olenya airfield...],” *Telegram* (12 February 2024); Operativnaya Linia, “Минобороны страны подсказывает американским ПВОшникам... [The country’s Ministry of Defense is telling American air defence personnel...],” *Telegram* (10 February 2024); Operativnaya Linia, “11 сентября пара Ту-95МС опять сходилa в район к западу от Аляски [On September 11, a pair of Tu-95MS again went to the area west of Alaska],” *Telegram* (13 September 2018).

40. “L’armée de l’air escorte deux avions russes [The French Air Force escorts two Russian aircraft],” *Défense.gouv.fr* (10 February 2017); “Russia resumes Cold War nuke bomber patrols – accident potential high, say analysts,” *Bellona* (20 August 2007).

41. “Проткнуть звук: рассказ казанского пилота Ту-160 [Piercing the Sound: The Story of a Kazan Tu-160 Pilot],” *Gazeta.ru* (18 August 2019).

continued support during a time when the country was shaken with unrest.⁴² These visits were subsequently repeated in 2013 and 2018.⁴³ Two *Tu-160s* also visited South Africa in 2019, while two *Tu-95MS* landed in Indonesia in 2017.⁴⁴ Egyptian President al-Sissi authorised Russia to position two *Il-78M* tanker aircraft in Cairo in November 2014, from where they could refuel two *Tu-95MS* bombers on patrol from Russia to the Mediterranean.⁴⁵ The sub-strategic component also undertakes numerous extra-territorial deployments, such as in March 2016, when four *Tu-22M3* bombers landed in Dushanbe, Tajikistan.⁴⁶ Subsequently, in the spring of 2021, *MiG-31Ks* landed twice at Latakia in Syria, with the second time being backed up by *Tu-22M3s*.⁴⁷ The overall trend indicates increased contact with China. The initial joint patrol of *Tu-95MS* and Chinese *H-6* bombers was observed in August 2017, before occurring annually since 2019.⁴⁸ In November 2022, Russian bombers landed in China, while Chinese aircraft were stationed in Vladivostok. Indeed, this is an unprecedented move at a time when Moscow appears rather isolated.

However, these conspicuous activities serve more of a political than a military purpose. A Kh-102 cruise missile could reach any part of Europe without its carrier bomber having to leave Russian airspace. Operational exercises are also organised, in particular to disperse resources in the face of simulated attacks. One such exercise, of unprecedented scale, took place from 7 to 9 February 2017, with crews from all strategic and sub-strategic bomber bases taking off on high alert to join other platforms – some being civilian – across the country.⁴⁹ There are also occasional LRA training flights to remote airfields, such as Anadyr.⁵⁰ Some simulated use of tactical

42. “[Russian bombers land in Venezuela](#),” *BBC* (11 September 2008).

43. “[Russian Tu-160 Strategic Bombers Land in Venezuela](#),” *Defense update* (30 October 2013); Operativnaya Linia, “[Леонидыч, ништяк, всё верно \[Leonidych, all right, all right\]!](#),” *Telegram* (3 February 2019).

44. P. Parameswaran, “[Russia Bomber Flight Over Indonesia Highlights Defense Ties](#),” *The Diplomat* (6 December 2017).

45. D. Cenciotti, “[Why are two Russian Il-78 Midas tankers deployed to Egypt? Are Moscow’s bombers heading to the Mediterranean Sea?](#),” *The Avionist* (3 November 2014).

46. “[Russia deploying Tu-22M3 bombers to Aini base in Tajikistan for drills](#),” *AKIPress* (11 March 2016).

47. Zapiski Okhotnika, “[Tu-22M3s arrive in Latakia](#),” *Telegram* (24 May 2021); Russian Ministry of Defence, “[Полёты Ту-22М3 над восточной частью Средиземного моря \[Tu-22M3 flights over the eastern Mediterranean\]](#),” *YouTube* (27 May 2021); D. Cenciotti, “[U.S., Chinese And Russian Bombers Each Flew Air Patrols Over East China, Sea Of Japan Close To The Korean Peninsula In Last 24 Hours](#),” *The Avionist* (24 August 2017).

48. L. Xuanzun, G. Yuandan, “[China, Russia hold joint aerial patrol for 4th consecutive year amid Biden’s Asia visit at Quad summit](#),” *Global Times* (24 May 2022).

49. “[Дальняя авиация России перебазирована на оперативные аэродромы \[Russia’s long-range aviation relocated to operational airfields\]](#),” *Lenta.ru* (9 February 2017); “[В Братске засняли выкатившийся с полосы Ту-22М3. Видео \[Tu-22M3 rolled off the runway in Bratsk. Video\]](#),” *Babr24* (10 February 2017). From Engels, *Tu-160s* took to the air to fly to Shaykovka, 850 km away, while *Tu-95MSs* also departed from Engels and landed at Novosibirsk Tolmachevo, 2,500 km away. As if to underline the unexpected nature of the operation, two *Tu-22M3* sub-strategic bombers took off on high alert from Belaya in Siberia and were directed to Bratsk civil airport, which had not yet been cleared of snow (causing the two aircraft to run slightly off the runway).

50. Operativnaya liniya, “[Что-то пока никак себя не проявили русские большие самолёты... \[The Russian big planes haven’t shown any sign of life yet...\]](#),” *Telegram* (21 August 2020). An initial land-

nuclear weapons occurred during the Zapad 2009 and Vostok 2010 exercises, though this practice was halted due to Western reactions.⁵¹ Nevertheless, this decision does little to preclude the use of payload transport exercises or alerts.⁵² It is worthy to note that despite such extensive activities, all these missions also lead to accidents. Since 2004, the VKS has lost a *Tu-22M3* in June 2016, followed by four more up until 2021. Three *Tu-95MS* were also lost between 2015 and 2016.⁵³ Yet, it seems that this cost appears to be accepted. Russia's airborne nuclear capability is regaining its availability and reasserting itself as a premier tool of military diplomacy, without facing the immediate risk of a shortage of equipment.



(All rights reserved) A *Tu-22M3* takes off from the Syrian base of Latakia in June 2021.



(All rights reserved) An IAB-500 dummy bomb used to simulate a gravity-operated nuclear munition, such as those carried on *Su-24M* and *Su-34* bombers.

From Deir ez-Zor to Starokonstantinovka: Nearly Ten Years of Conventional Combat

For a considerable amount of time, crews dedicated to nuclear strikes possessed little combat experience. The attack claimed by Daesh on a Russian *Airbus A321* on 31 October 2015 in Egypt prompted retaliatory strikes in Syria. Between 17 and 22 November, *Tu-95MS* and *Tu-160* strategic bombers conducted five raids. This became their baptism of fire, as Kh-101 and Kh-555 cruise missiles were employed. These conventional munitions targeted refineries near Deir ez-Zor and Raqqa, albeit with malfunctions.⁵⁴ The *Tu-22M3* sub-strategic bombers executed 16 bombing

ing of *Tu-22M3s* on the Anadyr runway was carried out in October 2017, followed by more insistence on landing *Tu-160s* in September 2018 (as part of the Vostok exercise), then in May 2019 and August 2020.

51. M. Czekaj, L. Zdanavicius, "[Russia's Zapad 2013 Military Exercise](#)," *Jamestown Foundation* (December 2015).

52. Fighterbomber, "[Пехоте нравится авиация \[Infantry likes aviation\]](#)," *Telegram* (25 April 2024).

53. "[Tupolev Tu-22M](#)," *Aviation safety.net*; "[Tupolev Tu-95](#)," *Aviation safety.net*.

54. "[Модернизация российских стратегических бомбардировщиков \[Modernization of Russian strategic bombers\]](#)," *BMPD-CAST* (17 April 2016); "[Road to Damascus](#)," *RAND Corporation* (2022): 27; "[Операция ВКС РФ в Сирии выявила проблемы с ракетами для дальней авиации \[Russian Aerospace Forces Operation in Syria Reveals Problems with Long-Range Aviation Missiles\]](#)," *Interfax* (19 December 2015).

missions until 8 December 2015.⁵⁵ Additional strikes were directed against Daesh in 2016 and 2017.⁵⁶ According to a compilation of Russian Ministry of Defence *communiqués*, the LRA is believed to have launched 58 raids in Syria up to 5 December 2017. Some of these strikes, in particular those with bombs around Deir ez-Zor where the population and regime garrison were besieged, may have hindered Daesh’s momentum, who eventually gave up on taking the city.

Yet, above all, these operations primarily allowed for prolonged equipment testing and ammunition improvement. Russia could have otherwise targeted the same sites more cost-effectively with its fighter aircraft already having been deployed in Syria. Some of the Russian *Su-34* and *Su-24M* bombers deployed in Syria originated from bases equipped with nuclear depots.⁵⁷ As such, the Syrian theatre has provided valuable training for the tactical strike component.

The confrontations in Ukraine followed those in Syria. This, thus, presents a different scale of commitment for Russia. LRA’s *Tu-95MS* and *Tu-160* were mobilised for the initial strikes. The Ukrainian air bases at Chuhuiv (not far from Kharkiv), Zhitomir, and Mikolayiv were amongst those hit, albeit quite superficially.⁵⁸ The radio frequencies of Russian bombers were monitored,⁵⁹ enabling the protection of Ukrainian aircraft before the attacks. These process persisted, with the LRA hitting approximately two-thirds of the 320 sites struck by cruise missiles in 2022, and occasionally near the front line.^{60, 61} The frequency of raids then diminished due to dwindling munitions stocks. Indeed, time was required for refabrication. Moreover, wear and tear also persisted on strategic bombers.⁶² From 2023 onwards, targets

55. “Как дальняя авиация ВКС РФ уничтожает ИГИЛ в Сирии. Хронология вылетов [How the Russian Aerospace Forces’ Long-Range Aviation is Destroying ISIS in Syria. Flight Chronology],” *Politrussia.com* (16 August 2016); “*Ту-22М3 снова бомбит боевиков в Сирии [Tu-22M3 bombs militants in Syria again]*,” *BMPD-CAST* (13 July 2016).

56. “*Road to Damascus*,” *op. cit.*, 27.

57. *Sukhoi Su-34* bombers from the Morozovsk and Komsomolsk on Amur bases are deployed in Syria, as is at least one *Su-24M* from Cherniakhovsk; “*History of the Su-34 series*,” *Airforce.ru* (29 June 2020); “*Самолеты в укрытиях на Хмеймиме [Aircraft in shelters on Khmeimim]*,” *BMPD-CAST* (21 April 2018); “*В Сирии погиб экипаж из состава авиабазы Балтфлота [Crew from Baltic Fleet airbase killed in Syria]*,” *Interfax* (10 October 2017).

58. M. Sheetz, “*Satellite imagery shows Russian attack on Ukraine from space*,” *CNBC* (24 February 2022). The satellite images published highlight targeting flaws: impacts around intact runways, destruction of aircraft already out of service.

59. “*Satellite imagery shows Russian attack on Ukraine from space*,” *The Blown Monitoring Post* (March 2021).

60. On 14 September 2022, Kh-101 cruise missiles were launched against dams on the Ingoulets river, in order to cause a flood that would slow down the Ukrainian offensive on Kherson, 40 km from the front; Tsapliencko, “*Удар по дамбі в Кривому Розі [Impact on the dam in Engels]*,” *Telegram* (15 September 2022).

61. This figure was obtained by cross-checking images of cruise missiles flying over Ukrainian territory with satellite or ground views of sites hit: 1 site hit = 1 strike, whether hit by one or more missiles. The other cruise missiles used are: 1) Kalibr missiles launched from the sea, 2) 9M728 missiles fired from Iskander land-based batteries, 3) Kh-35 missiles launched from Bal anti-ship coastal batteries against ground targets, 4) Kh-35U and Kh-59 missiles launched from combat aircraft.

62. *Tupolev Tu-160s* were last mentioned in strikes in May 2022.

became focused on Ukraine's airstrips and energy potential. Covered by multiple layers of ground-to-air systems, the most sensitive Ukrainian sites could be simultaneously cross-attacked by various munitions (such as the cruise missiles launched by *Tu-95MS*, as well as the *Kinzhal* fired by the *MiG-31K/I*) to overwhelm their defences (see [Map 2](#)).

Sub-strategic capabilities were deployed into theatre from 15 April 2022, with *Tu-22M3s* dropping their bombs on the Azovstal factory in Mariupol.⁶³ The LRA then mobilised these *Tupolevs* in early May 2022 to launch Kh-22s.⁶⁴ Subsequently, from March 2024, *MiG-31K/Is* became armed with Kinzhal missiles.⁶⁵ These high-speed aeroballistic munitions are favoured to protected targets, albeit with mixed results. The near-obsolete Kh-22 was noted for its inaccuracy and the collateral damage it caused. On the other hand, the newer Kinzhal managed to damage the radar of a Patriot ground-to-air battery in Kiev on 16 May 2023.⁶⁶ Air vectors with tactical nuclear capability have incurred losses. Namely, by 25 March 2024, 23 *Su-34* and 4 *Su-24M* bombers were consequently destroyed in flight.⁶⁷ Striking with unguided bombs and vertically at targets has become unfeasible due to Ukrainian ground-air defence activity.



Despite this, such Russian bombers continue to pose a persistent threat to Kiev, especially as their attrition in combat missions remains manageable.⁶⁸ However,

63. Milinfolive, “[Спикер украинского Минобороны заявил \[The speaker of the Ukrainian Ministry of Defense said\]...](#)” *Telegram* (15 April 2022); Defense Express, “[Russians Use Obsolete Missiles to Launch Strikes on Ukraine](#),” *Defence-ua.com* (10 May 2022).

64. The Kh-22M and Kh-32 (its modernised variant) are carried on *Tu-22M3* bombers. Originally designed for anti-carrier strikes, these weapons can also be used against ground targets (with limited accuracy for the older Kh-22s). Use will begin in early May 2022, with a possible first strike on 4 May against a road bridge in Dnipro; Defense Express, *op. cit.*

65. “[Ministry of Defence reports Kinzhal fire in Ukraine](#),” *Izvestia* (19 February 2022).

66. On 27 June 2022, a Kh-22 probably aimed at the Kredmach armour factory in Kremenchuk hit a shopping centre 300 metres away, killing 20 people; “[U.S. Officials Confirm Damage to Patriot Defense System in Kyiv Attack](#),” *New York Times* (16 May 2023).

67. “[Attack On Europe: Documenting Russian Equipment Losses During The Russian Invasion Of Ukraine](#),” *Oryx* (2024).

68. Two *MiG-31K/Is* capable of carrying the Kinzhal missile were lost in accidents during the war or its preparations: on 29 January and 25 December 2022, and two *Tu-22M3s* sub-strategic bomber on 1 April and 15 August 2024.

once grounded, these aircraft do still become vulnerable. Since 11 March 2022, former *Tu-141* jet reconnaissance drones, armed with explosive charges, were launched by Ukraine.⁶⁹ Virtually all of LRA’s western bases were exposed, with some aircraft dispersed towards the Arctic and Baltic zones.⁷⁰ An alert on 8 October 2022 of a Ukrainian drone hitting the perimeter of the Shaikovka base, led to the redeployment of the 8 *Tu-22M3* bombers on site to Ryazan, which is further from Ukraine.⁷¹ Three *Tu-141* drones targeted this new base and Engels – a key location in Russia’s deterrent system – on 5 and 26 December. This resulted in the deaths of 6 Russian servicemen and in damages to one *Tu-22M3* and two *Tu-95MS*.⁷²

Operational aircraft were then dispersed again to bases at Olenegorsk, Anadyr, Mozdok, and Ukraïnka,⁷³ often located far away from the Ukrainian theatre. The Morozovsk airbase, with its nuclear depot, was also hit three times by unmanned aircraft loaded with explosives. A conventional ammunition warehouse was destroyed, alongside a *Su-34* bomber⁷⁴. In addition to these long-range drone attacks, saboteur teams approached Russian airbases after autumn of 2022.⁷⁵ On 19 August 2023, a group of 11 *Tu-22M3s* stationed at Soltsy base was attacked by light drones armed with grenades. Piloted from the vicinity of the airfield,⁷⁶ it resulted in the destruction of a *Tupolev*, while other bombers evacuated the area.

As an alternative to hangars, various measures were implemented: silhouettes of aircraft painted on runways, tyres placed on aircraft, or containers set up to protect

69. OSINT Ukraine, “[Tu-141 wreckage found in Crimea](#),” *Telegram* (11 March 2022).

70. Interpretation of Maxar satellite image of Olenegorsk, 11 October 2022; “[Russia says 3 MiG warplanes with hypersonic missiles moved to Kaliningrad region -media](#),” *Reuters* (18 August 2022). The Olenegorsk Arctic base hosted 5 *Tu-160* bombers from 14 August to 10 October 2022, while three *MiG-31K/Is* left the Moscow region to train in Kaliningrad on 18 August 2022.

71. Interpretation of the Maxar satellite image of 12 October 2022.

72. Ukraine Weapons Tracker, “[#Russia: The aftermath of the recent Ukrainian long-range strike against Engels-2 Air Base](#),” *X* (6 December 2022); “[В Энгельсе простились с погибшими после атаки беспилотника офицерами \[In Engels, farewell to officers killed in drone attack\]](#),” *Vzgliad-Info* (29 December 2022).

73. “[Satellite image shows 16 strategic bombers deployed to Kola Peninsula](#),” *The Barents Observer* (13 May 2023); Operativnaya Linia, “[Дружище, это Вы нам намекаете \[My friend, are you hinting to us\]](#),” *Telegram* (15 January 2023); Monitoring war, “[Спутниковый знімок в/ае “Моздок”, Північна Осетія \[Satellite image of the Mozdok air station, Pivnichna Ossetia\]](#),” *Telegram* (16 February 2024); Milinfoive, “[ЗС РФ евакуировали с аэродрому “Енгельс-2” від \[The Russian military forces were evacuated from the Engels-2 airfield\]](#),” *Telegram* (26 December 2022); Milinfoive, “[На новых спутниковых снимках авиабазы \[New satellite images of the airbase\]](#),” *Telegram* (30 December 2022).

74. “Russian bomber activity – September 2023,” *Maxar* report, based on a Soltsy photograph taken on 31 August 2023; “[“От Ярика и Ани Лорак”: появились фото последствий атаки на аэродром “Морозовск” под Ростовом \[From Yarik and Ani Lorak’: Photos of the Aftermath of the Attack on the ‘Morozovsk’ Airfield Near Rostov Appear\]](#),” *24-Kanal* (17 December 2023); Milinfoive, “[Минобороны сообщает об уничтожении 44 беспилотников \[The Ministry of Defense reports the destruction of 44 drones\]](#),” *Telegram* (5 April 2024); “[Su-34 destruction in Morozovsk](#),” *Telegram* (6 August 2024).

75. Milinfoive, “[В продолжение вчерашней феерической истории \[Continuing yesterday’s enchanting story\]](#),” *Telegram* (1 November 2022).

76. “[How Ukraine managed to destroy Tu-22M3 bomber in the heart of Russia](#),” *Armyrecognition* (24 January 2024).

them from shrapnel.⁷⁷ These measures, however, were a last resort and sometimes raised doubts about the VKS commanders' assessment of the threat. Nonetheless, the force of attacks remain relatively light, and the damage caused has not yet significantly impacted Russian capabilities. In response to this new pressure, Russia's airborne deterrent is obliged to evolve deeper to maintain its credibility.



(Copyright) This *Tu-22M3* was damaged in a Ukrainian *Tu-141* drone attack on the Ryazan airfield on 5 December 2022.



(PG) Modern Pantsir short-range air-defence systems can protect runways against various types of drone attacks. However, their number is still insufficient to protect every Russian sensitive places.

III – The 2030 Horizon for Russian Airborne Nuclear Power

Continuing the Pre-war Re-equipment

Despite the strain of operations and its current activity, the Russian airborne nuclear force must continue to modernise, by drawing from feedback and being guided by equipment plans set for 2027 and 2034.⁷⁸ On 21 March 2018, the Russian Deputy Defence Minister announced ambitious goals:

“We are developing new aeronautical weapons, and it is impossible to compare the Tu-160 bomber and the Kh-55, Kh-555 or even the Kh-101 missiles with the aircraft that we hope to receive in series in the 2030s equipped with new aeronautical weapons, which will have completely different ranges.”⁷⁹

77. “Russian bomber activity – September 2023,” *Maxar*, report from Ukrainka (1 September 2023).

78. “[Мантуров рассказал, что госпрограмма вооружений на 2025-2034 годы включит раздел по ИИ](#) [Manturov said that the state armament program for 2025-2034 will include a section on AI],” *Tass* (7 October 2023).

79. “[Парк стратегических бомбардировщиков Ту-160 полностью обновится к 2030 году - Минобороны РФ](#) [The fleet of Tu-160 strategic bombers will be completely updated by 2030 - Russian Defense Ministry],” *Interfax* (21 March 2018).

The most notable progress concerns weapons. Those in service in the mid-2010s were designed (the Kh-102/Kh-101 cruise missile⁸⁰) or manufactured (the Kh-55 cruise missile and the Kh-22 ballistic missile) during the Soviet period. Modernisations have been made, such as replacing the Kh-22 with the more accurate Kh-32, capable of travelling much longer distances and at faster speeds. Particular attention has been paid to the self-protection of the Kh-102/101. They have become the standard cruise missile for long-range strikes by Russian bombers but are exposed to many threats while flying at low altitudes. A version equipped with an internal jamming station to protect it from opposing radars was evaluated in 2018 and has been fired in Ukraine conflict since 2022,⁸¹ without creating obvious and significant disruptions for Ukrainian systems. Since 2023, Kh-101 wrecks have also been identified with fragmentation charges,⁸² infrared decoy launchers, and optical navigation device, conceived to facilitate complex trajectories (see [Map 2](#)).⁸³ All these models are expected to pave the way to new weapons currently being tested. The Kh-BD cruise missile is set to replace the current Kh-101s for long-range firing,⁸⁴ while the smaller Kh-SD will target less distant targets (around 1,500 km).⁸⁵ Regarding high-speed munitions, in addition to the introduction of the Kinzhal ballistic missile (which production started around 2017), efforts are being focused on developing the Kh-95 Ostrota, which is a hypervelocity missile equipped with a scramjet engine.⁸⁶ By circumventing sanctions, key foreign electronic components remain plentiful for their construction in Russia.⁸⁷ With the exception of special models such as the Os-

80. Study of the Kh-102 missile (and the Kh-101, its conventionally loaded variant), capable of travelling 4,500 km, began in the 1980s. The fall of the USSR blocked the tests and stopped production of the bomber. *Tu-95MA* intended to carry it. The first Kh-101 flights took place in 1997, with modernised electronics (thanks to Western components) and, first, a Ukrainian R-95 engine then replaced by a Russian model. This missile entered service in 2013; S. Moroz, “The Kh-101/102 airborne missile,” *Naouka i Tekhnika* (14 March 2022).

81. G. Nikolai, “[Российские крылатые ракеты X-101 оснастили комплексами РЭБ \[Russian X-101 cruise missiles equipped with electronic warfare systems\]](#),” *Russkoe Orujie* (9 November 2018); “[Intiguing Features Seen On Largely Intact Russia Cruise Missile Wreck](#),” *The Warzone* (30 January 2023).

82. S. Flash, “[Під час нічного ракетного удару \[Before the hour of the night missile strike\]](#),” *Telegram* (2 March 2024).

83. Milinfolive, “[Упавшая 26 января в Виннице ракета X-101 \[The X-101 rocket that fell on January 26 in Vinitsa\]](#),” *Telegram* (4 February 2023). The L-504 decoy boxes seen on a Kh-101 missile, found on 26 January 2023, 150 km southwest of Kiev, are used to fool very short-range missiles, which are often guided by the heat emitted by the engines: on this new Kh-101, the decoy ejections are programmed before the raid to disperse their traps over high-risk areas.

84. “[Дальний укол: какие ракеты увеличат боевые возможности российских ВКС \[Long-range injection: which missiles will increase the combat capabilities of the Russian Aerospace Forces\]](#),” *Izvestia* (24 September 2023).

85. “[Удары наносят ракеты-невидимки: Для чего используют новые крылатые ракеты X-50 \[Invisible missiles strike: What are the new X-50 cruise missiles used for?\]](#),” *Russkoye Orujie* (3 August 2023).

86. “[Российским Су-34 и Ту-22М3 добавят гиперзвуковую “Остроту” \[Russian Su-34 and Tu-22M3 to get hypersonic ‘Sharpness’\]](#),” *Lenta.ru* (21 May 2021); V. Zarudnitsky, “Факторы достижения победы в военных конфликтах будущего [Factors for achieving Pobieda in military conflicts of the future],” *Voennaya Misl* (August 2021): 41.

87. D. Spleeters, “[Component commonalities in advanced Russian weapon systems](#),” *CAR* (September 2022).

trota, due to it requiring delicate machining, production is expected to continue at a significant rate.

As for the aircraft fleet, the aeronautics industry must ensure that existing bombers are maintained in operational condition, capable of carrying future munitions, and to be eventually replaced. The *Tupolev* design office is currently working on a model known as the *PAK-DA*, which is intended to be stealthy and feature a flying wing architecture. This model is expected to ultimately replace all the *Tu-160s*, *Tu-95MSs*, and *Tu-22M3s* that entered service during the USSR era. However, the *PAK-DA* is not anticipated to make its first flight before 2027.⁸⁸ The immediate focus, namely, is on renovating the *Tu-160* four-engine fleet in two phases. Ten existing airframes (out of 19) are to be upgraded to the *Tu-160M* standard, including new engines. The first of these took off on 25 January 2018,⁸⁹ and at least seven others have taken flight as of February 2024.⁹⁰ In parallel, 50 completely new airframes have been ordered under the name *Tu-160M2*,⁹¹ with ten expected to take off by 2027.⁹²

Other bombers are also undergoing extensive modernisation programmes. The *Tu-22M3M* is the upgraded standard of the *Tu-22M3*, and the *Tu-95MSM* is the upgraded standard of the *Tu-95MS*. None of these new versions have progressed beyond the prototype take-off stage.⁹³ In the absence of a revolutionary change, these bombers should still be able to utilise advanced weapons thanks to their intermediate upgrades during maintenance. As such, for the foreseeable future, the performance of the Russian fleet is likely to remain largely unchanged, particularly in terms of penetration capabilities and range. Nonetheless, this stagnation of ambitions does not create any weaknesses when it comes to launching from Russian territory. This is due to the *Tu-95MS* possessing the speed and range comparable to a U.S. *B-2* bomber. The lack of projected objections can be explained by a focus on other industrial and budgetary priorities. A *Tu-95MS* navigator interviewed by *Gazeta.ru* magazine in February 2015⁹⁴ summarised the perception of this virtual *status quo* amongst crews as follows:

88. “В России создали испытательную базу для бомбардировщика нового поколения [Russia creates test base for new generation bomber],” *Ria Novosti* (6 December 2023).

89. “КАРТОЧКА БОРТА «Петр Дейнекин» [FLIGHT CARD ‘Petr Deinekin’],” *Russianplanes.net* (25 January 2018).

90. The first *Tu-160* to be upgraded to the M standard was nicknamed “*Pieter Deïnikin*” and took off on 24 January 2018 with old engines. The “*Igor Sikorsky*” model will be fitted with new engines and will fly in March 2021. The *Tupolevs* “*Ilia Muromets*”, “*Boris Veremei*”, “*Alexandr Molodchii*”, “*Valentina Terchkova*” and “*Alexandr Molodchii*” took to the air between September 2021 and February 2023.

91. A. Nikolskii, “Россия разрабатывает сразу два стратегических бомбардировщика [Russia is developing two strategic bombers at once],” *Vedomosti* (14 October 2016).

92. “ВКС к 2027 году получат 10 бомбардировщиков Ту-160М2 [The VKS will receive 10 Tu-160M2 bombers by 2027],” *Ria Novosti* (3 March 2020).

93. “Первый полет нового дальнего бомбардировщика Ту-22М3М прошел в Казани [The first flight of the new long-range bomber Tu-22M3M took place in Kazan],” *Interfax* (28 December 2018); “Russia’s Tu-95MSM heavily upgraded strategic bomber performs test flight,” *Ruaviation* (16 January 2023).

94. V. Vashchenko, “«Даже штурман внутри подлодки слышит, когда он летит» [Even the navigator inside the submarine can hear when it flies],” *Gazeta.ru* (9 June 2015).

“Creating a new strategic bomber and training its pilots is an extremely costly process. As you know, our military budget is not elastic. I think it would be better to invest the money available in fuel for the pilots, so that they fly more often and improve their skills.”

Moreover, in regard to the alleged obsolescence of the *Tu-95MS* with propellers, the serviceman replied: *“Don’t look at these engines the wrong way [...] considering the conduct of combat operations [carried out in Tu-95MS] under fighter cover, supersonic speed is not a necessity.”*

The main uncertainty for the future concerns the operational support for this air fleet. The number of *Il-78* refuelling and *A-50U* early warning aircraft (19 and 5 respectively⁹⁵ as accounted for in March 2024) is essential for extending the bombers’ reach and warning of incoming enemy interceptors. It is also likely to be insufficient in a major crisis. Moreover, training new bomber crews presents another challenge. It is currently done using old *Tu-134* commercial jets,⁹⁶ however, the last of which is due to be withdrawn from service in 2033.⁹⁷ As such, the struggling Russian civil aircraft industry does not appear capable of providing replacements in the required quantities or within the necessary timeframes.⁹⁸ Finally, in terms of threats, the air fleet is likely to remain vulnerable to drone attacks. Effective anti-aircraft resources to counter this threat are expensive and in demand by every Russian formation, starting with those engaged on the Ukrainian front. Furthermore, the number of runways protected by these systems is likely to remain modest. While covering aircraft with shelters is another solution, progress is slow. A plan to build 300 shelters was announced by the Russian Defence Minister in April 2018 but has so far not materialised.⁹⁹ There have been bursts of effort in Russian history, but for now – like

95. [“Первый полет модернизированного самолета-заправщика Ил-78-2 \[The first flight of the upgraded Il-78-2 tanker aircraft\],”](#) *BMPD-CAST* (26 September 2019); [“ВКС России получили очередной модернизированный самолет А-50У \[Russian Aerospace Forces Receive Another Modernized A-50U Aircraft\],”](#) *BMPD-CAST* (22 September 2023). In February 2022, seven *A-50Us* were in service with the VKS. The most recently delivered aircraft suffered radome damage on 26 February 2023 in Belarus following a drone attack. Another was destroyed on 15 January 2024 by a Patriot system in Ukraine, followed by a third on 23 February by a (probable) converted Ukrainian S-200 ground-to-air system. One of these was delivered at the end of 2022, bringing the total available to 5, one of which is regularly seconded to Syria.

96. The *Tu-134UBL* and *Tu-134Ch*, produced until 1983, are variants of the *Tu-134* commercial aircraft designed for radar/weapons system training and navigation respectively.

97. Y. Vassiliev, [“Минобороны будет эксплуатировать самолеты Ту-134 до 2033 года \[The Ministry of Defense will operate Tu-134 aircraft until 2033\],”](#) *Russkoye Orujié* (23 April 2023).

98. Three commercial aircraft are on the aeronautics industry’s agenda for the period 2025-2030: the *Il-114-300* (two prototypes of which will be flying in 2024), the *Superjet-100* (the Russian-powered version of which is being tested – the original French engines are no longer being delivered) and the *MS-21*, whose capabilities and cost are inadequate for what the forces are looking for.

99. [“Для самолетов 5-го поколения и перспективной авиатехники будут построены более 300 аэродромных укрытий – Шойгу \[Over 300 airfield shelters will be built for 5th generation aircraft and advanced aviation equipment – Shoigu\],”](#) *Novosti VPK* (21 April 2021); Fighterbomber, [“Вот такое решение экстренно разработали \[This is the solution we urgently developed\],”](#) *Telegram* (10 September 2023). The only shelter identified to have been received to cover combat aircraft – of medium size, far from a bomber – since the Ukrainian war came from a private donation.

many of the country's other assets – this strike force seems perpetually exposed to unattributable attacks.



(All rights reserved) On 26 January 2023, circled in yellow is the L-504 decoy launcher, which has been newly observed on a Kh-101 cruise missile.



(PG) Without state-of-the-art multifunction touchscreens: the cockpit of an unmodernised *Tu-95MS* strategic bomber.



(PG) *Tu-160* bomber, simulating refuelling behind an *Il-78*, May 2016.



(PG) Training *Tupolev Tu-134Sh*, at repair plant n°407 in Minsk, 2017.

Sanctuarising Its Role and Rectifying the Way It Works

Subjected to attacks claimed by the Ukrainian army against its airborne nuclear assets,¹⁰⁰ Russia continues to retaliate with conventional and non-nuclear strikes. By the end of 2023, Moscow appeared increasingly frustrated with the current rules of engagement and response mechanisms.^{101, 102} The reform of the doctrine became clearer in late spring of 2024. Notably, Vladimir Putin declared on 7 June that “*the Russian nuclear doctrine is a living instrument, which can be modified if neces-*

100. “Галерея героїв Бабій Олег Іванович Герой України [Gallery of heroes Babii Oleg Ivanovich Hero of Ukraine],” *Gov.ua*.

101. S. Karaganov, “[Nuclear war can be won](#),” *Moskovsky Komsomolets* (11 October 2023).

102. In October 2023, Sergei Karaganov, Honorary Chairman of the Foreign and Defence Policy Council, said he would like to see a review of Russia's nuclear doctrine, which he described as “negligent” and “imprudent”.

sary.” Andrei Kartapolov, head of the Duma Defence Committee, concurred in an interview with the newspaper *Tass* on 11 June: “*New challenges and threats are emerging. If we find that, in order to stop these threats, we need to change certain documents, including nuclear doctrine, then we will change them.*”¹⁰³

If implemented, this doctrine reform could address the reality of new threats. Theoretically, the current text allows Moscow to carry out nuclear strikes after formal detection of strategic munitions launches that are directed against Russia (procedure for firing on warning). However, the advanced alert sensors required to identify and characterise an intercontinental ballistic missile attack are scarce. More importantly, they remain vulnerable, as demonstrated by the damage caused by a drone to the Armavir anti-ballistic missile radar on 23 May 2024. Closer to the ground, new models of cruise missiles with particularly discreet radar signatures are challenging as well. For instance, the U.S. AGM-181 is set to become the standard strategic munition on *B-52H* bombers and could thwart low-layer detection capabilities. A future doctrine may thus redefine the criteria required for retaliatory fire, even in the event of a degraded attack detection. In addition, the New START Treaty, which sets out the means and rules of conduct for nuclear forces, is due to expire in February 2026. Its renewal is uncertain, given the withdrawal from other security treaties¹⁰⁴ and after the Kremlin suspended its participation in February 2023, following much hesitation.¹⁰⁵ Renewal would have mixed advantages. It would limit the diversification of nuclear-armed airborne missiles and allow for the recording of the dispersal of bombers over areas not intended for this purpose. As it stands, however, this practice is open to misinterpretation.

The range of missions entrusted to Russia’s nuclear-armed airborne bombers is rationalising. The potential of bomber airframes has been partly utilised and cannot be fully restored. The capacity to carry low-power munitions on combat aircraft should remain, in the name of redundancy of deterrence resources. For nuclear engagement on the battlefield (meaning, tactical use), the range of long-range weapons fired from the ground is expanding and presents a less visible and predictable threat. They may be nonetheless more credible, and serve as an alternative to the airborne component. Ukraine has been the target of theatre ballistic missiles (9M723 missiles launched by the Iskander system and its North Korean equivalent, the KN-23), short-range ballistic missiles (Tornado-S missiles, 5V55 or 48N6 anti-aircraft missiles fired ground-to-ground), and anti-ship munitions aimed at land (Oniks, Bal, or Tsirkon). All have specific flight profiles that require a large number of high-perfor-

103. A. Novoderejkin, “[Картанолов: изменения ядерной доктрины могут быть продиктованы угрозами для РФ](#) [Kartapolov: Changes in nuclear doctrine may be dictated by threats to Russia],” *Tass* (11 June 2024).

104. In 2019, the United States withdrew from the Intermediate-Range Nuclear Forces Treaty (INF Treaty), followed by the Intermediate-Range Arms Reduction Treaty (MTCR) in 2020. That same year, Washington also withdrew from the Open Skies Treaty (which allows reciprocal inspections), followed by Russia in 2021.

105. “[New Start Treaty](#)”, *U.S. Department of State* (5 February 2011); “[Putin suspends Russia’s participation in New START nuclear treaty](#),” *Le Monde* (21 February 2023).

mance detection and interception systems to be neutralised in time. Compared with bombers stationed at distant, well-known bases, ground-launched missiles appear less predictable and their mobile launchers less vulnerable.

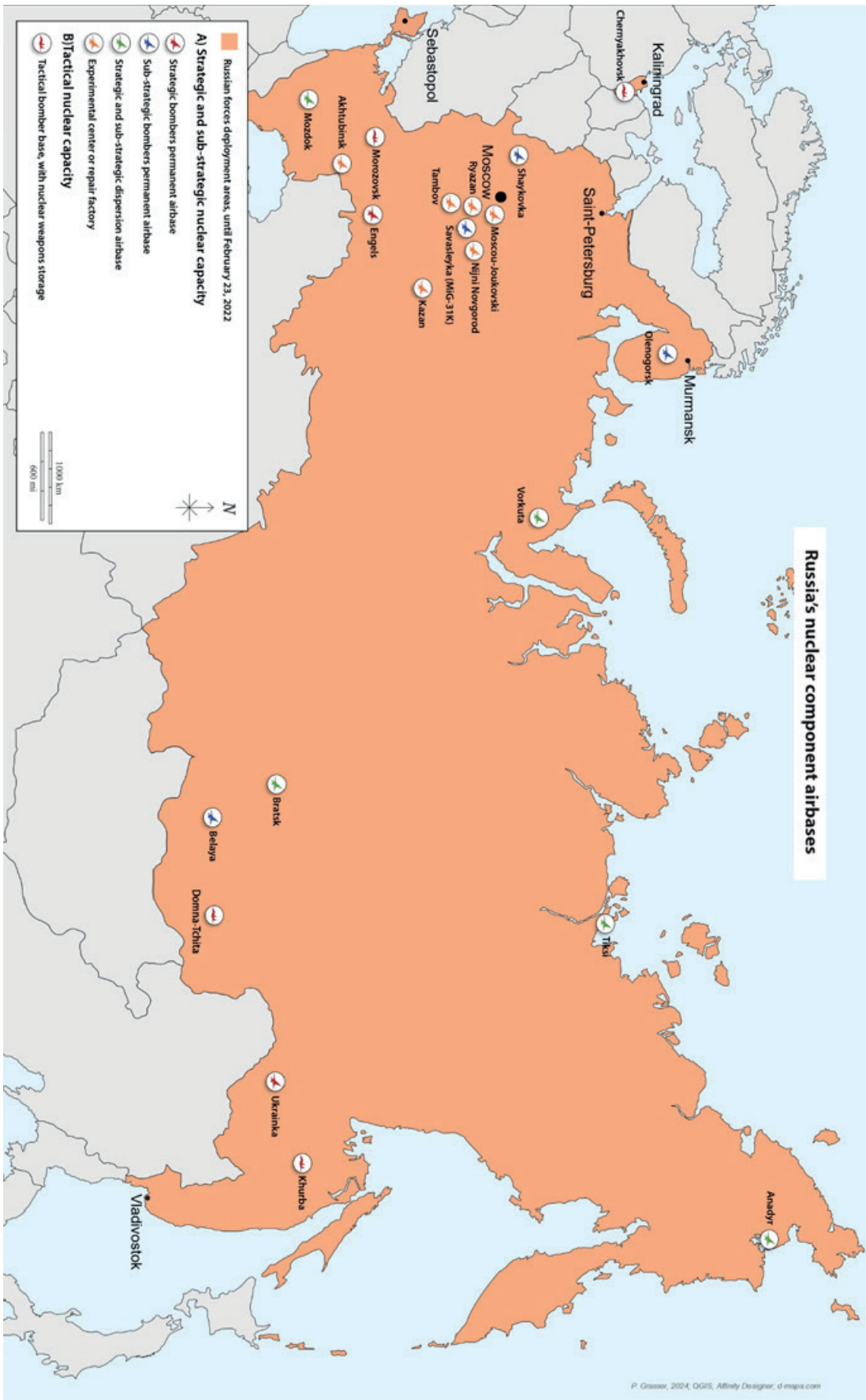
In addition to the importance of equipment and infrastructure, the conflict in Ukraine demonstrates the need for military manpower. Moreover, in parallel, crews are exposed to various types of hybrid action. Since 2014, private information about them has been littering the web and social networks. As early as 2015, pilots of *Tu-160* strategic bombers were targeted online by Ukrainian activists who disclosed their presumed email addresses, telephone numbers, and postal addresses.¹⁰⁶ These activities have spread and become more violent with the war in Ukraine. On 3 February 2024, the Ukrainian Ministry of the Armed Forces reported an ambush in Russia against an individual identified as a *Tu-95MS* pilot.¹⁰⁷ Nevertheless, these events remain of an exceptional nature. The protection of airborne nuclear personnel can also be improved by dispersing bombers and crews to isolated bases or by a reinforced internal security presence. Whether such conditions can be sustained over the long term, for military personnel and their families, remains to be seen.

With its crews and equipment under attack, Russia's airborne nuclear forces – whose designation has grown to become the *ultima ratio* of the Russian arsenal – has eroded. In addition, Russian strategic bombers are employed in conventional raids against Ukraine, which may have led to their primary mission being overshadowed. It may even have led to them being treated as legitimate targets in retaliatory strikes. Regardless of the solutions adopted to overcome these weaknesses, the most likely prospect is a strengthening of Russia's airborne nuclear capability, particularly for strategic applications. Moscow has little alternative to this, given the losses suffered by its conventional units in Ukraine. It is likely to take ten to fifteen years to restore these forces, in terms of both personnel and equipment, during which time the borders of the Federation are likely to remain fragile, including on its eastern flank. As such, it is now up to the Russian deterrent to guarantee territorial integrity more than ever. In the meantime, it can rely on the conspicuous nature of its *Tupolevs*, as well as the availability of Western observation systems, in order to render its air capacity a strategic marker of the first order.

106. [“Syria: Data on Russian Tu-160 Strategic Bombers’ Pilots Is Disclosed,”](#) *InformNapalm*, 25/11/2015.

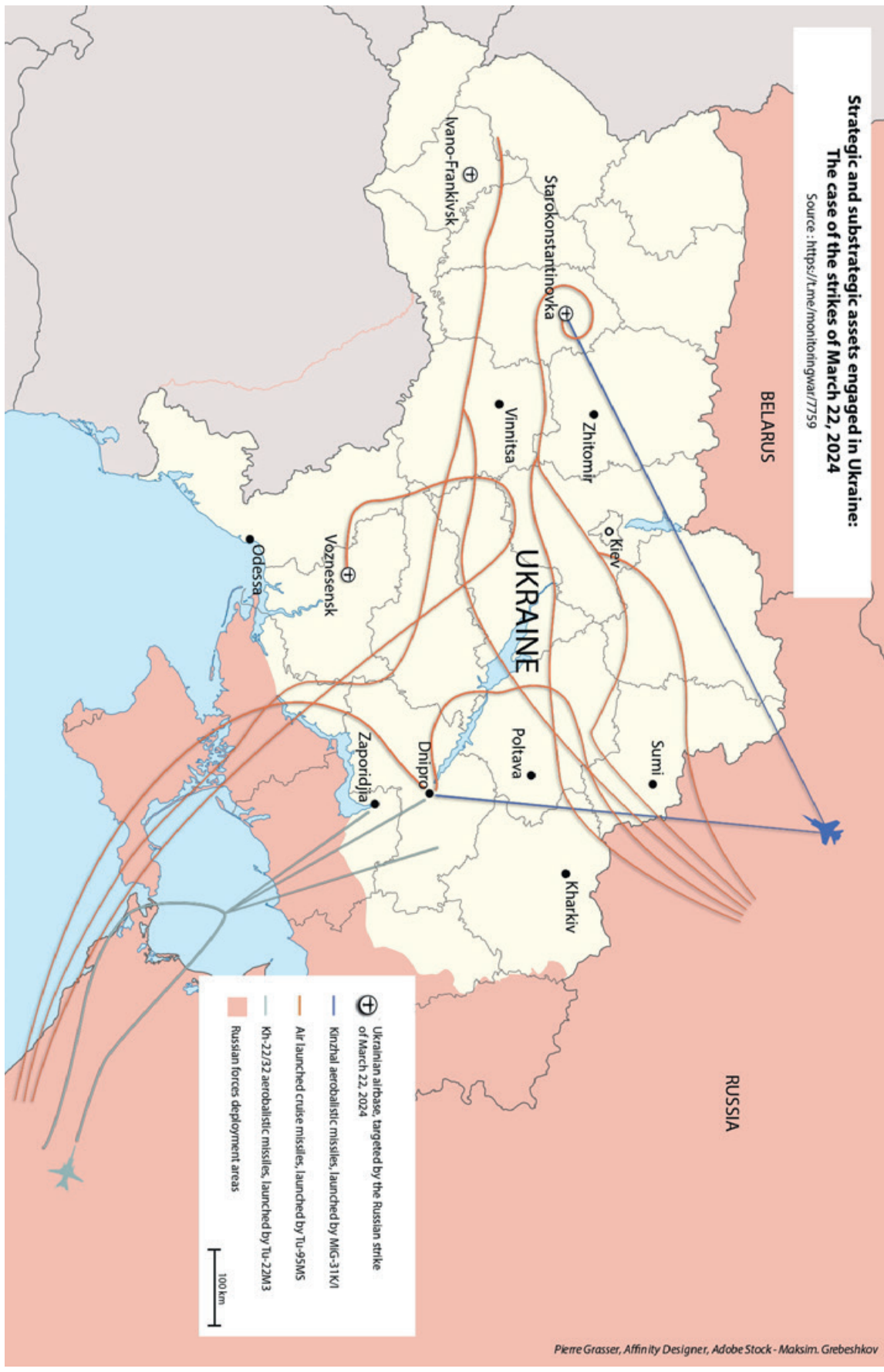
107. While the Ukrainian army did not claim responsibility for the action, which injured a former flight attendant, it did include a quote from one of its intelligence officers in its press release: “We remind you that all war criminals will face reprisals, we know your names, addresses, driving licences [...] justice is inevitable”; [“Defence Intelligence of Ukraine: A Tu-95MS bomber pilot was shot dead in Russia,”](#) *Mil.in.ua*, 03/02/2024.

Russia's nuclear component airbases



Strategic and sub-strategic assets engaged in Ukraine: The case of the strikes of March 22, 2024

Source : <https://t.me/monitoringwar/7759>



Asia: A Nuclear Powder Keg between Ruptures and Continuities

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The question of military nuclear power in Asia, when it is not entirely eclipsed by that of Russian nuclear capabilities, is often summarised in Europe as being centred on the North Korean military programme. However, in the context of the “pivot to Asia” and the Sino-United States strategic rivalry, the recent rise in the power of China’s nuclear arsenal could immediately prompt reassurance measures for both Japanese and South Korean allies. In the long term, this could also lead to a reflection on the evolution of the U.S. arsenal.

Further south, Indian and Pakistani arsenals stand at odds with the other, with China as the third member of the equation due to its historical support for Pakistan’s programme and the security challenge it poses to India. Pakistan also served as the cradle of a sprawling network of nuclear proliferation for military purposes. Islamabad has worked for the benefit of many Middle Eastern countries, as well as North Korea. In this series of Asian nuclear entanglement, Russia intervenes only marginally. As such, this article will approach these issues in the same manner.

In this context of a precarious equilibrium, the absence of a regional normative framework is particularly notable, with the exception of the Southeast Asia Nuclear Weapon-Free Zone (SEANWFZ) established by the 1995 Bangkok Treaty.¹ The

1. Including 10 States Parties: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. Mongolia also unilaterally declared itself a nuclear-weapon-free zone in 2000 under a national law.

situation mirrors that of “political” Asia, which has international organisations for cooperation but no integration. At the international level, two of the four non-signatories to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) are Asian – India and Pakistan with the other two being Israel and South Sudan. The only State that “withdrew” from it, North Korea, is also Asian.² China, on the other hand, is recognised by the NPT as one of the five *de jure* nuclear-armed States, endowed and adhered to the NPT with said status in 1992.

The outlook is hardly positive. India and Pakistan’s nuclear arsenals are inherently linked to the security challenges they pose to each other. China refuses to sit at the negotiation table and has every reason not to wish to bind itself to new treaties that limit its arsenals. North Korea, finally, stands defiant against the ban enforced by other nations.

Addressing these nuclear entanglements requires a particularly useful historical review, not only to understand the development of doctrines and operational resources, but also to grasp the most recent changes. The role of the airborne component within Asian nuclear forces is an all-too-often neglected area of study, and thus, deserves to be explored further.

1. The State of Play for Nuclear Power in Asia

Historically, episodes of proliferation in Asia have been of increasing severity, starting with China, which, thanks to its 1964 test, is recognised as a nuclear-weapon state under the NPT – that is, *de jure*. It is the only Asian state to hold this status. The Indian and Pakistani programmes also represented a significant disruption, altering international structures aimed at combating proliferation. Nevertheless, this did not prevent Dr. Abdul Qadeer Khan from selling his country’s nuclear secrets to the highest bidders. The North Korean crisis, ongoing since the early 1990s, poses a serious, immediate and proclaimed threat to regional security.

China: Rise in Power and Gradual Doctrinal Evolution

Chronologically, China is the last nuclear-weapon State under the stretches of the NPT. Initiated by Mao, the country’s nuclearisation developed hand-in-hand with the establishment of a doctrine that remained unchanged for several decades. Recently, China’s arsenal has begun to rise in power, apparently under the initial impetus of Xi Jinping, although it is not yet possible to determine its precise purpose.

2. However, it should be noted that “*the DPRK [Democratic People’s Republic of Korea] announced its unilateral withdrawal from the NPT on 10.01.2003, but this withdrawal is not technically valid, as the conditions for withdrawal do not comply with the provisions of Article X of the Treaty. No agreed statement on this announcement has therefore been issued by the States Parties to the NPT, nor by the depositary States of the Treaty (Russia, the United Kingdom, the United States), nor by the UNSC [United Nations Security Council],*” in E. Maitre, “[Le droit de retrait du TNP, vingt ans après la Corée du Nord](#),” Note de la FRS, n°6, Fondation pour la recherche stratégique (1 March 2023).

History of the Programme and Development of the Doctrine

Initially, Mao made no secret of his disdain for nuclear weapons. He even described them as “paper tigers”, in contrast to the power of the masses of the people in revolutionary wars, such as the one that brought the Chinese Communist Party (CCP) to power in 1949. The end of the Korean conflict in 1953 and the first Taiwan Strait crisis in 1955 nevertheless prompted Mao to reconsider the value of countering the U.S. nuclear threat with similar weapons.

The nuclear cooperation with the USSR that followed soon came to an end with the Sino-Soviet split in 1960. Nonetheless, it was beneficial for China, which had made progress on the path to nuclearisation but was now to navigate it alone.

The idea gradually emerged that nuclear weapons would deter both the United States and the USSR, and that they would be a lever of power in the emerging Cold War system.³ Less than ten years after the political decision to acquire nuclear weapons, and despite China’s considerable technological backwardness in the post-war period, the first fission device test took place on 16 October 1964.

However, Maoist China did not publish any information on its nuclear doctrine nor any White Paper. Mao’s 1964 statements crystallised a doctrine based on two pillars, which have been repeatedly affirmed ever since: Chinese nuclear weapons are purely defensive, and the country refuses to be the first to use them. From the outset, therefore, China synthesised these two elements by claiming minimal deterrence for itself. From this point of view, the transition to thermonuclear weapons in 1967 was a coherent technological leap forwards.

Like other nuclear powers, Maoist China viewed and continues to view its nuclear arsenal not as a weapon for use but as a political tool to deter nuclear attacks. In this regard, China’s response time was notably long due to the use of liquid-fuel missiles until the 1980s, which required fueling before launch, and the storage of warheads separately from their delivery systems, with the warheads⁴ themselves dismantled outside of alert periods (for reasons of strict CCP control).

This latency, in the eyes of the Chinese authorities, has never posed a credibility problem. The survival of even a single system following a disarming first strike, even if it had to be deployed weeks later, was sufficient to guarantee deterrence. The risk would remain too significant for an adversary to ignore.⁵

3. J. W. Lewis, L. Xue, *China Builds the Bomb* (Redwood: Stanford University Press, 1988).

4. A. Tellis, “[Striking Asymmetries. Nuclear Transitions in Southern Asia](#),” *Report*, Carnegie Endowment for International Peace (2022): 23.

5. Admiral Castex had already anticipated this in his visionary article of October 1945 on the atomic weapon: “*All that is needed is a very fleeting aerial action on a small scale, involving even a single aircraft*,” in R. Castex, “*Aperçus sur la bombe atomique*,” *Revue de Défense Nationale*, no. 17 (October 1945): 466-473.

Contemporary developments

Nonetheless, this doctrine is no longer on the agenda. The expansion of the Chinese arsenal mainly involves silos and transporter-erector-launcher (TEL) missiles, which are resilient systems in the context of a first enemy strike: the former can be launched before being struck, and the latter can be dispersed to reduce their vulnerability. As for the missiles themselves, improvements include the addition of penetration aids and MIRV warheads,⁶ but without significant advancement in accuracy (even though such technologies are within Chinese's reach, as demonstrated by their range of ballistic missiles). Combined, these elements could indicate Beijing's ongoing effort to ensure retaliatory capabilities, especially considering the development of a sea-based component, while the possibility of counterforce strike to disarm an adversary remains on the table.

According to estimates by the U.S. Department of Defense, the volume of China's nuclear arsenal has increased from around 200 warheads at the turn of the 2000s to more than 500 today.⁷ This growth has sparked an intense strategic debate in the United States known as the "Two-Peer Problem": the need to assure deterrence against not just one (Moscow) but two strategic competitors (Moscow and Beijing) on equal nuclear terms with the United States.

While it is not yet certain that China seeks to achieve this parity, it would still have to restart its production of fissile material nonetheless, which does not currently appear to be the case.⁸ The credibility of U.S. nuclear deterrence is put in question in the event of simultaneous or staggered conflicts with China and Russia. For instance, following a nuclear exchange with one of these two states, how can the United States guarantee the credibility of its deterrent against the second? The answer has been determined to lie in a qualitative reinforcement of the U.S. strategic arsenal, rather than in the relaunch of a dangerous nuclear arms race.⁹ Washington seeks to maintain its technological lead in this area, whether in terms of warheads, delivery systems, or platforms. The keel for the lead ship of the new *Columbia*-class nuclear-powered ballistic missile submarines was laid in June 2022 at the Rhode Island shipyard, while the first flight tests of the new *B-21 Raider* strategic bomber were carried out at Edwards Air Force Base (California) in November 2023.

The issue of testing is another significant source of uncertainty in China's nuclear programme. In a context where Russia threatens to resume a nuclear testing campaign in Novaya Zemlya, China has the greatest interest in breaking the Comprehen-

6. Multiple Independently targeted Reentry Vehicle: consists of equipping a missile with several nuclear warheads, each of which can be aimed at a separate target.

7. Department of Defense (DoD), "[2023 Annual Report to Congress: Military and Security Developments Involving the People's Republic of China](#)," *Report* (17 October 2023): viii.

8. A. Tellis, *art. cit.*, 39-43.

9. On this subject, see the comprehensive report by Brad Roberts: "[China's Emergence as a Second Nuclear Peer. Implications for U.S. Nuclear Deterrence Strategy](#)," *Report*, Center for Global Security Research, Lawrence Livermore National Laboratory (2023): 76 p.

sive Nuclear-Test-Ban Treaty (CTBT¹⁰). Indeed, its arsenal is not as sophisticated as that of the United States. Washington has carried out many more tests (1,032 compared with only 45 for China) while Beijing only tested around ten different designs.

As a result, the United States (like Russia) is capable of producing weapons that are both sophisticated and robust, while China lacks the experimental data needed to develop more advanced weapons. To compensate for this shortfall, espionage on the United States is doubly risky due to the extremely high level of protection of this data and its unlikely applicability to Chinese devices. The Trump administration has accused China of carrying out low-energy tests in containment chambers to obscure their detection by the CTBT monitoring network.¹¹ China is also said to be carrying out development work, like the United States and Russia, at its Lop Nur test site.¹²



Satellite image taken by the Maxar company of the Lop Nur nuclear test site (2020), showing five wells dug into the mountain.

It was here that Beijing tested its A (16 October 1964) and H (17 June 1967) bombs.

Source: “[China Set For Nuclear Weapon Test? What Satellite Images Show](#),” *NDTV* (22 December 2023).

10. It should be noted, however, that the Comprehensive Nuclear Test Ban Treaty (CTBT) – opened for signature on 24 September 1996 – has never entered into force: it has not been ratified by a sufficient number of States listed in its Annex II (known as “Annex II countries”) – including, in particular, China and the United States.

11. U.S. Department of State, “[Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments](#),” *Report* (2020): 49-50 and R. P. Ashley, “[Russian and Chinese Nuclear Modernization Trends: Remarks at the Hudson Institute](#),” *Speech and Testimonies*, Defense Intelligence Agency (29 May 2019).

12. W. J. Broad, C. Buckley, J. Corum, “[China Quietly Rebuilds Secretive Base for Nuclear Tests](#),” *The New York Times* (9 January 2024).

India and Pakistan: Two Intersecting Programmes

As the first nuclear-armed states in Asia, Beijing has played a significant role in shaping the balance of power in Asia by aiding Islamabad in developing its programme to counter that of New Delhi. Subsequently, Pakistan became a proliferating state, and China bears at least indirect responsibility for episodes of nuclear proliferation in the Middle East and North Korea, despite its ostensibly benign rhetoric on the matter.

Genesis of the Indian and Pakistani Programmes

In India, the military option was latent in its civil nuclear programme from its inception. Due to its limited exploitable uranium reserves but abundant thorium resources – a “fertile” element¹³ found in substantial quantities within Indian territory (one-quarter of global reserves) –, India decided to pursue a tailored nuclear programme in three phases.¹⁴ India’s thorium reserves were intended for use in the second and third phases of the programme. However, only the first phase materialised with the construction of “conventional” plutonium-producing pressurised water reactors. These plutonium reactors could deliver sufficient quantities of fissile material for potential military applications.

For Pakistan, even though existential security considerations have shaped the country’s political life since its independence in 1947, civil nuclear research institutions were established in the wake of the U.S. Atoms for Peace programme¹⁵ starting in 1954. There were therefore initially no intention of military applications.

India’s defeat in its war with China in 1962 launched an intense debate in India on the question of the bomb, prompting Pakistan to consider it for the first time as well.¹⁶ By 1965, the absence of Washington’s support during the Indo-Pakistani war over Kashmir¹⁷ seemed to prove to Pakistan that their country would henceforth have to defend itself alone. Moreover, the U.S. arms embargo on both countries resulted in tilting the conventional balance in India’s favour due to Pakistan’s heavier reliance on U.S. military hardware. In the years that followed, China rapidly became the leading supplier to Pakistan’s army.

13. In other words, by absorbing a neutron (typically by being placed in a nuclear reactor), it produces a fissile nucleus, which can then be used as fuel.

14. The first segment would consist of heavy-water nuclear power plants using natural uranium and extracting plutonium as a by-product. This plutonium would then be used in the fast neutron reactors of the second segment, which would transmute thorium into uranium-233. The reactors in the third segment would then use this U-233 as fuel.

15. Atoms for Peace Programme launched by the United States in December 1953 to facilitate access to civilian nuclear technologies for countries wishing to do so, in order to reduce the risk of proliferation.

16. B. Tertrais, *Le marché noir de la bombe* (Paris : Buchet Chastel, 2009).

17. Pakistan and the United States were linked by a military treaty, the South East Asia Treaty Organisation (SEATO). Washington’s failure to intervene during the 1965 and 1971 conflicts led Islamabad to withdraw.

However, it considered these weapons to be of insufficient quality and supplied in too low a volume. The nuclear option was becoming increasingly important.¹⁸ It was during this period that Ali Bhutto, then Minister of Foreign Affairs (1963-1966), uttered his now-famous phrase: “*If India builds the bomb, we will eat grass or leaves, even go hungry, but we will get one of our own. We have no alternative.*”

In the same vein, New Delhi’s refusal in 1968 to sign the NPT, arguing that it created a conventional aristocracy between the “endowed” States and others, provoked the same rejection by Islamabad. Pakistan’s overwhelming defeat in its war with India in December 1971 was a turning point. In addition to the independence of East Pakistan (now Bangladesh), it showed once and for all that the allies would not intervene. This observation led to the decision in January 1972 by said Ali Bhutto, but now Prime Minister, to launch a military nuclear programme, which was further accelerated by India’s 1974 nuclear test.¹⁹

Initially, Pakistan opted for the plutonium route disguised as a civilian project, with a CANDU reactor²⁰ and a plutonium reprocessing plant.²¹ Then, starting from 1974, following India’s test and the reaction of the “official” nuclear-weapon States to the region’s first proliferation crisis, Pakistan’s programme bore the brunt of the new international control system. On one hand, the nuclear-weapon States decided to place transfers of nuclear materials and equipment under the control of the International Atomic Energy Agency (IAEA). On the other hand, when the Nuclear Suppliers Group met in 1975 to oversee sensitive exports, it placed the reprocessing plant under the control of the IAEA and cancelled several contracts destined for Pakistan.²²

It was in this context that the country decided to pursue a second route – enriched uranium – thanks to Abdul Qadeer Khan, a former employee of the Dutch centrifuge leader Urenco. In 1975, thanks to his industrial espionage within this company and his well-stocked address book of various suppliers, Khan established an enrichment laboratory in Pakistan that made rapid progress. The first uranium conversion plant subsequently opened in 1977. The following year, the first prototypes of indigenous centrifuges were assembled, enabling an enrichment plant to operate at full capacity by 1981. These efforts were largely financed by Libya and Saudi Arabia, emboldened by the first oil shock of 1973, under the guise of Islamic solidarity.

18. S. Ahamed, “Pakistan’s Nuclear Program: Turning Points and Nuclear Choices,” *International Security*, vol. 23, no. 4 (1999): 178-204 (182-183).

19. However, this test, which was the first and was not repeated until 1998, was not really a militarisation project: the device in question was a fission device that was far too bulky to be placed on a delivery vehicle. No work on miniaturisation and vectorisation was undertaken by India until 1988, in response to Pakistan’s programme.

20. Canada Deuterium Uranium: a Canadian design using natural uranium and heavy water. It is particularly proliferative because it can be discharged during operation, allowing the plutonium generated to be recovered without shutting down the reactor, which is a visible and suspicious operation.

21. Plutonium needs to be chemically separated from other fission products to obtain weapons-grade plutonium. This type of installation is dual-purpose, since it is also used for the fuel cycle. The contract was awarded to the French company Saint-Gobain Techniques Nouvelles (SGN) because France was not in favour of the NPT at the time and wanted to position itself for a contract for the Chashma plant.

22. In particular with Germany for the production of heavy water and with Canada for the supply of spare parts and fuel.



Abdul Qadeer Khan giving a speech during the testing of the *Ghauri-II* ground-based missile in 1998.

Source: “[Nuclear secrets: the Dutch whistleblower who tried to stop Pakistan’s bomb](#),” *Financial Times* (24 July 2020).

The main driving force behind Pakistan’s success remains the secret nuclear co-operation signed with China in 1976, which Ali Bhutto considered in his prison testament as his greatest achievement. For 20 years, China provided technical assistance in constructing facilities, supplying heavy water, uranium hexafluoride, and deuterium, as well as in centrifuge bases. Beijing even went so far as to provide, likely by late 1982, the plans for an implosion device (a rudimentary but reliable model of their bomb tested on 27 October 1966). In 1987, Islamabad finally had a militarised device that could be vectorised – short-range Chinese M-11 missiles were acquired for this purpose that same year.²³

For its part, Pakistan shared its advanced know-how in centrifugation and metallurgy. In fact, Pakistan supplied China with an entire centrifuge factory in Hanzhong. This cooperation lasted until the mid-1990s, the period of China’s rapprochement with the United States.

In 1998, India and Pakistan carried out nuclear tests within a few weeks of each other. Since then, both countries were considered as possessors of nuclear weapons. However, in respect to India’s fusion capabilities, there remain several doubts. The three tests conducted on 11 May 1998 produced a power that is incompatible with a fully functional thermonuclear weapon (despite the fact that India’s

23. T. V. Paul, “[Chinese-Pakistani Nuclear/Missile Ties and the Balance of Power](#),” *The Nonproliferation Review*, vol. 10, no. 2 (1 July 2003): 5.

test facilities did not allow an H-bomb to be tested at full theoretical power). It is therefore likely that these, at best, were exalted fission devices.²⁴ Indian claims of operational thermonuclear weapons have thus not been tested and cannot be considered reliable.²⁵

The Indian Doctrine

India's doctrine is based on minimum credible deterrence: like China, it believes that it does not need a large arsenal to deter adversaries, nor does it require advanced technology to achieve this. It suffices that its weapons are functional and that at least one missile survives an initial strike.

In theory, India refrains from first use²⁶ or use against non-nuclear states²⁷ (except in response to a chemical or biological attack with similar military or political effects as a nuclear strike).²⁸ It envisages only a massive retaliation causing unacceptable damage. Consequently, its targeting strategy is more anti-city than counterforce, consistent with its arsenal structure, which is neither very precise nor very powerful.²⁹

Similar to Chinese weapons and for the same reasons, Indian weapons are stored unmated in different locations. They are separated from their delivery systems, which implies a gradual mating in the event of a strategic warning and the acceptance that the response may not be immediate. Indeed, like China, India has never considered an immediate retaliation to be necessary.

Despite a changing strategic environment, Indian doctrine has remained largely unchanged until recently. The Agni-P, the latest version in its ballistic missiles family, would have a probable circular error of a few dozen metres and would carry MIRV warheads. These characteristics may seem at odds with the national

24. A. J. Tellis, "[India's Emerging Nuclear Posture](#)," *Research Brief*, RAND Corporation (1 January 2001): 508-518.

25. Indian scientists involved in the nuclear programme have even published an article along these lines: "[On Thermonuclear Weapon Capability and its Implications for Credible Minimum Deterrence](#)," *Mainstream Weekly*, vol 48, no. 1 (26 December 2009).

26. The nuclearisation of Pakistan has had the opposite effect to what supporters of strategic stability might have expected. On the contrary, it has opened up a new front of support for terrorism and secessionists from Pakistan in India. This brings us back to the "stability/instability paradox" of nuclear armies. This state of affairs has prompted some Indians to suggest abandoning the no-first-use posture. But this is just rhetoric: it is hard to imagine New Delhi retaliating with nuclear weapons against terrorist attacks financed by Islamabad.

27. The two reference doctrine documents are "[Draft Report of National Security Advisory Board on Indian Nuclear Doctrine](#)," *Article*, Ministry of External Affairs, Government of India (17 August 1999) and "[The Cabinet Committee on Security Reviews Operationalization of India's Nuclear Doctrine](#)," *Press Releases*, Ministry of External Affairs, Government of India (4 January 2003).

28. A. Tellis, "[Striking Asymmetries. Nuclear Transitions in Southern Asia](#)," *art. cit.*, 77.

29. The Federation of American Scientists estimates the power developed by Indian warheads at between 10 and 40 kt. By comparison, the bomb dropped on Hiroshima caused an explosion of around fifteen kilotonnes. H. M. Kristensen, M. Korda, "Indian nuclear weapons, 2023," *Bulletin of the Atomic Scientists*, vol. 78, no. 4 (2022): 224-236 (225).

doctrine of massive anti-city retaliation³⁰ and could indicate a shift towards a counterforce logic.³¹

However, such strikes are incompatible with the implementation time of Indian nuclear weapons, which is at best several hours, more likely several days, due to the disassembled storage of the arsenal and the operational conditioning time of TELs. The encapsulation of these new missiles – *i.e.* their ready-to-use confinement in a sealed canister – does not necessarily mean that the warheads will be mated with the delivery systems either. The main aim of this provision is to protect the missiles and their propellants, in particular, from the wide variations in temperature and humidity to which they may be subjected and which impair their performance and reliability.

Finally, unlike Pakistan's, Indian warheads do not have "physical" safeguards: they do not require the insertion of a safety piece when loaded onto the missile to make them functional.³² While not a problem during normal times as these warheads are stored disassembled, it could become a concern if India were to handle complete warheads. The risk of accidental explosion would increase significantly.³³

The Pakistani doctrine

Like China, Pakistan does not publish a formal doctrine document. This choice stems from its sense of military inferiority *vis-à-vis* India and its desire not to define a threshold, however vague, below which the country could be attacked. Yet, numerous statements made by officials highlight three key points.

Firstly, Pakistan's security is based on a concept of minimum credible deterrence, as announced in 1999 by Prime Minister Nawaz Sharif.³⁴ The idea is not to burden the country's development by engaging in maintaining an oversized arsenal or in a potential nuclear arms race with India. This principle is underpinned by the notion that a limited arsenal is sufficient to deter India's conventional superiority.

Secondly, Pakistan considers the option of first-use. New Delhi can reject this principle: the scale of its conventional resources means that it can repel any Pakistani aggression of this type. On the contrary, Islamabad fears a major non-nuclear attack would jeopardise its own survival.

30. The Circular Error Probable (CEP) is the radius within which the missile has a 50% chance of falling in relation to its predicted point of impact. To hit a city, which is a very large target, a low CEP is not necessary.

31. E. Maitre, "[Agni-P: modernisation attendue ou évolution doctrinale](#)," *Bulletin* n°111 of the Observatoire de la dissuasion, Fondation pour la Recherche Stratégique (Summer 2023): 12-14.

32. The Pakistanis now have this kind of electronic security, combined with physical security elements, to ensure that a weapon cannot be detonated by accident or without the necessary authorisation. See here T. M. Azad, K. Dewey, "Assessing the security of Pakistan's nuclear weapon program," *Defense & Security Analysis*, vol. 39, no. 2 (2023): 123-145 (129).

33. A. Tellis, "[Striking Asymmetries. Nuclear Transitions in Southern Asia](#)," *art. cit.*, 109.

34. Speech by Nawaz Sharif in Islamabad on 20 May 1999, quoted in R. W. Jones, *Minimum Nuclear Deterrence Postures in South Asia: An Overview* (Reston, Policy Architects International, 2001): 27.

Finally, Pakistan's nuclear weapons are only aimed at India,³⁵ albeit these elements remain *a priori* unverifiable. If Pakistan were to enter into a strategic confrontation with another nuclear state, it is unlikely that it would refrain from planning strikes against it. In a major difference from China and India, Pakistan does not view nuclear weapons as a political means to avoid war but rather as a weapon that could be used for self-protection as a last resort.

The Pakistani proliferation axis

In 2004, Egyptian Mohamed el-Baradei, then Director General of the IAEA, labelled Pakistan as an “*atomic supermarket*.”³⁶ He positioned the country at the heart of a proliferation network targeting three Muslim countries (Iran, Iraq, and Libya),³⁷ as well as North Korea, for both strategic and financial reasons. The central role played by the Khan network in this mafia-like enterprise cannot eclipse the more discreet but original role played by China.

The Iranian issue gained momentum as early as 1984. Despite the disapproval of the first Supreme Leader, Ayatollah Ruholla Khomeini, three years of war against Iraq prompted Teheran to contact Pakistan with the intention of acquiring nuclear capabilities. These exchanges led to a formal cooperation agreement in 1987.³⁸

With the end of the war in 1988, the consequent release of credits, the death of Khomeini in 1989, as well as the arrival of pro-nuclear Hashemi Rafsanjani as President, cooperation between the two countries looked set for a bright future. For his part, General Beg, who succeeded Zia as Chief of Staff of the Pakistani armed forces in 1988, saw Iran as a means of financing his army by selling its most prized secrets.

However, by 1993, Tehran was very dissatisfied with the progress of its enrichment program. In six months, its technicians had assembled only one P-1 centrifuge³⁹ and struggled to procure spare parts, as it lacked a smuggling network as sophisticated as Khan's. While cooperation with China was fruitful – providing plans for a uranium ore conversion plant – it remained insufficient. The turnkey procurement of an enrichment plant from Russia was considered, but its discovery by the United States ended this project. Finally, unable to deplete his still modest national stock, Khan ultimately sent plans for the P-2 but only delivered 500 P-1 centrifuges in parts, allowing nonetheless the Iranian enrichment programme to take off.

35. This statement was made during Prime Minister Sharif's address to the United Nations General Assembly in September 1998.

36. B. Tertrais, *op. cit.*

37. The “Islamic bomb” concept was developed by Zulfikar Ali Bhutto in the 1970s to attract funding from oil-producing countries.

38. F. Shaikh, “[Pakistan's Nuclear Bomb: Beyond the Non-Proliferation Regime](#),” *International Affairs*, vol. 78, no. 1 (2002): 29-48 (40).

39. The P-1 centrifuge was the first model used by the Pakistanis. It was a rudimentary Urenco design that was already outdated when it was stolen by Khan. The P-2 model was developed in the late 1970s and has twice the separation power of the P-1 model. See A. Glaser, “Characteristics of the Gas Centrifuge for Uranium Enrichment and Their Relevance for Nuclear Weapon Proliferation,” *Science & Global Security*, vol. 16, no. 1 (2008): 1-25 (8-10).

The Iraqi program, on the other hand, began in the 1970s, but the Israeli raid on the Osirak reactor in 1981 significantly hindered it. In 1990, with Saddam Hussein feeling pressured by the fear of a U.S. intervention, Pakistan spontaneously reached out, offering a weapon's blueprint and all the necessary means to build it. However, the intervention of the international coalition (Operation *Desert Shield* and then *Desert Storm*) definitively ended these talks.

The Libyan case is even more astounding. Gaddafi was notoriously obsessed with the bomb. Less than a year after coming to power, he asked China twice in 1969 to sell him a weapon. China refused. After attempting to get a return on its financial investment in support of the Pakistani programme and through several contacts within the Khan network, an agreement was finally reached in 1997 for the supply of 10,000 P-2 centrifuges and three tonnes of uranium hexafluoride (enough for three bombs). However, the overthrow of Saddam Hussein in April 2003 and the channel opened shortly thereafter for compensation for the Lockerbie bombing (1988) prompted Gaddafi to inform the U.S. and the British that he was ready to abandon all his weapons of mass destruction, including in particular, nuclear ones.

It was within the framework of this agreement that the head of the Libyan nuclear program, Matuq Mohamed Matuq, handed over in January 2004 two white plastic bags bearing the logo of Good Looks Fabrics & Tailors, Khan's tailor in Islamabad. They contained 120 pages of complete documentation – save for a few details – on the manufacture of a nuclear bomb. These documents were so sensitive that most IAEA executives did not have the necessary accreditation to view them.

Their contents was confirmed by Jacques Baute, a former member of the French Atomic Energy Commission (CEA) who became the director of the IAEA's Iraq Nuclear Verification Office in 1999.⁴⁰ The presence of several pages in Chinese and the great similarity of the device described with the one used during the Chinese CHIC-4 test in October 1966 provided additional evidence of the very close Sino-Pakistani military nuclear cooperation and Beijing's responsibility for the proliferation that followed. These documents were then sent to the Oak Ridge laboratory in Tennessee on a specially chartered *Boeing 747*, sealed in a crate.

The North Korean Proliferation Crisis: The Most Serious Challenge of the 21st Century

Although the Iranian crisis remains acutely topical, the country has “only” reached the nuclear threshold, unlike North Korea. Pyongyang has successfully acquired nuclear weapons, albeit its actual capabilities remain questionable.

History of North Korean Proliferation

North Korea signed the nuclear Non-Proliferation Treaty in 1985, thereby integrating into the international non-proliferation architecture. The withdrawal of U.S.

40. A. Small, *The China-Pakistan Axis* (London: Hurst Publishers, 2015): 27-28.

nuclear weapons from South Korea, completed in December 1991, led to the signing of a Joint Declaration on the Denuclearization of the Korean Peninsula on 20 January 1992. Both states committed to not “*test, manufacture, produce, receive, possess, store, deploy or use nuclear weapons*” (Article 1) and to not possess nuclear reprocessing and uranium enrichment facilities (Article 3). Shortly thereafter, North Korea signed its safeguards agreement with the IAEA.⁴¹

However, in that same year, North Korea completed the construction of its UNGG reactor⁴² (a British MAGNOX model,⁴³ whose specifications had been public domain since the 1950s through the Atoms for Peace program). U.S. conviction of the existence of a clandestine nuclear programme was reinforced by North Korean authorities’ refusal to grant IAEA inspectors access to two suspicious sites.

Following the IAEA’s referral of the issue to the UN Security Council to authorise an *ad hoc* inspection, North Korea announced its withdrawal from the NPT on 12 March 1993. Under international pressure, however, it rescinded this decision on 11 June, just one day before the expiration of the 90-day notice period. A year later, in June 1994, former President Jimmy Carter made an official visit to Pyongyang. The Agreed Framework was reached in October, freezing North Korea’s military nuclear programme (including activities around the plutonium-producing UNGG reactor). It also allowed IAEA inspections in exchange for U.S. guarantees, the provision of two civilian reactors, and annual oil deliveries pending their commissioning.

At this point, the Pakistani proliferation network became crucial and came into full play again. Although the North Korean plutonium programme was frozen, there existed another secret uranium enrichment program. In 1991, Khan sought to have a complete nuclear programme for his laboratory and thus aimed to acquire delivery systems. He focused on the North Korean No-Dong missiles. Despite their liquid propulsion making them cumbersome and unreliable, their range of over 1,000 km was significantly greater than the 300 km range of the Chinese M-11 missiles sold to Pakistan. Beijing, in a phase of relative rapprochement with the United States, no longer wished to supply Islamabad. Given the financial crisis in Pakistan during those years, the option of bartering ballistic capabilities for enrichment technology was agreed upon between the two countries in 1996.

The discovery of this cooperation by the United States in 2002 led them to denounce the 1994 Agreed Framework. North Korea withdrew from the NPT and

41. Comprehensive Safeguards Agreements are signed between a non-nuclear-weapon State and the IAEA, which can and must verify that none of the nuclear material on the State’s territory is diverted to military use. North Korea’s safeguards agreement was signed on 30 January 1992 and ratified by the Supreme People’s Assembly on 9 April.

42. UNGG stands for Uranium Naturel Graphite Gaz, the technology initially favoured by France before EDF overtook the CEA and imposed the American design of the Pressurised Water Reactor (PWR). UNGGs have the advantage of not requiring enrichment capacity, since the fuel is composed of natural uranium, while the graphite that moderates it is an inexpensive material. It can be refuelled during operation, making it an excellent plutonium-bearing reactor.

43. Magnesium Non-OXidizing.

openly resumed its nuclear program. It carried out a series of tests in the following years. The first test, in October 2006, was likely a failure, but the second, on 25 May 2009, produced a yield of 4 kilotonnes (approximately a quarter of the yield of the bomb dropped on Hiroshima). A third test occurred on 12 February 2013. North Korea claimed mastery of the thermonuclear bomb in the next three tests that followed (6 January and 9 September 2016, followed by 3 September 2017). However, the scientific community remains sceptical and considers these to be enhanced fission devices.

What Are North Korea's Actual Capabilities?

Given that IAEA inspectors have not had access to North Korean facilities in the past two decades and that its enrichment programme remained secret for an additional ten years, assessing the country's true nuclear capabilities is challenging. The limiting factor for warhead performance remains the quantity of fissile material.⁴⁴ Based on this criterion, according to David Albright, founder of the Institute for Science and International Security and a nuclear proliferation specialist, the number of North Korean warheads ranges between 35 and 65. This wide discrepancy is due to the range of possible nature (fission, boosted fission, fusion) and composition of the warheads.⁴⁵

Within the field of missiles,⁴⁶ North Korea boasts a wide array of delivery systems, albeit shrouded in uncertainties. At short range, the KN-23, KN-24 and KN-25 do not yet appear to be in active service, nor capable of carrying a nuclear warhead, despite military exercises simulating tactical nuclear strikes in October 2022 and March 2023 aimed at highlighting such capabilities. At medium range, the dual-capable, TEL-mounted KN-15 can reach Japan. Finally, the Hwasong-15 and Hwasong-17 ICBMs might already be operational. On the other hand, the Hwasong-18, tested spectacularly in April and July 2023, is already on the verge of becoming so. Given their dimensions, these Hwasong-17 and Hwasong-18 missiles could potentially carry MIRV warheads.⁴⁷ However, despite these capabilities, North Korea has not demonstrated the necessary mastery of warhead miniaturisation to the extent needed for mounting them on its ICBMs. Nevertheless, the fact remains that, in the nuclear field more than in any other, there can be no room for doubt.

44. Of which there are two main sources: plutonium-producing nuclear power reactors and uranium enrichment. North Korea's spent fuel extraction, enrichment and reprocessing capabilities remain unclear.

45. D. Albright, "[North Korean Nuclear Weapons Arsenal: New Estimates of its Size and Configuration](#)," *Reports*, Institute for Science and International Security (10 April 2023).

46. "[North Korea's Nuclear Weapons and Missile Programs](#)," *Report*, Congressional Research Service (14 April 2023). For more details, see the reference site: <https://missilethreat.csis.org/country/dprk/>.

47. E. Suh "[Pyongyang and Its Nuclear Weapons Programme. A Credible Threat?](#)," *Publication*, German Council on Foreign Relations (21 August 2023).



Test firing of the *Hwasong-18* intercontinental missile on 13 July 2023.

Source: S.-H. Choi, J. Smith, "[North Korea says test launch was latest Hwasong-18 ICBM](#)," *Reuters* (13 July 2023).

North Korea also poses a proliferation chain reaction risk in East Asia, particularly concerning Japan and South Korea, who are directly threatened by its ballistic developments. Both Tokyo and Seoul possess cutting-edge civilian nuclear industries and thus possess all the expertise and facilities necessary to rapidly become nuclear-armed states in the face of a major strategic threat. To prevent this scenario, the United States has long implemented extended deterrence. This involves regularly reassurance measures to bolster these partners' confidence in U.S. determination. Notably, on 18 July 2023, the SSBN *USS Kentucky* visited Busan port in South Korea, the first such visit since 1980 in a country known for numerous North Korean spies, poised to approach the docks. Additionally, in another rare and notable event, a *B-52 Stratofortress* participated in the Seoul Air Show in October 2023, where it carried out flight demonstrations.

In the end, it is Russia that has emerged as a new factor of instability: the recent visit of Kim Jong-un to Vladivostok last October, where then-Defence Minister Sergei Shoigu presented him with Russian strategic bombers, casts doubt on a potential nuclear cooperation between the two countries in exchange for North Korean material support for the invasion of Ukraine.⁴⁸

48. J. S. Wit, "[Siegfried Hecker on the New Russia-DPRK Relationship and Nuclear Cooperation](#)," 38 *North* (21 September 2023).

2. The Role of the Air Component in Asian Nuclear Forces: An Analytical Framework

The air component of nuclear deterrence amongst various Asian states remains largely under-analysed. Recent discussions have predominantly focused on the construction of China's three missile silo fields in Inner Mongolia, Gansu, and Xinjiang. It also remains focused on the developments of SSBNs, including China's establishment of a continuous oceanic deterrence in late 2022, India's progression towards it, and North Korea's launch of its first such model. Airborne nuclear weapons seem notably absent from these narratives.

Yet, it is through strategic bombers that the United States maintains its most visible presence in Asia concerning extended deterrence, thus echoing former French President François Hollande's sentiment about the "visible" leg.⁴⁹

North Korea: The Air Component, the Neglected Branch of the Military

North Korea does not *a priori* possess an air component and has no known plans to set one up.⁵⁰ The country's sustained effort has been on missile delivery systems, banking on long-term advancements in warhead miniaturisation capabilities rather than aircraft stealth. However, the aerial dimension cannot be entirely dismissed.

In its Defense Reform Plan 2020, South Korea identified its main disadvantage *vis-à-vis* the North as the size of its military – 365,000 soldiers versus 1.1 million, which it intends to compensate with cutting-edge technologies, particularly in aviation, with the acquisition of the *F-35* aircraft. Pyongyang's recent pursuit of tactical nuclear weapons can be interpreted as a countermeasure to South Korea's undeniable superior air power, granting itself the potential for a disarming first strike on South Korean airbases at the outset of a conflict.⁵¹

Further north, the arrival of *Reaper* drones in Japan at the end of 2022, and the regular presence of *B-52s* capable of carrying cruise missiles on U.S. bases in the Pacific have rekindled North Korea's fear of a conventional decapitation strike. This fear was further fanned by the recent deaths of Qassem Soleimani and Islamic State higher-up cadres. In response, North Korea's law was amended in 2022 to specify and expand the conditions for nuclear weapon use. Amongst these included the stipulation that any decapitation strike would automatically trigger a nuclear response.⁵²

This new posture introduces significant risks of misinterpretation by Pyongyang, such as perceiving a strike on a location near the North Korean leader as an as-

49. "[Statement by Mr François Hollande, President of the Republic, on nuclear deterrence, in Istres on 19 February 2015](#)," *Speech*, Vie publique (19 February 2015).

50. 80 *Il-28 Beagles* in the arsenal of the Korean People's Air Force.

51. BW Bennett, "[How Kim Jong-un 's Fears Shape North Korea's Nuclear Weapons Agenda](#)," *The RAND Blog*, RAND Corporation (19 April 2023).

52. J. M. Acton, "[North Korea's Doctrinal Shifts Are More Dangerous Than Missile Launches](#)," *Foreign Policy* (4 November 2022).

sassination attempt, or the automatic launch of an ICBM following a false alarm. Additionally, South Korea has established procedures to kill Kim Jong-un in case of nuclear strikes or as preemptive measures, embodied by investments in intelligence capabilities and precision missiles. This stance could be viewed by the North as a threat of first resort.⁵³

Amongst North Korea's armed forces, the Air Force appears as being the weakest component. According to the Military Balance 2023, the Korean People's Air Force has 545 combat aircraft, but only 18 *MiG-29s* are of the fourth generation. The remainder includes 56 *MiG-23s*, over a hundred *MiG-21s*, and similar numbers of *MiG-19s* and *MiG-17s*.⁵⁴ Beyond the obsolescence of the aircraft, the Air Force suffers from a lack of combat experience, recurrent fuel shortages due to embargoes (limiting flight hours to 15-25 per pilot annually⁵⁵), and shortages of spare parts. However, over the past year, there has been an apparent effort with more frequent exercises at a more sustained pace (indicating possibly increased budgets),⁵⁶ including with it an expansion of the Sunchon Air Base.⁵⁷ These indications, however, in no way suggest the imminent establishment of a North Korean "strategic" air force in the short or medium term.

India and Pakistan: air components in line with doctrine

In 1998, the year of their birth, India's nuclear capabilities consisted essentially of gravity bombs carried by *Mirage 2000* and *Jaguar* aircraft, and short-range Prithvi-I missiles (of a 150-km range). Pakistan was a much bigger target than China.

Today, the air component of India's nuclear triad remains significant,⁵⁸ still involving the same objectives. This is despite advancements in ground-based ICBMs, which are more likely meant for deterring Beijing. Currently, the Indian Air Force employs gravity bombs and has developed dual-use glide bombs: the Garuda (100 km range) and the Garuthma (30 km range). The *Su-30MKI* appears, *a priori*, to have replaced the *Jaguar* in this role.

Pakistan, on the other hand, acquired *F-16s* potentially capable of conducting nuclear raids, despite the U.S. having made it a condition that they not be used for such a purpose. In the 1970s, Washington was reluctant about continuing its support for

53. A. Panka, "[South Korea's 'Decapitation' Strategy Against North Korea Has More Risks Than Benefits](#)," *Carnegie Endowment for International Peace* (15 August 2022).

54. The International Institute for Strategic Studies (IISS), *The Military Balance. The Annual Assessment of Global Military Capabilities and Defence Economics. 2023* (Abington (Oxfordshire): Routledge Journal, 2023): 264.

55. C. M. Lee, K. Botto (eds.), "[Korea Net Assessment: Politicized Security and Unchanging Strategic Realities](#)," *Research*, Carnegie Endowment for International Peace (2020): 27.

56. A. B. Abrams, "[How North Korea's Fighter Fleet Re-emerged from Obscurity](#)," *The Diplomat* (12 July 2023).

57. C. Zwirko, "[North Korea starts rebuilding major airbase in latest sign of air force revival](#)," *NK PRO* (13 September 2023).

58. For estimates, see the studies cited by A. Tellis, "[Striking Asymmetries. Nuclear Transitions in Southern Asia](#)," *art. cit.*, 113, which put the figure at around fifty heads.

Islamabad due to its nuclear programme. However, this perspective changed in 1979 with the loss of Iran as an ally following the Islamic Revolution and the Soviet invasion of Afghanistan. A clear foreign policy decision was made at the time, favouring Pakistan's requests. Zbigniew Brzezinski, National Security Advisor, noted in a memo to President Carter on 26 December 1979, that "*our security policy cannot be dictated by our nonproliferation policy.*"⁵⁹ Similarly, during his 1980 campaign, future President Ronald Reagan stated that Pakistan's nuclear programme was not a U.S. concern.

Thus, the United States sold *F-16s* to Pakistan despite the country already possessing a nuclear weapon delivery capability. By 1983, when the *Fighting Falcons* were delivered, Islamabad's arsenal also included Western aircraft, such as *Mirage III* and *V*, which were only modernised in the next decade under the Retrofit of Strike Element (ROSE) project.

Today, there is controversy over which aircraft are explicitly dedicated to nuclear strikes. According to sources, the *Mirage* is reportedly prepared for this type of mission. This is allegedly not the case neither for the *F-16s* nor the newly acquired *JF-17s*,⁶⁰ without any apparent reason.⁶¹

Originally, Pakistan's nuclear deterrence relied on the aircraft and gravity bomb combination, but its ground-based component has gradually become predominant in its strategic arsenal. This shift can be explained by the threat posed by the Indian Air Force to the air component of Pakistan's triad. They could acquire air superiority and prevent Pakistani aircraft from reaching their targets. This risk has prompted the Pakistani Air Force to acquire stand-off munitions such as the Ra'ad (or Haft-8), which has been developed since 2007. This missile, which successfully completed a test flight in 2016, has a range of 350 km and is dual-purpose. It is compatible with the *Mirage III* and should be compatible in the future with the *JF-17 Thunder*.⁶²

However, in 2011, Pakistan adopted a "full spectrum deterrence" approach. Islamabad moved away from the exclusive counter-value logic (targeting capitals or economic centres) prevailing since 1998 to adopt "*strategic, operational, and tactical*" nuclear capabilities.⁶³ This shift entails both quantitative expansion – since Pakistan's approximately 170 warheads of 12 kt⁶⁴ are only sufficient for targeting

59. B. Tertrais, *op. cit.*

60. The *JF-17 Thunder* is a multi-role fighter developed as part of an industrial partnership between China (Chengdu Aircraft Corporation) and Pakistan (Pakistan Aeronautical Complex).

61. H. M. Kristensen, M. Korda, "[Pakistani nuclear weapons, 2021](#)," *Bulletin of the Atomic Scientists*, vol. 77, no. 5 (2021): 265-278 (270-271) and H. M. Kristensen, M. Korda, "[Pakistani nuclear weapons, 2023](#)," *Bulletin of the Atomic Scientists*, vol. 79, no. 5 (2023): 329-345.

62. "[Ra'ad \(Haft 8\)](#)," *Missile Threat*, CSIS Missile Defense Project (16 August 2016) [Updated: 23 April 2024].

63. According to General Khalid Kidway, Senior Director General, Strategic Plans Division, National Command Authority: "*Full range of nuclear weapons in all three categories, strategic, operational and tactical, with complete coverage of the vast Indian territory and its peripheral territories,*" quoted in "[Rare Light Shone on Full Spectrum Deterrence](#)," *Dawn* (7 December 2017).

64. H. M. Kristensen, M. Korda, "[Pakistani nuclear weapons, 2023](#)," *art. cit.*

major cities – and qualitative enhancement, with various types of weapons designed for specific missions across different domains (land, air, and sea).

While Pakistan's Army Strategic Forces Command is by far the largest, its Air Force Strategic Command⁶⁵ regularly tests its operational capabilities through the rotation of aircraft amongst its various bases and exercises simulating degraded conditions (such as landings and takeoffs on highway sections or the pairing of nuclear weapons with sites not initially intended for that purpose).⁶⁶

The Chinese Airborne Component: The Final Modernisation of the Triad

For decades, the only operations that China's strategic bombers – the *Xian H-6* derived from the *Tu-16 Badger* and the *Harbin H-5* inspired by the *Il-28 Beagle* – could carry out were raids on cities on the outskirts of China. These aircraft were unable to penetrate the air defence systems of neither the Soviet Union nor the United States. Similarly, the onboard nuclear weapons could be used tactically or against peripheral cities but not deep within enemy territory.

In practice, China's nuclear deterrence relied both on its ground- and air-based components – notably its nuclear-capable *H-6A* and *E* bombers or its *Q-5A Nanchang* fighters. Although the latter lost its nuclear responsibilities at the end of the Cold War, the emphasis on regional targeting has led China to resurrect its nuclear bombing force in recent years. The modernised H-6N, capable of aerial refuelling, is now believed to carry the CH-AS-X-13. This new air-launched ballistic missile (ALBM⁶⁷) with a range of approximately 3,000 km carries a warhead of unknown yield.

The CH-AS-X-13 is set to become the cornerstone of the airborne component of China's nuclear deterrent. Despite the modernised versions of the *H-6*, China's strategic bomber fleet remains unable of penetrating the defences of its best-equipped regional adversaries, such as Japan and India, and is even less capable of conducting long-range strikes against continental United States. Consequently, bombers need to carry stand-off munitions, whether aeroballistic or cruise missiles, which can be launched from a safe distance from the adversary's air defences, thus improving the survivability of the launch platform.

Finally, China is developing a new strategic bomber, the *H-20*, for which very little information are available. It is reportedly a stealth flying wing with a range of over 10,000 km (capable of reaching into the Pacific, or further with aerial refuelling capability), and capable of carrying ten tonnes of conventional or nuclear weapons.⁶⁸ Such an aircraft would significantly enhance the power projection capabilities of the country.

65. On the organisation of the nuclear command and the role of the National Command Authority (NCA), see the contribution by Adil Sultan ("Pakistan's nuclear adventure: doctrinal developments and future challenges") in this issue.

66. A. Tellis, "[Striking Asymmetries. Nuclear Transitions in Southern Asia](#)," *art. cit.* 181.

67. Air-Launched Ballistic Missile.

68. Department of Defense (DoD), "[Annual Report to Congress: Military and Security Developments Involving the People's Republic of China. 2023](#)," *art. cit.* 92.

Conclusion

Successive episodes of proliferation in Asia have created balances that have endured, as evidenced by the remarkable constancy of the doctrines of China, Pakistan and India. In recent years, however, the changes initiated by these three states have manifested themselves in the development or acquisition of new equipment.

China is significantly increasing its arsenal without altering its regional nuclear capabilities as of now. Nonetheless, it disrupts the U.S. approach to extended deterrence in Asia and forces a renewal of the doctrinal debate in the United States, the outcome of which will be closely monitored. India, now seeking to credibly deter both Pakistan and China, is moving towards deploying more powerful ICBMs, even though its thermonuclear warheads have never been successfully tested. Pakistan, in turn, is seeking in its new “full spectrum deterrence” doctrine a response to India’s air (and conventional) superiority, which may drive it to acquire more of China’s latest-generation fighter aircraft.

Moreover, North Korea remains the main factor of nuclear instability in the region: as its programme advances and becomes increasingly credible, it compels the United States to conduct reassurance campaigns with Japan and South Korea. This could, in the event of an acute crisis, push North Korea to seek to acquire nuclear weapons for themselves.

India's Nuclear Challenges and Air Delivery as part of the Triad

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Introduction

India lives in a challenging nuclearised neighbourhood. Two of its neighbours, China on the northern and eastern front, and Pakistan on the western are nuclear armed. With both, India has contested borders and territorial disputes. Both of them have different nuclear doctrines and are building up their capabilities to meet *their* idea of credible deterrence. The two also share a robust nuclear and missile proliferation relationship between themselves and both perceive India as a strategic adversary.

China completes sixty years as a nuclear weapon state in 2024. Meanwhile, India and Pakistan completed 25 years of the conduct of their nuclear tests this year. Though India had conducted a peaceful nuclear explosion in 1974 which demonstrated its capability to build weapons, it nevertheless chose to hold back on acquiring nuclear weapons in the hope that universal nuclear disarmament would address its threat perception of a nuclear China. But, as the region became more nuclearized with Chinese nuclear and missile proliferation to Pakistan in the 1980s; and, as non-proliferation instruments like NPT and CTBT began to constrain India's choices in the 1990s, New Delhi felt compelled to conduct its own nuclear tests in May 1998 for the purpose of national security.

By mid-1990s, China had already conducted as many as 45 nuclear tests, had developed solid-fuelled, road-mobile, medium range missiles and the first generation SSBNs. China had also conducted a nuclear test for Pakistan and the latter was fomenting insurgency in the states of Jammu & Kashmir, and in Punjab, its confidence boosted by its nuclear weapons capability.

Caught in a security and non-proliferation bind, India felt compelled to develop its own nuclear weapons to establish credible deterrence against nuclear coercion or blackmail by countries that held claims on Indian territories. As explained by Jaswant Singh, India's external affairs minister in 1998, nuclear tests acquired for India "*the much-needed strategic space and to break free from the new nuclear paradigm that had come into existence in the nineties.*"¹

Prestige was a collateral benefit of India's tests. Since the world bestows a certain status to countries that possess nuclear weapons, India too became its beneficiary. But, prestige was not the primary driver for India's decision to acquire nuclear weapons. Security² was and still remains the rationale. A nuclear doctrine provides the basis for India's view of the role of nuclear weapons and provides the necessary guidance for the development, deployment and employment of the nuclear force structure to credibly address the threats.

The aim of this paper is to examine the specific role of the air leg in the Indian nuclear triad in the context of the country's nuclear threat environment. Accordingly, after this brief introduction that describes the rationale for why India went nuclear in 1998, Section I that follows examines the nature of India's nuclear challenges. It highlights the salient elements of the nuclear strategies of Pakistan and China and describes the kind of threat that India perceives from them. Section II offers a short overview of the country's nuclear doctrine, including its major attributes. Section III takes a deeper dive into the role of the Indian Air Force for air delivery of nuclear ordnance and examines the reasons as to why India has not acquired strategic bombers for this purpose. The final section then identifies some of the future challenges and recommends a way ahead for nuclear India.

1. India's Nuclear Challenges

Pakistan's nuclear capability is focused on deterring the possibility of a conventional conflict with the superior Indian military while itself pursuing a policy of cross-border terrorism. This creates a unique challenge for India of which there is no parallel where a nuclear armed state uses terrorism against another nuclear armed state, and then uses the threat of nuclear escalation as a way of averting a riposte. Pakistan's nuclear strategy relies on the projection of a low nuclear threshold. Through

1. R. Chengappa, *Weapons of Peace: The Secret Story of India's Quest to be a Nuclear Power* (New Delhi: Harper Collins, 2000): 434.

2. The security concerns were also well explained by PM Vajpayee in his letter to the U.S. President after the nuclear tests. See Appendix VI in ML Sondhi (ed.), *Nuclear Weapons and India's National Security* (New Delhi: Har Anand Publications, 2000): 165-166.

the articulation of a vague threshold for nuclear use, Pakistan seeks to amplify fears of an immediate and inevitable escalation to the nuclear level in case of a conventional conflict. These fears are stoked as much to deter India, as to scare the international audience. Such a strategy has played out after every incidence of terrorism in India that has been traced back to Pakistan.

Meanwhile, to make this projection look credible, Pakistan is steadily moving towards full spectrum deterrence that is based on the availability of a ready stockpile of nuclear warheads from low yield to high yield varieties, and a number of delivery systems from the very short-range to the longer ranges. In recent years, missile tests of multiple independently retargetable vehicles (MIRVed) missiles from sub-surface platforms, longer range cruise missiles *etc.*, have been undertaken. The projection of tactical nuclear weapons (TNWs) and placement of nuclear missiles on surface vessels are all part of this approach of deliberately creating risks to block New Delhi's response options even as it suffers frequent terrorist attacks. Therefore, for India, the challenge from Pakistan is its strategy of nuclear brinkmanship.

Meanwhile, on the eastern and northern fronts, nuclear China has a three and a half decade lead over India on nuclear capability build-up. While its military modernization, including in the nuclear dimension, remained slow until the 1990s, the pace somewhat picked up thereafter.

As the country's sustained economic growth and consequent ability to liberally spend on military modernization was complemented by technological advances, China focused on enhancing the reliability, accuracy, penetrability and survivability of its delivery systems. Much of this was triggered also by U.S. withdrawal from the anti-ballistic missile treaty (ABM) in 2002 and its subsequent focus on development and deployment of ballistic missile defence (BMD) along with its much-publicized strategy of conventional global prompt strike. This has changed China's threat perceptions and capability trajectory as an expansion of China's nuclear warhead numbers has been noticed over the last few years.

Given that China's deterrence strategy has been premised on the threat of its ability to cause 'unacceptable damage' while pledging no first use of own nuclear weapons, the focus of Chinese efforts is on ensuring survivability. Further, realizing the vulnerability of land-based missiles despite the survivability measures, the spotlight has been on making sea-based deterrence capability operational. The sea leg of the Chinese nuclear triad rests on *Julang 2 (JL-2)*, a second-generation submarine launched ballistic missile (SLBM) of over 7000 km range that would be deployed on indigenous *Type 094* submarines. China has also worked on MIRVing its missiles.³ China is known to have been miniaturizing warheads to make them lighter and easier to deploy in multiple numbers ranging from 3-10 atop its delivery systems. Beijing has also developed the capability to make the re-entry of its nuclear warhead manoeuvrable (MARVed missiles) thereby making it difficult to intercept. Well aware of the centrality of space-based capabilities for new technologies, China is rapidly modernizing these for both offensive and defensive operations. Beijing's demons-

3. "China Successfully Tests Multi-warhead Missiles," *Yomiuri Shimbun* (8 February 2003).

tration of an anti-satellite (ASAT) capability in 2007 has since been supplemented by its development of a range of soft kill technologies including electronic attacks through sophisticated jamming technologies.⁴ A test of the fractional orbital bombardment system (FOBS) has also been undertaken obviously to signal deterrence.

It is apparent that China is moving up to a higher level of strategic capability and credibility by showcasing the mobility, invulnerability and penetrability of its nuclear delivery systems. This capability enhancement and its concomitant impact on deterrence is primarily meant for the U.S. But it obviously has downstream effect on its deterrent equation with India too.

India is sandwiched between the two nuclear adversaries. With Pakistan, it faces the challenge of crisis instability triggered by continued use of terrorism, which creates potential for conflict escalation; and, China's arsenal expansion and capability enhancement heightens the risk of sucking India into an arms race.

2. India's Nuclear Doctrine

Just 18 months after the conduct of its nuclear tests, India announced a draft nuclear doctrine that unambiguously stated a political role for the nuclear weapon and explained the way India plans to 'put it to use'. It also guided the nation towards a desired ideal in a global, verifiable and non-discriminatory nuclear disarmament as a national security objective. The draft doctrine stated that "*India shall continue its efforts to achieve the goal of a nuclear weapon free world at an early date.*" While aspiring for this ideal, it nevertheless also fleshes out the concept of nuclear deterrence for India. For instance, in accepting the principle of no first use, the doctrine directs India's nuclear forces to be "*based on a triad of aircraft, mobile land-based missiles and sea-based assets.*"

As it stands, the draft doctrine remains a draft to this date, but in January 2003, India released a press note on operationalisation of the nuclear doctrine, which is recognised as the official nuclear doctrine of the country. The document is a brief one and it accepts the major attributes as had been put forth in the draft. Two of these need some explanation. The first is that of credible minimum deterrence that seeks to steer clear of a maximalist stockpile accumulation in an attempt to reach parity or superiority with the adversary's arsenal. The second is that of no first use (NFU) which aims to reassure the adversary that India would not introduce nuclear weapons into a conflict thereby relieving him of the use or lose dilemma.⁵ These doctrinal features are discussed in some detail in the following paragraphs.

Firstly, India maintains a narrow role for its nuclear weapons. These are meant only to deter the use of nuclear weapons by the adversary. Also, it conceives of them as weapons of deterrence, and seeks to deter by threatening retaliation of a kind that

4. For more on China's space capabilities see M. Sethi, *Code of Conduct in Outer Space: A Strategy for India* (New Delhi: Knowledge World, 2016): 97-122.

5. According to the dilemma "*use it or lose it*", a State may be tempted to use its nuclear weapons first in a conflict (*use it*) for fear that an opponent will succeed in neutralizing it (*lose it*). Henry Kissinger summed up this dilemma with the idea that a state has to choose "*Armageddon or defeat without war.*"

would negate the benefits that the adversary hopes to make by using them in the first place. India eschews the idea that nuclear weapons could be effective for fighting a war or prevailing over the adversary. Rather, it contends that the extraordinary destructive potential of these weapons constrains their utility for achieving any rational political objectives. India's prime minister at the time of nuclear testing in 1998, Mr Atal Bihari Vajpayee, had then stated in Parliament that India did not "*intend to use these weapons for aggression or for mounting threats against any country; these are weapons of self defence to ensure that India is not subjected to nuclear threats or coercion.*"⁶

With the principal role of India's nuclear arsenal being to protect the nation from nuclear blackmail and coercion, the country has opted for 'credible minimum deterrence', a concept that eschews stockpile accumulation of the kind that the U.S. and USSR built during the Cold War. No figure has been officially quantified as minimum. But, the underlying philosophy is based on building numbers that will be sufficient to undertake an assured counter strike capability to cause unacceptable damage to the adversary. This guiding principle insures India against the risk of falling into the trap of wanting to build superiority or even parity on nuclear warhead numbers. It is not surprising, therefore, that India has the least number of warheads guesstimated in the region.

Secondly, nuclear deterrence as conceptualized by India is premised on the threat of retaliation after the adversary's first use. With a no first use doctrine (NFU), India has conceded the onus of escalation to the adversary. In doing so, it has liberated itself on many fronts. The first of these is from the need to build large arsenals of first strike weapons (such as accurate missiles with multiple independently retargetable vehicles), nuclear superiority to carry out counterforce attacks against an adversary's retaliatory forces, elaborate and delegated command and control structures to handle launch on warning or launch under attack postures to launch simultaneous nuclear attacks from and over dispersed forces. NFU, on the other hand, requires a focus on survivability of nuclear forces through a mix of measures that include hardening of nuclear storage sites, deception, mobility, dispersal over different delivery vectors, and a level of defence. Secondly, NFU also does not necessitate keeping nuclear weapons in a hair-trigger alert posture. It does not require forward deployment of nuclear forces which increases the likelihood of accidental or unauthorised use. LOW/LUA postures require pre-delegation of authority to launch nuclear weapons and this can never be a risk-free option. Thirdly, maintaining own forces in a relaxed posture relieves pressure on the adversary to quickly launch his strike, fearing a nuclear strike from the adversary could be imminent. NFU, thus, mitigates the "use of lose" pressure and thereby lessens crisis instability. Finally, the NFU frees the political leadership from the psychological pressure of taking the difficult decision of using a WMD.

6. Suo Motu Statement by PM Vajpayee in the Parliament on 27 May 1998. As reproduced in *Strategic Digest* (July 1998).

Interestingly, CMD and NFU relatively reduce the demands on nuclear hardware. Given that by their very nature, nuclear weapons cause huge damage to life and property unrestricted in time and space, the numbers do not need to be too large. Moreover, given the high density of population in this region, even kiloton weapons dispersed intelligently over the target and made to explode at an optimum height to maximize damage easily suffice for credible deterrence.

The more important requirement, in fact, is availability of reliable and survivable delivery systems of adequate ranges to ensure retaliation. India has opted for a triad to be able to signal this for credible deterrence. Ballistic missiles of ranges from 750 km to 5,000 km make up the bulk of such a capability. These are mobile missiles and dispersed across the geographical expanse of India as well as on SSBNs to ensure survivability. Delivery of nuclear warheads by aircraft makes up the third leg of the nuclear triad.

It is pertinent to highlight at this juncture that the Indian nuclear doctrine clearly instructed the development of a triad for nuclear delivery in order to ensure flexibility, survivability and redundancy. So, para 3.1 of the draft nuclear doctrines reads, *“India’s nuclear forces will be effective, enduring, diverse, flexible, and responsive to the requirements in accordance with the concept of credible minimum deterrence. These forces will be based on a triad of aircraft, mobile land-based missiles and sea-based assets in keeping with the objectives outlined above. Survivability of the forces will be enhanced by a combination of multiple redundant systems, mobility, dispersion and deception.”*⁷

3. Indian Air Force for Nuclear Delivery – Strengths and Limitations

When India tested its nuclear weapons in 1998, aircrafts were the first delivery platforms that were available to project deterrence. Though the Indian missile programme had been started in the 1980s, credible missile systems of adequate ranges were not ready by then. Short range (150-250 km), liquid fuelled, Prithvi II missiles were amongst the earliest ballistic missiles to be operationalized in 2003, but these obviously did not offer adequate range for credible deterrence, especially not against China.

Therefore, even as missile development picked up pace, the first platforms for nuclear delivery were some of the nuclear capable fighter bomber aircraft that India was operating and which had undergone testing for this purpose. Initial plans had been for the *Jaguars* to be used for dropping free fall nuclear bombs. While these aircraft continue to be listed for such delivery in available literature on nuclear forces,⁸ there are also reports to suggest that the *Jaguars* did not provide adequate clearance and the plan then shifted to using the *Mirage 2000Hs*. Three flight tests of mating

7. India's Draft nuclear doctrine, August 17, 1999. Reproduced as Appendix in M. Sethi, *Nuclear Strategy: India's March towards Credible Deterrence* (New Delhi: Knowledge World, 2009).

8. H. Kristensen, M. Korda, [“Indian Nuclear Forces 2022,”](#) *Bulletin of Atomic Scientists*, vol. 78, no.4 (2022): 224-236.

these warheads without the cores were reportedly undertaken in 1994. It is also reported that one of the bomb designs tested in 1998 was that of a 12 kT warhead that had been already mock tested for air delivery. In more recent times, *Sukhoi-30s* and even the *Rafales* have been mentioned as potential nuclear delivery platforms.



Indian Air Force *Su-30MKI*.

© “Modernisation des Su-30 MKI indiens,” *Avions de chasse* (10 January 2024).

This journey, however, has not been easy. Some have attributed this to the “*extreme secrecy and compartmentalization within the government and the military*.”⁹ This contains some truth since the IAF, in the 1980s was unaware of the specifications of the nuclear weapons and hence unable to modify its aircraft for the purpose. Even with the *Mirage 2000s*, the warheads have been described as an “*awkward fit, and only highly skilled pilots could take off with the cumbersome payloads attached underneath their plane’s bellies – making the jets aerodynamically tricky to fly*.”¹⁰

9. G. Kampani, “[New Delhi’s Long Nuclear Journey: How Secrecy and Institutional Roadblocks Delayed India’s Weaponization](#),” *International Security*, vol. 38, no.4 (Spring 2014): 79-114.

10. R. Beckhusen, “[Why India Wants France’s Dassault Rafale Fighter Jet: They Can Carry Nuclear Weapons](#),” *National Interest* (21 September 2016).



The multi-role *Tejas* fighter.
© “[HAL Tejas](#),” *Avions légendaires*.

The IAF was also not sure whether the aircraft's fly-by-wire systems could withstand electromagnetic pulses from nuclear detonation, though France has been known to have used its domestic version for nuclear delivery. According to one scholar, “*the modification of aircraft for safe and reliable delivery of a nuclear weapon turned out to be a huge technical and managerial challenge that consumed the [state-owned Defence Research and Development Organization's] attention for six years and perhaps more.*”¹¹ In any case, the Indian *Mirage 2000H* is reported to be undergoing upgrades “*to extend its service life and enhance its capabilities to include new radar, avionics, and electronic warfare systems.*”¹²

Over the last quarter century that India has now possessed nuclear weapons, a discussion on the need for strategic bombers has surfaced every now and then. This has especially been mentioned in the context of a growing threat perception from China. Potential targets in China that would qualify as unacceptable damage are deep within the country, and hence distant from India. They are also likely to be well defended. Therefore, for the sake of signalling an ability to hit these targets, there has been talk of acquiring strategic bombers. The *Tu-160 Blackjack* or its follow-on *PAK DA* fifth-generation fighter has been mentioned in this regard. It has been argued that such a step would help showcase India's ‘strategic’ mind-set and thus deter China better, especially since Beijing is likely to have a stealth bomber force in the near future, equipped with the capability to conduct electronic warfare and deploy directed

11. G. Kampani, *art. cit.*

12. H. Kristensen, M. Korda, *art. cit.*

energy weapons. In the face of such capabilities with India's primary adversary, it has been opined that having a bomber of its own, capable of carrying a complement of weapon systems, would help India take the war deeper into neighbouring territory and make for a 'bigger deterrent'.

The above arguments, however, need some unpacking. Despite the perceived advantages, there are several reasons as to why the acquisition of this platform has not garnered much attention. In fact, there are few proponents of the idea within the IAF itself. Even those air force officers who have occupied important chairs in the Strategic Forces Command, the authority in charge of India's nuclear forces and action in case of deterrence breakdown, have not made a strong case in this regard.

This is despite the fact that IAF has had experience of operating heavy bombers. In fact, when the British left India in 1947, they left behind three squadrons of American heavy bomber *B-24 Liberator* which they had used in the second world war. IAF operated these aircraft until 1968.



Indian Air Force *B-24 Liberator* (1985).

© Airlines.



Canberra of the Indian Air Force.

© "[IAF marks 60 years of its Canberra bombers](#)," *The Economic Times* (1 September 2017).

India also placed an order for Canberra aircrafts in 1957 and used them for bombing raids and photo reconnaissance for five decades. But, this was much before India acquired nuclear weapons. Why has nuclear India not felt the need for building a fleet of strategic bombers over the last 25 years? Several reasons can be identified to answer this question.

Geography of threats

Amongst the unique attributes of strategic bombers is their ability to undertake bombing in adversary territories which are geographically far away. With strong stealth features, they are built to escape detection, including by flying at high altitudes over long distances, to carry out deep penetration missions to target the adversary's war waging capability and resolve. In the case of the U.S. Air Force, for example, the only Western country operating strategic bombers, its bombers are meant to carry out operations thousands of kilometres from the homeland. So, a *B-2 Spirit* bomber can travel 10,000 km in single fueling and is highly stealthy with very low "*acoustic, thermal, electromagnetic radar and visual profiles at all altitudes*."¹³ China's *H-20* and Russian *Tupolev PAK DA* are both believed to be capable of an operational range of 12,000 km.

Each of these three countries that operate strategic bombers have their adversaries at great geographical, even trans-oceanic, distances. In contrast to their potential areas

13. S. E. Dean, "[Strategic Bombers: Still Relevant?](#)," *European Security and Defence* (27 December 2022).

of operation, India's threats lie in geographically contiguous territories. This obviates the need for aircrafts to fly long-distances. In fact, India's potential targets easily fall within the attack limits of its present complement of fighter aircrafts and missiles.

Competing demands on scarce resources

The cost of raising and maintaining a fleet of strategic bombers is not inconsequential. In the case of U.S., the next-generation *B-21* Grumman strategic stealth bomber is expected to cost around \$0.5 billion each, the upgradation bill of the Pentagon triad for the next decade totalling around \$350 billion over a life cycle. According to some reports, "*The total cost, priced in fiscal year 2019 dollars, includes \$25.1 billion for development, \$64 billion for production, and \$114 billion for 30 years of sustaining and operating a fleet of 100 bombers.*"¹⁴

In view of the costs involved, for a developing though security stressed country like India, a balancing act is required on many fronts. Firstly, there is need for balancing development needs with defence spending. Then, within the budgetary allocations for defence, there is need to balance the requirements of the three Services. And, going further, there are competing priorities within each Service that need to be adequately considered and catered for. In the case of the Indian Air Force, for instance, currently the IAF is down to 30 fighter squadrons as against the authorised 42 squadrons. Going up to that level with the kind of defence budgets that can be expected is certain to be a challenging exercise. Meanwhile, as technologies advance, the need is also to move to newer generation aircrafts and weapon systems which naturally are more expensive too. Besides offensive platforms, the need for air defences is also on the rise and will have to be catered for from within the same frugal kitty. In fact, as future warfare trends bring in a greater role for drones, cyber warfare and precision guided munitions, the competition amongst platforms, systems and capabilities will only increase.

It is for this reason that India has not found it prudent to spend on a dedicated strategic bomber fleet. A mix of the existing and planned multi-role fighter bomber aircraft, as well as land-based ballistic missiles has been found to be adequate for projecting credible deterrence.

Benefits of multi-role aircrafts

The multi-role capabilities of modern attack aircraft have reduced the need for dedicated strategic bombers. Additionally, air to air refuelling has enabled enhancement of range to undertake deep strikes into adversary territory. In this context, India's fleet of *Mirage 2000*, *Su-30MKI* and now even the *Rafales* are IAF's options to deliver nuclear bombs inside adversary territory. The indigenously built *LCA Tejas* will also be available for this role in the coming years.

14. "[The future Air Force Northrop Grumman B-21 stealth strategic bomber will cost \\$203 billion over 30 years](#)", *Military Aerospace Electronics* (9 December 2021).



Mirage 2000H from IAF No 1st Squadron.

© "[L'Indian Air Force acte la fin du Mirage 2000 pour l'horizon 2030-2032](#)," *Avions légendaires* (20 July 2022).

Enabled by aerial refuelling, this would suffice to reach strategic targets in Pakistan and China. Such aircraft would also enable negating the traditional vulnerability of large bombers to modern air defences and anti-access/area-denial strategies. Additionally, they would continue to offer the traditional advantages of air delivery of nuclear weapons, such as recall even after take-off, the ability to change course frequently thereby making targeting unpredictable, and using not just gravity bombs but also stand-off cruise missiles to counter air defences. However, it needs to be mentioned that India has not declared any of its cruise missiles, irrespective of their launch platform, for nuclear delivery role.

Availability of land-based ballistic missiles of varied ranges

Over the last decade and a half, India has invested in the development and gradual deployment of a number of land-based ballistic missiles of multiple ranges. Short range Prithvi and intermediate range Agni variants are already operational. The latter are rail and road mobile, solid-fuelled missiles. Graduating to the next level, long-range, canisterised Agni V missiles are in a process being tested for operational induction. Meanwhile, in the context of the sea-based leg of India's nuclear triad, *INS Arihant*, the indigenous SSBN, has marked the initiation of the journey. But an operational, credible sea-based deterrence requires a fleet of at least 4-5 SSBNs with the ability to carry SLBMs of longer ranges. What have been tested until now are the K-15 with a range of 700-750 km and the K-4 with a range of 2,000-2,500 km.¹⁵ But, the missile range will have to be enhanced to at least 5,000 km to remain away from

15. "[India Tests New Underwater Nuclear Missile](#)," *The Times of India* (26 March 2014).

the adversary while being able to hit targets whose loss would be deemed unacceptable by Beijing. This remains a work in progress.

Meanwhile, India has maintained a clear distinction of only designating its ballistic missiles as nuclear delivery platforms. The sub-sonic Nirbhay or the super-sonic Brahmos cruise missiles have not been designated for carrying nuclear warheads. Even though the Brahmos has been tested from *Su-30 MKI*, official statements do not attribute a nuclear role to them.¹⁶

Nature of India's nuclear deterrence

New Delhi has always maintained that nuclear weapons are not for war fighting. Their purpose is narrow and limited to safeguarding the country against nuclear coercion, blackmail or its possible use. This strategy seeks to deter nuclear use by conveying assured retaliation in response to a first use, irrespective of its yield or choice of target. For India, therefore, any use of the nuclear weapon would have strategic implications and would invoke a punitive response. The focus of the Indian nuclear arsenal has, therefore, remained on ensuring credibility through survivability of reliable delivery systems to mount necessary retaliation. Effective nuclear signaling must dispel any doubt in the mind of the adversary that he could get away with any kind of a nuclear misadventure without having to suffer the consequences of retaliation of the kind that would inflict unacceptable costs on him. For this reason, perhaps, India has not been fixated on counterforce nuclear targeting capabilities. Despite the high accuracy targeting available with its cruise missiles, these have not been designated for a nuclear role.

Basically, India needs a secure second-strike arsenal in the form of hardened storage sites, mobile launchers, deployment beyond the reach of hostile delivery systems, dispersion of the arsenal on a triad, and structured weapon release authority in order to guarantee an assured appropriate response facilitated through a robust Command, Control, Communication and Intelligence systems (C3I). Effective surveillance and early warning capabilities to acquire intelligence on adversary's force posture is also necessary to minimize risks of a miscalculated or inadvertent strike based on faulty intelligence or false alarms.

New Delhi should put its focus on building its own military strength (conventional and nuclear) and political influence, including through the use of its unique soft power appeal. While on the one hand, India must undertake conventional modernization to raise the nuclear threshold, on the other, it needs to enhance the credibility of own nuclear deterrence through a programme aimed at increasing the survivability of its nuclear forces. In view of the varied and complex nuclear threats that India faces, its relevant strategy must be able to find the right approach to stabilize the situation with Pakistan while avoiding getting into a messy and expensive arms race with China. This requires staying focused on certain necessary nuclear hardware while at the same time playing a sophisticated game of perception manipulation of the adversary.

16. "[Successful Firing of BrahMos Air Launched Missile from Su-30 MKI Aircraft](#)," Press Information Bureau, Ministry of Defence (22 May 2019).

4. Conclusion – Future Challenges and Way Ahead

As indicated in its doctrine, the IAF well recognises that, “*One of the important national military objectives is to prevent war through credible deterrence across the spectrum of conflict... The air-vector, which is the most flexible element of our nuclear deterrence, remains robust, ready and resilient.*”¹⁷ While strategic bombers could better assure aerial strategic targeting, India's multi-role fighters can effectively undertake the tasks too and the doctrine acknowledges that “*given the depth of such targets, coordinated planning, surprise, decoy, and deception is necessary to enhance mission success.*”

The IAF also realises that it must develop a ‘balanced air force’, which can carry out both strategic and tactical missions. Even a tactical fighter aircraft can well carry out a strategic role. Hence, the need for putting into place a dedicated strategic bomber fleet has been deemed unwarranted and unnecessary. While it may lead to a desirable force accretion, it is not an essential one, especially since India's nuclear threats are all in relatively close vicinity. The physical proximity, in fact, could make the bombers more vulnerable since their operating bases could be within range of strategic competitors aircraft. This would only make this leg of the triad, besides being expensive to build and maintain, most vulnerable too, including to fast improving air defences and electronic warfare capabilities. In the Indian threat landscape, missiles offer more cost – effective and credible delivery platforms owing to the speed at which they could travel. If these become hypersonic and manoeuvrable in the future and provide requisite ranges, they would offer better advantage of credible deterrence.

It would be most prudent for the IAF to continue with its envisaged acquisition plans centred around *Su-30*, *Rafales* and the AMCA (Advanced Multi-Role Combat Aircraft). Availability of these aircraft for multi role tasking, including being made available to SFC when necessary, should suffice as a credible deterrent. This will, of course, be supplemented with land and sea-based ballistic missiles of multiple ranges for nuclear targeting.

Nuclear deterrence is premised on the principle of assured retaliation. Accordingly, the credibility of India's deterrence demands focus on survivability of its nuclear forces. In this journey, India has to build at least 4-5 SSBNs with long range submarine launched ballistic missiles, a number of canisterised Agni V land-based missiles that could be effectively moved around on road for the purpose of deception and dispersal, and a redundant and robust command and control infrastructure. All of these are time and cost intensive enterprises. At this juncture, therefore, a move towards acquisition of strategic bombers with the attendant infrastructure for maintenance and operations could prove to be a distraction. As stated earlier in the paper, while it would always be good to have the bombers, it is not an essential component of India's nuclear deterrence. Its addition would be desirable, but its absence does not reduce India's projection of deterrence credibility.

17. *Doctrine of the Indian Air Force* (24 June 2022): 59.

Pakistan's Nuclear Journey, Doctrinal Evolution and the Future Challenges

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Introduction

Pakistan was a reluctant entrant in the nuclear field. It started its nuclear pursuit purely for peaceful purposes with the United States (U.S.) assistance. As a country with limited resources and political objectives, it could not afford to develop nuclear weapons and neither had the ambition to emerge as a regional hegemon. The 1965 war and subsequent 1971 war with India, where Pakistan had to bear its dismemberment, left a deep impact on the national leadership and the public. India's 1974 nuclear weapon test further reinforced the national resolve that Pakistan would have to build its own nuclear deterrent to deal with the existential challenge that it faced from the Indian side, and to restore the strategic balance in the region.

Despite extreme adversity, Pakistan was able to demonstrate its nuclear weapons capability in 1998 and managed to establish a nuclear command and control structure that brought all three strategic forces (land, air, sea) under the direct operational control of the National Command Authority (NCA).

Pakistan has not published its nuclear doctrine but has shared key elements of its nuclear policy that provide insight into its nuclear use policy. The primary aim is deterring a major war with India. With the introduction of new technologies and war fighting doctrine, Pakistan had to adjust its nuclear posture to a Full Spectrum Deterrence (FSD), which aims to cover the entire spectrum of threats posed by the adversary.

The role of Pakistan Air Force (PAF) in Pakistan's nuclear history has remained critical. Before Pakistan acquired missile delivery systems, it was the PAF that had the responsibility to deliver nuclear weapons. Over the past decades, the PAF has been successful in dealing with conventional as well as nuclear threats and has demonstrated its potential in various crises with India. This was particularly the case during the most recent one during the 2019 Balakot crisis, where it was able to not only launch a successful tit-for-tat kind of a surgical strike against India, but it also managed to shoot down two aircrafts of the Indian Air Force.

This paper aims to explain primary drivers behind Pakistan's nuclear pursuit and discuss its nuclear use policy, based on the statements made by senior leadership. It also discusses the role of PAF in the nuclear mission of the country, its strengths and achievements. The final part of the paper identifies major challenges that could adversely impact strategic stability in the region.

The Road to Nuclearization

Pakistan started its nuclear program in the 1950s to benefit from the peaceful applications of nuclear technology. As a newly created country with limited resources at its disposal for the scientific exploration, the pursuit for nuclear technology was considered a difficult task. However, it was made possible through President Eisenhower's 'Atoms for Peace' initiative that was launched in 1953 to help the developing countries to embark on this relatively new path that had many civilian applications besides the military uses.

The U.S. agreed to train several scientists in the field of nuclear technology who came back and laid the foundation of a national nuclear program. In 1965, the U.S. helped build a first research reactor which continues to remain in operation nowadays under the International Atomic Energy Agency (IAEA) safeguards after undergoing several upgrades.¹ Subsequently, Pakistan managed to build several power reactors with the help of Chinese assistance that are operating under the IAEA safeguards and providing energy for socio-economic development of the country.

The military application of nuclear technology was not considered a feasible option for a country that had limited resources and also because the national leadership had a misplaced confidence in the U.S. led security alliance, the Southeast Asia Treaty Organization (SEATO) that comprised the U.S., France, Great Britain, New Zealand, Australia, the Philippines, Thailand, and Pakistan.² A few voices who urged starting a nuclear weapons program, in response to the reports that India was on its way to build nuclear weapons,³ were silenced by President Ayub Khan and other cabinet members, as these were considered too expensive to build and maintain.

1. For more details see [Pakistan Nuclear Regulatory Authority \(PNRA\)](#).

2. [Southeast Asia Treaty Organization \(SEATO\)](#), 1954.

3. Z. Akram, *The Security Imperative: Pakistan's Nuclear Deterrence and Diplomacy* (Karachi: Paramount Books (Pvt.) Ltd, 2013): 25.

The 1965 war and the subsequent war of 1971 that led to Pakistan's dismemberment shattered the national leadership's trust in the U.S. led security alliances and emboldened the 'bomb lobby' led by Zulfikar Ali Bhutto. After taking over as President in 1972 and later as Prime Minister the following year, Bhutto gave a new direction to country's nuclear program. Acquisition of nuclear weapons became a national priority but there were not enough resources to pursue this capability due to the debacle where half of the country was lost in the 1971 war.

India's decision to test its first nuclear device in 1974, three years after its war with Pakistan, left no other option but to pursue nuclear weapons capability at all costs. Pakistan had hoped that the international community would intervene and admonish India for pushing the region towards the nuclear weapons path, but there was no serious condemnation of the Indian nuclear tests.⁴ Some of the western countries appeared encouraging India to build on its newly acquired capability and opted not to criticize India.

Realizing India's progress and boosted by the lack of international reactions, Islamabad was determined to accelerate its military nuclear program. All available human and material resources were diverted towards this purpose making the acquisition of the nuclear weapons a national obsession. For Pakistan, security was the main driver for shifting its orientation from the peaceful pursuit of nuclear technology towards the weapons path with a primary objective of restoring the strategic balance and to prevent the repetition of the 1971 debacle.

Contrary to the treatment meted out to India, Pakistan had to face hurdles from the very beginning because of the determination of Western countries not to encourage nuclear proliferation in the region. When India tested its nuclear weapon in 1974, Pakistan was punished as Canada decided to freeze nuclear cooperation with Pakistan. The Karachi Nuclear Power Plant (KANUPP-1) that was built with Canadian assistance became the first casualty of the Indian tests. Canada refused to supply nuclear fuel citing its apprehension that Pakistan might use the reactor for producing military grade plutonium as was done by India by extracting his radioactive metal from the Canadian supplied reactor (CIRUS) that allowed the test of a nuclear device in 1974.

To prevent Pakistan and India from developing nuclear weapons, the U.S. Congress adopted the Symington Amendment in 1976 and later in 1977 the Glenn Amendment that made it difficult for states that did not accept a full scope safeguards on their nuclear facilities to acquire U.S. security assistance.

These amendments affected Pakistan more as compared to India for its dependence on the U.S. assistance. But it did also help strengthen national resolve that if Pakistan had to survive in the region, it must build its own nuclear deterrence that could help restore the strategic balance between the two South Asian adversaries.

4. One of the explanations generally put forward from a legal point of view is that New Delhi had not signed the Non-Proliferation Treaty. India was therefore not in contravention of any international commitment.

Despite the sanctions, Pakistan managed to acquire fissile material through an alternate route of uranium enrichment by using the centrifuge technology. By early 1980s, Pakistan had acquired a modest nuclear capability and was able to conduct a 'Cold Test'⁵ on 11 March 1983.⁶ While it was pursuing its own nuclear weapons capability, Pakistan continued to offer several proposals that could have prevented the nuclearization of the region. These proposals were based on a realization that starting a nuclear arms race would be difficult to sustain and manage for both South Asian countries. Nevertheless, with India's refusal to engage in arms control measures and the failure of initiatives to improve bilateral relations (India and Pakistan signed a non-attack treaty on 31st December 1988 that is still valid today), Pakistan chose to continue its military program by all means. In March 1994, negotiations with Washington on non-proliferation issues led to Islamabad's refusal to freeze its nuclear program.

With India's decision to formally declare itself as a nuclear weapon state in 1998 after its second round of tests, Pakistan decided to test its devices and formally declare itself as a nuclear weapon state.

The Development of a Nuclear Management Structure

Before declaring itself as a nuclear weapon state in 1998, Pakistan did not have a formal nuclear command and control structure. The nuclear decision making was in the hands of a few and was deliberately kept lean to avoid unwanted leaks and scrutiny from within and outside the country. Since there were no other delivery systems in the form of land-based or air launched missiles, the Pakistan Air Force (PAF) was entrusted with the primary responsibility of delivering nuclear weapons. As a last resort, the PAF could use gravity bombs in the case there was a need to cross the nuclear threshold.

After becoming a declared nuclear weapon state in 1998, Pakistan moved swiftly and announced establishment of the National Command Authority (NCA). The NCA is a politico-military management structure with equal representation from the political and military leadership and is headed by the Prime Minister as the Chairman of the NCA.

The NCA comprises of two committees: the Employment Control Committee (ECC) and the Development Control Committee (DCC). The ECC is headed by the Foreign Minister as its Deputy Chairman. ECC is responsible for threat assessment, developing response options, and the employment and deployment of nuclear forces. ECC has three senior ministers as its members besides the foreign minister, who are the minister for Defence, for Finance and for Interior. Military members of the ECC include the Chairman of the Joint Chiefs of Staff Committee (CJCSC), the Chief of Army Staff (COAS), the Chief of Naval Staff (CNS) and the Chief of the Air Staff (CAS).

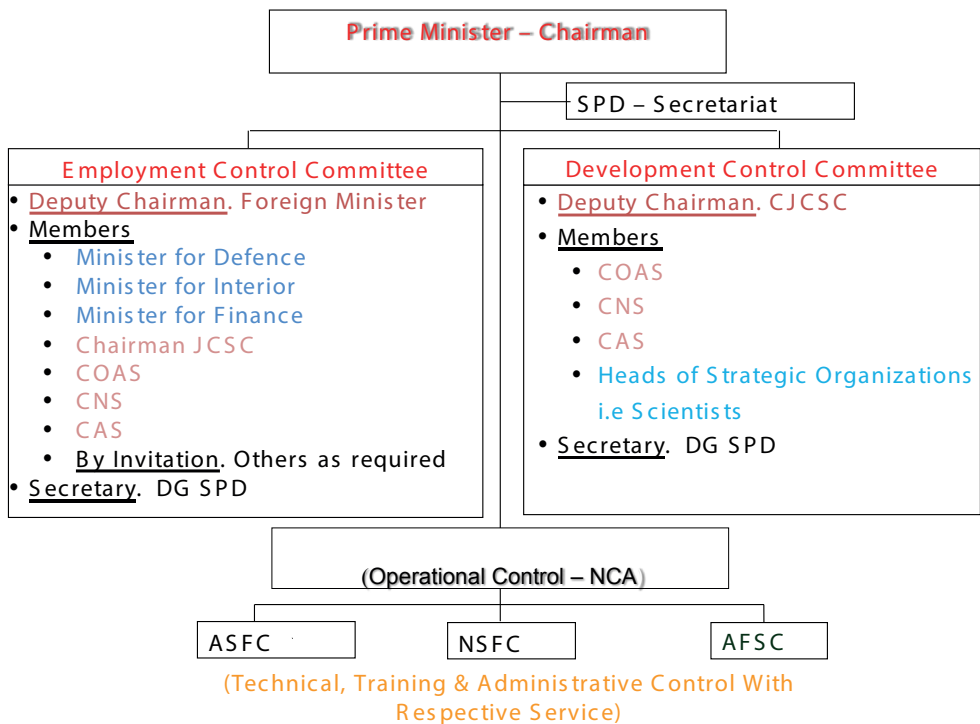
5. A Cold Test is intended to test the bomb design without using the fissile material.

6. F. H Khan, *Eating Grass: The Making of the Pakistani Bomb* (New Delhi: Cambridge University Press, 2013): 185.

The DCC is a military-technical body headed by the CJCSC as its Deputy Chairman. All three services chiefs and heads of various scientific organizations involved in development of the nuclear program are members of the DCC. DG Strategic Plans Division (SPD) acts as the Secretary of both the committees and is responsible to implement the decisions taken by the NCA.

Under the NCA, there are three separate strategic commands: the Army Strategic Forces Command (ASFC), the Naval Strategic Forces Command (NSFC), and the Air Force Strategic Command (AFSC). While they are administratively managed by their respective services, the operational control remains with the NCA. The deployment and employment authority of nuclear weapons for all three services rests with the NCA under the chairmanship of the Prime Minister.

ORGANIZATION OF NCA



Evolution of Pakistan's Nuclear Doctrine

There is not much known about Pakistan's nuclear posture during the pre-nuclearization period. This is understandable as the nuclear weapons program was being developed under secrecy. Only a select few had the knowledge about its progress and its objective. Few statements that came out from senior scientists and national leadership indicate that Pakistan had a very modest nuclear potential of building a basic nuclear device. It was intended to be used only under extreme circumstances, mainly to deter major military aggression coming from India.

Since Pakistan had no delivery systems in the form of ballistic or cruise missiles, the only means available were aircrafts. The role of PAF was therefore critical during the initial phase of nuclear planning. The employment of nuclear weapons mainly remained the preserve of the PAF during the pre-1998 period. After the 1998 nuclear tests, Pakistan moved swiftly to develop various delivery systems such as ballistic and cruise missiles, which eventually became a preferred choice for nuclear employment. The nuclear doctrine that initially revolved around aerial nuclear strikes became more diverse and integrated the ground and sea-based delivery platforms of various yields and ranges.

Pakistan has not published its nuclear doctrine and has preferred to maintain ambiguity about its nuclear use policy. From Pakistan's perspective, this helps to deter India's conventional as well as nuclear aggression, without having to compete for nuclear or conventional parity. This nevertheless does not mean that Pakistan has no nuclear use doctrine. Periodic statements made by senior officials over the past several years have consistently identified deterrence of aggression as the primary objective of Pakistan's nuclear capability, which is to be achieved by maintaining a 'credible minimum deterrence' posture.

The 'minimum', however, has not been quantified and remains a dynamic concept. It could vary depending upon the adversary's growth potential and what kind of technologies and war fighting doctrines are introduced by India to achieve its political objectives.

One of the very first articles that was published in October 1999 did provide some insight about Pakistan's initial nuclear thinking. The article was written by senior former officials, including former Foreign Minister Agha Shahi, former Foreign Secretary Abdul Sattar and retired Chief of the Air Staff Zulfikar Ali. It described 'deterrence' as the primary role of nuclear weapons for which a small arsenal was considered sufficient. According to these authors, Pakistan would not contemplate the use of nuclear weapons for war fighting or seek to develop capability for a pre-emptive strike.⁷

This was a modest start and in-line with the limited nuclear weapons potential that Pakistan had during the first few years after becoming a declared nuclear weapon state in 1998. Subsequently, as the weapons capability grew both in terms of numbers and variety, the role of nuclear weapons in Pakistan's national security also increased. Based on the statements by senior officials over the past two decades, the key elements of Pakistan's nuclear policy could be summed up as follow:⁸

- Pakistan will maintain a credible minimum deterrence (CMD) posture, but the 'minimum' is unquantifiable, and would remain dynamic to deal with emerging threats.
- The primary purpose of nuclear deterrence is to prevent a major war with India, both conventional as well as nuclear.

7. A. Shahi, Z. Khan, A. Sattar, "Securing Nuclear Peace," *The News* (5 October 1999).

8. Z. Akram, *op. cit.*, 182.

- Pakistan will not engage in an arms race, nor it seeks parity with India, but will continue to maintain sufficient conventional forces to deter conflict even at the lower rungs of the escalation ladder.
- Pakistan does not subscribe to the 'No First Use' (NFU) posture and wishes to maintain an adequate stockpile of weapons and delivery systems to ensure first and second strike capabilities.
- Pakistan will continue to maintain effective command and control, and the requisite measures for safety and security of its strategic assets.
- Pakistan will maintain a unilateral moratorium on nuclear testing and will not be the first to resume testing.
- It will continue to maintain strong control on the export of nuclear technology and materials.

These elements of Pakistan's nuclear policy have not changed much since. But with the emergence of new technologies and the introduction of new war fighting concepts by India, there have been some transformations that are often misconstrued as a shift in Islamabad's nuclear posture, which is not necessarily true.

The Transition to a Full Spectrum Deterrence (FSD) Posture

After the 1998 tests, both India and Pakistan realized that the existence of nuclear weapons made it difficult to engage in a major war with each other. This led to the start of a peace process in February 1999 where both sides recognized that "*the nuclear dimension of the security environment of the two countries adds to their responsibility for avoidance of conflict between the two countries.*"⁹ Both Prime Ministers in the 'Lahore Declaration' also agreed that they will take "*immediate steps for reducing the risk of accidental or unauthorized use of nuclear weapons and discuss concepts and doctrines with a view to elaborating measures for confidence building in the nuclear and conventional fields, aimed at prevention of conflict.*"¹⁰

While there was not much progress on the 1999 declaration, both countries found themselves embroiled in another military crisis later the same year. This was the first military crisis under nuclear shadow where Pakistan was alleged to have mobilized its missiles – notwithstanding the fact that it didn't have an operational missile delivery system at that time. Several analysts have attributed the crisis to the 'stability-instability' paradox, where stability at the strategic level could provide incentives for the adversaries to engage in a military conflict at the lower spectrum of the conflict, as was the case during the Kargil conflict.

The 1999 crisis brought focus on the nuclear employment preferences of both South Asian neighbours. India was in the process of debating its draft nuclear doctrine while Pakistan was trying to consolidate its nuclear deterrence by developing

9. "[The Lahore Declaration](#)," *United States Institute for Peace* (21 February 1999).

10. *Ibidem*.

missile delivery systems. The nuclear factor, if at all affected the outcome of the crisis, was indirect as it attracted the attention of major powers who helped diffuse the crisis from further escalation. There was no direct nuclear signalling from either side during this crisis.

Within a short period of two years, India and Pakistan were once again engaged in another serious military crisis that had the potential to escalate to a major war with the possibility of a nuclear exchange. The eight-month military stand-off in 2001-02 saw nuclear brinkmanship from both sides in the form of missile tests and threats being hurled against each other. This was the first classic example of nuclear deterrence in South Asia where Pakistan, despite being conventionally weaker, was able to deter a larger adversary from crossing the international border.

An important lesson learnt from the 2001-02 military crisis was that if India had to exploit its conventional superiority, it would need to reduce the mobilization time of its offensive forces from weeks to a few days. This led India to develop a new limited war fighting doctrine in 2004 that was initially labelled as the 'Cold Start Doctrine' (CSD) and later renamed 'Pro Active Operations strategy' (PAOs). As part of this doctrine, the offensive formations were reconfigured into smaller and more agile Integrated Battle Groups (IBGs) with an objective to launch an offensive across the international border in a time compressed environment of 72-96 hours.

Not responding to this new challenge would have discredited Pakistan's nuclear deterrence. At the same time, responding with strategic weapons against the major Indian cities could have been deemed as a disproportionate response. To deal with this 'credibility dilemma', Pakistan introduced its short-range ballistic missiles (SRBMs), also known as tactical nuclear weapons (TNWs) as part of what is now described as the Full Spectrum Deterrence (FSD) posture.

Introduced in 2011, the FSD was aimed at deterring a full spectrum of threats ranging from a limited to an all-out war with India. It was not a quantitative shift, but a qualitative response to deter India from contemplating even a limited war with Pakistan under a nuclear environment. The initial notion of FSD was to cover the entire spectrum of threats ranging from tactical, operational to the strategic levels. However, with the induction of new capabilities and new war fighting concepts, the FSD seems to have undergone significant transformation while remaining within the ambit of CMD.

Speaking at an event hosted by the International Institute for Strategic Studies (IISS), London, in Feb 2020, Lieutenant General (Retd.) Khalid Kidwai, who was the first Director General of the SPD and current Advisor to the NCA, and who is considered as the most authoritative source on Pakistan's doctrinal issues, had described FSD to be comprising "*a large variety of strategic, operational and tactical nuclear weapons, on land, air and sea, which are designed to comprehensively deter large-scale aggression against mainland Pakistan.*"¹¹ The main objective identified was deterring

11. "[Keynote address and the Discussion Session with Lieutenant General \(Retd\) Khalid Kidwai.](#)" *International Institute for Strategic Studies* (6 February 2020).

a ‘large-scale aggression’. However, in his most recent speech of May 2023 delivered on the 25th anniversary of the nuclear tests, Gen. Kidwai seemed to have expanded the scope of the FSD. According to him, the FSD consists horizontally of a “*robust tri-services inventory of a variety of nuclear weapons*” – a triad – and vertically “*the spectrum encapsulates adequate range coverage from 0 meter to 2,750 km...*,” including the potential to launch “counter-massive retaliation.”¹²

The reference to ‘0’ meter range attracted significant attention because of its potential implications for the regional deterrence equation. As such, it would have changed the role of nuclear weapons from ‘deterrence’ to nuclear warfighting. Some analysts, while drawing parallels to the Cold War thinking, alluded the possibility that Pakistan may be thinking of developing M-28/ M-29 Davy Crockett type recoil-less rifle system or deploying nuclear mines across the India-Pakistan border to deter India’s military operations or limited war fighting doctrines.¹³

This perception, nevertheless, was refuted through a tweet by one of the official thinks, where Gen Kidwai was quoted to have used the term ‘0 meter’ metaphorically, without any other interpretation.¹⁴

The Role of PAF in Nuclear Employment

During the initial years of its nuclear development, when Pakistan had not formally declared itself as a nuclear weapon state, it was the Pakistan Air Force (PAF) that was responsible for nuclear missions. Being a relatively smaller force compared to its adversary, the PAF had no dedicated squadrons or aircraft for nuclear delivery missions. Only select aircrew with limited knowledge of Pakistan’s nuclear capability were assigned the task of preparing themselves for nuclear missions in the case of a conflict with India. This was intended to maintain secrecy and avoid bringing unnecessary focus on the nuclear weapons program, especially during the covert period of its development.

The aircraft that were integrated in the nuclear planning missions were mainly French built *Mirage V/ IIIs* and the Chinese *A-5* aircraft.

12. “[Speech by Lt. Gen. \(Retd\) Khalid Kidwai, Advisor, National Command Authority and former DG SPD, on 25th Youme-e-Takbeer](#),” *Institute of Strategic Studies Islamabad* (26 May 2023).

13. S. Noor, “[Did Pakistan Just Overhaul Its Nuclear Doctrine](#),” *Foreign Policy* (19 June 2023).

<https://foreignpolicy.com/2023/06/19/pakistan-india-nuclear-weapons-zero-range-cold-start-doctrine/>

14. [Tweet](#), Centre for International Strategic Studies Sind (13 July 2023).



Mirage III/V from the No. 8 Squadron PAF.

Source: “[Pakistan intends to buy from Egypt a batch of decommissioned Mirage-5 fighters,](#)” *Top War* (06 September 2019).



A-5 from the No. 26 Squadron PAF.

Source: “[Nanchang A-5C Ground Attack Aircraft,](#)” *Aircraft of the Pakistan Air Force.*

There is ambiguity about the role of *F-16* aircrafts due to the restrictions on U.S.-made origin platforms used in nuclear delivery missions. Nevertheless, if the situation warranted, it would have been very difficult to restrain Pakistan from employing these aircraft for its national security needs.



F-16 AM from the No. 9 Squadron PAF.

Source: A. Shamim, "[US To Deliver 10 Refurbished F-16s to Pakistan](#)," *F-16.Net* (04 June 2008).

After phasing out the *A-5* aircraft, the nuclear role has been assigned to the *JF-17* aircraft that have been built jointly with Chinese assistance. This platform has the capability to carry at least one nuclear-armed 'Raad' air launched cruise missile (ALCM). The *Raad* missile initially had a range of 350 km. But in 2020, the PAF test-fired another version of the missile (*Raad-II*) that had an extended range of 600 km and can be used against land and sea-based targets. There are also reports that the missile is being made compacter in order to be carried out under each wing and become compatible for other platforms that Pakistan may acquire once the older *Mirages* are phased out from the service.¹⁵ The reduced radar cross section area of *Raad-II* also makes it difficult to be detected by India's missile defense system. It is also viewed as complimenting Pakistan's FSD posture as it provides more flexibility in targeting which seems to be one of the objectives identified by Pakistan's senior military planners.¹⁶

The Air Force Strategic Command (AFSC) is the oldest amongst the three services and was already operational when the other two were still in the process of developing their capabilities and respective strategic commands. After the formal

15. "[The Future of Pakistan's Airborne Nuclear Deterrence](#)," *Defence News & Analysis Group* (8 November 2020).

16. S. Ali, Z. Jaffery, "[The Ra'ad II and Pakistan's Full Spectrum Deterrence](#)," *South Asian Voices* (31 March 2022).

announcement of the NCA in 2000, operational control of the AFSC was placed under the NCA as was the case for the other two services, while administratively still managed by the PAF.

There is no published data that could identify the role of the three strategic commands and the number of warheads assigned for each service. According to the 2023 estimates published by the Bulletin of Atomic Scientists, Pakistan may have built a stockpile of approximately 170 warheads, which includes 36 warheads reserved for the Raad ALCM. These weapons, according to the report, could be delivered from the French built *Mirage III/ V* aircraft or the *JF-17* aircraft.¹⁷

Looking at the inventory and the development patterns, the ground-based delivery systems seem to be the preferred choice for Pakistan to deliver nuclear weapons. But the inherent flexibility of air power, and the difficulty in detecting submerged platforms make the air and sea-based capabilities equally important for ensuring the credibility of the country's nuclear deterrence.

The estimates about the total number of nuclear warheads that Pakistan possesses and how many are dedicated for each strategic force command are not publicly known. There is however a constant pattern in most such analyses that Pakistan's nuclear weapons are generally projected to be 5 to 10 weapons ahead of India, notwithstanding the fact that India started its fissile material production much earlier and has a greater number of nuclear facilities dedicated for military purposes only.

Strengths and Weaknesses of Pakistan Air Force

PAF is a relatively small force compared to its Indian adversary. But this is not the only factor to evaluate its operational effectiveness. Besides the quantity, the quality of platforms, the employment concepts, how well is the integration with ground and other airborne systems, training and morale, and the past performance during crises are all important elements that could help distinguish one force from another.

From its inception, PAF had maintained mostly western-made platforms that were considered superior to Soviet origin aircrafts that formed most part of the IAF inventory. The U.S. supplied *F-86s* established PAF's credentials during the first major war with India in 1965 that eventually led to a stalemate with both sides claiming victory. Notwithstanding the conflicting claims from both sides, the role of PAF was crucial in the 1965 war as it was able to cause significant losses to a numerically superior adversary.

Subsequently, the French *Mirages* and the U.S. supplied *F-16s* became the mainstay of PAF as it provided qualitative edge over India. After the Cold War, India's preference towards western platforms and Pakistan's difficulty to acquire more advanced aircraft due to political and economic constraints forced Islamabad to shift towards Chinese weapon systems. These included *F-7P* that were subsequently replaced by more able *JF-17* aircraft jointly manufactured between Pakistan and China.

17. H. M. Kristensen, M. Korda, E. Johns, "[Pakistan nuclear weapons, 2023](#)," *Bulletin of Atomic Scientists* (11 September 2023).



JF-17 from the No. 26 Squadron PAF.

Source: "Thunderbird! Pakistan's JF-17, Ten Years On," *Livefist* (14 June 2017).

The Future Challenges

The changing geo-political preferences of the U.S. and its western allies have a direct bearing on the South Asian security environment. As part of the U.S. led efforts to contain China, India is being helped by several western powers to build its conventional as well as nuclear capability. The India-U.S. strategic partnership that stems from the Next Steps in Strategic Partnership (NSSP) framework of 2004, includes collaboration between the two countries in nuclear, conventional military, high-end technologies including the aerospace, artificial intelligence, cyber, *etc.* Similarly, other countries afraid of China's rise are helping India for their own political and commercial interests that have a direct bearing on the South Asian strategic stability. Some of the major factors that could adversely impact regional stability are discussed briefly here.

1. India-U.S. Nuclear Cooperation Agreement. In 2008, India and the U.S. agreed to establish a civil nuclear cooperation agreement that allowed the former to keep at least eight nuclear facilities outside the International Atomic Energy Agency (IAEA) safeguards for military purposes.¹⁸ This has helped India to use its domestic uranium reserves purely for military purposes while the requirements for the power plants would be served from foreign supplies. This has significantly enhanced India's bomb making potential. India is also building fissile material production facil-

18. S. Squassoni, "[India's Nuclear Separation Plan: Issues and Views](#)," *Report*, Congressional Research Service (22 December 2006).

ities that it claims are mainly for fuelling its nuclear-powered submarines. But there is no restriction that could prevent it from using these for the weapons purposes as these are kept outside the IAEA safeguards.¹⁹ The resultant imbalance because of this nuclear cooperation agreement would have an adverse impact on Pakistan's future strategic thinking forcing it to increase its nuclear potential.

2. U.S.-India Foundational Agreements. In 2020, India and the U.S. signed last of the four foundational agreements as the Basic Exchange and Cooperation Agreement (BECA). It will enable India to access classified real-time signal intelligence (SIGINT) from U.S. owned satellite network. Earlier, the U.S. and India had also signed agreements that included the General Security of Military Information Agreement (GSOMIA), the Logistics Exchange Memorandum Agreement (LEMOA), and the Communications Compatibility and Security Agreement (COMCASSA). These agreements are likely to improve India's situational awareness for planning conventional as well as nuclear strikes, especially taking into consideration the fact that India is developing hypersonic weapons with greater precision for possible counterforce strikes against Pakistan.

3. Second-Strike Capability. As part of their respective doctrines, India and Pakistan are developing second strike capabilities, which would require acquisition of nuclear capable submarines. India has already demonstrated its potential and is in the process of operationalizing its first nuclear powered submarine *Arihant*, and is likely to build a number of similar platforms in the future. Pakistan, on the other hand, is still in the process of building the third leg of the 'triad'. Unless both sides acquire a credible second-strike capability, which is considered essential for mutual vulnerability, there would always be a risk of deterrence breakdown.

4. Anti-Ballistic Missile Systems. India is also in the process of developing its indigenous anti-ballistic missile systems besides acquiring S-400 from Russia. Notwithstanding the limited efficacy of these systems in a particular India-Pakistan security environment due to a very short reaction time of a few minutes, the deployment of such systems is likely to create instability as it could incentivize the possessor to launch an offensive strike against the other. To deal with this relatively new challenge, Pakistan has introduced its cruise missiles and is in the process of testing MIRVs missiles that could evade the ABM system of the adversary.

5. Militarization of Space. In 2019 India tested its anti-satellite weapon by shooting down one of its own satellites in low earth orbit. Besides creating significant debris, the test was seen as destabilizing as it could encourage other countries to build their own capabilities in this domain, primarily to deter others from targeting their own satellites. This could trigger a new competition leading to the militarization of space.

6. Doctrinal Shift in India. India's nuclear doctrine of 2004 provided a conditional assurance that it will not be the first to use nuclear weapons, unless attacked

19. A. Levy, "[India is Building a Top-Secret Nuclear City to Produce Thermonuclear Weapons, Experts Say](#)," *Foreign Policy* (16 December 2015).

by chemical and biological weapons. This caveat had diluted India's NFU commitment, even though it continues to profess its NFU posture in order to establish its credentials of a responsible nuclear weapon state. More recently, several senior Indian decision makers have further diluted this commitment by advocating that New Delhi should revise its NFU stance against Pakistan. These developments are likely to impact Pakistan strategic thinking forcing the latter to look for remedial measures that could prevent India from embarking on such a strategy.

7. New Warfighting Doctrines. Besides the CSD and PAOs strategy, India attempted in 2019 an aerial surgical strike against Pakistan. This new doctrine apparently aims to take punitive measures against a nuclear weapon state but could lead to uncontrolled escalation resulting in a major war with the possibility of a nuclear exchange. The 2019 Balakot crisis is the most recent example where India had to face military failure at the hands of a relatively smaller air force that resulted into domestic backlash. To repair his damaged reputation, Prime Minister Modi hurled nuclear threats that could have further escalated the crisis if Pakistani leadership had not acted with restraint. PM Modi also stated that if India had French *Rafales*, the outcome of the brief conflict may have been different.²⁰ This statement was more likely intended to deflect the internal criticism within India. But with the growing tide of militant nationalism in India, where religion and nationalism are being used for domestic politics, there is a likelihood that a future crisis could escalate quickly and become uncontrollable due to the emotive nature of relations between the two countries. This could be a serious challenge for maintaining strategic stability in the future.

8. Growing Conventional Imbalance. India is spending around \$78 billion on its conventional defense; whereas Pakistan spends around \$12 billion to maintain some rough parity with its adversary. The growing imbalance in all four domains of warfare, *i.e.* land, air, sea and space would push Pakistan to increase its reliance on nuclear deterrence and lower the threshold for nuclear use.

9. Emerging Technologies and Strategic Stability in South Asia. The introduction and integration of new technologies, including the cyber, artificial intelligence, hypersonic weapons and several others, is likely to further complicate the regional security dynamics in South Asia. The use of unmanned combat aerial vehicles (UCAVs) with autonomous decision making is likely to bring new opportunities as well as challenges for air power employment in South Asia, since both India and Pakistan are in the process of developing some of these platforms. Similarly, the use of artificial intelligence for nuclear command and control can be both stabilizing as well as destabilizing. It is not yet clear how some of these technologies would be integrated and employed by all nuclear armed states and how it might impact deterrence dynamics in the future.

20. "Modi's Rafale statement ignores India's huge lead over Pakistani air power, say experts," *Scroll.in* (4 May 2019).

Conclusion. Pakistan's nuclear journey from its inception to becoming a declared nuclear weapon state was not smooth due to several internal and external challenges. Domestically, lack of human and financial resources, and political will during its inception were the major impediments during the early period. But as the nuclear weapons program progressed the external pressures and denial regimes became major hurdles that Pakistan had to navigate during the development of its nuclear weapons program.

From the very early start, the role of PAF had remained instrumental in operationalizing the nuclear weapons capability but it has not been well recognized for reasons of secrecy. While there exists plenty of literature on various missile systems that now form major component of Pakistan's nuclear program but not much is written about how PAF with its limited strength and capabilities was able to develop an operational capability to deliver nuclear weapons during the pre-1998 period, when Pakistan had not formally declared itself a nuclear weapon state. After the overt nuclearization, the role of PAF in nuclear delivery missions continues to remain critical for its inherent quality of agility and short reaction time.

AIR NUCLEAR COMPONENTS
Challenges

Doctrine: from the general concept to its use in nuclear deterrence

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The term “doctrine” is common to various fields: economics, philosophy, politics and, of course, the military. But what does “doctrine” truly mean? The etymology indicates that the Latin term *doctrina* refers to a certain form of “education”, a “culture” or even a “method”. At first glance, a doctrine might be viewed as a body of knowledge that could serve as a basis for teaching, or as a set of reference points for action in a specific field.

Nevertheless, this understanding of doctrine remains imprecise: how can we pinpoint this concept in relation to theory, ideology, dogma or, more broadly, systems of thought? Thus, it may be useful to start by building a precise definition of this term, which – in the military realm – exists alongside ideas such as “strategic vision” and “strategic concepts”.

This article will first attempt to clarify the ins and outs of the concept known as “doctrine”, so as to highlight its role in inspiring action. Secondly, we will focus on a particular form of doctrine: “nuclear doctrine”, which defines the role and the

“structural elements”¹ of nuclear deterrence. We shall attempt to show that this type of doctrine is in fact based on philosophical constants – in this case, on a utilitarian form of calculation – and that it accounts for certain specific features within the strategic cultures of so-called “nuclear” states.

I. The nature of a doctrine: definitions and distinctions

The definitional understanding of doctrine generally presents the concept as a summation. It can be likened to a “*set of principles, of statements*”, be they structured or merely listed (i.e. “*established as part of a system or not*”²). This set of principles offers a certain vision of a specific topic (e.g. “*the universe, human existence or society*”) and is accompanied by “*the formulation of thought models and rules of conduct for the field under consideration.*” In other words, doctrine exposes the representation of an idea, in order to inspire – and justify – an attitude or behaviour to be observed regarding our understanding of said idea.

Hence the more connotative meaning carried by the term “*doctrine*”, i.e. “*a specific, clearly and publicly defined position taken by a school of thought or an individual regarding a particular – generally delicate and controversial – issue.*” This definition may imply a certain form of rigidity, both because it establishes a clear-cut position and because it deals with a potentially divisive issue.

In his *Introduction à l'étude de la médecine expérimentale*, Claude Bernard³ aims to distinguish *theory* from *doctrine*:

*“Theory is a verified hypothesis [...]. Yet a theory, if it is to remain sound, must always be updated as science progresses. Were we to consider a theory as perfect and cease to verify it through daily scientific experimentation, it would become a doctrine [...], one which we believe is no longer required to be subjected to experimental verification.”*⁴

Theory is an intellectual construct that strives to provide an accurate account of a given phenomenon, based on observations of the latter’s workings. Yet, from a scientific – and perhaps epistemological – point of view, such accounts remain relative, “*which means that the mind is not averse to thinking that things may happen differently.*”⁵

How, then, can a theory be revised? The answer lies in real-world testing, which is the alpha and omega of any theory. A theory exists as soon as a phenomenon has become manifest, with sufficient recurrence that it arouses interest and calls to be studied. One must then attempt to build an explanatory model that can account for this phenomenon. Once drafted, this explanatory model – called a “theory” because it leads one to

1. See “[La dissuasion nucléaire française](#),” Official website of France’s Ministry for the Armed Forces.

2. According to France’s National Centre for Text and Lexical Resources ([CNRTL](#)).

3. Claude Bernard (1813-1878) was a French physician, epistemologist and science philosopher, considered one of the founding fathers (if not *the* founding father) of the experimental method.

4. C. Bernard, *Introduction à l'étude de la médecine expérimentale* (Paris: Delagrave, 1920): 349.

5. C. Bernard, *Principes de médecine expérimentale* (Paris: Presses universitaires de France, 1947): 263.

“contemplate” this phenomenon from a universal, and therefore abstract, standpoint – is put to the test in order to assess its relevance. This back-and-forth motion between the observed phenomenon and the explanatory process is the lifeblood of all scientists, as they strive to verify the relevance of their theories over time.

Claude Bernard also draws our attention to the possibility of a doctrine becoming dogma. Dogma refers to “*a point of doctrine established as fundamental, undisputed and certain.*”⁶ As such, a dogma holds authority in a given field and group. It is viewed as an essential truth – rightly or wrongly so – and thereby becomes the foundation of a construct, one that characterises the school of thought or institution in question.

Strictly speaking, the problem with *dogma* (which, etymologically, refers to a given *way of thinking* among others) is not so much the rigidity that may accompany it, but the possible gap between reality and the truth being claimed. In *Un certain 18 juin*, Maurice Schumann puts it bluntly: “*The invasion of Paris became an absurd hypothesis from the very moment that the Maginot Line’s impenetrability became a dogma.*”⁷ Securing solid foundations – or “*first principles*” as Descartes and Pascal called them – is the main priority for any school of thought that aims to achieve harmony with the object that it is seeking to explain or take position on.

Thus, in her *Lexique des sciences sociales* Madeleine Grawitz summarises that, “*while theory aims only to show (from the Greek *theorein*, to contemplate) and can be hypothetical, doctrine tends to convince and perhaps inspire practical conduct.*”⁸ The vocation of a doctrine is to gain support, in order to harmonise the modes of action derived from its precepts. Thus, it must be anchored in what Kant called a relevant and updated *Weltanschauung* (“worldview”) of the topic at hand.

As we can see, there are different ways of approaching and considering doctrine.

First of all, it can be seen as a teachable form of ideology. Maine de Biran explains how the concept of ideology can be viewed through a geographical metaphor. Picture the land being dotted with ideas instead of cities. These ideas lead to each other via road networks, *i.e.* theories. Ideology, then, is an overall view of the coherent structure formed by these idea networks across the land: “*All of these roads have an origin; most of them even start from a common point and then diverge; it is this origin, these commonalities – which are generally unknown to travellers – that the ideologist is primarily responsible for teaching.*”⁹ Doctrinal knowledge is therefore the key to understanding the intricacies of a territory by studying its primary axes. Despite being crucial for understanding, doctrine is also hindered by its inherent quality: it is fundamental in nature, as it forms the basis of our understanding, mak-

6. A. Gretillat, “[Le dogme grec](#),” *Revue de Théologie et de Philosophie et Compte-rendu des Principales Publications Scientifiques*, Vol. 26 (1893): 267-283 (269).

7. M. Schumann, *Un certain 18 juin* (Paris: Plon, 1989): 262.

8. M. Grawitz, *Lexique des sciences sociales* (Paris: Dalloz, 1991): 125.

9. P. Maine de Biran, “Mémoire sur les rapports de l’idéologie et des mathématiques,” in *Œuvres complètes – Tome III* (Paris: Vrin, 2000): 9.

ing it all the more difficult to bring into question. This potential hindrance is encapsulated in the idea of indoctrination, where a thought model ends up being imposed, at the risk of quashing all forms of thought outside of the dogma being professed.

On the other hand, a doctrine can also be used as a form of guideline; one that provides information on its own origins (where does this doctrine come from? How and why did it come into being?) and puts its own application into perspective (What does it lead to?), while exposing the elements that can be rethought in light of developments in the field at hand. This very concept can be found in document *FT-03*, by the Doctrine Centre for the Employment of the French Armed Forces, titled *L'emploi des forces terrestres dans les opérations*. This text is presented as a “doctrinal document”, in which the authors specify that:

*“Its content serves as a reference for land forces in training and operations, yet it is not prescriptive. Its use allows us to reconcile theoretical requirements, the reality of operations and the constraints of each situation. This doctrine is a guideline that preserves the freedom of action of the joint commander, who is responsible for organising forces during operations and for designing, directing and carrying out missions.”*¹⁰

The document goes on to conclude: “*Doctrine is alive. It also feeds on your reactions and suggestions.*” A reference is not necessarily a rule: it can inspire action without ordering it, thereby preserving “*the freedom of action of the joint commander,*” which is essential if decisions are to be made in accordance with the realities on the ground. This implies not setting the doctrine in stone, but allowing it to evolve in line with feedback on the one hand, and, on the other, learning to use it as a resource, to make it a means for positioning oneself in a given situation.

Nevertheless, these different understandings of doctrine converge on the idea that, once established, doctrine must give rise to concrete action in the decision-making process and be used to define modes of action. In the words of Roger Scruton: “*Doctrine is useless if it does not translate immediately into practice.*”¹¹

In his *Dictionary of Political Thought*, Scruton offers a semantic distinction between *politics* and *policy*, one that sheds light on a whole other facet of doctrine. *Policy*, he explains, refers to “*the general principles that guide the creation of laws, administration and executive acts of government in domestic and international affairs.*”¹² Scruton pinpoints three levels of action. The first and most theoretical (in the etymological sense of the word, *i.e.* the *contemplation* of ideas) of the three is philosophy. The second and more intermediate level is doctrine, which translates ideas into precepts. The third level is strategy (expressed here as *politics*), which endeavours to put these precepts into practice through decision-making, by interpreting the principles of doctrine in light of a given context.

10. “[FT-03. L'emploi des forces terrestres dans les opérations interarmées](#),” Doctrine Centre for the Employment of the French Armed Forces (2015 Edition, amended on 01 July 2015): 2.

11. R. Scruton, “Introduction: Philosophy, Policy and Doctrine”, in *The Meaning of Conservatism* (Basingstoke (Hampshire): Palgrave Macmillan, 2001): 2.

12. R. Scruton, *Dictionary of Political Thought* (London: Macmillan, 1983): 358.

For pedagogical purposes, one might draw a parallel between this trichotomy and the structure of morals. In the latter, the first level consists in values; the second, in the corpus of moral rules deduced from these values; and the third, in ethics, which aims to translate these rules into action – given that rules are not always directly applicable in context. For example: on the first level, integrity is a value – and more specifically, one of the core values of the Air Force. This value is defined by following through with one's commitments and behaving with honesty and respect. On the second level, this value is broken down into more precise moral precepts: cultivating a sense of responsibility, showing determination to remain reliable and demonstrating accountability for the success of one's missions. On the third and final level, one must adapt and apply these precepts to specific everyday situations. Thus, doctrine lies at the junction between thought and action, providing “*a set of well-founded beliefs and behaviours, ones that are commendable in virtue of their intrinsic qualities*,”¹³ Scruton adds.

It is therefore possible to define a political doctrine according to three major axes. First, the doctrine defines a certain area of action, based on the rational organisation of resources and stated objectives. Secondly, it devises an overall strategic plan, *i.e.* a general orientation for action, which then branches out into various processes. Finally, the doctrine rests upon the belief that its founding principles – and the precepts for action to which it gives rise – will allow effective results to be achieved.

II. The origins and specific features of nuclear doctrine: philosophy, concepts and grammar

The mere possession of nuclear weapons is not enough to deter a potential adversary, although the effects of nuclear weapons, since the bombing of Hiroshima and Nagasaki and the numerous tests carried out in the second half of the 20th century, are sufficiently well documented to inspire fear. On the topic of “*International relations during the Cold War*”, historian François Gaüzère-Mazauric points out that “[...] *when the two A-bombs were dropped on Hiroshima and Nagasaki on 6 and 9 August 1945, they were used not as tools of deterrence, but as lethal weapons* [...].” He goes on to stress that the Korean War highlighted the need for a discourse that frames the use of nuclear weapons.

In fact, according to François Gaüzère-Mazauric, “*these were times when deterrence doctrines had not yet been the subject of profound theoretical debate*.”¹⁴ Thus, on the one hand, General MacArthur was denied his request to wield and use such weapons in Korea and, on the other hand, China was never deterred from participating in the conflict in any way, despite being aware that the United States possessed nuclear power. This attitude gave substance to Mao Zedong's famous words, uttered a few years prior: “*The atomic weapon is a paper tiger used by American reactionaries in order to intimidate*.”¹⁵

13. *Ibidem*, 133.

14. F. Gaüzère-Mazauric (ed.), *Précis de géopolitique et de relations internationales* [Précis of geopolitics and international relations] (Paris: Éditions Ellipses, 2024).

15. Interview of Mao Zedong by American journalist Anna Louise Strong in August 1946.



General MacArthur at the Battle of Incheon (September 1950).

© W. Mayo, "[US Planned to A-Bomb N. Korea in 1950 War](#)," *B-29s over Korea*.

To achieve deterrence, it is therefore necessary to possess formidable and effective technical means (*i.e.* possessing weapons and being able to use them to penetrate enemy defences by ballistic or airborne means), but also – and perhaps above all – to articulate these means through *discourse* (in the Greek sense of *logos*, a rational construction). This discourse must be developed in such a way as to convey a concept for the weapon's use, and should express political determination to take action if circumstances so dictate. This is called a nuclear doctrine.

On 12 January 1954, a few months after the Korean Armistice, U.S. Secretary of State John Foster Dulles presented the first American nuclear doctrine, dubbed "*massive retaliation*". It stipulated that any attack on a NATO member country – whether conventional or not – would trigger massive and unrestrained nuclear retaliation.



President D. Eisenhower (left) and Secretary of State J. F. Dulles (right) in September 1953.
© A. Glass, "[Eisenhower expands nuclear arsenal, Oct. 30, 1953](#)," *Politico* (30 October 2018).

The asymmetrical nature of this posture is clearly based on nuclear superiority. What's more, the proclaimed systematic nature of this total nuclear response was not tied to a "threshold" beyond which the use of nuclear force might be envisaged, in other words "*the circumstances in which a state would use nuclear weapons*."¹⁶ From the moment one's competitors wield significant nuclear force and, more specifically, the capabilities to carry out two strikes, the doctrine launched by Dulles turns into the "nuclear first use" conundrum, *i.e.* the question of one's initiative to use nuclear weapons. This doctrine puts the state actor promoting it in a bind, both strategically and morally: in the event of a proven hostile act, they can either act on their word and risk spiralling towards "*mutually assured destruction*,"¹⁷ or they can refrain and allow the credibility of their deterrence doctrine to collapse.

In 1962, the McNamara doctrine introduced the principle of proportionality to the assessment of the state's response to aggression. Yet Georges Le Guelte notes that, as a consequence, this criteria "*made it possible – in certain circumstances – to actually use tactical nuclear devices on the battlefield*."¹⁸ Thus, the question of legitimacy arises regarding the use of nuclear weapons, including when the aggressor is not a nuclear state.

Doctrine allows for deterrence, in that it establishes the role of nuclear weapons – as well as their possible use – in defence policy and is communicated to the public. Developing such a doctrine also points to a will to make nuclear weapons a means of last resort, while reflecting strong determination to be consistent with doctrinal principles. Generally speaking, nuclear doctrines rest upon three pillars: philosophy, grammar and rhetoric.

16. B. Tertrais, *L'arme nucléaire* (Paris: Presses universitaires de France, 2008).

17. "Mutual Assured Destruction", also known as the MAD doctrine (as in "madness").

18. G. Le Guelte, "La nouvelle posture nucléaire américaine : révolution dans les concepts stratégiques?," *Revue internationale et stratégique*, Vol. 47 (2002): 67-74.

Philosophy

From a strictly lexical point of view, to “deter” is to divert someone from their intention to do something, to make them abandon a given disposition, to lead them to renounce certain possibilities. Consequently, the will to deter leads one to reflect upon the motives underlying a given action: what might motivate someone to act, and conversely, what might make them refrain from taking action? Here, the aim is to determine a “normative ethic” (*i.e.* a decision-making process), as explored by the utilitarian movement – and by philosopher Jeremy Bentham in particular. In his *Theory of Punishment and Reward* (1811), Bentham explains that to be deterred is to correlate one’s knowledge of a given threshold with the prospect of being punished for exceeding said threshold. This takes the form of a causal relationship: a given action exposes one to a given effect. As a result, “punishment” is all the more feared, as one realises that it can affect anyone – including oneself – and gives rise to the unbearable experience of punishment. Deterrence is based on a utilitarian calculation, wherein the prospect of gain is weighed against the prospect of loss: therefore, it calls upon an interest-based “moral” (*i.e.* a principle for action).

This infers a presupposition, according to which the most constant guideline for state actors is in fact a pragmatic form of rationality, as exposed in the neorealist paradigm of international relations theory, devised by Kenneth Waltz¹⁹: the anarchical nature of the international system (the state governs its citizens, but there are no regulatory bodies to govern the state) leads state actors to reason in terms of survival.

From a utilitarian perspective, if citizens are to reason as the state intends (*i.e.* “*I will remain within the law to avoid punishment*”), the reality of punishment must be proven and enforced. This, in fact, was the whole point of public executions: to show that warnings are followed by consequences.

Grammar

Thus, deterrent doctrines issue a utilitarian warning for potential competitors: by attacking a nation that bears nuclear weapons, there is infinitely more to lose than there is to gain. The aim here is to pre-emptively banish destructive decisions and to encourage a dialogue-based, negotiated approach to conflict. The roots of such doctrines are no less complex and stem from a particular form of “grammar”. Corentin Brustlein notes that “*the Berlin and Cuban crises marked the beginning of a transition towards a second age, marked by the codification of both the grammar of nuclear deterrence and the grammar of strategic balances.*”²⁰

19. See K. N. Waltz, *Theory of International Politics* (Reading (Massachusetts): Addison-Wesley Company, 1979).

20. See C. Brustlein, “Un ordre international contesté par des puissances nucléaires désinhibées,” in M. Rosselet (ed.), *Démocratie(s) et dissuasion* (Paris: Odile Jacob, 2024).



President Kennedy addressing the nation on October 22, 1962, during the Cuban missile crisis.

© “[John F. Kennedy. Cuban Missile Crisis Address to the Nation](#),” *American Rhetoric*.

“Grammar” is a collection of conventions and “rules that govern a given language and enable the formulation of statements that are recognised as correct by the speakers of that language.”²¹ By “grammar of deterrence” or “nuclear grammar”, we are referring to a form of language based on norms and codified through a certain number of concepts. This grammar is regularly reiterated and updated: it can be found in speeches on deterrence by French presidents, in the U.S. *Nuclear Posture Review*²² or in the *Basic Principles of State Policy of the Russian Federation*²³ – a decree issued by the President of the Russian Federation.

The utilitarian philosophy that forms the basis of this grammar is shared by several states, leading certain concepts to be widely used. Others, however, belong to a strategic culture that is specific to nuclear states. For example: President Macron mentioned the concept of “*absolutely unacceptable damage*” in his speech on 7 February 2020; the Russian Federation’s *Basic Principles* of 8 June 2020 mention “*guaranteed unacceptable damage*”; and finally, China has regularly brought up the concept of “*no first use*” in the past²⁴.

This grammar can also help promote a global strategic vision, including the place of deterrence within this framework. This was the case with the concept of “integrated deterrence” in the latest U.S. *Nuclear Posture Review*. The *National Security Strategy* document published by the White House in October 2022 bases its integrated deterrence principles on an assessment of the threat currently at hand: “More

21. Definition provided in [La nécessaire modernisation de la dissuasion nucléaire](#), French Senate Information Report No. 560 (2016-2017) by France’s Senate Foreign Affairs, Defense and Armed Forces Committee, submitted to the Presidency of the Senate on 23 May 2017: 11.

22. See U.S. Department of Defense, “[2022 Nuclear Posture Review](#).”

23. See Russian Ministry of Defense, “[Basic Principles of State Policy of the Russian Federation](#).”

24. Speech by Chinese Foreign Minister Wang Yi on 11 June 2021 at the Conference on Disarmament in Geneva.

capable competitors and new strategies of threatening behavior below and above the traditional threshold of conflict mean we cannot afford to rely solely on conventional forces and nuclear deterrence." It goes on to define the notion of "integrated" as "*the seamless combination of capabilities to convince potential adversaries that the costs of their hostile activities outweigh their benefits.*"²⁵ Yet the American grammar of deterrence is evolving, as it moves "*from the traditional two-part definition of deterrence (denial and retaliation) towards a three-part definition: denial, resilience and cost imposition,*"²⁶ as per Jean-Louis Lozier's analysis. From France's standpoint, former Commander of France's Strategic Air Forces General Mathe summarised the concepts of French deterrence grammar as being "*composed of five intangible rules: permanence, vital interests, unacceptable damage, strict sufficiency and national independence.*"²⁷

Rhetoric

The "grammatical" codification of a nuclear doctrine goes hand in hand with the art of reaffirming the latter's principles, while adapting to a constantly evolving strategic context that is also being analysed by other nuclear states. One might call this art form "rhetoric". The idea of "*vital interests of national security*", referred to in the American NPR, constitutes a rhetoric that remains purposefully vague. One's doctrine should, of course, be clear – in the name of "*the transparency and the trust we owe to the international community, which is part of our responsibilities as a "nuclear-weapon State" under the NPT,*"²⁸ as President Macron emphasised – yet without providing an exhaustive definition of the nature or scope of these fundamental "vital interests".

In order for potential competitors to heed the deterrent message, it must be sufficiently legible, while avoiding any clear-cut definitions of "vital interests", which would compromise the concept's flexibility. This particular rhetoric must include a degree of ambiguity, to avoid "*circumventing deterrence from below,*"²⁹ paradoxically, a too greater deal of precision regarding the nuclear threshold may inspire forms of aggression just below said threshold.

Since Russia's military aggression against Ukraine, a form of rhetoric that harnesses both the written definition and underlying meaning of nuclear doctrine has found its way into the media spotlight. As an example, on 27 February 2022, the

25. See "[National Security Strategy](#)," The White House (October 2022): 22.

26. See J.-L. Lozier, "[La dissuasion intégrée américaine : Pertinence et limites du concept](#)," *IFRI Briefings* (11 April 2023): 3.

27. P.-H. Mathe, "Dissuader, une singularité stratégique : conjoindre éthique de conviction et éthique de responsabilité, ou comment ne pas "condamner ce qui existe au nom de ce qui n'existe pas," in L. Matz, C. Trotoux (eds.), *Éthique de la puissance aérienne et de la maîtrise du domaine spatiale* (Paris: La documentation française, 2022): 33.

28. "Speech of the President of the Republic on the Defense and Deterrence Strategy," *Official website of the French Presidency* (2 February 2020).

29. France's Secretariat-General for National Defense and Security (SGDSN), "[National Strategic Review 2022](#)," (9 November 2022): §62, 20.

President of the Russian Federation went live on television to put his “deterrent force” on alert, while personalities with close ties to the government (but not involved in decision-making processes) spoke up to exacerbate the potential use of Russia’s nuclear option. This was then counterbalanced by additional official spokespersons, who said they were prepared for this eventuality, but mainly wished to avoid it.



President Putin on 27 February 2022, ordering his Minister of Defence and Chief of Staff to put the Russian Army’s deterrent forces on “*high combat alert*.”

© “[Poutine met en alerte la force de dissuasion nucléaire russe](#),” *Challenges* (27 February 2022).

Rhetoric is also the art of choosing terms, whether they be used or avoided: the position of a doctrine is determined through a form of rhetoric that puts significant emphasis on what it claims not to have said, on what it says differently, or even on what it no longer says. Following President Hollande’s speech on 19 February 2015, Bruno Tertrais noted that “*unlike his predecessor, Mr Hollande did not say that French deterrence was aimed at these centres of power “as a priority”*.” He added that “*this nuance is not insignificant*”, as it led to the conclusion “*that France has now renounced all forms of “demographic” planning*.”³⁰

Regardless of the field at hand, doctrine consists in a set of theoretical precepts that serve as a standard for action and teaching. We have attempted to show how doctrine lives at the crossroads between theory and practice, and how this type of posture requires one’s doctrine to remain “alive”, *i.e.* capable of evolving by integrating changes in context, so as to remain a reliable reference. The same applies to nuclear doctrine. “*In a changing world, nuclear deterrence cannot stand still*”: this phrase, uttered by former French President Sarkozy in his speech in Cherbourg on 21 March 2008, illustrates the “living” nature of deterrence doctrines. The constant reassessment of the strategic field and of its players’ behaviour leads us to perform certain analyses and define certain postures. This is the meaning of a deterrent doctrine; it translates – in prescriptive terms – the way nuclear states understand the use of deterrence.

30. B. Tertrais, “La dissuasion selon François Hollande : continuité, précisions et inflexions,” *Revue Défense Nationale*, No. 782 (2015): 23-27 (26).

Conventional and Nuclear Forces within the U.S. Strategic Debate

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The significant development of U.S. nuclear forces may seem *a priori* paradoxical, or at least unjustified. Given their privileged strategic position (bordered by two oceans, surrounded by weak neighbouring countries, and possessing overwhelming economic means and conventional military superiority), the United States have the option of settling for minimal nuclear capabilities to benefit from the essential advantages provided by nuclear deterrence: protection against invasion and conquest, and thereby preserving its territory and nation.¹

However, due to their history involving the strategic competition with the Soviet Union, and later, external security commitments and guarantees, and finally, to avoid any nuclear blackmail, no other state has been as determined to build a large number

1. It should now be pointed out that nuclear weapons can be used for different purposes by different states, depending on the political and strategic situation. For this thesis, see M. S. Bell, *Nuclear Reactions: How Nuclear-Armed States Behave* (Ithaca, Cornell University Press: 2021).

of atomic weapons associated with the most sophisticated delivery systems. These were designated to be used in relatively aggressive strategies. Simultaneously, the United States has endeavoured to deny other states the development of independent nuclear weapons capabilities.

Furthermore, the most dangerous nuclear crises involving the United States (the Korean War, the Berlin crises, and the Cuban missile crisis) have centred on political issues that remained non-existential for Washington. They could have likely been addressed with other diplomatic and military tools in a world without nuclear weapons – that is, if they had occurred at all.

It is therefore essential to understand the multiple strategic functions of the United States' nuclear policy. For Washington, this involves:²

- Deterring adversaries from attacking its homeland territory and its ally, even in geographically distant regions. The United States offers a security guarantee and/or extended deterrence to dozens of countries, which shapes their force posture.
- Dissuading Allies from acquiring their own independent nuclear forces. The United States have regularly threatened its Allies with various measures, ranging from withdrawal of support to sanctions – if they were to pursue such a path. This orientation is rarely discussed publicly due to the sensitive nature of controlling the ambitions of, otherwise, Allied countries.
- Deterring neutral and independent countries from acquiring their own nuclear forces.
- Reassuring Allies by affirming that they will neither be abandoned nor involved in a conflict they do not wish to participate in.
- Ensuring independent and neutral countries that the United States will strive to create an international environment that reduces the perceived need and appeal of independent nuclear weapons.
- Competing with an adversary and potentially gaining the upper hand without resorting to war. On multiple occasions, the United States has used its nuclear weapons as a means of coercion (Berlin crisis of 1948, Formosa Strait crises of 1954-1958, Middle East crises...).

These various missions sometimes create friction against each other, and their relative weight has evolved over time and circumstances. However, this multiplicity of objectives must require varied options to be accomplished. As will be elaborated later, nuclear capabilities alone, despite their exceptional nature, cannot suffice to conduct a comprehensive international policy. This premise is an important factor to consider as it determines the significance of analysing and understanding the relationships and articulations between nuclear and conventional forces in the con-

2. F. J. Gavin, "[Beyond Deterrence: U.S. Nuclear Statecraft Since 1945](#)," *Meeting the Challenges of the New Nuclear Age: U.S. and Russian Nuclear Concepts, Past and Present*, American Academy of Arts and Sciences (February 2018).

ception of the U.S. strategy. These links have significantly evolved in parallel with modifications and adjustments in nuclear doctrine. It then becomes apparent that nuclear strategy and capabilities influence the role assigned to conventional forces.

This nuclear strategy depends on the connection between three elements: strategic debate, doctrine, and the operational planning of a nuclear campaign. These elements were never harmonised during the Cold War, and it is likely that they continue to remain unharmonised today.

The strategic debate in the United States is of excellent calibre, supported by contributions from academics and high-level research centres. The freedom of tone is remarkable, allowing authors to openly criticise official policies and even at times, praised for doing so.³ Without specific access to operation details, the quality of this strategic debate is maintained for the simple reason that the basic information required for reasoning (for example, what is the flight time required for a ballistic missile to reach its target) is publicly available. Other precise data is classified as needed (for instance, can a Minuteman III missile fired from Warren Air Force Base in Wyoming destroy a missile silo at Aleysk in Russia?), but this information is mainly used for operational planning, not for developing and analysing the conceptual principles of defence policies.⁴ The vitality of the U.S. strategic debate has thus been maintained despite the highly debatable argument of operational secrecy.

The content of official doctrines has regularly benefited from the richness of this debate: doctrinal evolutions have often been intellectually conceptualised. However, during the Cold War, there was a gap between doctrine and operational planning due to the planners' reluctance to implement doctrinal evolutions. Conversely, political decision-makers were relatively reluctant regarding planning documents, which were often considered too rigid. Hence, the flexibility sought in nuclear strategy inevitably induced a divergence between doctrine and planning.

These elements, developed further on, demonstrate that the U.S. nuclear strategy is not a perfectly harmonised continuum, which, unfortunately, complicates its understanding. Moreover, to this tripartite non-alignment (debate-doctrine-planning) related to nuclear capabilities, one must add the dissonance concerning the role of conventional forces within or alongside the nuclear deterrence strategy. Indeed, in reflections and debates, the conventional component is thought to complement the nuclear dimension. It is also meant to avoid the intellectual and politico-military deadlock created by the hypothesis of a nuclear exchange. This would ultimately lead to mutual suicide. The challenge is thus to understand how and to what extent this articulation operates.

3. A recent case in point is the reaction of the USAF Chief of Staff, who publicly invited a colonel who had written several articles critical of the Air Force's human resources policy to join his team. General D. L. Goldfein, "[The Air Force Chief Responds: Keep Writing Col. 'Ned Stark', and Join My Team,](#)" *War on the Rocks* (21 August 2018).

4. H. Lin, *Cyber Threats and Nuclear Weapons* (Palo Alto, Stanford University Press: 2021).

This article therefore endeavours to offer an overview of U.S. strategic thinking on the nexus between conventional and nuclear means. Given the complexity and scope of the subject, it is impossible to provide a historical summary from 1945 and onwards. Too many nuances would be lost, and too many tensions in the debate-doctrine-planning triptych would have to be regrettably skipped over.

Instead, this article offers a review of the main doctrinal developments during the Cold War, to then dive deeper through three episodes in which the relationship between conventional and nuclear weapons was widely discussed in the United States. They correspond to the debate on the “nuclear revolution”; the management of escalation permeating U.S. reflection on (limited) nuclear warfare – as illustrated by the development of the “pentomic division”; and finally, the contemporary debates on conventional-nuclear integration in the “nuclear third age”. These examples will enable us to study the challenge of the articulation between these two strands: how does nuclear warfare reinforce conventional warfare through its “compensatory” effects and its exceptional nature; and how the conventional component complements nuclear strategy can – *theoretically* – provide a way out of a strategic impasse.

In short, this article examines how the connection and integration of nuclear and conventional forces attempt to address the great dilemma of U.S. security, as commonly stressed by Henry Kissinger. Namely, it is the realisation that we have become “*infinitely vulnerable and our rebellion against it.*”⁵

The Evolution of the U.S. Doctrine During the Cold War

Summarising in a few paragraphs the richness of the U.S. strategic debate on nuclear deterrence is a daunting task.⁶ This section first endeavours to recount the major stages of doctrinal evolution during the Cold War, demonstrating that it is particularly determined by the conjunction of the strategic context and the available technological means. It also illustrates how the articulation between nuclear and conventional means is a thread weaving through the debate.

Massive Retaliations

“Massive retaliation” embodies the first U.S. nuclear doctrine. It was theorised by Secretary of State John Foster Dulles in January 1954 and adopted by NATO in December of the same year. In the years following the end of World War II, Soviet military power far exceeded that of the United States in Europe, be it in manpower, vehicles, or equipment.⁷ However, Washington retained its numerical superiority in

5. H. Kissinger, *Nuclear weapons and foreign policy* (New York, Harper & Brothers, 1957): 17.

6. The reference summary is in L. Freedman and J. Michaels, *The Evolution of Nuclear Strategy*, 4th edition (Basingstoke: Palgrave, 2019). See also E. S. Edelman, “Nuclear Strategy in Theory and Practice: The Great Divergence,” in H. Brands (eds.), *The New Makers of Modern Strategy* (Princeton: Princeton University Press, 2023): 665-691.

7. According to Lord Ismay (NATO’s first Secretary General), in the early years of the Cold War, the USSR and its satellites fielded 175 divisions – compared with around thirty divisions for the Atlantic Alliance. See H. L. Ismay, NATO, *The First Five Years. 1949-1954* (Utrecht: NATO Publishing, 1954).

terms of nuclear weapons and even maintained this monopoly until 1949. Namely, this was when the Soviet Union joined the club of nuclear states.



Secretary of State John Foster Dulles (left) and President Dwight D. Eisenhower (right).

Source: "[John Foster Dulles, the Cold War architect](#)," *Acton Institute* (10 March 2020).

Massive retaliation guarantees that any act of aggression by the Soviet Union, regardless of its scale, would trigger an overwhelming nuclear response from the U.S.⁸ The Radford Plan, carved out by the Chief of Staff and advisor to President Dwight D. Eisenhower from 1953 to 1957, posits that the use of nuclear weapons may become necessary due to this conventional inferiority. The aim of the Alliance's conventional forces was to delay the Soviet advance. Washington thus succeeded in deterring any conflict in Europe despite the numerical inferiority of its conventional army at the time.

However, the launch of *Sputnik* in 1957 bore immediate consequences. The following year, analysts considered that the U.S. guarantee no longer reassured minds. Namely, the launch by the Soviets of their first *Sputnik* into outer space made the United States appear vulnerable to a Soviet thermonuclear attack.⁹ By the early 1960s, the USSR had then caught up and achieved near nuclear parity with the U.S.

8. In a speech to the Council on Foreign Relations on 12 January 1954, J. F. Dulles stated that local defences "*must be reinforced by the further deterrent of massive retaliatory power.*"

9. A. Wolfers, "[L'Europe et le bouclier de l'OTAN](#)," *Politique étrangère*, 23/5 (1958): 493.

An evolution of nuclear doctrine was therefore necessary. Moreover, even back in the late 1950s, Eisenhower's policies were already being criticised for their rigidity and inadequacy. These various elements were at the heart of what was then to be called "*mutual assured destruction*" (MAD).

Mutual Assured Destruction

The evolution of the Soviet nuclear arsenal and the increasingly parity-based relationship at the strategic level, then coupled with the capability tandem between the intercontinental ballistic missile and the atomic weapon, subsequently created a new situation.

From a technological point of view, the introduction of nuclear-powered ballistic missile submarines in 1960,¹⁰ and the testing of multiple independently-targetable reentry vehicles (MIRVs) from 1968 and onwards, strengthened these nuclear capabilities. Namely, the unitary destructive power of these weapons increased massively and reciprocally.

Of notable interest is that it is virtually impossible to eliminate all nuclear-powered ballistic missile submarines. MIRVed nuclear warheads can therefore still be launched from the sea, specifically as retaliation after a first nuclear attack. The probability of it destroying its targets is relatively high due to the lack of credible missile defences that could counteract the saturation induced by MIRVs. In this configuration, no power can destroy another without a retaliatory nuclear strike being launched. Nuclear war thus moved away from the concept of "victory" towards a situation of "mutual suicide."

As a result, nuclear doctrine and thinking then naturally advanced into the realm of possibility for a mutually assured destruction. This became an increasingly certain eventuality should there be an uncontrolled escalation. U.S. security now depended on the stability of the U.S.-Soviet strategic relationship. Offensive strategic parity was hence encouraged.

This MAD was the most enduring nuclear doctrine during the Cold War, lasting from the end of the 1960s until 1991. More than a doctrine, it is sometimes analysed as a *situation*¹¹ – or even a nuclear structure – which conditions strategic relations between atomic powers. This was due to the risks of escalation to the extremes, despite the emphasis of a doctrine on "graduated" or "limited" response. In other words, MAD would not just be a strategy adopted by a State or a decision-maker: it would be an inescapable state of affairs for any nuclear escalation. Subsequently, whether a posture was chosen based on massive retaliation or a graduated response, the escalation and uncertainty inherent in the nuclear domain would have led to

10. The first U.S. SSBN of the *George Washington* class became fully operational on 20 July 1960 with the successful launch of its first missiles.

11. M. S. Bell (*op. cit.*) refers to it as a "situation". For an analysis of MAD as a strategy and structure, see S. J. Cimbala, "[Forever MAD: Essence and Attributes](#)," *Armed Forces & Society*, 12/1 (1985): 95-107.

mutually assured destruction. Herein emerges what can be determined as the value of integrating the conventional aspect into the strategic and deterrent dialectics. This would then be aimed at avoiding the prospect of shared suicide.

While nuclear strategic doctrines evolved, the implementation plans prepared within the Single Integrated Operational Plan (SIOP) seemed more rigid.¹² There was an ever-widening gap between the political guidelines issued by the White House and the strikes envisaged in this document. One of the central problems was the dialectical inflation between the number of targets and capability modernisations: the greater the number of targets in the SIOP, the more warheads were planned. Similarly, the more available warheads increased, the more targets were added. From the John F. Kennedy/Robert McNamara era onwards, presidents and defence secretaries were systematically disconcerted by SIOP presentations. This involved the suggestion of extreme levels of overkill, assigning a significant number of nuclear warheads to a single target. For example, at the time, planning astoundingly witnessed decrees to strike Moscow by no fewer than 689 nuclear warheads – many of which being megaton-class ones.¹³

At the politico-strategic level, the SIOP seems ultimately unsuited to any nuclear dialectic. In particular, its agenda was not suited to the McNamara doctrine of “flexible response”, which called for further nuance. The objective was then to introduce a wider range of options than those provided for in the nuclear employment and targeting plans.

Indeed, in the early 1960s, the new “flexible response” strategy – based on tactical or strategic nuclear options and the mobilisation of conventional means – became more attractive to military planners and political decision-makers. This doctrine was designed to deter conventional aggressions, including guerrilla warfare.¹⁴ The approach required strengthened conventional forces, as well as enhanced and diversified nuclear forces to theoretically make its objectives credible. This could not have been done previously with the massive retaliation strategy.

The major difference between the two theories might have lied in the predominance of the conventional component: massive retaliation is based on large-scale nuclear strikes, while flexible response integrates limited conventional (or nuclear) strikes. The idea is to be able to respond to aggressions across the conflict spectrum without automatically feeding into an escalation towards a globalised nuclear war. It envisioned the use of newly created special forces units for training, advising, and unconventional combat operations in proxy wars at the lower end of the spectrum. Conversely, the use of nuclear weapons launched by missiles and bombers was reserved for the higher end of the spectrum.

12. F. Kaplan, *The Bomb: Presidents, Generals, and the Secret History of Nuclear War* (New York: Simon & Schuster, 2020). The SIOP is a document that defines the strategy for using and targeting U.S. nuclear weapons in the event of a nuclear conflict.

13. See *ibidem*, 187.

14. A. L. Ross, “The origins of Limited Nuclear War Theory,” in J. Larsen, K. M. Kartchner (eds.), *On Limited Nuclear War in the 21st Century* (Palo Alto: Stanford University Press, 2014): 21-48.

The challenge was both technological and political. Planning had to be less rigid and be able to adapt to new technologies (such as the possibility of striking moving targets). Furthermore, the posture of extended deterrence towards Washington's Allies, *i.e.* the U.S. nuclear umbrella, had to become credible enough without automatically leading to the destruction of the United States.

In subsequence, the Nixon and Ford administrations then became the first to seek options within the framework of a so-called "limited" nuclear conflict.¹⁵ However, it was not until the end of the Reagan administration that the SIOP's target inflation ended, and significant flexibility was introduced thanks to efforts by Defence Secretary Richard Cheney. He emphasised the need for technologically advanced conventional forces with chemical and tactical nuclear capabilities. Politically speaking, these options needed to be designed flexibly and independently – as in independently of third parties – while being more oriented towards protecting access to critical resources. This would have been in the place of a strategic perspective *vis-à-vis* the Soviet Union.¹⁶

The divergence between doctrine and nuclear planning ultimately remained constant. Doctrine seemed to have sought to grant greater importance to limited options, such as tactical nuclear or conventional means. Moreover, a third dimension was then added to this dissension: the U.S. strategic debate. Academic discussions then focused on the role of nuclear power within international policy and on the possible linkage between conventional and nuclear domains.

U.S. Strategic Thinking and Nuclear-Conventional Nexus

A fundamental debate quickly emerged on the nature of nuclear weapons, the transformation of the nature of the conflicts they provoked and the exceptionality of the nuclear domain compared with the conventional one. The first two generations of U.S. strategists working on the subject (Bernard Brodie, Thomas Schelling, Glenn Snyder, Robert Jervis, to list a few) associated nuclear weapons with a profound change. They gradually sketched the outlines of the existence of a "nuclear revolution"¹⁷.

A New Era of Inter-state Relations

The impossibility of achieving a military victory when both parties have secure second-strike capabilities is fundamental to this hypothesis. The situation of MAD, as described above, then prevails. Once this mutual vulnerability is reached, the risks of retaliation and the impossibility of preventing it render any search for advantage futile

15. J. A. Larsen, K. M. Kartchner (eds.), *op. cit.*, 55.

16. R. B. Cheney, T. N. Harvey, "Strategic Underpinnings of a Future Force," *Military Review* (October 1986).

17. B. Brodie (eds.), *The Absolute Weapon: Atomic Power and World Order* (New York: Harcourt, Brace and Co., 1946); T. C. Schelling, *Arms and Influence* (New Haven: Yale University Press, 1966); R. Jervis, *The Illogic of American Nuclear Strategy* (Ithaca: Cornell University Press, 1984); and R. Jervis, *The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon* (Ithaca: Cornell University Press, 1989). For an intellectual history of thinkers on nuclear deterrence, see F. Kaplan, *The Wizards of Armageddon* (Palo Alto: Stanford University Press, 1983).

for both parties. One of the axioms of deterrence can be stated as follows: in the event of an attack, the costs will outweigh the potential benefits that could be obtained.

Moreover, the balance of will strongly favours the defender of the *status quo*. In a nuclear world, the party that seeks to prevent any change in the situation by possessing nuclear weapons generally succeeds because of its adversary's fear of crossing a "red line". This is the reverse process in the conventional world, where the party with greater capabilities (military, economic, technological, *etc.*) will *a priori* have the upper hand over its opponent – that is, even if the latter has greater willpower. This fundamental idea, developed in 1946 by Bernard Brodie in the United States, was first put forward in 1945 by French Admiral Raoul Castex, who wrote about how this consideration of numbers weighs very little when it comes to machines of such great individual power.¹⁸ It was then taken up, summarised, and democratised in France by General Pierre Marie Gallois under the formula of the "*equalising power of the atom*."¹⁹

Several consequences from this could be drawn. The first is that it is unlikely that nuclear-armed states would fight each other. In his seminal work, *The Absolute Weapon*, Bernard Brodie formulates the importance and necessity of exercising caution between nuclear-armed states at the dawn of the nuclear age. This idea was found in all academic variants of the nuclear revolution. It was also examined in recent statistical analyses of nuclear weapons and conflicts and is well known to national security policymakers. From this assertion flow two sub-hypotheses: the first, narrower hypothesis is according to which nuclear deterrence can only deter nuclear strikes; the second and broader hypothesis is according to which nuclear-armed states generally avoid conflicts.²⁰

Another consequence that can be drawn from the atom's equalising power is that the impossibility of achieving a military victory could ultimately grant advantages in terms of international security. It would reduce the arms race, the incentives for pre-emptive wars, as well as the risk of other states acquiring nuclear weapons.

Indeed, the arms race is becoming problematic: possessing conventional or nuclear quantitative superiority is no longer synonymous with military victory against a nuclear-armed state. Furthermore, nuclear-armed states no longer need to launch preemptive attacks to counter any military disadvantage, since the atom evens out the balance of power. However, this second point can be put into perspective in the event of suspicion of a nuclear programme, where pre-emptive strikes can be carried out against a programme under development (for example, the 2007 Israeli operation against a Syrian reactor under construction). Finally, the impossibility of winning could discourage the quest for nuclear weapons. The issues and consequences of

18. R. Castex, "[Aperçus sur la bombe atomique](#)," *Revue de Défense Nationale*, no. 17 (October 1945).

19. P. M. Gallois, *Stratégie de l'âge nucléaire*, Preface by Raymond Aron (Paris: Calmann-Lévy, 1960). See also Colonel Gallois's thesis, defended in September 1954 as part of his year's training at the *École Supérieure de Guerre Aérienne* (Superior School of Aerial Warfare), reproduced in this issue.

20. P. C. Avey, "MAD and Taboo: U.S. Expert Views on Nuclear Deterrence, Coercion, and Non-Use Norms," *Foreign Policy Analysis*, 17/2 (2021): 1-14.

nuclear proliferation are nevertheless the source of lively controversy, such as that between Kenneth Waltz and Scott Sagan.²¹ The potential instability created by the process of nuclear proliferation remains highly debated today.

The “Nuclear Counter-revolution”

Broadly speaking, the elements outlined above form the basis of the idea of a “nuclear revolution” and the “exceptionality” of nuclear power. However, a number of authors question this latter aspect. The common point of their critiques is that states have good strategic reasons to pursue policies that do not align with the theses of the nuclear revolution.²²

Firstly, innovation can weaken mutual vulnerability. During the Cold War, the survivability of nuclear weapons systems varied over time between the superpowers and via different processes. For example, the introduction of early warning radars and the dispersal of facilities (Wohlstetter recommendations of 1952) or the development of active defence (anti-aircraft batteries and missile defence), particularly by the Soviet Union in the 1980s,²³ had altered the credibility of certain capabilities, such as gravity bombs.

Technological advances in weapon precision (including conventional), detection, data processing, communications, and artificial intelligence are gradually eroding the foundations of the nuclear revolution. These improvements enhance the capabilities of nuclear or conventional platforms and their ability to destroy an adversary’s nuclear forces with a first strike. Of course, a strike to disarm or limit damage would be neither easy nor attractive. Nevertheless, the evolution of technology may allow one of the parties to risk war if it believes that the political stakes are essential and that it can win.

In this sense, the more technology advances, the less mutual vulnerability is considered a unanimous constant within the strategic debate. The SIOP is increasingly relegated to an auxiliary role in favour of a more flexible approach that envisages targeting mobile military objectives, as well as political and economic ones via limited strikes. The idea is to consider the conduct and victory of a nuclear war should deterrence fail. This victory would be possible without total annihilation thanks to technological advances, and would end with a negotiation between the two superpowers.²⁴

On the basis of this premise, certain specialists advocated for what came to be known as the “nuclear victory” theory, on the additional grounds that the Soviets ac-

21. S. D. Sagan, K. N. Waltz, *The spread of nuclear weapons: an enduring debate*, 3rd edition (New York: W. W. Norton, 2013).

22. K. A. Lieber, D. G. Press, *The Myth of the Nuclear Revolution: Power Politics in the Atomic Age* (Ithaca: Cornell University Press, 2019); F. J. Gavin, *Nuclear Weapons and American Grand Strategy* (Washington D.C.: Brookings Institution Press, 2020); B. R. Green, *The Revolution that Failed: Nuclear Competition, Arms Control, and the Cold War* (Cambridge: Cambridge University Press, 2020); M. S. Bell, *op. cit.*

23. J.-P. Baulon, “Surprise et stratégie nucléaire: aux sources de la dissuasion,” *Stratégique*, 106/2 (2014) : 80-81.

24. L. Freedman, J. Michaels, *The Evolution of Nuclear Strategy*, *op. cit.*, 478-479.

cepted this battle and victory scenario. They hence justified the pursuit of nuclear superiority to maintain stability.²⁵ Colin Gray is one of the leading figures in this movement. Contrary to the idea of Armageddon, which foresees total destruction, he considers that a nuclear war can have different outcomes. Moreover, in his view, the notions of victory and defeat exist at all levels of war, including nuclear war. What is more, recognising that nuclear war is possible opens up a variety of politico-military objectives, including ultimately the destruction of the Soviet political apparatus – a result that was not possible considering the vision that rejected the waging of nuclear war.²⁶

Secondly, small or unsophisticated nuclear arsenals may be insufficient to deter nuclear strikes during a war. Possessing an assured retaliatory capability is the necessary condition for nuclear deterrence. This threshold is difficult to reach and can only be maintained with policies countering qualitative and quantitative developments likely to compromise the survivability of one's own elements. A minimal deterrence that might not survive could incite an adversary to launch a pre-emptive nuclear strike to eliminate any risk of retaliation.

Of course, success is never guaranteed with such strikes. In peacetime, the dangers involved are sufficient to deter strikes of this nature. However, in wartime, perceptions and risk calculations can change. The minimum Soviet nuclear deterrent in the 1950s was a double-edged sword. It benefited the Soviets in peacetime by reducing the likelihood of U.S. aggression. Yet, this greatly increased the damage the Soviets would suffer in the event of war. This logic also applied to China's nuclear arsenal before its development began, or to Pakistan's confrontation with India, which sought to acquire a sanctuarising second-strike oceanic capability.

Thirdly, stability at the nuclear and strategic level allows, and may even increase, the risk of conflict at lower levels. This phenomenon is known as the "stability-in-stability paradox".²⁷ Indeed, if both parties possess second-strike capabilities and are aware of it, they may be less inhibited to initiate a limited conventional war with objectives that will not be existential for the adversary than if the strategic balance was unstable.

A stable nuclear strategic relationship can thus lead to unstable conventional military relations. Acquiring a nuclear deterrence capability cannot do without robust conventional capabilities, be it in the framework of conventional or non-conventional deterrence. These conventional capabilities also curb manoeuvres of any "circumvention by below" of deterrence. There are several examples of non-nuclear-weapon states attacking nuclear-armed adversaries, such as the Six-Day War in 1967, the Yom Kippur War in 1973 and the Falklands War in 1982.

25. C. S. Gray, "Nuclear Strategy: The Case for a Theory of Victory," *International Security*, 4/1 (1979): 54-87.

26. C. S. Gray, K. B. Payne, "Victory Is Possible", *Foreign Policy*, 39 (1980): 14-27.

27. Concept theorised by G. Snyder, "The Balance of Power and the Balance of Terror," in P. Seabury, *The Balance of Power* (San Francisco: Chandler, 1965): 184-201. Repeated and analysed by C. L. Glaser, *Analyzing Strategic Nuclear Policy* (Princeton: Princeton University Press, 1990).

Fourthly, states have a variety of political objectives. The unique characteristics of nuclear weapons enhance the security of states, while facilitating the pursuit of their multiple objectives. The precise behaviour that states adopt depends on the degree of threat they face, their alliances, and their trajectories of relative power. The invasion of Ukraine by Russia is an example where the possession of nuclear weapons emboldens a state to launch military aggression, as it provides a deterrent shield against direct external military intervention. This behaviour is termed by Jean-Louis Gergorin as “aggressive sanctuarisation.” The nuclear-armed state is “supersanctuarised” thanks to its nuclear arsenal and can manoeuvre conventionally within its regional environment if necessary.²⁸

Fifthly and lastly, the effectiveness of nuclear deterrence provides a strong incentive for nuclear-armed states to prevent new countries from acquiring such weapons. While theoretically, the atom may pacify, however, in practice, a state will always be better positioned to pursue its objectives if it possesses nuclear weapons. According to Francis J. Gavin: “*The United States had a deep strategic reason to limit nuclear proliferation – not for moral reasons, not even because of the fear of nuclear war, but because nuclear deterrence limits U.S. freedom to act as it sees fit in the world.*”²⁹ Furthermore, Mark S. Bell adds that “*it is [U.S.] policymakers’ recognition of the benefits that nuclear weapons offer to states that has led the United States to seek to prevent proliferation.*”³⁰ More generally, as Matthew Kroenig argues, states with global interests or the ability to project conventional power into other regions will be less inclined to see nuclear weapons spread.³¹

Thus, the theory of the “nuclear revolution,” which *a priori* underpins the first few doctrines and deterrence postures, is a foundational reflection. Nonetheless, it seems to have certain blindspots and limitations. Mainly due to technological changes, and at times doctrinal ones, the balance between conventional forces and nuclear forces is in perpetual evolution. Some strategists, therefore, seek to move beyond the structure of MAD – which may appear to freeze international policy under certain conditions – by means of more flexible and limited options as outlined above.

Reflections on the very nature of the nuclear revolution, its strategic consequences, and the quest by some for a “nuclear victory”, inevitably contain questions about the relationship between nuclear and conventional forces. In short, this relationship is primarily considered within the framework of a central concept in U.S. strategy: the management of escalation.

28. J.-L. Gergorin, “Quelles nouvelles menaces, quelles ripostes, quelle dissuasion,” *Revue Défense Nationale*, 532 (1992) : 43-49.

29. F. J. Gavin, *Nuclear Weapons and American Grand Strategy* (Washington D.C.: Brookings Institution Press, 2020): 162.

30. M. S. Bell, *op. cit.*, 170.

31. M. Kroenig, “Force of Friendship? Explaining Great Power Nonproliferation Policy,” *Security Studies*, 23/1 (2014): 1-32.

Managing Escalation and the Beginnings of the Integration of Conventional and Nuclear Means

These initial ruminations outline the contours of a central concept in U.S. strategy that would launch the integration of nuclear and conventional capabilities: escalation and, more precisely, the pursuit of its management. While strategic theory and the doctrine for the use of nuclear weapons have evolved, a number of studies and experiments have sought to link nuclear and conventional means. Their goals were to achieve, when necessary, control and by consequence, domination in escalation.³² These attempts can be explained not only by the desire to contemplate (limited) nuclear war and the escalation process, but also by internal issues (as illustrated by the case of the “pentomic division”) and external commitments, such as security guarantees in Europe and the “extended” deterrence posture.

From a theoretical point of view, two authors significantly contributed to the reflection on nuclear escalation in the 1960s: Thomas Schelling and Herman Kahn. Schelling applied game theory to strategic thinking and the risk of nuclear escalation. In his view, the manipulation of the risk of escalation incorporates the notions of chance and luck. This in a sense lent credibility to deterrence and regulated relations between nuclear powers. On the contrary, it also limited speculation and predictions in the event of an escalation.³³

Kahn, on the other hand, adopted a much more rational approach by modelling escalation to the maximum. Known for his “44-step”³⁴ nuclear escalation ladder, his early works had already criticised the concept of “mutual suicide,” which he deemed logical but “*very uninspiring*.”³⁵ He then sought to move beyond this sole scenario, describing with dizzying precision the different phases and options in the event of nuclear escalation and war.

These two visions, albeit relatively different, contributed to the strategic reflection aimed at apprehending, understanding, and controlling the escalation process within U.S. thinking. However, the debates of the time were not solely focused on the nuclear aspect. Kissinger highlighted the contradictions between the supporters of a nuclear strategy and those of a conventional strategy.³⁶ The former emphasised the complexity of the adversary’s calculations, the technological superiority of the United States in the nuclear domain, and the impossibility of waging a conventional war against a nuclear-armed enemy. Conversely, the latter school considered the

32. Charles-Philippe David presents mastery and domination in escalation as two of the five major concepts leading to the choice of an anti-force strategy (along with stability, symmetry and negotiation). The idea is to be superior to the USSR at every possible level, which would *ultimately* dissuade the adversary from venturing into a logic of escalation. See C.-P. David, “L’évolution de la doctrine nucléaire américaine de contreforce,” *Études internationales*, 17/1 (1997): 10.

33. T. C. Schelling, *The Strategy of Conflict* (Cambridge (Massachusetts): Harvard University Press, 1960). On the subject of nuclear deterrence, he refers to “*the threat that leaves something to chance*.”

34. H. Kahn, *On Escalation: Metaphors and Scenarios* (New York: Praeger, 1965).

35. H. Kahn, *On Thermonuclear War* (Princeton: Princeton University Press, 1960).

36. H. Kissinger, “Limited War: Conventional or Nuclear? A Reappraisal,” *Daedalus*, 89/4 (1960): 800-817.

hypothetical use of nuclear weapons as inconsistent with the concept of “limitation”. This was because all restraint would leave the room once the first bomb exploded.

Furthermore, a conventional strategy reduces the chances of conflict breaking out, while remaining as the best guarantee against the occupation of Allied territories. Later becoming the U.S. Secretary of State, Kissinger then proposed a formula of compromise that seemed to have been the one eventually adopted by U.S. administrations: conventional forces must not be considered as a substitute for the ability to wage a limited nuclear war, but as a complement. It would be “suicidal” to rely solely on conventional means against a nuclear power. Finally, a conventional war could only remain “limited” if nuclear war were to appear more costly and less desirable. This therefore raised the question of what form this “complement” of conventional forces should take in relation to nuclear forces. This thus launched the search for a means of linking the conventional with the nuclear, and then subsequently, integrating the two.

Beyond these theoretical and doctrinal considerations, concrete experiments were developed. A famous case in point is that of the “pentomic division”, which was a doctrinal and organisational effort to integrate tactical nuclear weapons into conventional land combat... and a failure.

The doctrine of using tactical atomic weapons stemmed from efforts by the Army to maintain its relevance during President Eisenhower’s terms. As soon as he entered the White House, he instituted new national security policies aimed at reducing defence costs. He favoured air means for the use of atomic weapons³⁷ within a general strategy of massive retaliation against the Soviet Union. This “new look” on national security limited the Army’s budget, thus forcing a doctrinal innovation. As a result, the Army began to envision the modalities needed for a limited land-based atomic war against the Soviet adversary. This war would not involve atomic strikes on cities but rather tactical exchanges of nuclear weapons between ground forces.

In 1955, General Maxwell Taylor was appointed Chief of Staff of the U.S. Army. In order to justify the Army’s budgets and missions, he developed a doctrine and structure that would allow its forces to operate on a nuclear battlefield. Taylor presented his reform as a way of contributing to the strategy of massive retaliation. In reality, it was a question of redefining the Army’s missions in order to influence national strategy and, concurrently in the process, obtain an internal increase in the budget allocated to the Army.

37. E. Kaplan, *To Kill Nations. American Strategy in the Air-Atomic Age and the Rise of Mutually Assured Destruction* (Ithaca: Cornell University Press, 2015).



General Maxwell Taylor in 1962. He was then Chairman of the Joint Chiefs of Staff.

Source: "[Maxwell Davenport Taylor](#)," *Britannica*, n.d.

Convinced that future conflicts would inevitably involve atomic weapons, Army commanders argued that mobility and dispersion were crucial to survival and victory on the battlefield. The "pentomic" division, designed to be mobile and able to disperse, would thus increase the forces' survivability.

At the same time, the army developed guided missiles and artillery capable of firing conventional and nuclear munitions. The aim was to provide long-range fire support under all conditions to highly mobile ground units.³⁸ This approach was partly based on the U.S. experience in the Korean War. During this conflict, Chinese volunteers employed their large numbers in what were described as "*human wave attacks*." U.S. leaders feared that the Soviet Union would follow a similar doctrine and, given its numerical superiority, would quickly overwhelm the lines of defence in Europe.

The 1954 edition of *Field Manual 100-5: Field Service Regulations, Operations* instructed commanders to use "*atomic fires as additional firepower of large magnitude to complement other available fire support for [manoeuvring] forces, or he may fit his [manoeuvre] plan to the use of atomic fires.*"

Atomic technology and weapons were thus a means of compensating for numerical superiority, but the best way to use nuclear weapons on the battlefield required a change in divisional structure and doctrine.

To fight in the atomic age, U.S. planners assumed that the doctrine and organisational structures of the units would have to be adapted to make them less attractive targets for Soviet nuclear weapons, while still being able to form larger formations for offensive action. The structure eventually adopted consisted of five battlegroups, each made up of five companies, transforming the division from a ternary to a pen-

38. A. J. Bacevich, *The Pentomic Era. The U.S. Army Between Korea and Vietnam* (Washington D.C.: National Defense University Press, 1986). A similar experiment was emerging at the same time in France under the name of the "Javelin Brigade"; J. Planchais, "[La brigade Javelot, unité de l'âge atomique peut être le point de départ d'un renouveau militaire français](#)," *Le Monde* (5 October 1954).

tomic structure. Each battlegroup had to be capable of fighting independently, and above all be sufficiently mobile to hamper enemy manoeuvre and prevent them from exploiting the depth of the battlefield. Once constrained in their movements by the action of the battlegroups, the enemy became a prime target for the division's support resources: five 105 mm artillery batteries and above all a battery equipped with Honest Johns – the missiles capable of carrying an atomic warhead.



Rocket Honest John of the 1st Field Artillery Battalion (U.S. Army) in 1959.

Source: "[Honest John Rocket, 1959](#)," *Stars and Stripes* (2021).

By implementing this new divisional structure, the army hoped to force a re-evaluation of tactics and doctrine. However, the latter was never codified in an updated field manual. Instead, much of the tactical atomic doctrine came from professional journals and books written by senior officers. The key was to maintain sufficient combat power after the initial atomic strike – an objective that could be achieved by dispersing units.

The fundamental problem with the concept, however, lay in the findings from field exercises. Any use of a tactical nuclear weapon on the battlefield would rapidly lead to escalation, culminating in a massive nuclear exchange. As a result, any advantage gained by the one-off use of tactical nuclear weapons would be wiped out by the likelihood of uncontrolled escalation.³⁹ The concept was henceforth abandoned in 1962.

39. M. H. Halperin, "Nuclear Weapons and Limited War," *Journal of Conflict Resolution*, 5/2 (1961): 146-166.

The pentomic division is generally presented as the epitome of failed reform, as well as of the immense difficulty of combining conventional and nuclear weapons on the battlefield from a tactical point of view. However, the reform played its political role by justifying the strategic importance of the Army in a nuclear context. It denied the Air Force its monopoly and prevented a sharp reduction in the budget allocated to land forces. Finally, it contributed to the evolution of the U.S. nuclear doctrine from massive retaliation to flexible response during the Kennedy administration.

Taylor himself was strongly opposed to the doctrine of massive retaliation, believing that a strategy that risked wiping out the national community in the face of potentially limited attacks was both implausible and irresponsible. Supported in this by the Navy and the Marines, he believed, on the contrary, that the judicious use of conventional forces (and land forces in particular) would provide an opportunity for greater flexibility in dealing with a wider range of conflicts. Taylor was thus one of the architects behind the adoption of the graduated response doctrine, which enhanced the strategic role of the Army.⁴⁰ In short, while the pentomic division did not improve the operational capabilities of U.S. land forces, it did contribute to the development of U.S. strategic doctrine by emphasising the need to combine conventional and nuclear means in a policy of deterrence.

In short, the loss of credibility of (massive) retaliation and the need for greater nuclear flexibility were central issues during the Cold War, particularly in the context of Washington's external commitments. Security guarantees to Allies in Europe required a rethinking of the deterrent posture to avoid the "all or nothing" dilemma, which explains the various doctrinal changes. These changes were obliged to address two issues in relation to the so-called U.S. "extended" deterrence.

The first issue was the need to acquire greater flexibility, and therefore to include more limited conventional and nuclear options in order to lend credibility to the deterrent posture and the control of escalation as Soviet capabilities developed. The second was not to encourage the European Allies to consider a possible "decoupling" between the United States and Europe, as well as between tactical and strategic nuclear capabilities. This would have turned the Old Continent into a "nuclear theatre", while the territories of the other two great powers would be kept safe.

At the end of the Cold War, advances in conventional technology and capabilities, as well as the diversity of strategic threats gave rise to new questions on the place of nuclear weapons and their relationship with conventional weapons in defence and deterrence strategies.

40. I. Trauschweizer, *The Cold War U.S. Army. Building Deterrence for Limited War* (Lawrence: University Press of Kansas, 2008).

After the Cold War: Nuclear-Conventional Integration as a Response to New Threats?

The Evolution of the U.S. Doctrine After 1989

Since the end of the Cold War, the United States has taken on a different view of the role of its nuclear deterrent. The 1994 *Nuclear Posture Review* (NPR) considered that the nuclear arsenal inherited from the bipolar period no longer corresponded to the new challenges of proliferation and, in particular, terrorism. The new version in 2010 asserted the intention to diminish the importance of nuclear weapons in the U.S. strategy, while continuing to strengthen its conventional capabilities. The link between nuclear and conventional aspects was therefore *ipso facto* less developed as a result of these new political and doctrinal dynamics.

During this post-Cold War period, the question of linking nuclear and conventional capabilities was not neglected, but it did become less of a priority, as noted in U.S. documents and reflections. This can be explained by the reduced risk of escalation vis-à-vis U.S. territory or the European continent. However, a relative form of integration is emerging in the context of regional security architectures, where the NPR plans to maintain credible nuclear deterrence through “*missile [defences] and other conventional military capabilities*.”⁴¹

Today, the international strategic context has more than changed since the 1990s: the United States faces the prospect of regional competition with nuclear-armed adversaries. Russia and the People’s Republic of China (PRC) have both invested heavily in dual-theatre missile systems, allowing them to threaten the use of nuclear weapons in a regional conflict against the United States and its Allies, while concurrently avoiding the threshold of a strategic nuclear exchange.

The report of the Congressional Commission on the U.S. Strategic Posture published in October 2023 analyses this “two-peer deterrence” situation. It states that the objectives of the U.S. strategy must include effective deterrence and the ability to defeat simultaneous aggressions by Russia and China in Europe and Asia using conventional forces. However, if the United States (and its Allies) could not achieve this objective due to a lack of conventional forces, it would then be necessary to rely more on nuclear weapons to deter, or even counter, aggression in the other theatre.⁴²

This issue arises at a time when analysts are observing a “third nuclear age” marked by the proliferation of non-nuclear strategic weapons (long-range missiles), advanced missile defences, means of sabotaging adversary nuclear systems, and the digitalisation of the information environment affecting crisis management.⁴³ These

41. “[Nuclear Posture Review Report](#),” *Report*, U.S. Department of Defense (2010): vi.

42. “America’s Strategic Posture,” Congressional Commission on the Strategic Posture of the United States (2023): viii.

43. A. Futter, B. Zyla, “Strategic Non-Nuclear Weapons and the Onset of a Third Nuclear Age,” *European Journal of International Security*, 6/3 (2021): 257-277; and L. Freedman, H. Williams, *Changing the Narrative. Information Campaigns, Strategy and Crisis Escalation in the Digital Age* (London: IISS, 2023).

technical and operational developments are also taking place in a context of nuclear multipolarity, of which the dynamics are still poorly understood.⁴⁴

As such, the questions facing U.S. analysts are as follows. How can the United States and its Allies discourage the use of nuclear weapons by their adversaries, while pursuing the United States' regional objectives? What is the U.S. theory of victory if it attacks with conventional or nuclear means? U.S. strategists indeed need a strategy to win limited regional conflicts with nuclear-armed adversaries and have identified deeper conventional-nuclear integration (CNI) as a potential solution.

CNI is not explicitly defined in U.S. national security documents. This issue appeared in the 2014 *Quadrennial Defense Review*, which mentioned the risk that an adversary might decide to extricate itself from a failed conventional attack by escalating the conflict to the nuclear stage. However, the national defence strategy adopted by the Biden administration in 2022 speaks of “integrated deterrence” – a term that evolves from the conceptual discussions on “Cross-domain Deterrence” of the 2010s.⁴⁵

Broadly speaking, CNI can be understood as the intersection of conventional and nuclear forces to strengthen deterrence. The U.S. efforts in CNI require conventional forces that operate with nuclear considerations in mind, and nuclear forces that conduct deterrence operations. Thus, for Washington, nuclear force is the ultimate support for non-nuclear capabilities in the exercise of deterrence.⁴⁶

The U.S. conception of CNI comprises three major politico-strategic necessities: (1) managing escalation in regional conflicts and deterring the adversary from using nuclear weapons (which is generally the concern of decision-makers at the command level), (2) developing an integrated series of options to strengthen deterrence, and (3) depriving the adversary of any advantage arising from the use of nuclear weapons in a regional conflict through resilience and readiness.⁴⁷ The objective is to provide U.S. strategists with the widest possible range of response options, from the continuation of a limited conventional conflict to conventional strikes with strategic effects, and also, if necessary, to a nuclear response. The operationalisation of CNI is an important goal of implementing the 2022 NPR.

Russian and Chinese Visions

The new developments in CNI must be seen as a response to the threat posed by Chinese and Russian doctrinal and capability developments. The latter are interpreted as signs that Beijing and Moscow would be willing to use nuclear weapons

44. V. Narang, S. D. Sagan (eds.), *The Fragile Balance of Terror. Deterrence in the New Nuclear Age* (Ithaca: Cornell University Press, 2022).

45. E. Gartzke, J. Lindsay (eds.), *Cross-Domain Deterrence. Strategy in an Era of Complexity* (Oxford: Oxford University Press, 2019).

46. D. Pappalardo, “Does France really have a problem with the U.S. concept of integrated deterrence?,” *Le Rubicon* (14 December 2023).

47. D. Horschig, N. Adamopoulos, “Conventional-Nuclear Integration to Strengthen Deterrence,” *Center for Strategic and International Studies* (2023).

on the battlefield to gain a strategic advantage in conventional conflicts with the United States or their Allies.⁴⁸

Both adversaries seem to subscribe to similar theories of victory for limited regional conflicts. They exploit the potential use of nuclear weapons and perceived asymmetries in theatre access (related to geography) and stakes to deter the United States from intervening. They also aim to break Washington-led alliances, reminiscent of what is often called in France “aggressive sanctuarisation.”

Contrary to the U.S. conception of CNI, which is primarily aimed at maximising their ability to pursue a conventional war even in a nuclear environment, Russia and China have different objectives. Instead, both countries have focused on developing capabilities that enhance the credibility of limited nuclear threats without provoking a strategic nuclear response from the United States or its Allies.⁴⁹

The Russian strategy seeks to manage escalation to deter the adversary’s intervention and aggression, prevent the conflict from expanding geographically, ensure the state’s survival, and offer acceptable conditions for the resolution of the conflict. Generally, Russia first aims to achieve these objectives by instilling fear in the adversary’s decision-makers. Subsequently, it then seeks to carry out increasingly damaging strikes on its adversary’s targets, all while remaining below the threshold of a response that could lead to escalation.

Russia has therefore invested heavily in the development of a variety of advanced and dual non-strategic weapons systems to support conventional military operations abroad. This grants Moscow the necessary flexibility it needs to manage crisis escalation and allows Russia to wage limited nuclear wars below the threshold of using strategic nuclear weapons.

These systems include the 9M729/SSC-8 ground-launched cruise missile (responsible for the collapse of the Intermediate-Range Nuclear Forces Treaty) and the Kh-47M2 Kinzhal aeroballistic missile. In both cases, these are dual-theatre missile systems, capable of threatening targets in Europe and Asia. Russia also possesses several conventional precision-strike missile systems. This array thus creates a range of capabilities that provides decision-makers with the flexibility to credibly threaten escalation and rising costs (including with non-nuclear systems) in regional conflicts, while maintaining a significantly wide margin between a regional nuclear war and a major one.

48. J. Anderson, J. R. McCue, “Deterring, Countering, and Defeating Conventional-Nuclear Integration,” *Strategic Studies Quarterly*, 15/1 (2021): 28-60.

49. D. Adamsky, *The Russian Way of Deterrence: Strategic Culture, Coercion and War* (Palo Alto: Cornell University Press, 2023); and J. M. Smith, P. J. Bolt (eds.), *China’s Strategic Arsenal: Worldview, Doctrine, and Systems* (Washington D.C.: Georgetown University Press, 2021).



Test of a 9M728 missile and a Kinzhal missile on the *MiG-31K*'s mid-air port.
Sources: "[British intelligence assesses potential of Russian Kinjal missiles over Black Sea](#),"
Ukrinform (26 June 2024); and "[9M729 \(SSC-8\)](#)," *Missile Threat* (23 April 2024).

For their part, China's new capabilities offer decision-makers an increasing range of options in the event of a regional conflict. China is seeking to equip itself with a series of dual-use systems capable of threatening U.S. Allies in the region. In addition, it already possesses a wide variety of intermediate-range, dual-use weapon systems.

From Washington's perspective, China's nuclear strategy is even less clear. It raises important questions about how the United States and its Allies would manage Chinese nuclear coercion, aimed at deterring them from intervening during a conflict. It also raises questions about the prospect of a limited use of Chinese nuclear weapons to end a crisis on Chinese terms. For example, in the case of a crisis concerning Taiwan, Chinese theatre nuclear forces could seek to deter the United States from intervening, prevent them from crossing the combat space and, if necessary, end the conflict under conditions favourable to Beijing.

China's latest systems include the DF-26 intermediate-range ballistic missile and the DF-17 hypersonic vehicle, albeit it remains unclear how many of these are dedicated to either conventional or nuclear missions. In addition, the People's Liberation Army Rocket Force jointly deploys conventional and dual brigades, requiring its personnel to train for both nuclear and conventional operations.



DF-26 on tractor-erector-launcher and DF-17 at the 2019 parade.
Source: "[DF-26](#)" and "[DF-17](#)," *Missile Threat*, CSIS Missile Defense Project, n.d.

While China publicly adheres to a no first use policy, Chinese officials have privately questioned its relevance in the event of conventional attacks on the regime's nuclear forces. This suggests a shift towards a conventional-nuclear combat concept that offers the PRC's leaders new strategic options. This could also increasingly cast a nuclear shadow over the military operations of the U.S. and its Allies in the region.

Moreover, due to the high probability that regional conflicts would break out near their borders, Moscow and Beijing could see CNI as the best asset to discourage, or at least limit, Allied participation or Washington's intervention in a confrontation. This is notably evident in the deployment of so-called "theatre" nuclear and conventional capabilities near Allied territories.⁵⁰ CNI is therefore an option for Washington's two strategic competitors who aim for a dual objective: to deter U.S. intervention and to persuade regional states to no longer rely on these security guarantees, ultimately driving them to negotiate bilaterally, without the presence of the United States. In short, CNI could challenge the United States' extended deterrence posture, from the point of view of both the protector and the protected.

The Current Debate in the United States

The integration of conventional and nuclear planning poses two key problems and has given rise to considerable debate in the United States.⁵¹

Firstly, there is a risk of blurring the lines of demarcation between conventional and nuclear forces due to their (real or perceived) entanglement. The integration of conventional and nuclear command and control (C2) systems deserves particular attention because it carries the risk of entangling these C2 systems. This could happen due to platform ambiguity or by combining conventional and nuclear systems within a command controlling multiple forces.

This link between conventional and nuclear is further complicated by capabilities in other conflict domains – such as space and cyberspace. They introduce new dimensions to warfare by enabling advanced surveillance, disruption of communications, and precise targeting, which all must be taken into account in traditional military planning. The debate on this subject was initiated in the late 2010s through a highly circulated article by James Acton. He points out that this risk of entanglement is potentially escalatory.⁵² Since then, the debate has mainly focused on this same risk, but now applied to Chinese systems.

Secondly, the convergence of conventional and nuclear operations can influence the risk of nuclear escalation and the adversary's willingness to use nuclear weapons. A classic problem of coercion strategies is that it is difficult to simultaneously signal both determination and restraint to the adversary. On the one hand, the United States

50. J. Anderson, J. R. McCue, *op. cit.*, 36.

51. R. Peters, J. Anderson, H. Menke, "Deterrence in the 21st Century: Integrating Nuclear and Conventional Forces," *Strategic Studies Quarterly*, 12/4 (2018): 15-43.

52. J. M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War," *International Security*, 43/1 (2018): 56-99.

and its Allies must signal their willingness to respond quickly to the use of nuclear weapons. On the other hand, they must also show that they are prepared to exercise restraint if the adversary does not aggravate the situation by using nuclear weapons. The difficulty in calibrating these signals and attitudes can lead to “security dilemmas”: CNI can affect adversaries’ security postures and lead to a strengthening of their weapon systems and the development of more aggressive strategies.

Conversely, integration can strengthen the overall deterrence posture, manage the dynamics of escalation in the event of a crisis and influence the adversary’s perception of the possibility of achieving its objectives through the limited nuclear use. It could help signal and convince adversaries that they cannot resort to escalation to extricate themselves from a failed conventional aggression against the United States or its Allies.

In this sense, the strengthening of this global deterrence posture is equally aimed at the Allies. CNI would indeed demonstrate a willingness for the relative integration of U.S. conventional and nuclear forces with its Allies to lend credibility to the extended deterrence posture. Similar to the “nuclear sharing” agreements during the Cold War and the stationing of nuclear weapons on Allied soil, the new strategic context and the security demands of Allies resulting from it, could lead the United States to further develop CNI within its alliance frameworks. While there is now a consensus that nuclear weapons are not shared, deterrence and reassurance signals or the capability to deploy forces can be strengthened by integrating Allies via various mechanisms: coordination, information sharing, consultation, planning, and exercises.⁵³ Ultimately, the full spectrum of the United States’ CNI could consolidate the role and conventional capabilities of its Allies within its overall and extended deterrence posture.

In parallel, investments in CNI can help improve the resilience of conventional forces in the event of nuclear attacks through the dispersion of operational bases (a fundamental element of nuclear deterrence), maintaining operational capacity in a contaminated environment, and hardening command, control and communications (C3) systems to make them sufficiently agile, resilient, and well-manned. The NPR identifies resilient conventional forces as a cornerstone of its integrated deterrence. It specifies that the “*Joint Force must be able to survive, maintain cohesion, and continue to operate in the face of limited nuclear attacks. This form of resilience sends a distinct deterrence message to an adversary – that limited nuclear escalation will not render U.S., Allied, and partner forces incapable of achieving our warfighting aims.*”⁵⁴

If conventional forces are resilient, an adversary’s limited nuclear strikes will not have a decisive military advantage. For example, NATO has agreed to a new CBRN (chemical, biological, radiological, and nuclear) defence policy⁵⁵ at the Madrid Summit in 2022, while Japan has announced new investments in the resilience of its defence facilities to ensure wartime operations.

53. B. Y. Jo, “Conventional-Nuclear Integration (CNI) as Alliance Practice for Extended Deterrence and Assurance,” *Journal of Peace and Unification*, 14/1 (2024): 113-130.

54. “[Nuclear Posture Review Report](#),” *art. cit.*, 10.

55. See NATO, “[NATO CBRN \(Chemical, Biological, Radiological and Nuclear\) Defence Policy](#),” *Official Documents* (14 June 2022).

Finally, if conventional resilience is assured, the NCI can grant decision-makers greater flexibility and reduce the prospects of a limited nuclear war. This flexibility of response allows leaders to have several options in the event of a nuclear or CBRN attack, rather than ordering a massive nuclear counter-attack. Particularly, after a possible nuclear strike on nuclear command, control, and communications (NC3) structures or nuclear forces, the integration of conventional and nuclear command and forces can increase reaction capabilities, providing more flexible and proportional response options.

As can be inferred, these debates clearly echo those of the Cold War with the adoption of a “graduated response” and the need to calibrate responses. However, these discussions are taking place in a completely renewed strategic (nuclear multipolarity) and technological environment. For the United States, the fundamental challenge remains not limiting their nuclear doctrine to a choice between suicide and capitulation. This would be for the purpose of maintaining control of an escalation, while lending credibility to its extended deterrence posture.

Conclusion

This article has provided an overview of U.S. strategic thinking regarding the relationship between conventional and nuclear means, from the Cold War to the conceptualisation of the CNI. It has examined how these two dimensions accompany each other in tandem in order to avoid, on the one hand, mutual destruction and, on the other hand, a political and strategic deadlock. The article has presented, in a relatively succinct manner, the doctrinal evolutions in the United States during the Cold War. As technology progressed, the different strategic approaches adopted incorporated a more assertive conventional dimension. The elements developed highlight the desire not to be confined within a rigid MAD structure by managing escalation at multiple levels, from conventional to strategic nuclear.

This vision of escalation thus brings to the forefront the conventional-nuclear integration as well as the logic of “nuclear battle” and “nuclear victory” (as exemplified by the pentomic division). Furthermore, Washington’s external commitments and responsibilities, notably to its extended deterrence posture, strongly encouraged the integration of conventional and nuclear components. This served to obtain significant flexibility in order to adapt to threats against its Allies.

Although the role of nuclear weapons has become less central to U.S. foreign policy since the end of the Cold War, the conventional-nuclear link has not been entirely abandoned. The contemporary strategic context seems to compel the United States to renew their reflection on the matter. Thus, CNI presents itself as a new strategic concept stimulating a new wave of debates. It carries on from the continuity of discussions on the linkage between the two fields. It also seeks to respond to the emergence and demands of a “two-peer challenge.”

Thus, the question of the relationship between conventional and nuclear forces in the United States has evolved over time depending on the international situation, the state of doctrine, and technological advances. The relative place of conventional forces in U.S. nuclear policy represents both an attempt to render possible more flexible and diversified responses to aggression, while respecting extended deterrence commitments. It also represents an effort to render credible what President Barack Obama coined as “mad logic”. In order to convince an adversary that it will use its nuclear arsenal if necessary (deterrence), the United States must convince Allies and partners (and also themselves) that they will continue to fight even after the adversary has potentially retaliated. This would continue until one of the belligerents gave up. The objective is to conceptualise a conflict and achieve conventional and nuclear superiority at all levels to reassure Allies and deter the adversary from such confrontation.

Airborne Nuclear Forces and Missiles Types

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For several years now, the question of airborne nuclear forces has been revisited, largely due to the ongoing development of hypersonic weapons.¹ Owing to their range, speed, and certain unique features, these types of missiles have now opened up new and unprecedented operational domains. Of specific interest, some of these new domains involve air power.

Indeed, it is true that, in nuclear matters, the characteristics of equipment have long been key factors in defining and evolving the concepts of employment. The nuclear weapon's yield and the quality of its firing system – which allows the explosion to be produced at an altitude that optimises the desired effects – have thus been

1. Hypersonic weapons are defined as devices flying in the atmosphere (at an altitude of less than 100 km) at speeds in excess of 1.5 km/s (Mach 5) and capable of manoeuvring. They can take the form of gliders launched by a space launcher or ballistic missile into near space. The glider is a craft that is separated from the launcher body, re-enter the atmosphere and glide to its target.

Propelled missiles are generally referred to as hypersonic cruise missiles. They are equipped with a super ramjet that propels the missile for several minutes. Since the super-ramjet uses air as its oxidant, the missile is launched into the atmosphere by a booster that provides speed (up to around 1.2 km/s) and, sometimes in conjunction with an aerial platform, altitude (20 to 30 km, depending on the performance of the super-ramjet).

In addition, air-to-ground ballistic missiles (Kinjal type) have similar performance and are classified as hypersonic weapons. Surface-to-surface, single-body, quasi-ballistic missiles, on the other hand, have lower performance but are capable of manoeuvring in the atmosphere at high speeds, and are largely hypersonic at the start of their trajectory.

considered as essential parameters. The missile's accuracy is also of a significant regard. The more hardened a target is, the higher the accuracy of the weapon system – that is to say, the correlation between the missile's accuracy and that of the firing system – must be.²

Moreover, depending on the nature of the targeted objectives – whether weapon systems deployed from the surface or from silos, or highly hardened tactical or strategic command and control centres (C2) – and the specific characteristics of the weapon systems in use, certain types of armament will naturally be preferred over others. Similarly, depending on the limitations of all available weapon systems (including accuracy, range, platform, defence penetration capability, stocks of deployed and operational systems, availability and reactivity), certain strike options may either be selected or discarded. These considerations directly contribute to the development of an employment doctrine and the definition of the military or political objectives associated with a nuclear strategy.

Intercontinental ballistic missiles (ICBMs³) have historically suffered from limited accuracy, primarily due to their delivery systems. Their circular error probable (CEP⁴) has long fluctuated between 300/500 metres and one kilometre. However, with the introduction of cruise missiles, this margin has been reduced to approximately a hundred metres. As for gravity bombs dropped from high altitudes, their CEP remained high for quite some time, as the large carrying capacity of strategic bombers facilitated the use of very high-yield weapons.

The modernisation of targeting and delivery systems, combined with adjustments in altitudes and trajectories, has led to a significant increase in precision – an aspect that has been well-documented for bombs carried by tactical aircraft.⁵ The importance of individual equipment characteristics, therefore, no longer seems as evident today as it once did. The modernisation of delivery vehicles and nuclear devices (in terms of accuracy and miniaturisation) now provides, to a certain extent, interchangeability between weapon systems, which could eventually lead to the elimination of any redundant components.

Airborne components are clearly affected by these ongoing developments. They have always represented a fundamental element in the initial establishment of the nuclear forces of most nuclear powers – a role that was only partially challenged by the development of missile technology. This longevity can be explained not only by

2. At the same time, the inaccuracy of the weapon system can be compensated for by the power of the nuclear device. This nevertheless has an impact on its mass and dimensions and, consequently, on the type of delivery system (the missile or gravity bomb associated with an air platform) that can be associated with it.

3. ICBM: Intercontinental Ballistic Missile - with a range of over 5,500 kilometres.

4. The circular error probable (CEP) is defined as the probability that a device will detonate at a given distance from the target. Westerners define this probability as 50%. So a missile with a CEP of 200 metres will have a 50% chance of falling within 200 metres of its target.

5. See for example Advisory Group for Aerospace Research & Development (AGARD), "[Weapon Delivery Analysis and Ballistic Flight Testing](#)," *AGARD Flight Test Techniques Series*, vol. 10, AG-300, NATO (July 1992): 172.

the technical limitations of earlier missiles, which were relatively inaccurate and few in number, but also by the evolution of nuclear strategies – some of which continue to rely heavily on aerial weaponry.

As a result, despite the growing precision of ballistic missiles, the airborne component has retained its specific role, primarily due to its greater flexibility and, most importantly, its ability to generate more discriminating effects. The advent of hypersonic systems, far from making it obsolete, could in fact restore its centrality, as aerial delivery systems are particularly well-suited to specific hypersonic technologies. The challenges associated with mastering these advanced weapons, and the methods of defending against them, will be addressed in the conclusion of this chapter.

The Earliest Weapons: Gravity Bombs and Airborne Missiles

The U.S. and Soviet Approaches to Airborne Nuclear Forces During the Cold War

From a historical perspective, the very first operational nuclear component was based on airborne delivery systems. For a while, the development of aviation, which specialised in nuclear bombing, represented the most accessible “ticket” for acquiring an operational nuclear arsenal.

Beginning with the bombings of Hiroshima and Nagasaki in August 1945, this component, equipped with gravity bombs, served a strategic purpose. However, in the 1950s, a tactical-operational dimension was added. This shift corresponded to the increasing desire to strike not only directly on the battlefield but also deeper within enemy territory to ensure the destruction of conventional units. The weapons used here, defined as tactical weapons, could be relatively powerful, with early versions reaching several hundred kilotonnes, or of low yield that ranged from a few tens of kilotonnes to even less for more recent versions.

Air weaponry offered great flexibility in this area. While some tactical bombers were developed with a nuclear mission in mind (such as the *F-105 Thunderchief* or the *F-111 Aardvark*), the majority retained a conventional capability. Some air fighters can even carry out this mission, such as the *F-104 Starfighter*, which was initially designed as an interceptor, but was also adapted for nuclear attack.

Soon, however, airborne platforms encountered significant competition from surface-to-surface ballistic missiles. They quickly emerged as the preferred means of striking at “intermediate” ranges (between 3,000 and 5,500 kilometres). Then, by the late 1950s, they were also used for “intercontinental” ranges (over 5,500 kilometres). Although these missiles were not particularly accurate and remained rather expensive, ballistic missiles had the distinct advantages of reactivity⁶ and penetration.

6. Initially, reactivity was low. The first systems (Atlas type, for example) were propelled by liquid oxygen (LOX) / paraffin mixtures and required loading with fuel just before firing. Then, with the arrival of storable propellants (introduced with the Titan missiles) and propellants (introduced with the Minuteman I) in the early 1960s, the system could be parked in a silo and launched almost immediately.

Furthermore, from the early 1960s onward, flying over enemy territory became an increasingly pressing issue for air forces, particularly due to the development of the SA-2 Guideline (S-75) and later, the SA-5 Gammon (S-200) surface-to-air missile systems. Nevertheless, despite the rapid expansion of ballistic missile arsenals and the modernisation of surface-to-air defences, the airborne nuclear component was maintained by both established and emerging nuclear powers

Although their arsenals are broadly similar in nature, the U.S. and Soviet airborne nuclear components have played different roles. The United States Air Force (USAF) held a dominant position within the country's deterrent system up until the 1960s,⁷ at which point it began to reorient itself towards more specific and focused missions. In contrast, the Soviet – and later Russian – air force assumed a predominantly tactical role. The volume of its strategic resources remained relatively low and was primarily allocated to follow-up strike missions.⁸

This difference can largely be explained by the essential role that the USAF – and in particular its Strategic Air Command (SAC) – played in U.S. military planning during the 1950s and 1960s. The SAC imposed a strike logic that focused on the destruction of a vast number of targets, which ballistic systems alone could not realise. This approach led to the development of a powerful airborne component, capable of engaging a wide range of military or economic targets with the goal of destroying not only the adversary's nuclear forces but also its capacity to recover its economic and military strength. In contrast, the USSR, which had a relatively small stockpile of nuclear weapons at the time, placed priority on ballistic systems and showed a relative lack of interest in reinforcing its airborne component, which was considered significantly less effective by comparison.

From the 1970s onwards, a new doctrinal shift began to emerge. U.S. nuclear strategy gradually transitioned towards the concept of limited strategic strikes as a counterforce option. They were designed with a twofold objective: first, to mitigate the risk of escalation by carrying out a limited strike on critical targets, and second, to erode the adversary's military capacity, both in conventional and nuclear terms (see below). Regardless, the capability for conducting massive strikes was, of course, retained, with the entire nuclear component continuing to be mobilised.

Airborne systems offered a degree of flexibility that other systems had not yet been able to provide, particularly in terms of better calibration of effects and more easier targeting. This was especially the case against targets that were poorly protected or for follow-up strikes, which helped ensure their longevity well into the 1990s. Moreover, until the late 1970s, dealing with heavily hardened targets using Minuteman I and II ICBMs alone remained problematic: the missiles were not precise enough, and the weapons themselves were poorly suited to the task. As a result, the complete annihilation of the adversary's strategic C2 infrastructure relied heavily on the capability of airborne platforms to engage them.

7. For the record, the surface-to-surface ballistic component is also under the control of the U.S. Air Force.

8. In other words, strikes aimed at completing the destruction of the adversary's nuclear, industrial, or demographic potential after the use of ballistic systems.

In contrast, throughout the Cold War, Soviet nuclear strategy was predominantly shaped by a logic of massive and indiscriminate strategic strikes. This choice further reinforced the essential role given to ballistic systems. In this regard, the Soviets cleverly exploited the provisions of the SALT I agreement⁹ to develop heavy ICBMs that were coupled with extremely high-yield weapons. The USSR's rapid acceptance of limiting the performance of *Tu-22M* bomber – following the intense U.S. debates in the 1970s regarding the bomber's intercontinental range – illustrates Moscow's relative lack of interest in developing a robust strategic airborne capability.¹⁰ A decade earlier, Soviet leaders had already abandoned the strategic strike mission that had been assigned to the *Sukhoi T-4* (the Soviet equivalent of the *XB-70 Valkyrie*) and its heavy *Kh-45* missile. Ultimately, the Soviet airborne nuclear component consisted of a limited number of *Tu-95 Bear* bombers and, from the 1980s onwards, *Tu-160 Blackjack*.

Moscow showed a more pronounced interest in its nuclear naval aviation component, particularly after the failure of the attempt to develop the R-27K anti-ship ballistic missile during the 1960s. By the following decade, this component was centred around the *Tu-22M Backfire*/*Kh-22* combination,¹¹ which aimed to prevent U.S. fleets from approaching Soviet territory. Soviet naval aviation – that was land-based – therefore played a very different role from that of the U.S. Navy. The latter, moreover, never assigned a genuine nuclear mission to its dedicated platforms (*A-3 Skywarrior* and *A-5 Vigilante*), nor to its carrier-based fighter units. It eventually abandoned this mission entirely in the early 1990s.

U.S. and Soviet Weapons and Strategic Doctrines

As with their respective doctrines, fundamental differences emerge in the development logic of the weapon systems employed by the Anglo-Saxon and Soviet airborne components. The United States and the United Kingdom were pioneers in the development of strategic nuclear air-to-surface missiles, with their *Skybolt* (AGM-48) and *Blue Steel* programmes, which were intended for the *B-52 Stratofortress* and the *Avro Vulcan*, respectively. However, these projects were rather quickly abandoned in favour of more conventional ballistic systems. In addition to certain technical reasons that explain the abandonment of the *Skybolt* and the relatively minor role played by the *Blue Steel*,¹² a specific reflection arose within the United States concerning the role that was to be attributed to the nuclear missile.

Indeed, despite the development and subsequent entry into service of the *Hound Dog* (AGM-28) and later the AGM-69 (otherwise known as the Short Range Attack Missile – SRAM), from the end of the 1950s to the late 1960s, strategic targeting

9. Strategic Arms Limitation Talks: signed on 26 May 1972 and entered into force on 3 October, this is a strategic arms control and limitation agreement between Washington and Moscow.

10. This decision was made all the easier by the fact that Soviet officials initially envisaged the *Backfire* being used in an anti-ship role.

11. NATO designation: SS-N-6 Serb.

12. London abandoned strategic air strikes in the 1970s.

continued to rely on gravity bombs.¹³ In this context, nuclear-capable air-to-surface missiles were mainly deployed to eliminate air defences, which served to facilitate bomber penetration. Bombers were specifically designed to evade enemy surface-to-air missiles by exploiting high altitude (such as the *B-47* and *B-52*), speed (*B-58*, *XB-70*, *B-1A*), their low altitude (*B-52H*, *B-1B*), and finally stealth capabilities (*B-2* and now *B-21*). The modernisation of air defences, which required penetration strategies to evolve, led to the development of stand-off capabilities for platforms that had lost their penetration capacity. Nonetheless, this has not led to the disappearance of gravity bombing missions.

The differentiation between the missions assigned to missiles and those assigned to gravity bombs can be explained by the characteristics of these weapons. Nuclear weapons of very high yield are generally too heavy and bulky to be carried by a standard air-to-surface missile. These missiles, still heavy, drastically limit the strike capability of bombers (the reduction in the number of weapon systems per aircraft, the carrying of external pylons that affect the platform's range, *etc.*). Moreover, the missiles still lacked precision. Combined, these factors limited their ability to destroy heavily hardened targets or to produce a massive effect against less hardened zones of interest, which gravity bombs could achieve.

The AGM-69 represents an important first step in this regard. Developed during the 1960s, this solid-propulsion missile combines very high speeds (Mach 2 to Mach 3) with reduced size and weight.¹⁴ These characteristics make it particularly well-suited for deployment on heavy bombers. Despite its relatively short range of around 200 kilometres depending on the flight configuration, the SRAM was specifically designed to neutralise air defences, similar to the role previously fulfilled by the Hound Dog missile. The development of rotary launchers for *B-1Bs* (capable of carrying 18 weapons of this type in the payload bay), as well as its use on *FB-111As*, strongly suggests that this missile had additional missions in a theatre of operations, though the precise targets of these missions remain largely unknown.

The Soviet approach was, once again, notably different. While the strategic bombers were capable of dropping gravity bombs, the naval airborne component was soon equipped with a broad range of missiles designed specifically to engage U.S. fleets from a safe distance. A prime example of this is the nuclear-capable Kh-22 (AS-4 "Kitchen"). The technological choices made during the design and development of this missile are particularly noteworthy.

Like the U.S., but to an even greater extent, Moscow faced serious challenges with respect to both the mass and volume of its missiles. It thus lagged considerably

13. Strategic bombs included the B41, with a power of over 20 megatonnes (Mt), the B53 (9 Mt) and the B83 (1.2 Mt). Secondary targets could be dealt with by less powerful bombs such as the B61 (a few hundred kilotonnes).

14. Less than 5 metres long and weighing one tonne, in contrast to the 13 metres and 4.5 tonnes of the Hound Dog.

behind in the development of solid-propellant systems. As a result, Russia had to rely on liquid-propellant systems, which were significantly heavier and bulkier, such as the Kh-22. However, the propulsion system of the Kitchen does, nonetheless, allow it to achieve a high velocity, reaching around Mach 4 in its terminal phase.

For naval operations, the missile was carried under the wings of the supersonic *Tu-22M* bomber. Penetration of enemy defences was achieved through what is referred to as a “double speed”: the speed of the platform itself, which reduced the adversary’s reaction time, and the speed of the missile, which was to be launched from a safe distance. Although the *Backfire* has been deployed in strategic aviation, the Kh-22 will not be highly valued in that role, primarily due to its complexity.

With the introduction of the Kh-15 (AS-16 “Kickback”) in the 1970s, the Soviets finally had a solid-propellant system with performance close to that of the SRAM. Paired with *Tu-95* and later *Tu-160* heavy bombers for intercontinental missions, its relatively short range likely meant it was intended for eliminating air defence systems. Conversely, in the European theatre, the Kh-15 and the *Tu-22M* (followed by the *Tu-160*) were capable of conducting strategic strikes at very short notice, thus optimising their penetration capability. Although this threat has subsided today, the combination of *Backfire* and *Kickback*, along with the RDS-10 Pionnier (SS-20), contributed – particularly during the Euromissile crisis (1977-1987) – to reinforcing the perception amongst Europeans of their vulnerability to a Soviet decapitation strike.

Moving Towards Turbofan Engines and Cruise Missiles

Cruise Missiles at the End of the Cold War

At the turn of the 1970s, the mastery of turbofan engines represented a major technological advancement. It enabled the development of long-range subsonic cruise missiles, such as the AGM-86 for the U.S. and the Kh-55 (AS-15 “Kent”) for the Soviets. This allowed strikes to be carried out from a safe distance, including against highly strategic targets. This new technology extended the operational lifespan of bombers that had previously been outpaced by the rapid modernisation of anti-air systems (*B-52*, *Tu-95*).

Designed to be relatively stealthy, flying at low altitude and with a reduced radar cross section, these cruise missiles had the mass and dimensions that allowed bombers to carry them in numbers. As a result, the role of bombers was not only strengthened in follow-up strikes but also – at least theoretically – in second-strike capability. The modernisation of navigation systems (TERCOM and DSMAC¹⁵) led to another fundamental advancement. Namely, these improvements ensured the high accuracy of the munitions with a 50 to 100 metres CEP. This allowed a reduction in the weapon’s overall yield, while still achieving the desired effect.

15. TERCOM: Terrain Contour Matching; DSMAC: Digital Scene-Mapping Area Correlator.

The development of cruise missiles could have announced the end of gravity bombs and, on the U.S. side, a significant transformation in the missions carried out by penetrating bombers. However, this was not the case. The launch of the *B-2* programme in the 1970s provides a clear indication of the Pentagon's enduring commitment to this type of weaponry and its specific mission profile. The United States remains one of the few countries capable of developing a specialised weapons system, designed to archive a particular strategic objective. This holds true for the *B-2* programme, as well as for the development of submarine-launched ballistic missiles, such as the Trident II D5, and their associated nuclear warheads, most notably the W88.

The Impact of Strategy on the Definition of Systems

Unlike the USSR, the need for extended deterrence and the deficit in NATO's conventional capabilities forced the United States to consider strategic strike operations against their adversary – including the possibility of a first-use scenario. The formulation of Limited Nuclear Options (LNO) in the early 1970s was aimed at planning limited strategic strikes in order to compel Moscow to cease its military operations. The spirit of the LNO was confirmed in *Presidential Directive 59* (PD-59) in July 1980 and its subsequent decisions.

The rationale of damage limitation (counterforce) or even the “targeted” destruction of economic infrastructures – in other words, minimising collateral damage – became the prevailing approach. PD-59 further modified the typology of targets by including both political and military decision-making centres that could be destroyed through a limited strike. The need for flexibility and precision in targeting these specific objectives naturally increased. This thus justified the development of a new generation of aircraft, capable of penetrating defences and striking such targets with a combination of powerful and reasonably precise weapons.

This particular capability became a sufficiently important element of the strike doctrine for the Reagan administration to maintain the *B-2* programme, despite the fact that the deployment of MX missiles (the future Peacekeeper) and Trident II D5 was expected to provide the ability to strike most targets with a high level of precision in the near future.

The value of the *Spirit* was also enhanced by the development of mobile ICBMs amongst potential adversaries. Their destruction was initially envisaged through barrage fire.¹⁶ However, such strikes were incompatible with the principles of the LNO. As a result, the penetrating bomber was assigned a new mission in which its ISR (Intelligence, Surveillance, Reconnaissance) sensors could locate mobile targets. The *B-2*'s high-altitude flight profile subsequently optimised its reconnaissance and identification role.

16. These firings must create an overpressure zone by multiple detonations over a geographical area where the launchers are likely to be deployed.

Technological Developments Since the End of the Cold War

Making Subsonic Cruise Missiles A Household Name

The end of the Cold War, combined with the collapse of Russia's nuclear potential, led to significant development. Due to its greater flexibility and reasonable cost, the subsonic cruise missile gradually overshadowed the development of high-velocity missiles, even within Russia. Its high penetration capability was ensured not only by the systematic use of stealth technologies but also, more generally, by the inadequacy of detection systems at low altitudes.

From the late 1980s to the present day, the United States developed two distinct generations of cruise missiles: the AGM-129 and the AGM-181. At the same time, they abandoned high-velocity systems like the SRAM, including an other and more evolved version of this weapon, which was discarded in the 1990s. The use of such high-speed weapons was primarily considered for the destruction of A2/AD (Anti-Access/Area Denial) systems. Although several weapons were studied for this purpose, none of these resulted in tangible results.

Russia, for its part, maintained a theoretical interest in high-velocity and hyper-velocity systems.¹⁷ However, due to budget constraints, it was ultimately forced to modernise its airborne component by focusing on the development of the subsonic Kh-101 missile. This missile was notably stealthier than the Kh-55 and had a significantly extended range.

The prominence of the subsonic cruise missile can be explained by its distinct technological advantages and relatively modest costs, particularly at a time when the perceived Soviet threat was fading. Moreover, the improved accuracy of ballistic missiles, especially those launched from submarines, significantly reduced the interest in supersonic systems. This shift further increased the appeal of subsonic cruise missiles for air forces. The reduction in nuclear arsenals that followed subsequently gave oceanic and land-based components a more predominant role.

The political aspects of deterrence often take precedence over operational requirements, which were increasingly neglected as a result of the lower level of tension between nuclear powers. This environment led to a rationalisation of the resources allocated to deterrence missions. The decline of the U.S. strategic airborne component between the 1990s and the 2000s can thus be explained by the gradual disappearance of some of its traditional roles, the growing importance of conventional missions, as well as the waning interest of political authorities and some military leaders in maintaining a focus on nuclear operations. By the turn of the millennium, a lengthy debate shook the Pentagon regarding the role of the next strategic bomber – the future *B-21 Raider*, which was initially conceived as a non-nuclear platform.

17. For the purposes of this article, the expression “high velocity”/“very high velocity” has been preferred to “high velocity”/“hypervelocity” in order to include high performance ramjets and super ramjets in the same framework of thought when the question of speed is addressed.

The phenomenon is even more pronounced in the United Kingdom. By deciding to base its nuclear capabilities exclusively on the SSBN/SLBM¹⁸ and to abandon the tactical airborne component, London gave up a certain degree of flexibility. This political and budgetary choice is justified, in part, by the close integration of British and U.S. deterrence components, which allowed the UK a greater flexibility in defining how to divide the means of deterrence.

French Exceptionalism: The ASMP and ASMP/A

The French approach is different, as it considers that the exercise of deterrence necessitates full sovereignty over its resources. By maintaining both oceanic and airborne components, as well as a nuclear air and naval force, Paris ensures optimal flexibility, allowing it to adapt its effects in line with the specific objectives sought and the players targeted.

Given that France possesses a relatively small arsenal of around 290 warheads, its strategy is structured through a straightforward scale of escalation: a warning strike which, if operations continue, heralds a strike designed to inflict unacceptable damage. Therefore, the weapon system's ability to fulfil its mission is considered a crucial criterion. This aspect is the basis for the decision of acquiring a high-velocity missile for the air component – the ASMP and then the ASMP/A from 2009¹⁹ – in order to guarantee penetration capability.

While the yield of the ASMP/A, estimated at around 300 kilotonnes,²⁰ suggests that it could be used to launch a strategic warning, the missile's "*very high precision [...] offers the possibility of destroying highly resistant targets and carrying out strikes with adaptable effects that are strictly in line with those decided by the President of the Republic.*"²¹

The decision to adopt a ramjet engine in the 1970s for the ASMP, and the subsequent modernisation of the system into the ASMP/A in the following decades, stemmed from common sense. This propulsion system allows for the missile to achieve very high speeds, between Mach 2 and Mach 3 at the end of the propulsion phase, and provides a range extending several hundred kilometres. Capable of reaching across a broader flight domain, the missile is able to execute flight trajectories at both high and low altitudes.

Combined with a fighter-bomber that is itself capable of providing a high-speed launch – thereby minimising the need for initial propulsion – ramjets offer significant advantages over subsonic missile propulsion, while adhering to almost identical

18. SSBN: Sub-Surface Ballistic Nuclear (in French: *Sous-Marin Nucléaire Lanceur d'Engins* – SNLE); SLBM: Submarine Launched Ballistic Missile.

19. ASMP: Air-to-Ground Medium Range; ASMPA: Improved Medium-Range Air-to-Ground.

20. For comparison, the atomic bomb used for Hiroshima had a yield of 15 kilotonnes.

21. "[Audition du Général Patrick Charaix, Commandant des Forces aériennes stratégiques, Assemblée Nationale, 15 avril 2014](#)," *Recueil d'auditions sur la dissuasion nucléaire*, Commission de la Défense nationale et des Forces armées (27 June 2014): 97.

weight and space constraints. Although the current trend is moving towards super-ramjets, which achieve speeds ranging between Mach 5 and 8, the potential of high-performance ramjets – capable of propelling a missile to speeds above Mach 3 – continues to look highly promising. These high-performance ramjets offer a credible and viable alternative to hypersonic systems in the short and medium term, both in terms of managing technological risks and optimising the operational use of the weapon.

High-Velocity Systems

The constraints that previously hindered the systematic use of airborne missiles, such as the relative lack of precision and their excessive mass, are no longer deciding parameters, even for very high velocity missiles.²² With the emergence of hypersonic propulsion, long-range systems are now significantly smaller in both size and mass compared to traditional missile systems. The only exception to this trend concerns aero-ballistic missiles, which still have a less favourable mass-size-range ratio.

Additionally, the importance of having onboard ISR capabilities is becoming less critical due to the deployment of space architectures based on massive constellations, such as the U.S. PWSA,²³ which set forth considerable advancements in target location and identification.

The criteria that determine the choice between gravity missiles and weapons, on the one hand, and slower but stealthier missiles or those with high or very high velocity, on the other hand, are increasingly focused on the importance of kinetic characteristics depending on the intended mission. The issue of penetration is also becoming more acute due to the improved performance of air and missile defences. For instance, the conflict in Ukraine tends to highlight the vulnerability of subsonic cruise missiles, a tendency that could increase significantly with the continued modernisation of radar technologies and the standardisation of distributed architectures.

In this context, if it is accepted that a nuclear strike must systematically be achievable – even against an IADS²⁴ or an IAMD²⁵ that has not been previously degraded –, speed offers greater security of achievement than stealth. High-performance ramjets and super-ramjets provide very high velocities along with particularly advantageous mass-to-range ratios. Similarly, despite the partial failure of the AGM-183 programme,

22. A nuance must be made for hypersonic systems whose accuracy could remain highly dependent on the satellite geopositioning signal (GNSS – Global Navigation Satellite Systems) for both navigation and terminal guidance. In the case of a nuclear device, consideration must be given to the quality of the system's accuracy based on inertial guidance supplemented, in the terminal phase, by TERCOM and DSMAC-type aids. Assuming a terminal phase of flight at high speeds (greater than 1 km/s, for example), these systems may be less effective than on slower craft.

23. Proliferated Warfighter Space Architecture. A project currently underway, which aims to deploy a massive constellation in low orbit relayed by another constellation in medium orbit. These two levels must ensure optimal detection of all types of targets and reinforce ground sensors intended for ballistic and hypersonic interception. The PWSA must allow data to be transferred in real time and should increase by tenfold the strike capacity into a strategic depth.

24. IADS: Integrated Air Defense Systems.

25. IAMD: Integrated Air and Missile Defence.

hypersonic gliders present another promising way of deploying longer-range systems, capable of reaching at least 1,500 km with speeds of 2 km/s and above. For both solutions, their flight altitudes are a parameter that favours penetration.²⁶ The combination of speed and altitude poses a considerable challenge for interceptors, which must be able to cover long engagement distances, sustain high speeds over extended periods, and exhibit significant terminal phase manoeuvrability.

Aero-ballistic systems also present undeniable advantages, particularly in the short term. The example of the Kinjal – a missile that uses older technology but operates at hypersonic speeds and is extremely difficult to intercept – clearly demonstrates the benefit of combining a very high velocity missile delivery system with a high-speed platform.²⁷ Unfortunately, they offer limited scope for potential in their future development.

Ultimately, missiles of more modern technology (including gliders and missiles propelled by high-performance ramjets or super-ramjets), alongside the exploitation of the speed and altitude of the aircraft, present the opportunity to use lighter missiles by limiting the mass and size of their chemical propellant (including the booster required for a super-ramjet). This reduction in weight provides a significant advantage, as it allows for a higher number of missiles to be carried per platform.

Airborne systems therefore provide a means of saturation over long and very long distances with a relatively limited number of aircraft. They also allow flexible combination – greater than ground-based systems – of missile trajectory, range, and speed (both average and during the terminal phase), posing additional challenges for enemy defences.

Although ground-based and naval platforms are capable of deploying manoeuvrable hypersonic systems, the airborne component continues to offer the most flexibility. It effectively prevents enemy forces from exploiting the flight phases where these systems are at their most vulnerable.

Similar observations could be made in the anti-ship field with the Kh-32. Although this missile is based on relatively old technology and is not considered of very high velocity, its highly supersonic speed nonetheless poses considerable interception challenges. The case of airborne anti-ship ballistic missiles (ASBMs) is different, particularly the heavy systems developed by China. These missiles are designed specifically to target carrier strike group, which are very high-value assets that can only rely on their own defences. As a result, despite their bulk, ASBMs offer a combination of very long range and strong penetration capability, providing interesting solutions even in the long term. For vehicles equipped with separable warheads, the speed of their re-entry body could allow them to exploit hypersonic bounce at low altitude, significantly complicating their tracking process.

26. 20 to 35 kilometres for a super-jet, 80 to 40 kilometres at cruising speed for a glider.

27. Bearing in mind that the size and drag of the single-body missile probably have a negative impact on its terminal velocity and expose it to significantly more defences than would the re-entry vehicle of a modern hypersonic system.

The Contribution of Stealth: Different Solutions for Different Countries

Although accuracy constraints could have a lasting effect on conventional hypersonic systems currently under development, the use of a nuclear munition significantly reduces this requirement and opens up the prospect of deploying an operational capability in the near future. However, the development of space architectures that are optimised for the warning and tracking of ballistic and hypersonic systems poses a substantial limit to the use of nuclear hypersonic systems with a strategic range.²⁸ Despite these systems being incredibly fast, they cannot guarantee surprise nor be used on a massive scale without triggering early warnings. In this context, stealth missiles have a clear advantage, as they are capable of infiltrating defences with a much lower probability of detection, thereby creating a genuine element of surprise.

Moreover, while the difference between speed and surprise is often minimal in conventional terms, it can be decisive in a nuclear context, especially for strikes against C2 posts or counterforce targets. Unless a nuclear conflict is initiated by surprise – a scenario that is generally excluded – the escalation process would likely involve neutralising certain defences to facilitate the subsequent penetration of stealth systems. For the targeted state, the disintegration of its defences and exposure to a strikes by undetectable missiles represent a risk that could lead it to escalate or prompt it to revise its objectives in favour of seeking a political solution.

Despite the advantages of very high-speed systems, subsonic missiles are likely to continue offering superior accuracy for many years to come. This is particularly true in comparison to high-velocity systems, especially in situations where where Global Navigation Satellite System (GNSS) signals or external data links are unavailable – a scenario that remains likely for nuclear payloads. Slower missiles can be equipped with lower-yield warheads, thereby providing more discriminating effects. In this regard, a weapon's lower yield should not necessarily be interpreted as a lowering of the threshold but rather as a strategic response to specific political demands.²⁹

The nuclear powers that implement complex employment strategies – essentially the United States, due to the constraints associated with its extended deterrent – will likely continue to employ both stealthy and high-velocity systems. The primary aim would be to provide themselves with as many strike options as possible, thereby retaining the flexibility needed to manage engagements against a wide range of adversaries at different levels of escalation. Washington's announce-

28. Which would, moreover, very likely be made up exclusively of gliders.

29. For nuclear powers anxious to respect their commitments in terms of international humanitarian law, the discrimination of effects is a factor to be taken into account. While this point may seem trivial in the context of a nuclear conflict, it would be less so in the context of a selective strike designed, for example, to neutralise the potential of a proliferating country or an emerging nuclear power that has used its arsenal first. The acquisition by the U.S. Air Force of the B61 Model 11 (a gravity weapon with a high penetration capacity for hardened targets) and the Model 12 (a high-precision variable-power gravity weapon) shows that the question of the operational use of nuclear weapons outside a major conflict can be raised. This implies that the delivery vehicle must be perfectly suited to the mission.

ment that it is upgrading the B61 gravity bomb to a more powerful version than the Model 12 for the *B-21 Raider*³⁰ further demonstrates that the combination of penetrating bomber and gravity bomb retains distinct advantages that even stealth cruise missiles cannot offer.

For a country such as France, whose strategy is based on the ability to respond and which does not intend to use warning strikes as a counterforce option, high-velocity systems appear to be the preferred choice. They provide optimal penetration of defences, regardless of the level of their readiness. Russia is also likely to adopt this type of solution, particularly within the European theatre, where the posture of its nuclear forces has traditionally been based on systems capable of executing decapitation strikes.. In this context, the Kinjal represents a serious threat that NATO will need to take into account in its defence plans.

Finally, on the Chinese side, the geographical elongation constraints of operating within the expansive Pacific theatre almost naturally necessitate the use of hypersonic systems. These systems effectively shorten engagement loops over long distances, while subsonic systems are increasingly exposed and vulnerable to ISR detection capabilities from U.S. or allied Asian naval and air forces.

Missiles for the Future: New Challenges in Hypersonic Missile Development

Arms Controlling for Hypersonic Missiles

The high likelihood that hypersonic systems will be used for nuclear strikes raises significant concerns regarding arms control and the duality of conventional and nuclear systems. This issue is particularly pertinent in the context of hypersonic systems used with a conventional capacity.

U.S. officials, for example, do not rule out the possibility of future nuclearisation, even though the current programmes are entirely conventionally armed focused. Such statements could indicate the potential integration of dual-use systems for strategic purposes within the United States' military arsenal. In contrast, French officials tend to exclude the conventional use of weapons that are intended to fulfil a strategic role but are primarily classified as medium to intermediate range.

The positions of Russia and China are also subjects of debate. Moscow assigns a nuclear capability to its strategic systems, such as the *Avangard* glider, although there remains some degree of ambiguity regarding the Kinjal. Beijing, on the other hand, maintains complete ambiguity over its intentions. However, it seems highly probable that its anti-ship systems (including ASBM and gliders derived from the DF-ZF/DF-17) will possess a nuclear capability. This is likely to bolster the deterrent role of these strike systems, particularly in the event of a confrontation with the United States.

30. The B61 Model 13 is expected to use the same guidance system – a JDAM (Joint Direct Attack Munition) type kit – as the B61 Model 12, but with a higher maximum power rating.

The revival of hypersonic programmes in the United States immediately urged the disarmament community to call for restrictive measures, as these systems are viewed as destabilising. The New START treaty³¹ imposes a *de facto* constraint on gliders if their thrusters can be considered as strategic delivery systems. However, the rapid dissemination of technologies related to gliders – technologies that are directly derived from manoeuvrable warheads³² – indicates that their inclusion in the legal framework of arms control can only be partial. The exception occurs when weaponry is defined by criteria other than the nature of the weapon (such as a weapon of mass destruction) and the range of the delivery system.

Additionally, several states with the capability to develop such systems are not involved in ongoing discussions to legally control them. Nevertheless, in smaller theatres, such as Europe, the ranges of hypersonic systems are such that they pose a threat to a large number of strategic targets. Therefore, they should not be excluded from any future disarmament process.

These challenges regarding the control of long-range nuclear-capable weapons are not new. For ground-based systems, several solutions exist, including geographical exclusion (which prohibits deployment in specific areas), the characterisation of flight domains,³³ or the verification of equipments *in situ*. However, the flexibility that airborne platforms provide to hypersonic systems could make this type of control more difficult.

Although the idea of including non-strategic hypersonic weapons in the framework of arms control raises a number of difficulties, it is nonetheless imperative to give it careful consideration. Should Russia decide to equip the Kinjal or its future intermediate-range systems with nuclear capability, it would then have a strategic strike capability that could encompass almost the entirety of Western Europe. In response, the United States could choose to counter with its ground-based systems that are currently being deployed, such as the Black Eagle. Moscow and Washington would then find themselves confronted with the same issues as the Euromissile crisis in the 1980s.

The dual nature of airborne systems increases the complexity of the problem for Moscow. The combination of platform and missile would grant hypersonic systems based in NATO countries the ability to hit key strategic targets in western Russia. In the event of a conventional conflict, the extension of targeting to tactical targets deep inside Russian forces – including air and missile defence sensors – would expose Moscow to the (likely exaggerated) risk of nuclear decapitation strikes, creating a further degree of instability. However, a similar problem would arise with the use of stealth subsonic nuclear missiles when, paradoxically, their slow speed generates less concern – at least it is so amongst disarmament specialists.

31. The New START (New Strategic Arms Reduction Treaty) was signed in April 2010 and entered into force in February 2011. Expiring in 2021, it has been extended to 2026.

32. This is not the case with super ramjet technologies, which are still highly confidential and probably beyond the reach of many industrialised military powers for many years to come.

33. Criteria such as range and speed, and possibly altitude, could be used to characterise strategic systems.

The same risk is also evident from the European perspective. Despite this, Washington's ongoing concern to maintain credible extended deterrence – alongside the oceanic components of British and French forces, as well as the nuclear capabilities provided to NATO by the United States, puts the problem into perspective. Even if a Russian decapitation strike were to cause significant damage to NATO's land-based nuclear assets, it would not severely undermine a second-strike capability

Those who favour stringent regulation of hypersonic weapons argue that these systems generate instability because of their unpredictable nature, particularly due to their speed and manoeuvrability, which exacerbate the logic of decapitation strikes. One way of addressing these problems is to adopt a rigorously opposite approach. Given the development of highly advanced anti-missile and anti-aircraft defences, the very high penetration capability of hypersonic systems could instead be perceived as a guarantee of a limited first or second strike. This would reinforce the shared sense of vulnerability among major nuclear powers, which missile defences otherwise tend to diminish.

In this context, the airborne component provides genuine added value. It greatly enhances the effectiveness of hypersonic systems against mobile systems and C2 centres, allowing these targets to be struck even if they are located within the strategic depth of the enemy's system. There is, of course, a downside to this. These systems are set to play a full role in the operationalisation of nuclear strategies. This is particularly the case for theatres where the flexibility of the platform-missile pairing and the reduction of weapon yields act as strong incentives for conducting precision strikes or for the development of warfighting strategies.

Defending Against Hypervelocity

Generally speaking, while stealth missiles are of undeniable operational interest and may be perceived – perhaps wrongly – as less destabilising than their faster counterparts, there are nonetheless two potential pitfalls in their development: the increasing proliferation of hypersonic means within tactical-operational ranges and, in the longer term, the growing viability of super-ramjets.

This phenomenon will lead to an increase in the tempo of operations and a geographical extension of the vulnerability of critical targets. To respond to aggression, the defender must be able to act in the depths of the aggressor's territory, at the same or higher tempos than the enemy, and sometimes with a pre-emptive logic.

Exposure to a hypervelocity strike³⁴ is also set to increase with the announced revolution in C4ISR³⁵ and the deployment of space architectures that are organised around massive constellations, such as the U.S. PWSA. This system, which is structured around several hundred satellites and further reinforced by civilian constellations, aims to develop a global architecture that enables, amongst other

34. That is to say, from highly supersonic, hypersonic, and ballistic devices.

35. Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance.

things, the identification of fixed, relocatable, and mobile targets deep within the adversary's territory. It also seeks to support the development of a C3 (Command, Control, Communication) system, which allows the user to rapidly utilise the data collected at very short notice.

The structuring of a C4ISR system for conducting strikes at great depth in the theatre and, for European countries, at strategic depth, raises a significant problem of vulnerability, particularly concerning the airborne component. Although this threat is not entirely new, it had considerably diminished in Europe and the United States following the fall of the USSR. The consolidation of IAMD resources in response to emerging theatre threats has improved the security of the most sensitive bases. However, despite these improvements, substantial efforts still need to be made to further limit the vulnerability of key infrastructures in the future.

More broadly, the vulnerability of air bases depends on the context. For instance, in the case of a limited conventional conflict, this vulnerability would be relatively manageable, as strikes at strategic depth would tend to be occasional and could be mitigated by the adoption of appropriate active and passive defence measures. However, in a nuclear context, if it is accepted that the coupling of the aerial platform and the hypersonic missile optimises the missile's performance, then the airborne component would naturally represent a priority target. This aspect, again, is not entirely new, and measures to harden or disperse forces have thus far succeeded in limiting their exposure. Despite these efforts, the combined transformation of ISR and strike resources may lead to a reappraisal of strike systems that are perceived as less vulnerable, such as oceanic platforms or, with considerably less certainty, ground-based platforms.³⁶

The issue of vulnerability is not confined to the bases or platforms themselves. The U.S. PWSA is supplemented by a Hypersonic and Ballistic Tracking Space Sensor (HBTSS) component, which could consist of at least several dozen satellites. This type of architecture is expected to offer strong detection and discrimination capabilities. It would represent the most crucial link in the development of an interception capability against glider-type platforms.

In parallel, advancements in super-ramjets could make it possible to design significantly more powerful interceptors, capable of engaging hypersonic gliders in the terminal phase of their cruise flight, when altitudes are lower. In the medium term, it cannot be ruled out that the survivability of hypersonic gliders will be drastically reduced because of their lack of stealth. Hypersonic cruise missiles, which fly at lower altitudes, can probably be detected. However, in the absence of data on the capabilities of the HBTSS, it is difficult to establish if this architecture will significantly increase the risk of interception of craft powered by super-ramjets.

In any case, it could prove unwise to base a deterrent exclusively on hypersonic devices. This observation makes a strong argument in favour of maintaining a stealthy subsonic capability, which, for some time to come, will remain exposed primarily to ground-based radars.

36. As a reminder, the United States is developing a hypersonic surface-to-surface system known as "Black Eagle".

Conclusion

This analysis has primarily focused on missiles rather than on the air component. The brief descriptions given illustrate the causal link between several domains. The choice of a weapon system (including the kinetic characteristics of the delivery system) remains closely tied to the strike strategies that are selected. These strategies depend on the nature of the target and the military or politico-military effect sought after. The final decision, however, must also take stock of the question on the defences that are likely to prevent, impede, or complicate the implementation of the chosen system.

In terms of airborne weapons, the criterion that is common to all these approaches is the penetration capability of the platform as well as the missile. This capability is ultimately what helps to define the use of nuclear weapons on a specific target.

For strikes against mobile targets that are located deep within geographic areas, the ISR function of the platform plays a crucial role. This requirement explains the continued development of stealth bombers that are paired with gravity bombs or stealth subsonic missiles. This is particularly evident in advanced systems like the *B-2 Spirit* and the Long Range Stand-Off Weapon.

As regards to the air component in a more general manner, its vulnerability is a well-known factor and can only be partially mitigated. However, it is important to bear in mind that deterrence is not solely exercised against the major nuclear powers; maintaining a certain degree of flexibility helps to give it credibility when facing third-party actors. Moreover, this component should not be viewed in a static prism. Over the past thirty years, advances in stealth technologies, jamming capabilities, and the development of munitions have enabled the air component to overcome the modernisation of air defences and reduce its overall level of vulnerability.

Propulsion systems are currently undergoing significant evolution, which is already evident in cruise regimes but has the potential to be even more impactful at higher speeds. Both the United States and China are heavily investing in super-ramjets as well as in combined propulsion systems, including super-ramjets paired with turbojets or super-ramjets integrated with chemical propulsion. These technological developments could eventually lead to major advances in future aircraft. Preserving the airborne dimension will require an evaluation of these evolving technologies, as they present promising solutions that could benefit both military and civilian applications.

AIR NUCLEAR COMPONENTS
History

The French bomber revival, 1942-1945: learning about aerial warfare, victory without glory

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“The stars of heaven will fall unto the earth and men will perish from fright.”¹

Introduction: a historiographical paradox

The history of French aviation during World War II, analyzed from the viewpoint of 20th and 21st century historiography, reveals three dominant themes. The first concerns the *Forces aériennes françaises libres* (FAFL – Free French Air Forces), General de Gaulle’s military air force, whose courage and heroic exploits by its several thousand volunteer men and women have left an extensive memorial legacy.² The second, to a lesser extent, focuses on the disaster of the Battle of France in 1940, a deep and lasting trauma for the Air Force, which has also been the source of numerous testimonies and academic studies.³ A third angle of study, which appeared much later, focused on the dark side of these war years, with the complex history of the Vichy Air Force.⁴

1. Jules Roy, paraphrasing the Gospel in *Retour de l'enfer* (Paris: Gallimard, 1951): 189.

2. In addition to the many testimonials from airmen, notably from the “Normandie-Niemen” fighter group, see the works of François Pernot (notably special issue no. 10 of the magazine *Fana de l'aviation*, June 1999), and the twenty-three dedicated issues of the magazine *Icare*.

3. In addition to the works of P. Garraud, see J.-C. Foucrier, A. Renaudière, “Victories in Defeat? The Writing of Air Forces’ History in the ‘Battle of France’,” *Nacelles* magazine, no. 10, Presses universitaires du Midi, Université de Toulouse (2021).

4. C. d’Abzac-Epezy, *L’armée de l’Air des années noires, 1940-1944* (Paris: Économica, 1998).

These different aspects of French aviation during World War II cover most of the conflict, until August 1944, with the end of the Vichy General Secretariat for Air Defense, and the theoretical disappearance of the FAFL one year earlier.⁵ The continuing hostilities, which dragged on until May 1945 in Europe and September in the Far East, were characterized by an unprecedented air campaign against the Reich. This has strangely fallen into a historiographical void. While the term “Heavy Groups in the UK” can be found in a few specialist works,⁶ it would be particularly difficult to find a detailed history of the “1st CAF” and “11th BBM”, or even to identify these military acronyms. The paradox, however, seems striking: these were the two largest French Air Force formations, exceeding 50,000 men and women in the autumn of 1944, deployed to support the entire 1st French Army and some of the Allied troops until victory. A remarkable achievement, unprecedented since the Battle of France in the spring of 1940. Although the FAFL had played an important symbolic and political role for Free France, its few thousand volunteers had never had any influence on the ground other than a tactical one, since it lacked the volumes or the command to be given a role on the operational level.

This study offers a historical introduction to the revival of the French Air Force from 1943 onwards, focusing on the medium bomber units gradually united in the 11th *brigade de bombardement moyen* (BBM – medium bomber brigade), and on the heavy formations, made up solely of the 2/23 “*Guyenne*” and 1/25 “*Tunisie*” *groupes de bombardement* (GB – bomber groups) deployed in the UK. These units, among the least well known along with the other reconnaissance and transport formations, nevertheless served as a crucible and trained the vast majority of the Air Force’s future senior officers.



1/25 “*Tunisie*”.

Source: SHDAI_AI_6_FI_B85_2039_0001_4.

5. Merged with the African Army in the summer of 1943, although the majority of London-based airmen were stationed in the UK until the end of the conflict.

6. L. Bourgain, *Les bombardiers lourds français 1943/1945, sarabande nocturne* (Saint-Martin-des-Entrées: Heimdal, 1996); “Les bombardiers lourds français dans la Royal Air Force, 1943-1945,” *Icare* magazine, no. 187 (2003).

In particular, we look at how air warfare was taught in Allied schools, with the non-negotiable obligation to follow a full training course; at the sometimes tense assimilation between former FAFL and ex-Vichy force airmen in Africa; at the formation of major bombing units; at operational conditions of engagement; and finally at the memory of these formations. The primary sources come from unit archives held by the *Service historique de la Défense* (SHD – Defense Historical Archives) in Vincennes, enriched and illustrated by oral testimonies from airmen also collected by the same department.

The art of aerial warfare: in Allied schools

North Africa's switch to the Allied side in November 1942 led to the rallying of 200,000 French soldiers who had remained with the Vichy force since June 1940. These included 30,000 airmen, a considerable number compared with the cumulative total of 5,000 members of the FAFL during the war.⁷ Three challenges had to be met if an Air Force was to be reborn and engaged for the liberation: healing the fractures caused by the June 1940 armistice by merging manpower; rearming and re-equipping existing formations; and creating new major units capable of playing a role in operations. A vast task, dependent on the goodwill of the Allies, who were at first seriously troubled by French political quarrels in North Africa.

The gradual removal of generals who had kept their post after November 1942 but were too compromised with Vichy (notably Mendigal and Bergeret)⁸ enabled the rise to prominence of new cadres, such as General René Bouscat, appointed Chief of Staff of the French Air Force (officially reconstituted on August 1, 1943), his Chief of Staff General Paul Gérardot, and *Lieutenant-Colonel* Philippe Hartemann of the third bureau. These three officers skillfully negotiated with RAF Marshal Arthur Tedder, head of Allied air forces in the Mediterranean. In the summer of 1943, Tedder set up the Joint Air Commission, responsible for overseeing the French Air Force's rearmament program. The principle was accepted: the Allies would train, arm and equip new French units, under Allied command, for the continuation of campaigns in the Mediterranean and Europe.

For the French airmen, and bomber crews covered by this study, the foundation of this renaissance was conditioned on a *sine qua non*: a return to the benches in Allied schools. The art of aerial warfare had evolved since 1940, a time when the French army did not leave a major impression. Even aircrew with thousands of flying hours had to start all over again. This was not always a source of pride, as was the case for the French volunteers who were sent to England in 1943 to form two new heavy groups. "*I found myself volunteering to go and reinforce the heavy groups in England in January 1944,*" recalls radio navigation operator Robert Nicaise, who had

7. S. Albertelli, *Atlas de la France libre* (Paris: Autrement, 2010): 49-50.

8. General Jean Mendigal, head of the African air forces, fought against the Allied landings in North Africa, before being retained in his post and initiating the rearmament of the Air Force until his dismissal in June 1943. General Jean Bergeret, Vichy Secretary of State for Aviation, was noted for his anglophobia, anti-gaullism and zealous application of anti-Semitic measures within the secretariat.

experienced his baptism of fire during the Battle of France four years prior. “*People were arriving from all over the place, supposedly with certificates, but nobody had any serious training; we were all sent back to school.*” This obligation applied to all ages, as evoked by another radio navigation operator, Captain Alexandre Barbe: “*During the training period, there were no psychological strains, apart from the fact of having to start again from scratch – especially for me, since I was already 29.*”⁹

The training process at Royal Air Force schools, tried and tested since the beginning of the war, nonetheless commanded respect from French newcomers. Following initial selection, a four-week training course in Canada was devoted to initial flight training or consolidating skills (Elementary Flying Training School) and flying in formation (Service Flying School). RAF pilot qualification (Advanced Flying Unit) took place back in the UK, as did specialization in fighter, bomber or observation aircraft (Operational Training Unit – OTU). Navigators and radio operators/gunners underwent specialized training (School of Technical Training). In all, training varied from 32 to 64 weeks, requiring up to 240 flying hours for bombers.¹⁰

French volunteers for the heavy groups also had to specialize on their future platform, the four-engine *Halifax*. In service since 1940, this strategic bombing veteran appeared outdated four years later. In particular, it was far less maneuverable than the new four-engine *Lancaster*, the spearhead of Bomber Command, which was reserved for its best groups. Training was carried out on training sites in Scotland. The training facilities in England and Wales were dedicated to operational units carrying out raids in Europe. Captain Barbe sums up this long and difficult experience, which was nonetheless a guarantee of efficiency for the future, in this brief account:



2/23 “*Guyenne*”.

Source: SHDAI_AI_6_FI_B92_463_0001_4.

9. SHD AI 8 Z 440, interview with Colonel Alexandre Barbe, December 10, 1985; January 30, 1986 and February 16, 1987.

10. SHD 4 D 56, Fonds Seconde Guerre mondiale : Forces aériennes libres et Forces alliées, FAFL/Staff/second bureau, *Instruction du personnel navigant des FAFL dans les écoles de la Royal Air Force*, March 1, 1943.

“You had to complete all the courses, or risk being eliminated, or having to repeat them with another crew. All training was in English. Elementary Training was carried out in Canada, and then in England, exclusively at night, on obsolete twin-engine aircraft that sometimes broke up in flight. The crew was then reunited, before leaving for OTU in Scotland. Training was extremely tough, with appalling weather, often snowy, and icy runways. We were taught to evacuate the fuselage of an aircraft stranded on water in eleven seconds, matching the average time an aircraft floated before sinking. It was December 1943, and the water temperature was 3°. It was really extremely tough, but probably also necessary, as I never encountered such harsh conditions in my subsequent operational missions.”¹¹

The GB 2/23 “*Guyenne*” was declared operational on June 1st, 1944, three weeks ahead of its twin unit, the GB 1/25 “*Tunisie*”; both were based at Elvington, which was under the command of a Frenchman – a unique occurrence in England – Colonel Paul Bailly.

U.S. airmen were also involved in the training of French aircrews. In March 1943, USAF General Carl Spaatz authorized contingents to be sent to schools in the United States, notably Turner Field and Lincoln Field (Georgia and Nebraska) for bombing training.



French bomber training school in the U.S.
Source: SHDDE_DE_2021_PA_84_0095_4.

Boeing B-26 medium bomber crews were trained directly in North Africa. Training took place during daytime and followed American doctrine. Less demanding over the long term, this training nevertheless involved learning to fly in very tight formation, which was considered a determining factor in maintaining an airborne operation, whatever the weather conditions, and reaching the target in force. Here, too, the discipline and quality of the equipment aroused the enthusiasm of French airmen, as in the case of Captain Charles Lasnier-Lachaise, squadron leader with GB 2/52 “*Franche-Comté*”:

11. SHD AI 8 Z 440, interview with Colonel Alexandre Barbe, December 10, 1985; January 30, 1986 and February 16, 1987.

“The 2/52 converted to B-26 Marauders at Blida under American command. Organization was meticulous, backed by sportsmanship and unflappable composure. American equipment was superior to the French. Flight formations were very tight, with rigid regrouping phases after take-off. The Americans were very keen on flight discipline, almost more so than on the result of the bombing itself – which seems paradoxical. But it was the cohesion of the formation that produced the results. I felt I was on the winning side thanks to these tight, reassuring formations, while taking advantage of air superiority, which was quite a change from the first part of the war.”¹²



Crew pose in front of B-26 (with Norden bombsight), 1st squadron of GB 1/52 “*Franche-Comté*”.
Source: SHDAI_AI_6_FI_B78_1058_0001.

In all, by summer 1944, the program set up by the Joint Air Commission had equipped eight fighter groups, four bomber groups and nine reconnaissance and transport groups, crewed by 30,000 airmen – the vast majority from the African Army, which had joined the Allied force in 1942.¹³ Immediately engaged in operations, these units served as a crucible for the large formations of the new French Air Force.

Operational impact: the 11th BBM and the 1st CAF

The faster pace of American training on the B-26 accelerated the entry into the field of the 31st medium bomber wing on March 29, 1943. It was commanded by General Guillaume Gelée, and comprised the GB 1/19 “*Gascogne*”, 1/22 “*Maroc*”

12. SHD AI 8 Z 345, interview with General Charles Lasnier-Lachaise, April 29, May 6, May 11 and July 5, 1983; May 18, 1944.

13. A. Corvisier (ed. A. Martel), *Histoire militaire de la France*, tome IV: “De 1940 à nos jours” (Paris: PUF, 1994): 184.

and 2/20 “Bretagne”. According to Major François Ernoul de la Chenelière, a former member of General Bergeret’s entourage in Vichy, who was assigned to the squadron after the Allied landings in North Africa, the combination between the first two GBs from the Vichy Air Force and the last one from the FAFL did not go smoothly at first:

*“The 31st squadron was made up of regular army, not to say Vichy, personnel, with the exception of a group from Free France, the “Bretagne”. In the beginning, during training with the Americans, it was very difficult, the atmosphere was not good. The Free France guys accused the others of being Nazis, and were called Communists. General Gelée finally got things back on track, as did the daily routine of joint missions.”*¹⁴

For Captain Lasnier-Lachaise, “The combination with the FAFL was rather difficult, especially for the ground crews, who thought that those who were not Free France were of no interest. It was easier with the flight crews, since we were all in the same business.”¹⁵

Quickly operational, the 31st wing took part in the Italian campaign in 1943 and early 1944, then in Operation *Dragoon* in the spring in preparation for the Provence landings. This unit operated under the command of the 42nd Bomb Wing (attached to the XIIth Tactical Air Force). The UK-based heavy groups, meanwhile, were attached to Bomber Command, which was not far from being an independent command due to the tetchy authority of RAF Marshal Arthur Harris. The other fighter, light bomber and reconnaissance groups were similarly scattered between British and American commands. So, even though the French Air Force was back in action and participated in the liberation of France in the summer of 1944, none of its major formations exceeded the size of a squadron and none of them had the capability to support land forces at the operational level. This was the crux of the restructuring carried out by General Gérardot in the autumn of 1944.

On November 5, 1944, the 1st *Corps aérien français* (CAF – French air corps) was officially activated. Although it remained under American command (henceforth 1st Tactical Air Force), it was given unprecedented leeway – it was assigned to support an entire army, the 1st French Army: “The mission of the 1st CAF was to deploy the air assets required to provide air support for the operations of the 1st French Army, and to participate, if necessary, in air operations carried out on behalf of Allied forces.”¹⁶ For this support mission, the corps could call on – an unprecedented luxury – three fighter and fighter-bomber squadrons, a reconnaissance wing, a transport group and an air artillery group. With the exception of the two French heavy bomber groups of Bomber Command and the British-led “Lorraine” light bomber group, all medium bomber groups were brought together in a new medium bomber brigade,

14. SHD AI 8 Z 140, interview with General François Ernoul de la Chenelière, April 2, May 30, June 1 and 22, July 2, 1979.

15. SHD AI 8 Z 345, interview with General Charles Lasnier-Lachaise, April 29, May 6, May 11 and July 5, 1983; May 18, 1944.

16. SHD AI 4 D 101, 1st French air corps/ staff / third bureau, *Historique du 1^{er} corps aérien français*, no date.

no. 11, based in Lyon. This brigade included the 31st squadron, which had already been operating since spring 1943, and a new unit, the 34th squadron, comprising the GBs 2/52 “*Franche-Comté*”, 2/63 “*Sénégal*” and 1/32 “*Bourgogne*”.¹⁷

The 11th BBM remained under the American command of the 42nd Bomb Wing, but like the 1st CAF, its commander, General Gelée, had effective control of operations for the first time, with his third bureau headed by Major Ernoul de la Chenelière. The latter was satisfied with relations with the Americans, despite the culture shock:

*“The American system surprised us. It was fine-tuned. We received target files, which were perfect, with briefings and debriefings. They were so well-equipped that any aircraft returning with a simple malfunction could remain grounded for the following day. The Americans were all on a first-name basis, and played baseball, which shocked us. But from a disciplinary point of view, organization was perfect, refueling impeccable, maintenance rules very strict. Relationships were excellent.”*¹⁸

Relations were so harmonious that they led to the failure of the attempt fomented by General Gérardot, to remove the 11th BBM from under the umbrella of the 42nd Bomb Wing in favor of the 1st CAF. The aim was to reinforce this vast French formation with the 31st and 34th squadrons, and potentially give it the status of an air force. The maneuver failed, however, due to the lack of experience of the 1st CAF chiefs of staff in indirect support, a mission performed by the brigade’s medium bombers. According to Captain Lasnier-Lachaise, this attempt at “annexation” provoked fierce opposition from General Gelée:

*“We were under American command, despite an attempt to regain control by the 1st French Air Corps, commanded by General Gérardot. It was an operational disaster. Their staff had no experience in medium bombing missions: they sent us to impossible targets. General Gelée arranged for us to return to American command under the 42nd Bomb Wing. We refused to be under French command, which lacked the capability to lead us.”*¹⁹

Gérardot’s hegemonic operation thus failed, not without irony, due to the brigade’s French revolt – which, incidentally, was operationally justified. By the end of 1944, all the French Air Force’s medium and heavy bomber formations were in place, under American and British command, ready for their final and most difficult campaign against the Reich.

Two common enemies: the Luftwaffe and winter

In November 1944, when the French Air Force regained its powerful operational potential with the activation of the 1st CAF and 11th BBM, Allied air control over

17. SHD AI 4 D 62, Organisation, operations, personnel, Air Ministry – first bureau, *Tableau des Etats-majors, formations et unités rattachées au général, inspecteur de l’armée de l’Air, commandant les forces aériennes engagées*, January 17, 1945.

18. SHD AI 8 Z 140, interview with General François Ernoul de la Chenelière, April 2, May 30, June 1 and 22, July 2, 1979.

19. SHD AI 8 Z 345, interview with General Charles Lasnier-Lachaise, April 29, May 6, May 11 and July 5, 1983; May 18, 1944.

Europe had been firmly established since the previous spring.²⁰ Strategic air raids launched from the UK and Italy were now able to overfly the whole of Germany and reach Austria, Czechoslovakia and Poland, usually without incurring prohibitive losses. Defeated German fighters, however, were still capable of sporadic, localized reactions until the end of hostilities, with the threat of jet fighters more psychological than real due to the lack of experienced pilots and fuel. At the beginning of December 1944, General Gelée himself alerted the second bureau of his brigade:

*“Squadron intelligence officers are reminded that German fighters are not only seen on the ground. Reports from fighters and bombers are received almost daily of fighter formations. These formations are generally well-equipped, and in addition to the well-known older fighters (Me-109 and Fw-190), there are also formations of jet fighters (Me-262). It is important that in preparing and briefing for every mission, the crews’ attention is drawn to the danger this represents.”*²¹

Despite the spurts of activity of German fighters, the opposition encountered by the 11th BBM stemmed above all from two other factors, as indicated by General Lasnier-Lachaise, of the third bureau: *“The brigade’s missions were very difficult over the Reich, not so much because of fighters, but because of air defense, and the weather conditions in the winter of 1945.”*²² Bad winter weather, which had already represented a major obstacle for Bomber Command during the Battle of Berlin a year earlier, was once again severe on the Western Front, reducing the effects of Allied air superiority and encouraging the German counter-offensive in the Ardennes in December 1944, then the fierce defense of the Rhine until early spring 1945. The brigade carried out just 144 sorties in January and 466 in February, before a relative return to favorable weather conditions in March (778 sorties)²³. As for the flak, organically attached to the *Luftwaffe*, it remained a constant peril right up to the end of hostilities, when it reached its peak. Units were increasingly concentrated on the Reich’s shrinking territory. It also benefited from the vast industrial credits granted by Hitler, who believed that the spectacle of thousands of anti-aircraft guns firing in concert would comfort the population. This was the main threat identified for aviation, according to alarming estimates by Allied intelligence services in January 1945:

*“It is estimated that the German air force and navy have 18,000 heavy guns and 37,000 light guns in all theaters of war, with production at a rate of 200 heavy guns and 500 light guns per month. The replacement of worn-out guns absorbs only a small proportion of production, and combat losses are offset by the reduction in the territory to be defended; it is therefore expected that the Germans will have a surplus of equipment over the coming month.”*²⁴

20. See J.-C. Fouchier, *Ciel du Reich – 1944* (Paris: Perrin, collection “Champs de bataille”, 2025 [forthcoming]).

21. SHD AI 4 D 115, 11th medium bomber brigade / second and third bureaux, *Memo*, December 7, 1944.

22. SHD AI 8 Z 345, interview with General Charles Lasnier-Lachaise, April 29, May 6, May 11 and July 5, 1983, May 18, 1944.

23. SHD AI 4 D 116, 11th medium bomber brigade / third bureau, *Compte-rendu d’activité du mois de mars 1945*, April 5, 1945.

24. SHD AI 4 D 115, 11th medium bomber brigade / second and third bureaux, *Air Intelligence Summary no. 522 – Prevision FLAK*, January 28, 1945.

At the beginning of 1945, countermeasures to limit the danger posed by flak were a daily priority for the brigade's staff, as explained by its new chief, General Pierre Louis Bodet, successor to General Gelée:

"In the current military situation on the Western Front, it is becoming extremely difficult to keep an up-to-date map of flak deployment. It seems, however, that the Germans are attempting to deploy batteries that have been pulled back along the country's main rail and road routes. We can therefore expect to encounter flak, often sparse, but accurate, throughout the duration of flights over enemy territory. Consequently, in order to limit enemy defensive action as much as possible, commanders will apply the following measures:

- a) Constant use of evasive actions while flying over enemy territory.*
- b) Choose routes that are as far as possible from major traffic arteries. The formation's flight details can be chosen accordingly, and navigation should be as precise as possible.*
- c) In addition, avoid important communication centers, which will almost always be systematically defended."*²⁵

Improved weather conditions from March 1945 onwards enabled an increase in the number of missions and improved accuracy, as General Bodet was pleased to report, despite the brigade's transfer to Haute-Marne:

*"The percentage of results achieved rose from 35% in January to 45% in February and over 50% in March. It is important to note that the most active period (March 15 to 22), during which the maximum effort was required on a daily basis, coincided with the brigade's move from Lyon to Saint-Dizier. This effort could only be maintained thanks to the absolute dedication of all the personnel under my command, who performed admirably, day and night."*²⁶

Unlike the fighter-bombers of the 1st CAF, the medium bombers of the 11th BBM did not take part in direct support of the 1st French Army, but carried out a battlefield interdiction campaign in the German XIXth sector, mainly targeting major railway centers (Stockach, Engen, Neustadt, Biberach...), airfields (Laupheim, Ristissen...), fuel and ammunition depots (Ebenhausen, Geislingen, Strass...) or barracks and factories (Donaueschingen, Lahr...).²⁷ As of May 8, 1945, out of a total of 4,796 missions carried out since March 1944, the losses of the 11th BBM remained light, and mainly due to flak: 21 aircraft lost (416 damaged), for only one shot down by the *Luftwaffe*.²⁸

25. SHD AI 4 D 115, 11th medium bomber brigade / second and third bureaux, *Memo*, January 24, 1945.

26. SHD AI 4 D 116, 11th medium bomber brigade / third bureau, *Compte-rendu d'activité du mois de mars 1945*, April 5, 1945.

27. SHD AI 4 D 121, 11th medium bomber brigade / first, third and fourth bureaux, *Résultats de la brigade en Allemagne du sud*, May 15, 1945.

28. Personnel losses were 130 killed; 20 German aircraft were destroyed, most of them (19) on the ground. SHD AI 4 D 116, 11th medium bomber brigade / third bureau, *Activité de la brigade de bombardement no. 11*, May 8, 1945.



Damage assessment, bombing of ammunition depots in Strass Forest (11th BBM).

Source: SHDGR_4_D_118_002.



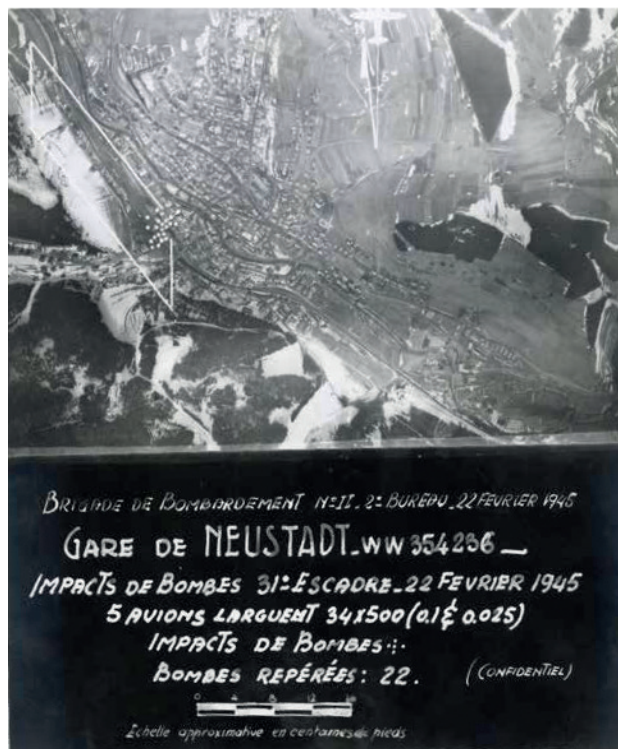
Damage assessment, bombing of Ristissen airfield (11th BBM).

Source: SHDGR_4_D_118_003.



Damage assessment, bombing of Stockach station (11th BBM).

Source: SHDGR_4_D_118_001.



Bombardment report, Neustadt station, February 1945 (11th BBM).
Source: SHDGR_4_D_118_001.

In England, the question of merging former FAFL personnel with the African army did not arise, if at all, for the heavy groups, which had their own base at Elvington. The head of the “Guyenne”, *Lieutenant-Colonel* Gaston Venot, makes no secret of the barrier with historical FAFL groups, which officially became the French Air Forces in Great Britain after the merger, under the command of General Valin:

*“We had absolutely nothing to do with the FAFL; we were entirely under British command, according to the RAF’s own rules. We did not request reinforcements from the French Air Command in England, which would not have given them to us. Our reinforcements came from Africa, calculated on the basis of a statistical loss rate of 5%. A safety margin, since losses varied from 3% to 4% per mission.”*²⁹

The “Guyenne” and the “Tunisie”, attached to Bomber Command, were theoretically intended to carry out strategic bombing raids on the *Reich*, in order to achieve economic paralysis and possibly provoke an uprising of the civilian population against the Nazi authorities. In fact, the entry into operation of the two heavy groups in June 1944 coincided with the temporary provision of Bomber Command resources for *Overlord*, in support of the land operations of the Battle of Normandy. French airmen intervened on tactical interdiction targets in France (railway stations), against

29. SHD AI 8 Z 104, interview with General Gaston Venot, May 18, 1978.

V1 launch pads, and sometimes even in direct support of the attacking forces, as at Caen in July and Le Havre in September. That same month, with Bomber Command regaining its quasi-independence, the “*Guyenne*” and “*Tunisie*” took part in strategic missions over Germany, bombing the few major cities still more or less intact (Munster, Essen, Duisburg, Wilhelmshaven...).

The two French heavy groups at Elvington faced the same obstacles encountered by the 11th BBM, be they fighters, flak or bad weather. However, they suffered far more intensely, taking twice as many losses as the six groups of the 11th BBM: 41 aircraft shot down and 216 flight crew killed.³⁰ This was partly due to the fact that Bomber Command raids were flown at night. Air Marshal Harris’s staff ordered missions to be carried out in bad weather much more frequently than the brigade’s staff. The risk of collisions and accidents was greater, and British bomber crews were subjected to the deadly efficiency of German night fighters. The *Nachtjagd* was not defeated in the spring of 1944, unlike the daytime fighters. On March 31, 1944, shortly after Allied daytime air superiority was established, the Royal Air Force suffered its worst disaster in history in a raid on Nuremberg: 107 four-engined aircraft destroyed, including 95 shot down (11.9% of the fleet), and 545 airmen killed (20.8%).³¹ Although gradually diminished by the desperate injection of its pilots into daytime fighter operations, the *Nachtjagd* remained an enemy threat until March 1945. It relied on a final core of experienced pilots flying twin-engine aircraft equipped with the latest radar technology. General Werner Streib, night fighter inspector, belatedly succeeded in imposing the dispatch of his fighters directly to England to attack British bombers as they landed, when they were particularly vulnerable. Captain Alexandre Barbe, navigator on the “*Guyenne*”, witnessed these surprise attacks:

*“From early 1945 onwards, and particularly in the spring, the group faced the strongest enemy opposition. The Germans used an offensive defense that paid off, consisting in sending night fighters to follow the bombers back from British missions, all the way to their bases. Taking advantage of lighting on the aircraft and on the ground, they shot down a large number of aircraft over the airfields.”*³²

For French crews, the threat of being shot down on a mission was compounded by the demoralizing fact that they were fighting belatedly in a war considered by much of the French population to be already finished.

“A war long over...”

The apprehension of Allied airmen engaged in major strategic raids on the Reich, a phenomenon identified from April 1940 onwards under the gentle euphemism of “*Lack of Moral Fibre*” (LMF), greatly worried the chiefs of Bomber Command,

30. “[French Squadrons at Elvington during WW2](#),” Royal Air Force Association website.

31. M. Middlebrook, C. Everitt, *The Bomber Command War Diaries* (Barnsley: Pen & Sword Aviation, 2014): 486-488.

32. SHD AI 8 Z 440, interview with Colonel Alexandre Barbe, December 10, 1985; January 30, 1986 and February 16, 1987.

at least until 1944.³³ These psychological victims, more or less on the verge of being considered cowards, threatened to topple a workforce under constant strain. Although American aircraft were not spared, LMF particularly affected British bomber crews, who often flew at night without seeing their *Nachtjagd* attackers or the other members of their unit, unlike the huge American daytime formations of over a thousand bombers. This debilitating affliction, which would have to wait until the Vietnam War before finally being designated “Post Traumatic Stress Disorders”, also affected the French members of the heavy groups to varying degrees.

The most famous of its members, the writer Jules Roy, described this complex of fears and apprehensions in works such as *La Vallée heureuse*³⁴ and *Retour de l'enfer*. This phenomenon is certainly illustrated by the unparalleled hecatomb suffered by Bomber Command during the war (55,500 men lost out of 125,000 enlisted, including 47,000 killed (38%).³⁵ However, this view is nuanced by other, lesser-known aviators, such as Captain Barbe on the “Guyenne”: “*I didn't really feel fear, but, as captain, I was extremely nervous about whether I was doing everything I could to protect my crew. What's more, as navigator, I had to check our status every six minutes, which kept me constantly busy.*”³⁶ Others, such as non-commissioned officer Robert Nicaise, are more critical of Jules Roy's emotions:

*“There was a bit of recklessness. We were caught up in it, we charged forward, there was no question of backing off. I never saw people call in sick, unlike what I saw later in Indochina and North Africa. We realized the danger a little more when we debriefed in the evening. We'd go into a room where each table was reserved for a crew. When we arrived late, there were empty tables. We realized that we wouldn't see our comrades again until after the war, or maybe not at all. We were more apprehensive then. I don't want to use the word “fear”, because La Vallée heureuse somewhat glorifies fear, which Jules Roy has been criticized for. But it's true that he was a coward... He couldn't do anything but praise fear.”*³⁷

While fear, apprehension and dread were perhaps less prevalent within the 11th BBM – often forced to cancel missions due to the weather – morale was not necessarily any higher, at least during the winter of 1945 when the operational tempo was limited. The brigade's engagement in the autumn of 1944 was far from ideal in terms of morale. With the liberation of Paris on August 25, 1944, and then of a large part of the country in early September, the war appeared to be over for the vast majority of French civilians, unless they had relatives still engaged in operations or still detained in Germany. A striking observation was made in February 1945 by Commandant de Maricourt, head of the 31st squadron, in a report to Air Minister Charles Tillon:

33. Edgar Jones, ““LMF”: The Use of Psychiatric Stigma in the Royal Air Force during the Second World War,” *The Journal of Military History*, no. 70 (April 2006): 439-458.

34. J. Roy, *La Vallée heureuse* (Paris: Charlot, 1946).

35. M. Middlebrook, C. Everitt, *The Bomber...*, *op. cit.*, 184

36. SHD AI 8 Z 440, interview with Colonel Alexandre Barbe, December 10, 1985; January 30, 1986 and February 16, 1987.

37. SHD AI 8 Z 518 1, interview with Colonel Robert Nicaise, April-June 1988.

“I think it’s safe to say that, without ever having dropped to zero, morale reached its lowest level in December, and that since then it has seen and will continue to see steady improvement. This morale curve is a function of:

- *Inactivity due to bad weather;*
- *Disillusion of personnel in view of the civilian population’s apathy towards the war.*

[...] The squadron has got used to the bad weather, and with the terrible force of habit, the morning briefing, followed by the classic cancellation of flights, is greeted with resignation. The flock of sheep returns to the fold with, at the bottom of their hearts, a desire to fight as strong as ever, and now convinced that it is pointless to shout curses against the skies. On the other hand, recent military events (the reduction of the Ardennes pocket, the Eastern Front, the Alsace offensive) have fired the men’s enthusiasm and distracted their gaze from the not exactly admirable spectacle offered by the population.”³⁸

Frenchmen on leave from heavy groups in France seemed to make the same observation. Some, like Captain Barbe, even found it difficult to justify belonging to the Royal Air Force in order to return to their unit:

“My first leave was in November 1944. I was very disappointed by the psychological climate that prevailed in France, and in particular by everybody’s purely opportunistic pretense of resistance. When I wanted to go back to England, my RAF card wasn’t enough, and they wanted to investigate me, throwing me into a rage. I had to turn to the English authorities on my own territory to rejoin my crew.”³⁹

In March 1945, the transfer of the 11th BBM to Saint-Dizier was appreciated by the crews, if only for the change in relations with the local population, as indicated by a report on the morale of GB 2/52 *“Franche-Comté”*:

“Relations with the local population [were] few and far between, but the people in the east gave a warm welcome, making a better impression than the people of Lyon, for whom the war, long over, seemed only have been an opportunity to boost business. This distressing impression was echoed by personnel returning from leave in various regions, particularly Paris.”⁴⁰

Although morale was restored from the end of March with the arrival of spring and the crossing of the Rhine by Allied forces in April 1945, the end of the fighting quickly halted the upward trajectory of the 11th BBM and the 1st CAF. The two largest formations in the revamped French Air Force never emerged from anonymity.

38. SHD AI 4 D 115, 11th medium bomber brigade / second and third bureaux, Report by Maricourt commander to Air Minister Tillon, February 2, 1945.

39. SHD AI 8 Z 440, interview with Colonel Alexandre Barbe, December 10, 1985; January 30, 1986 and February 16, 1987.

40. SHD AI 4 D 115, 11th medium bomber brigade / second and third bureaux, *Rapport sur le moral*, GBM 2/52 Franche-Comté, May 3, 1945.

Conclusion: bombers as the cornerstone of French Air Force revival

Victory in Europe and the rapid withdrawal of American military aid in the summer of 1945 sounded the inevitable death knell for heavy and medium bomber aircraft. Repatriated to the Bordeaux-Mérignac base in October, the GBs “*Guyenne*” and “*Tunisie*” were integrated into the French Air Force and reunited in a 21st bomber squadron. This unit soon became a transport unit, like most of the former bomber groups. From the 11th BBM disbanded in March 1946, only the 2/52 “*Franche-Comté*” and later the 2/63 “*Sénégal*” remained as transport groups, sent to Indochina, where the French Air Force was short of everything until 1949, when it began to benefit from new American aid under the Military Assistance Program (MAP).



GB 2/23 “*Guyenne*”.

Source: SHDAI_AI_6_FI_B92_541_0001_4.

If the heavy groups, the 1st CAF and the 11th BBM, did not make a lasting imprint during the conflict, neither did their memory extend beyond the circles of military insiders over the following decades, especially in the case of these last two large formations. A good part of the explanation lies in their late engagement, in the autumn of 1944, after the liberation of most of France, combined with a certain disinterest on the part of war-weary public opinion. Another factor can probably be found in the comparison with the FAFL, whose units were endowed with a powerful symbolism and supported by a major propaganda effort, notably by the BBC, which as of 1941 boosted their popularity and made them into political, rather than military, objects. Furthermore, these volunteers wanted to take up the fight against the Axis, sometimes as early as June 1940 – unlike the vast majority of French airmen at the end of the war, most of whom had seen service in the Vichy army at least until November 1942. Nonetheless, these latter contingents were to form the bulk of 1st CAF and 11th BBM personnel, the first French air formations to be operationally active since 1940, and capable of supporting an armed force on the ground.

Although the aircraft and the bomber units did not survive the victory for long, they remained a decisive asset for the new French Air Force. All its future chiefs of staff during the Fourth Republic came from these two major units, or to a lesser extent from the heavy groups in the UK – after having served the Vichy Army of Africa until 1942: this was the case of Generals Gérardot, Piollet, Léchères, Fay, Bailly and Gelée. Largely forgotten, or perhaps ignored by history, the 11th BBM and 1st CAF thus served as a crucible for training and perfecting the art of modern air warfare for hundreds of senior officers, forming the backbone of the air forces of the Cold War and the conflicts of decolonization.

The French Air and Space Force and the nuclear deterrence mission: history of the Strategic Air Forces

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The atomic bombs dropped on Hiroshima and Nagasaki in the summer of 1945 irrevocably transformed the art of warfare. The dawn of the “first nuclear age”¹ prompted a recognition of the revolution introduced by this new technology, and led to a redefinition of the role of the warplane, the only platform capable of delivering the bomb.

In France, these upheavals led to early, partially secret, research into the potential military applications of atomic power. The Pierre Mendès France government, for example, was behind the decrees creating the first think-tank and research bodies (whose successors would be responsible for nuclear testing): the *Comité des Explosifs Nucléaires* (CEN – Nuclear Explosives Committee) on November 4, 1954² and the *Bureau des Études Générales* (BEG – General Studies Bureau) on December 28 of the same year.³ Alongside military structures, such as the *Commandement des Armes Spéciales* (CAS – Special Weapons Command) created in 1952, civil-military responsibilities in the nuclear field gradually took shape, and were finalized – not

1. The historiography of nuclear strategy includes the notion of age or epoch. The first age corresponds to the period of the Cold War and the confrontation between the Western bloc and the Eastern bloc.

2. J. Crépin (General), “Histoire du Comité des explosifs nucléaires,” 77-86 (84), in *L'aventure de la bombe. De Gaulle et la dissuasion nucléaire. 1958-1969* Université de Franche-Comté et Institut Charles de Gaulle, conference proceedings, Arc-et-Senans, September 27, 28 and 29, 1984 (Paris: Éditions Plon, collection Espoirs, 1985): 380 p. In its early days, the CEN was a “*secret organization*.”

3. B. Failles, “[Pierre Mendès France et la construction de l'arme atomique. Une responsabilité collective, un défi personnel](#),” *Matériaux pour l'histoire de notre temps*, no. 63-64 (2001): 136-147 (141).

without fierce competition – in March 1957. Weapon testing was the responsibility of the armed forces.

In the autumn of 1956, the Suez Canal crisis acted as a catalyst⁴ leading to legitimization of the clandestine efforts undertaken under the Fourth Republic. General de Gaulle's return to power sanctioned the creation of the French "strike force", and on March 17, 1959,⁵ the government definitively decided on the first platform for France's nuclear deterrent capability: series production of the *Mirage IV A* bomber could begin. Pending the entry into operational service of strategic land-based missiles and nuclear-powered ballistic missile submarines, the French Air Force had sole responsibility for implementing France's military nuclear program.

The theory of deterrence took on a new meaning when applied to the nuclear domain. It was now embodied in the credibility of a state's posture and capability to retaliate in the event of an attack on its vital interests. By instilling the fear of reprisals that would exceed any gains, these elements were designed to discourage an adversary from initiating action. The organization of national defense – and therefore the French Air Force – was gradually transformed on the basis of this ambition to protect France's sovereignty on the international stage.

For airmen, this capability to deploy the nation's atomic weapons has been embodied since 1964 by Strategic Air Forces (FAS) command. For its men and women, the year 2024 marks sixty years of uninterrupted operational readiness to ensure the permanent mission of nuclear deterrence. This mission continues to shape the institution, from the earliest stages of its history to its current adaptation to the third nuclear age, synonymous with new challenges for the Air and Space Force.⁶

The French Air Force prepares for the nuclear deterrence mission (1956-1964)

The legacy of the strategic bombing mission and the transition to a modern force

Having disappeared with the end of World War II, bomber aircraft began coming back into favor among airmen in the 1950s.⁷ To consolidate this trend, a bombing training center (CIB 328), part of the recently created Bomber Command (CAB), was set up at Cognac air base on January 1st, 1957. Equipped with *B-26* medium

4. P. Boureille, "La marine française et le fait nucléaire 1945-1972," *PhD thesis* in history, under the supervision of Georges-Henri Soutou, Université Paris-Sorbonne (2008): 1,111 pp. (385). This term best characterizes the consequences of the Suez crisis for the organization of France's national defense and for the armed forces in the nuclear sector.

5. P. Vougy, "La mise en place et le développement de la première génération des Forces nucléaires stratégiques," 139-153 (141), in *L'arme nucléaire et ses vecteurs. Stratégies, armes, parades*, Institut d'histoire des conflits contemporain and Centre d'histoire de l'aéronautique et de l'espace, conference proceedings, Paris, Grand amphithéâtre de la Sorbonne, 24-25/01/1989 (Paris: CHEAE/IHCC, 1990): 407 p.

6. E. Maitre, "[La dissuasion française au troisième âge nucléaire](#)," *Recherches & Documents*, no. 14, Fondation pour la recherche stratégique (October 2023): 20 p.

7. P. Facon, "L'armée de l'Air face au problème nucléaire (1945-1954), un nouvel âge d'or du douétisme," *Revue historique des armées*, Service historique de la Défense, no. 178 (1990): 32-39 (36).

bombers and *Vautour* fighter-bombers, the center's mission was to train pilots and – for the first time – navigator-bomb aimers and radar operators. The French Air Force reconnected with its history and its offensive capabilities. As the arrival of the *Mirage IV A* took shape, the Air Force's skills were gradually enhanced.

In early 1962, the *commandement aérien stratégique* (CAS – Strategic Air Command) took over from the CAB in Bordeaux. At its head was General Bernard Marie, previously commander of the bomber force. Two years later, General Marie became the first commander of the strategic air forces when they were created on January 14, 1964, taking over the traditions of the CAS. He was soon succeeded by General Philippe Maurin on the following May 1st. Familiar with atomic weapon procedures, General Maurin “supervised the complete transformation of the tactical air squadrons assigned to the nuclear mission”⁸ deployed under the aegis of the Atlantic Alliance while he commanded the French *F-100* forces in Germany, then the *1^{er} commandement aérien tactique* (1er CATac – 1st Tactical Air Command). This made him the general officer best prepared to command the strategic air forces and ensure that the air forces' nuclear deterrence mission would be pursued in the long term within a strictly national, rather than NATO, framework.

Chosen from among the three armed forces “for reasons both historical and operational,”⁹ the Air Force as a whole was restructured to ensure its ability to assume this responsibility. The traditional organization by major air regions gave way to a new scheme. In 1962, the decree on specialized air unit groupings – operational commands dedicated to specific missions – gave rise to the FAS.¹⁰ The array of resources available to airmen expanded, benefiting from the impetus provided by political leaders, whose role was itself strengthened at the dawn of the 1960s.

The Constitution of the Fifth Republic and a series of decrees in 1961 and 1962 established the primacy of the President of the Republic and his authority in the military sector.¹¹ They set the pace for the overhaul of the defense apparatus and all sectors involved in the strike force. A number of examples can be cited, such as the creation of the Ministerial Delegation for Armaments (DMA, future DGA), the position of Chief of Staff of the Armed Forces, the General Secretariat for National Defense (SGDN) and the National Center for Space Studies (CNES). General de

8. A. Poilbout, “Quelle stratégie nucléaire pour la France? L’armée de l’Air et le nucléaire tactique intégré à l’OTAN (1962-1966),” *Revue historique des armées*, Service historique de la Défense, no. 262 (March 2011): 46-53 (49).

9. S. Gadal, *Forces aériennes stratégiques* (Paris: Économica and Institut de Stratégie Comparée, Coll. “Bibliothèque Stratégique”, 2015): 397 p. (16).

10. A. Corvisier (ed.), *Histoire militaire de la France, Tome 4 : de 1940 à nos jours*, sous la direction d’André Martel (Paris: Presses universitaires de France): 700 p. (462). Four major commands were created: *Forces aériennes stratégiques* (FAS – Strategic Air Forces), *Force aérienne tactique* (FATac – Tactical Air Force), *Commandement air des forces de la Défense aérienne* (CAFDA – Air Defense Forces Air Command) and *Commandement du Transport aérien militaire* (CoTAM – Military Air Transport Command).

11. B. Chantebout, “L’organisation générale de la défense nationale en France depuis la fin de la seconde guerre mondiale,” *doctoral thesis in law*, Bibliothèque constitutionnelle et de science politique, tome XXVI, Paris, Librairie générale de droit et de jurisprudence (1967): 500 p.

Gaulle's foresight could also be seen in 1960, with the promulgation of the very first military spending law, which secured and protected the financial effort to equip the country with nuclear delivery systems over the long term.

However, it was the bomber-tanker combination that symbolized the airborne component of nuclear deterrence for the French Air Force. The *Mirage IV A*, a twin-engine supersonic aircraft built by Générale Aéronautique Marcel Dassault, was France's first major weapons system.¹² However, to bomb targets in the Soviet Union, a solution had to be found to increase the range of the sixty-two aircraft ordered.¹³ In the spring of 1962, France turned to the United States and sent a delegation to meet with Strategic Air Command (SAC) and the State Department to study the feasibility of purchasing the four-engine *Boeing C-135* tanker, which had already been in service with the U.S. Air Force for several years. A contract was signed in August: twelve aircraft modified for French requirements – christened *C-135 F* – were delivered to the French Air Force starting in February 1964. They would contribute to the full operation of the component entrusted to the FAS.

Military test centers and atomic weapons testing

The smooth operation of a nuclear weapon system is essential to guarantee the credibility of deterrence. The French armed forces therefore had to carry out operational validation of their nuclear weapons, to demonstrate their performance to political authorities, allies and potential adversaries.

The first mission to evaluate the future site of the test area in North Africa took place on January 10, 1957.¹⁴ In July, major work was carried out in the Algerian desert. The *Centre saharien d'expérimentations militaires* (Sahara Military Test Center), was set up in the Tanezrouft region of Reggane, and housed up to 10,000 people during the decisive test campaign. Civilian engineers from the *Commissariat à l'énergie atomique* (CEA, the Atomic Energy Commission, in charge of the bomb's operation and safety), scientists and soldiers from the three armed forces worked discreetly under the orders of General Charles Ailleret, head of the *Commandement interarmées des armes spéciales* (CIAS – Special Weapons Joint Command).

On February 13, 1960, the *Gerboise Bleue* atmospheric test marked France's entry into the select club of atomic powers: a 70-kiloton bomb – almost five times more powerful than the Hiroshima bomb – exploded successfully. The French performance was convincing, and its independent, reliable nuclear capability was now credible.

12. Service historique de la Défense (SHD), archives de l'armée de l'air (AA), AI 85 E 24191/2, theses and dissertations from the École supérieure de guerre aérienne, Lieutenant-Colonel Roland Glavany, "Conception et réalisation des systèmes d'armes aériens" (1963): 48 p (5).

13. J. Doise, M. Vaïsse, *Diplomatie et outil militaire. Politique étrangère de la France 1871-2015* (Paris: Éditions du Seuil, Points, Coll. "Histoire", reprint 2015): 768 p. (616). The government's first order was for fifty aircraft, but the strike force was quickly expanded with an order for twelve more *Mirage IV*s in November 1965.

14. J.-D. Pô, *Les moyens de la puissance, les activités militaires du CEA 1945-2000* (Paris: Éditions Ellipses et Fondation pour la recherche stratégique, Coll. "Perspectives stratégiques", 2001): 268 (135).

A few hundred kilometers to the north, still in Algeria, other military sites were built, contributing to the French nuclear adventure. In 1947, for example, the French Air Force set up an initial nucleus of specialists at the Colomb-Béchar base. The *Centre Interarmées d'Essais des Engins Spéciaux* (Special Weapons Joint Test Center), which included living quarters for some 800 people, gradually expanded from the main Hammaguir launch site, built in 1951. A large detachment from the CEV Flight Test Center also arrived at the site, carrying out experiments on a wide range of air-to-air, ground-to-air and air-to-ground weapons and systems.

The benefits of the military nuclear project were not limited to the armed forces. The civilian sector also benefited from the trickle-down effect of technological innovation. In the space sector, for example, the first French ballistic missiles and rockets (the Véronique rocket, the Diamant launcher and the Asterix satellite) were tested and fired from the Sahara.



Brigitte launch pad at Hammaguir. The Diamant-A launcher and its Asterix satellite would take off from this site into space.

© “[Les centres de lancement français](#),” CAPCOM Espace.

Nonetheless, in 1968, at the end of the five-year extension of use of these sites negotiated at the time of Algeria’s independence, the space test centers were transferred to Kourou. The end of the Algerian war also saw the transfer of the joint nuclear test sites to French Polynesia. The joint dimension of these structures was confirmed with the appointment of Air Force General Jean Thiry, who succeeded General Ailleret. The creation of the *Centre d’expérimentations du Pacifique* (CEP – Pacific Test Center) was approved by the Defense Council on July 27, 1962.¹⁵ General Thiry,

15. “Les activités opérationnelles et le soutien logistique du Centre d’Expérimentations du Pacifique,” in *Les expérimentations nucléaires françaises*, Groupe d’études français d’histoire de l’armement nucléaire (GREFHAN), Nuclear History Program (NHP), Table ronde du 12/06/1992, Institut d’histoire des relations internationales contemporaines, Institut de France (1992): 109 p. (73).

who played an active role in the choice of the new site,¹⁶ was appointed head of the *Direction des Centres d'Expérimentations Nucléaires* (DirCEN – Nuclear Test Center Directorate), which succeeded the CIAS and oversaw testing from 1964 onwards. The CEP became operational in 1966, after considerable infrastructure work. FAS *C-135 F*, *Mirage IV* and *Vautour* aircraft (essential for collection of scientific samples)¹⁷ flew to the Polynesian islands, demonstrating France's air projection capability and the high degree of readiness of its forces. It was from Hao atoll, during Operation *Tamouré* in July 1966, that the FAS AN-21 airborne nuclear weapon was successfully tested. It proved that the weapon, which the airborne component was the only one to deploy at that time, was working properly.

Creation of Strategic Air Forces Command; FAS crews achieve operational alert

The official birth certificate of the Strategic Air Forces was the decree of January 14, 1964, which repealed the CAS decree. This new command, which was both an organic and operational structure, would receive the launch order from the President of the Republic. The Constitution of the Fifth Republic confers on the latter the exclusive and pre-eminent role of launching a nuclear strike.

FAS crews, who would carry out this order in the event of an engagement, were distributed across France according to a principle of dispersion and survivability. Nine nuclear bases (three of which could accommodate *C-135 F* tanker squadrons) operated *Mirage IV* nuclear bombers. At Taverny, an underground command post housing the FAS operations center – the COFAS – was also part of the operational system.

In order to satisfy the operational contract established by the President of the Republic – *i.e.* to be able to carry out the nuclear mission without delay – the FAS achieved operational alert at the Mont-de-Marsan base on October 8, 1964. Crews were given only five minutes' notice before takeoff, which meant that special alert zones and facilities had to be created for FAS airmen. Given the political priority of their mission, squadrons dedicated to the nuclear mission were completely autonomous on their base.

At the strategic level, this unique characteristic also required the creation of a robust chain of command and permanent alert. It relied on extensive detection, data processing and transmission systems, in addition to available operational resources and government control procedures. These imperatives gave a key role to the air defense mission¹⁸ and its operations center (CODA), also installed at Taverny; the impact of the nuclear mission was felt across the entire Air Force.

16. R. Meltz, A. Vignon (eds.), *Des bombes en Polynésie, Les essais nucléaires français dans le Pacifique* (Paris: Vendémiaire, 2022): 707 p. (38).

17. SHD/AA, AI G 8264, Centre d'instruction des Forces aériennes stratégiques (CIFAS) 328, history of the 92nd bomber wing.

18. L. Paoletti, "Analyse du rôle de la défense aérienne dans la diplomatie et la stratégie françaises dans le contexte de début de guerre froide 1945-1961," *dissertation* for diploma in historical and philological sciences, under the supervision of Professor Martin Motte, École pratique des Hautes Études (2019): 178 p. (136).

The FAS become an integral part of France's defense strategy (1965-1989)

France achieves full autonomy: withdrawal from NATO's integrated command

The growing role of air force personnel in the defense apparatus, and more particularly those who contributed to the implementation of national deterrent systems, was reflected in the number of positions of responsibility they occupied – or promotions they obtained. As Chief of Staff of the French Armed Forces, Chief of Staff of the Élysée Palace, in the political cabinets, at the SGDN, CNES, DMA or DirCEN, airmen interacted with political leaders, even beyond national borders. In 1965, for example, Lieutenant General Jean Accart, a former fighter ace in 1940 and French theorist of post-war air defense, was appointed by NATO to chair the committee responsible for installing the Nato Air Defense Ground Environment (NADGE) system in Europe.¹⁹ NADGE was an electronic network contributing to air defense and early warning. Indeed, to be able to ensure a credible deterrent, France had to be fully capable of defending its airspace.²⁰

Surprisingly, however, this appointment came at a time when Paris was expressing significant reservations about NATO's *modus operandi*.²¹ In fact, the status of independent nuclear power ensured France's emancipation from the structures of the Atlantic Alliance's integrated command. Following the Suez Crisis (1956) and the nuclear blackmail exerted by the USA and USSR on London and Paris to withdraw their troops and put an end to the crisis, France felt politically humiliated. The government of the Fourth Republic – and General de Gaulle from 1958 onwards – learned their lessons: France could no longer freely conduct its foreign policy without the backing of its allies. The possession of an autonomous national nuclear weapon appeared as a necessary attribute of power to break free from this subordination.

Far from being a “*thunderbolt in a clear sky*,”²² France's departure from NATO's integrated command structures was rather the culmination of a process that had begun in the late 1950s²³ and was completed in March 1966, when the French strike force became fully operational. In the summer of 1967, the signing of the secret Ailleret-Lemnitzer agreements²⁴ marked a new stage in the process of autonomy for

19. Archives Nationales, Pierrefitte sur Seine, Papiers des chefs de l'État, AG5(1)/512, État-major particulier, affaires internationales, note dated 10/03/1965 relating to the NADGE plan.

20. J. de Lespinois (ed.), *Nouvelle histoire de l'armée de l'air et de l'espace* (Paris: Éditions Pierre de Taillac, 2022): 480 p. (137).

21. J. Marriot, “Le NADGE, bouclier radar de l'OTAN,” 35-42, *Forces Aériennes Françaises*, French Air Force monthly magazine, article originally published in *Aerospace International*, translated by Controller General B, no. 271 (July 1970).

22. F. Bozo, “De Gaulle, l'Amérique et l'Alliance atlantique. Une relecture de la crise de 1966,” *Vingtième siècle, revue d'histoire*, no. 43 (July-September 1994): 55-68 (58).

23. Firstly, with the withdrawal of the French Mediterranean fleet from NATO's integrated command in 1959. See here F. David, “John Foster Dulles, secrétaire d'État (1953-1959), Les relations franco-américaines entre idéalisme politique et réalités militaires,” *PhD thesis* in history under the supervision of Professor G.-H. Soutou, Paris-Sorbonne University (2006): 1,616 p. (1 332).

24. The agreement bears the names of its signatories. General Lyman Lemnitzer becomes Supreme Allied Commander Europe.

the French forces. For General Charles Ailleret, Chief of Staff of the French Armed Forces, the challenge was to negotiate France's continued participation in various NATO structures, including the NADGE network for the Air Force. He eventually succeeded. Paris continued to receive alerts from Supreme Headquarters Allied Powers Europe, as part of the military cooperation between Western bloc forces.

Paris also broke away from the NATO path due to the specificities of its doctrine. Distancing itself from the United States and the United Kingdom (aligned with American doctrine), France considered nuclear weapons to be political and strictly defensive. The fundamental principles of French nuclear deterrence were set out in the 1950s. Among its most famous theorists was air force general Pierre Marie Gallois, who developed the notions of the “*equalizing power of the atom*” (atomic weapons reset the balance of power between two nuclear-armed powers on the international chessboard) and “*deterrence of the strong by the weak*.” These principles were well-suited to France's status as a middle power.²⁵

French Army generals Charles Ailleret, André Beaufre and Lucien Poirier also played a major role in laying the foundations of French thinking on nuclear deterrence. Ailleret was quick to grasp the revolution in military strategy introduced by atomic weapons. An advocate of a joint approach to general strategy, he emphasized the scientific and technical dimension of this new weapon. General André Beaufre theorized the dialectic of wills in deterrence strategy. Finally, Lucien Poirier developed, among other things, the notion of the critical aggressiveness threshold (linked to vital interests). Unaligned with the American doctrine of graduated response of the 1960s, French doctrine was enshrined in the government's first *White Paper on Defense*, published in 1972. This seminal text marked a break with the past: it set out a new strategic posture, claimed nuclear power status for France, and established the nation's strategic orientations for the Cold War.

Albion and the ground-to-ground component of deterrence: sanctuarizing the homeland

Taking a long-term view, the decision to manufacture strategic ballistic missiles was taken in the summer of 1958. The *Société d'études et de recherche des engins balistiques* (SEREB), under the supervision of the Ministry for the Armed Forces, was set up in September 1959 to centralize studies relating to the production of nuclear-armed missiles. Engineers carried out the first tests on the various missile variants in French Algeria, then at the Landes test center. In 1968, the first ground-to-ground strategic ballistic missile (SSBS) was launched in its operational version: the S2, weighing 23 tons, 15 meters in length and with a range of 3,500 kilometers. The complexity of deploying this new missile posed logistical challenges, both military and civilian. On November 26, 1965, the launch of France's first satellite, *Asterix*, by

25. P. M. Gallois, “La dissuasion du faible au fort,” in *L'aventure de la bombe. De Gaulle et la dissuasion nucléaire 1958-1969*, Université de Franche-Comté and Institut Charles de Gaulle, conference proceedings, Arc-et-Senans, September 27, 28 and 29, 1984 (Paris: Éditions Plon, collection “Espoirs”, 1985): 380 p. (165-173).

the Diamant launcher on which the S2 missile was based, confirmed the close links between the nuclear and space programs.

The construction of the SSBS launch site was no mean feat. The government selected the Albion plateau in Vaucluse in April 1965.²⁶ Apt-Saint-Christol support air base 200 was built from scratch in three years. It included a 1,700-meter runway, housing for 800 families, 18 underground silos housing the same number of missiles (managed from two launch control stations), associated launch zones, transmission sites and facilities – both above and below ground – capable of surviving an enemy atomic strike.²⁷ The Plateau d’Albion facilities, scattered across an 875-hectare military zone, were designed to ensure France’s nuclear response capability in the event of a second strike. Immobile and therefore visible, they sanctuarized mainland France.²⁸ According to the “tethered goat” principle, any attack on the site would confirm the act of aggression. The SSBSs were a “*stabilizing factor*”²⁹ during the Cold War, protecting the totality of the homeland.

Responsibility for the SSBS component of deterrence was entrusted to the French Air Force in 1964, more specifically to the *1^{er} groupement de missiles stratégiques* (1er GMS – 1st strategic missile group), a new unit of the FAS. From 1968 onwards, some 2,000 military personnel were based in Provence. The 1st GMS achieved operational alert on August 2, 1971. The FAS thus found themselves responsible for implementing two of the three components of the nuclear triad.³⁰

The tactical nuclear mission and the “final warning”

The 1970s saw an expansion of the spectrum of nuclear deterrence systems embodying the political message set by the French President. After an initial period of adaptation to tactical nuclear weapons within NATO,³¹ the decision in principle to acquire tactical nuclear weapons was taken by the Defense Council in July 1963.³² The decision to manufacture the AN-52 airborne fission bomb was taken in 1966.³³ The bomb underwent two validation tests – the *Tamara* and *Maquis* operations³⁴ – which marked the last French atmospheric tests using air-drops at the Pacific Test Center (CEP).

26. G. Mercier, “La mise en place et le développement de la 2^{ème} génération des forces nucléaires stratégiques,” in *L’arme nucléaire et ses vecteurs. Stratégies, armes, parades*, op. cit., 197.

27. R. Galan, *Forces aériennes stratégiques. Missions au cœur du secret défense* (Paris: Éditions Privat, 2014): 218 p. (79-82).

28. L. Boité, “[Le 1er GMS](#),” 15-22 (20), *ANFAS Contact no. 110*, Association nationale des Forces aériennes stratégiques (ANFAS), newsletter.

29. SHD/AA, audio archives, AI 8 Z 79, interview with General Michel Fourquet, tape 6.

30. 1971 also saw the commissioning of the ocean-going component, with the first nuclear-powered ballistic missile submarine, carrying the strategic sea-to-ground ballistic missile.

31. In the 1950s, Washington supplied Paris with fighter aircraft (*F-84G*, *F-100D*...) capable of carrying nuclear gravity bombs, although these remained under American control via the “dual key” principle.

32. M. Duval, Y. Le Baut, *L’arme nucléaire française : Pourquoi et comment* (Paris: Éditions SPM, collection “Kronos”, 1992): 303 p. (72).

33. S. Cohen, *La défaite des généraux, le pouvoir politique et l’armée sous la V^e République* (Paris: Fayard, Paris, 1994): 276 p. (105).

34. At an altitude of 250 meters, from a *Mirage III E* and a *Jaguar A* on August 28, 1973 and July 25, 1974, respectively.

The AN-52 was declared operational in 1973, and was immediately deployed by units of the French Tactical Air Force (FATac): the 2/4 “*La Fayette*” squadron at Luxeuil on *Mirage III* was the first to receive the weapon, followed in 1974 by the 1/7 “*Provence*” squadron on *Jaguar* at Saint-Dizier. The historiography of tactical nuclear power in the French armed forces is relatively discreet.³⁵ However, up to five Air Force squadrons deployed the AN-52 between 1975 and 1991,³⁶ when the tactical nuclear mission was abandoned and all nuclear “Air” systems came under the command of the FAS.³⁷

Starting in 1978, the AN-52 was also carried by French Navy *Super-Étendard* aircraft as part of the *Force Aéronavale Nucléaire* (FANu – Nuclear Naval Aviation Force), the Navy’s non-permanent airborne deterrent component, which could be activated on presidential orders. In all, between 80 and 100 AN-52s were in service with both armed forces, and integrated into the French nuclear deterrent posture.

The objectives pursued with tactical nuclear weaponry were referred to as “*interdiction*”³⁸ and they designated military targets. Soviet maneuver forces were also the target for the French Army’s tactical nuclear weapons, with its five regiments equipped with Pluton, then Hadès, ground-to-ground missile systems, between 1974 and 1997. Deployed along the borders with Belgium and Luxembourg, they were intended to stop any potential territorial invasion. Tactical weaponry completed the range of political responses to aggression, by establishing an intermediate threshold not to be crossed during dialogue with the adversary. Above all, it marked a desire to contain escalation rather than try to control it.³⁹

In the early 1980s, a shift in nuclear terminology took place: tactical weapons became, in the words of President François Mitterrand, “pre-strategic” weapons, now guaranteeing “the final warning”. They were fully integrated into France’s deterrence strategy. The fear of proliferation of this type of weapon – which was no longer seen as a battlefield weapon, but as a political weapon – justified this semantic change.

Subsequently, the history of the FAS was marked by constant adaptations of missiles and command structure to the international context – and, by capillary action, of the French air forces as a whole. In the summer of 1988, for example, a new aircraft/weapon combination entered operational service, capable of penetrating enemy defenses at very low altitudes, and fully integrating the technological developments of the Cold War. The *Mirage 2000N* bomber and the air-to-ground medium-range missile (ASMP) drove the Air Force to higher levels of performance, due to the operational requirements they imposed and the ambitious infrastructure work carried out to accommodate them at airbases.

35. M. Theleri, *Initiation à la force de frappe française 1945-2010* (Paris: Éditions Stock, 1997): 385 p (101).

36. The tactical nuclear component comprised 30 *Mirage III Es* and 30 *Jaguar As*.

37. “[55 ans des Forces aériennes stratégiques, 20 000ème jour d’alerte nucléaire](#),” 19, ANFAS, Association nationale des Forces aériennes stratégiques (ANFAS), published by EDIACA via the *Centre des études, réserves et partenariats de l’armée de l’air* (September 2019): 32 p.

38. S. Gadal, *op. cit.*, p. 203. He quotes the Chief of Staff of the French Armed Forces, General François Maurin.

39. SHD/AA, audio archives, AI 8 Z 79 Fourquet tape 6.

As early as 1986, part of the *Mirage IV A* fleet was upgraded to *Mirage IV P* (for “penetration”), so that it could also carry the ASMP. This new airborne nuclear missile – the first with ramjet propulsion – was a real technical exploit. It replaced both the AN-52 for the final warning mission and the AN-22 for strategic strike.⁴⁰

It was also during the final years of the Cold War that the FAS forces played an unprecedented role in France’s foreign operations.

Adaptation of France’s defense capabilities and versatility of strategic air force missions

Linkage between strategic and conventional missions

In the early 1970s, the *Mirage IV A* made its mark in electronic warfare (EW) missions. It was the first combat aircraft in service with the French Air Force to be equipped for this type of mission⁴¹. Fitted with self-protection systems, it carried the most powerful navigation and bombardment system in Europe at the time. As it was gradually employed for long-range reconnaissance missions, it was logical to equip the *Mirage IV A* with systems to reduce its vulnerability. The *Centre d’instruction des Forces aériennes stratégiques* (CIFAS 328 “Aquitaine” Strategic Air Forces Training Center, the successor to CIB 328) tested the reconnaissance versions of the *Mirage IV A*, as well as electronic countermeasure (ECM) equipment. In this way, FAS airmen acquired new capabilities that were then disseminated throughout the Air Force. Preparing the forces for the nuclear mission was indeed the driving force behind the EW policy for the entire Air Force.⁴²

Another little-known aspect of this command’s history is electronic intelligence (ELINT). Knowledge of the enemy’s electromagnetic systems is a prerequisite for penetrating the enemy’s defenses and successfully executing a mission. The 1/59 “Bigorre” squadron, comprising the four *Astarté* airborne relay stations,⁴³ was also an electronic warfare unit with a specific mission. It was created in 1987 and came under the command of the FAS in 1992.⁴⁴ Its function was to ensure transmission of the presidential order for nuclear engagement to the forces, in a potentially degraded environment. To do this, its *C.160 H* aircraft were equipped with electromagnetic pulse-resistant equipment.

40. P. Wodka-Gallien, *La dissuasion nucléaire française en action, Dictionnaire d’un récit national* (Paris: Éditions Decoopman, 2019): 485 p. (461).

41. H. Beaumont, *Mirage IV, le bombardier stratégique* (Paris: Éditions Larivière, Docavia, 2003): 367 p. (218).

42. P. Hénin, “De la dissuasion nucléaire à la politique de guerre électronique de l’armée de l’air,” 39, in *La guerre électronique sur Mirage IV, quarante années de guerre secrète racontées par ses acteurs* (Paris: Éditions Lavauzelle, Documents Renseignement, Histoire & Géopolitique, 2006): 210 p.

43. Composed of four *C.160 H Gabriel*.

44. It was itself replaced in 2001 by the *Système du dernier recours* (Syderec) squadron.



French Air Force C.160 H Astarté.

© "[Transport Allianz C-160H Astarté](#)," *AvionsMilitaires.net*.

The final years of the Cold War saw a profound transformation of the airborne component. In a context marked by the “*peace dividend*”, the entry into service of the *Mirage 2000N* helped reduce the size of FAS bombing units, leaving only three operational squadrons equipped with the new missile between 1988 and 1990 (“*La Fayette*”, “*Limousin*” and “*Dauphiné*”).⁴⁵ Two units maintained the *Mirage IV P/ASMP* (“*Gascogne*” and “*Bretagne*”).

The *C-135 F* tankers were extensively modernized and renamed *C-135 FR* (for “re-engined”). Unlike bombers, the FAS fleet of these four-engine aircraft grew – three *KC-135s*⁴⁶ were purchased from the United States in 1994 – and their range of missions expanded dramatically. At the time of their entry into service in 1964, tankers were reserved exclusively for the airborne nuclear component. However, these platforms were soon called upon for certain missions in France’s intervention zones, and the practice became widespread from the 1970s onwards.⁴⁷ Tankers now form the Air and Space Force’s core capability for power projection around the globe. Air and Space Force combat aircraft dedicated to conventional missions can all be refu-

45. The format of FAS units had already been reduced by three squadrons in June 1976, then by two squadrons in September 1983.

46. Tanker version, not the mixed cargo/passenger combi aircraft acquired in 1962.

47. *Lamantin* (1977) in Mauritania was the first external operation involving Air Force tankers.

eled in flight from the *C-135 F*. Airborne projection has been revolutionized by the nuclear mission, leading to a change in the way the air force is perceived.⁴⁸

When the Soviet bloc collapsed, the end of bipolarity in international relations and the signing of treaties to combat arms proliferation led to a further change in France's nuclear posture. It became centered around the threshold of sufficiency. The volume of armed forces was also subject to the State's intransigent criterion of financial resources, and in the summer of 1996, the French government announced that it was abandoning the Albion plateau. The 1st GMS was officially disbanded in September. This decision put an end to FAS command of the ground-to-ground ballistic component of the nuclear deterrent. The chain of dialogue and responsibility was also modified by decree in 1996. The Armed Forces Chief of Staff now sits between the Air Force and the political authorities. He is responsible for carrying out the operations required to employ the nuclear forces.

Finally, 1996 was a pivotal year for the FAS. On May 30, the twelve *Mirage IV P* aircraft took part in their final *Poker* exercise as part of the airborne component of the deterrent. They then ceased to ensure the nuclear alert, and were dedicated exclusively to long-range strategic reconnaissance missions, until they were withdrawn from service in 2005. The *Mirage IV P* of the "*Gascogne*" squadron would distinguish themselves during Operation *Héraclès* in 2001 and 2002, when they were deployed from the United Arab Emirates and carried out several flights over Afghanistan.

The Strategic Air Forces in the age of external operations

As General Bruno Maigret, former FAS Commander, reminds us, the need to meet the requirements of both strategic and conventional missions creates a virtuous dynamic that anticipates "*further, faster and stronger*." This need to constantly evolve⁴⁹ has been present since the very origins of the FAS: when peace arrived, they had to continuously demonstrate their credibility and effectiveness.

To this end, in the nuclear field, they carry out visible and demonstrative actions, such as the *Poker* training and weapon-firing simulation exercises that take place several times a year, demonstrating that equipment is working properly. How can we deter an adversary if he is not convinced of our ability to launch a nuclear weapon? Escalation scenarios contribute to the credibility of the nuclear capability, and the era of external operations therefore has had a logical impact on the engagement of the FAS.

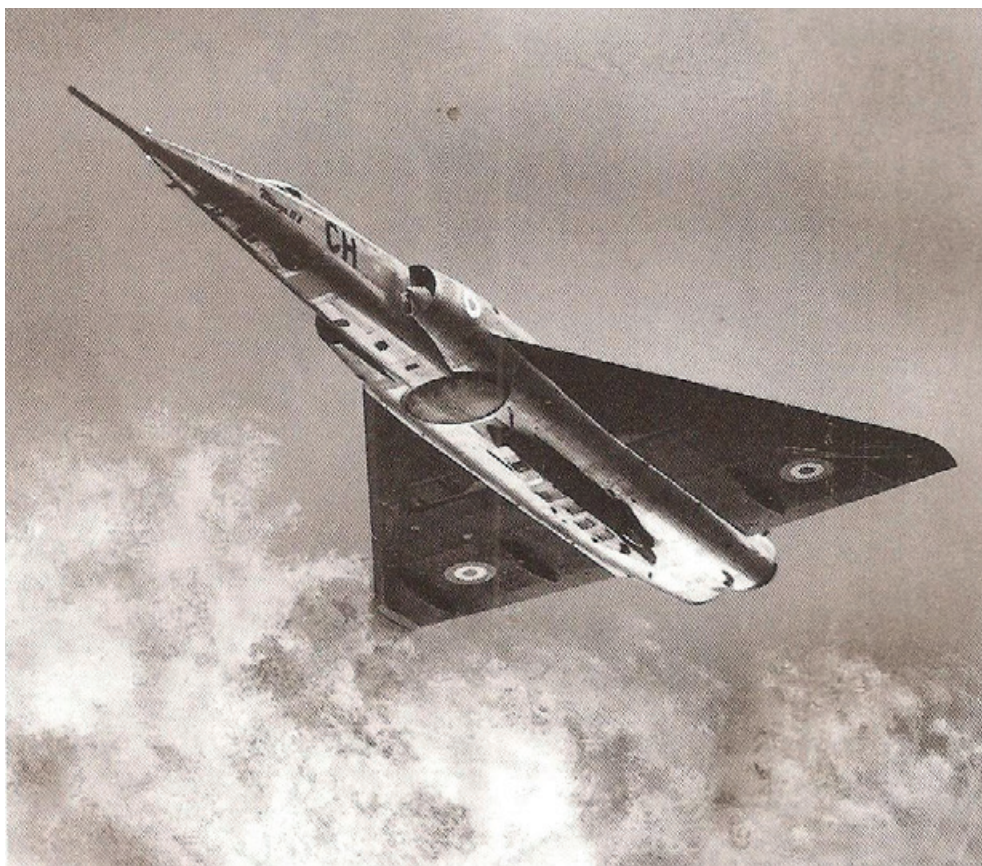
In the conventional arena, the squadrons' range of missions expanded. In the 1970s, *Mirage IVs* newly equipped with⁵⁰ cameras were used in secret to gather

48. I. Sand, "Géographie politique et militaire de la projection aérienne des armées françaises depuis 1945," *Doctoral thesis* in geography, under the direction of P. Boulanger, Sorbonne University, Paris (2020): 594 p. (423-428).

49. B. Maigret, *Opération Poker; au cœur de la dissuasion nucléaire française* (Paris: Édition Tallandier, 2021): 256 p. (149).

50. "Sur le Tibesti," R. Galan, *Forces aériennes stratégiques, missions au cœur du secret défense. Témoignages* (Clermont-Ferrand: Éditions Privat, 2014): pp.178-181 (178). Precisely eight. The CT.52 *recce* pod referred to includes a set of nose-mounted, ventral and lateral cameras.

detailed information. The kidnapping of CNRS ethnologist Françoise Claustre in northern Chad in April 1974 gave FAS aircraft the opportunity to showcase their skills in photographic reconnaissance missions carried out at Mach 0.9, scouting out the terrain for a possible assault landing by *C.160 Transalls*. The French government was considering an operation to free the hostage by force at a time when negotiations had reached an impasse. Serge Dassault would confide that these demonstrations of the *Mirage IV*'s operational capabilities were decisive in the government's decision to extend their service life.



Mirage IV P no. 61 “Charlie Hotel” equipped with a CT.52 recce pod attached to the center hard point.
© “[Dassault Mirage IV, le temps de la reconnaissance stratégique](#),” *Spot'Aero* (27 July 2013).

A few years later, on February 18, 1986, the Ouadi Doum airstrip in Chad, used by Libyan forces, was bombed and neutralized by French *Jaguars*. Two *Mirage IV* Ps from the *Escadron de Reconnaissance et d'Instruction* (ERI – reconnaissance and training squadron) completed the mission. They carried CT.52 recce pods to take pictures of the runway, which would be used for airfield damage assessment.⁵¹ After

51. J. Merouze, “Opération Tobus : une mission de reconnaissance stratégique,” 155-161, in *La guerre électronique sur Mirage IV...*, *op. cit.*

more than eleven hours in the air and twelve refueling operations, the mission was a success. The crews landed in Bordeaux, where they were welcomed by General Fleury, commander of the FAS. The films, of excellent quality, were quickly developed and the reels were transported to Paris by *Alphajet* for detailed interpretation. The results were immediately presented to the political authorities.

Since 1986, FAS squadrons have taken part in wars in the Gulf (1991 and 2003), former Yugoslavia (1995), Kosovo (1999), Afghanistan (2001) and Libya (2011). Called upon at the start of Operation *Chammal* in 2015, FAS *Mirage 2000Ns* eventually took part in five detachments in Jordan, before being deployed five times in support of Operation *Barkhane* between 2017 and 2018.

The FAS have thus demonstrated that they have a part to play in strategic and conventional arenas.⁵² The notion of “*mutual reliance*” resurfaced in a recent speech by the French President, and has taken on new meaning in the wake of post-Cold War geopolitical upheavals. Strategic and conventional forces thrive on their respective complementarity and mutual credibility.⁵³

As summarized in a report by the French National Defense and Armed Forces Commission in 2004, “*in addition to their complementarity with the FOST,*⁵⁴ *it should be noted that the FAS offer a kind of ‘dual’ use: only 15% of the missions carried out by the Mirage 2000N are strictly nuclear in nature, and the separation between conventional and nuclear is sometimes artificial. A conventional long-range projection mission during an exercise also contributes in some way to the credibility of deterrence.*”⁵⁵

Today, the visibility of the FAS is guaranteed by operations such as Operation *Hamilton*, carried out in April 2018. The mission involved seventeen aircraft, eleven of which belonged to the FAS.⁵⁶ The aim of this operation was to destroy infrastructure contributing to the production of chemical weapons by the Syrian regime. It was carried out jointly with the United States and Great Britain. More than 7,000 km were covered in ten hours of non-stop flying, proving once again the endurance and power projection capabilities of the French Air and Space Force. Other missions, such as the *Excalibur* force evaluation exercise (conducted by the FAS on February 4, 2019 and simulating a nuclear attack with all its characteristic phases), demonstrate the capabilities of the FAS. The success of the FAS must be measured against this less publicized strategic mission – ensuring the credibility of France’s ability to impose unacceptable damage on any State threatening its vital interests.

52. C. Ailleret, “[Unité fondamentale des armements nucléaires et conventionnels](#),” *Revue de Défense nationale*, no. 223 (April 1964): 565-577.

53. O. Baudet, D. Marty, “[L’épaulement des forces nucléaires et conventionnelles](#),” *Les Cahiers de la Revue Défense Nationale*, hors-série Au(x) défi(s) de la puissance – Regards du CHEM 72^e session (2023): 111-131 (114).

54. Strategic Oceanic Force.

55. Commission de la Défense nationale et des forces armées, 2004-2005, Examen de l’avis budgétaire “[Dissuasion nucléaire](#),” *Compte Rendu* n°12, Antoine Carré (député), rapporteur pour avis (3 November 2004): 14 p. (8).

56. Five *Rafale* and six *C-135 FR* tankers.

Capability and technology changes in FAS delivery systems

Technical advances since the end of World War II, not least in information technology and its impact on weapon systems, have stimulated and dictated the modernization of nuclear deterrent delivery systems. The FAS command is probably less concerned (though not spared) than other commands by through-life support and technical availability. Its permanent mission remains vital to France's sovereignty, it cannot afford to suffer from malfunctioning, obsolescent or ageing equipment. Considerable funds have been committed since its creation, but these are inherent to this type of operation.

Resolutely focused on innovation, the logic of technological breakthroughs and modernization of delivery systems justifies the fact that the FAS are currently equipped with fifth-generation nuclear weapon (from the AN-11 to the ASMP-A – A for “*amélioré*”, improved – since 2009), their third strategic bomber (from the *Mirage IV* to the *Rafale* since 2010) and the second-generation tanker (from the *Boeing C-135 F* to the *Airbus A330 MRTT* in 2020). Since the end of nuclear testing and its consequences for the manufacture of French nuclear weapons, in 2009 the FAS was the first component in the world to deploy an airborne nuclear warhead (TNA) fully guaranteed by simulation.⁵⁷

2010 marked a new milestone for the FAS, with the entry into service of the *Rafale* fighter from Dassault. This multi-role aircraft carries the ASMP-A missile, a modernized version of the ASMP. The FAS gradually bid farewell to the *Mirage 2000N*, the last model of which was withdrawn from service in 2018.

The challenge of adapting the air forces has since crystallized around the renewal of the in-flight refueling fleet. In the 1980s, when FAS equipment was at its peak in terms of numbers, the need to replace the aging and then very expensive *C-135 FR* led to an order for fifteen⁵⁸ *A330* Multi-Role Tanker Transport (MRTT) aircraft from Airbus. The first of these aircraft, named “*Phénix*”, was delivered to the French Air Force in September 2018. The *C-135 FRs* would be withdrawn from operational service between October 2020 and December 2023, in line with MRTT deliveries.

This aircraft represents a breakthrough in terms of capabilities in more ways than one. Versatile and technologically advanced, it can be used for in-flight refueling, VIP transport, medevac (equipped with the *Morphée* care module) or evacuation of nationals (resevac). On March 31, 2020, for example, the 31st *escadre de ravitaillement et de transport stratégique* (EARTS – strategic transport and refueling squadron) – based at Istres, which brings together all FAS air-to-air refueling systems and

57. D. Mongin, *Dissuasion et Simulation, De la fin des essais nucléaires au programme Simulation* (Paris: Éditions Odile Jacob, 2018): 314 p. (245). Program led by the Military Applications Division of the French Atomic Energy and Alternative Energies Commission (CEA DAM).

58. Final number of aircraft, decided in 2018.

the “*Esterel*” squadron⁵⁹ since summer 2023 – carried out a *Poker* exercise and evacuated patients to hospitals as part of Operation *Résilience* (fight against Covid-19), on the same day.

In 2024, the operational resources of the FAS are grouped together on three nuclear air bases (BAVN), in accordance with the principle of sufficiency of nuclear deterrence resources. Today, the “*Gascogne*”, “*La Fayette*” and “*Bretagne*” squadrons are responsible for the nuclear deterrence mission. By October 2024, the nuclear alert will have been maintained by FAS airmen without interruption for sixty years, in defense of the nation’s vital interests. Complementary to the Strategic Oceanic Force (FOST), the airborne component of deterrence has radically changed the perception of the military. The skills acquired and mastered in the course of building up the strike force and carrying out the deterrence mission have since shaped the contours of the institution.

In keeping with the core principles of deterrence – visibility, flexibility and permanence – the command structures of the FAS have changed very little since their creation, which bears witness to their relevance from the outset. To guarantee their operational performance, the delivery system themselves have regularly incorporated technical advances. The capability renewal of the triad required⁶⁰ to carry the political message of nuclear deterrence has led the FAS to adopt a complete third generation of delivery systems. The *Rafale*, MRTT and ASMP-A combination confirms the force’s constant adaptation to the international dynamics it reflects.

At a time when the “*specter of nuclear conflict is emerging again*”⁶¹ amidst international tensions, the latest military spending law (*Loi de Programmation Militaire* – LPM) confirms the new modernization of France’s deterrent forces for the period 2024-2030. The ASMP-A (ASMPA-R) mid-life update (MLU) program anticipates the arrival of a new generation of airborne missiles in around ten years’ time: the ASN4G.⁶² As part of the Air and Space Force’s major power projection operations (*Skyros*, *Heifara*, *Wakea*, *Pegase*), the FAS continue to follow their path, fulfilling operational contracts. In this third nuclear age, the FAS, and the Air and Space Force as a whole, are preparing to respond to the demands of multi-domain combat, along with digital issues and future multi-faceted challenges, once again requiring flexibility, resilience and adaptation from all forces.

59. Claude Baillet, “[Les FAS et l’Esterel](#),” 30-33, *ANFAS Contact n°115*, *Association nationale des Forces aériennes stratégiques* (ANFAS – National Association of Strategic Air Forces), newsletter, 45 p. There is a certain logic behind the “*Esterel*” squadron’s subordination to the FAS, since its very existence stems from the deterrence mission. In 1968, its first *DC-8* was tasked with providing strategic transport between metropolitan France and the CEP in Polynesia. The squadron was then placed in charge of special transports for the DirCEN. In 2015, for example, it took over the traditions of the “*Bigorre*” electronic warfare squadron.

60. These include a bomber aircraft, a tanker aircraft to enable the bomber to reach its targets, a reliable bomb, and finally, a robust communications environment.

61. “[Objectifs LPM 2024-2030: garantir la crédibilité de notre dissuasion](#),” official website of the Ministry for the Armed Forces (10 May 2023).

62. 4th generation air-to-ground nuclear missile.

Strategic Air Command: A History of Adaptation throughout the Cold War¹

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The Cold War began almost immediately after World War II. Western diplomats, politicians and military leaders all recognized the pending ideological confrontation coming between communism and democracy. The succession of three events that happened in short order confirmed suspicions about the forecasted struggle for world prominence: the Berlin Airlift of 1948, the announcement of the People's Republic of China in October 1949 and the beginning of the Korean War in spring 1950 started with the invasion of the South by the North. Faced with the rise of global communism, the United States needed to develop a strategy to prevent communism from spreading. It was not solely a military strategy, but a grand strategy that enlisted all aspects of U.S. power.

There were multiple fronts to the Cold War. Everything everywhere was a competition between the instruments of power wielded by the United States and the Soviet Union. Even during the Olympic games, both Americans and Soviet athletes were competing for more than just 'gold'. Nevertheless, the Cold War never turned 'hot,' even if Moscow and Washington the two sides did meet on various battlefields

1. The views in this work are solely those of the author and do not reflect the views of the Department of Defense, the U.S. Air Force, on the Air University.

through proxy wars in places like Korea and Vietnam. Each side form alliances of countries aligned against one another. In Western Europe, the U.S. helped form the North Atlantic Treaty Organization (NATO). The Soviet Union countered in 1955 by creating the Warsaw Pact.

Then, there was the deterrence front. It was this front that kept the Cold War from turning hot. At the forefront of deterrence was Strategic Air Command (SAC), the Air Force organization responsible for two legs of the U.S. strategic triad. Despite SAC succeeded on the deterrence front, the fall of the USSR triggered the dissolution of the SAC. In 1992, the Air Force decided to disband SAC and distribute its assets to other commands.

From afar, deterrence in the Cold War remained somewhat ‘static’ with both sides aiming nuclear armed missiles at each other and both sides having nuclear armed bombers on alert ready to take off within a matter of minutes. SAC, and the deterrence it provided, was anything but static throughout the Cold War. The command had to innovate and adapt at various times throughout the Cold War due to changes in the geopolitical environment, technology, politics, or all three.

There were three specific instances where SAC demonstrated an ability to adapt to the changing environment. The first came upon LeMay’s assumption of command in 1948. He initiated changes of operating mentalities to have the SAC being able to face the evolutions of the U.S. security policy and a need for nuclear deterrence, initially with only intercontinental bombers. This was an internal adaptation to prepare the command for its mission under U.S. national security policy.

Second moment occurred with the launch of *Sputnik* in 1957 which ushered in the ‘missile age’. A nuclear strike could now happen within a matter of minutes. This technological advancement changed the strategic environment, which forced SAC to innovate again with ‘alert operations.’ The final adaptation explored here is the period following the Vietnam War. While Air Force leaders considered the ‘limited war’ in Korean an anomaly as they prepared for the ‘all out atomic offensive’ with the Soviet Union, the Vietnam War showcased the lack of conventional focus in SAC. In the years following Vietnam, SAC would focus on expanding conventional capability as well as tactical training that gave the organization a successful performance in Operation *Desert Storm*. Although successful during the first Gulf War, the end of the Cold War shifted Air Force priorities and the command once focused on deterrence would become a memory.

Origins of SAC

SAC, the organization, began a year before the Air Force became a separate service. While still under the Army as the U.S. Army Air Forces (AAF), AAF leaders formed SAC after World War II as an organization dedicated to the mission of independent, strategic bombing.² During World War II, strategic bombing advocates la-

2. This work provides a summary of Strategic Air Command over its existence. It is a synthetic work that draws upon the author’s work as well as others who have explored SAC’s history. Therefore, the

mented the lack of focus in the European theater on strategic bombing. Several times throughout the war, strategic bombers, primarily *B-17s*, were pulled of their primary mission of strategic bombing to service other targets for the war effort.³ When the focus shifted to the Pacific theater, the AAF constructed a unique organization to insure that the two theater commanders in the Pacific, Gen MacArthur and Admiral Nimitz, could not re-task the newly fielded *B-29s* (nicknamed “*Superfortress*”) from their primary mission of strategic bombing. To do this, a numbered Air Force, 20th Air Force, stood up and reported directly to the Joint Chiefs of Staff with Gen Arnold as the executive agent. In the field, a consolidated XXI Bomber Command, under 20th Air Force, eventually commanded by Gen LeMay, would direct the strategic bombing campaign against Japan.⁴ The precedent set by 20th Air Force during World War II severed as the precedent for the stand up of Strategic Air Command in 1946.

General George Kenney served as the first SAC commander. Kenney spent most of World War II serving as commander of Allied Air Force in the Southwest Pacific. During this time, he continually provided air support to Gen. MacArthur’s scheme of maneuver.⁵ Kenney’s Pacific operations lacked a true bomber campaign. When the strategic bombing of Japan actually started, it fell under 20th Air Force not Kenney. General Carl A. Spatz, who had commanded bombing campaign in Europe, would stand up the U.S. Strategic Air Forces in the Pacific in July of 1945 in time for the bombings of Hiroshima and Nagasaki. Despite not having orchestrated a bombing campaign during World War II, Kenney took over SAC, the one organization dedicated to independent strategic bombardment. As the Air Force became a separate service, Kenney’s focus appeared to be split between SAC and other interests. With the formation of the United Nations (UN), there was talk of a UN military. Kenney wanted to position himself to take the helm of the UN’s air forces if it was created. The inaugural SAC commander spent too much time away from his command job, which left his deputy to run the organization. Without the guiding hand of its commander, SAC’s readiness and training began to wane.

During this time, the United States realized that the Soviet Union, and its ideology of communism, were presenting an ever-growing threat. In 1948, Stalin closed off West Berlin forcing the U.S. to resupply the city through the Berlin Airlift. A year later, China fell to communism and the Soviet Union acquired the atomic bomb. Finally, in 1950, North Korea invaded South Korea. All these events led President Truman and the newly formed National Security Council (NSC) to issue NSC-68, a policy

references offered here designed to provide the reader an opportunity for further research. For an explanation on the formation of SAC see M. Deaile, *Always at War* (Annapolis: Naval Institute Press, 2018): Chapter 3.

3. For a complete history of the Combined bomber Offensive in Europe see T. D. Biddle, *Rhetoric and Reality* (Princeton: Princeton University Press, 2002).

4. For a history of the strategic bombing of Japan see K. P. Werrell, *Blankets of Fire* (Washington D.C.: Smithsonian Institution Press, 1996).

5. For a complete history of Kenney’s air operations see T. Griffith, *MacArthur’s Airmen: General George C. Kenney and the War in the Southwest Pacific* (Lawrence: University of Kansas Press, 1998).

document that expanded the military budget, provided funding for the development of the hydrogen bomb, and sought aid for allies facing the threat of communism. The containment of communism was now a military as well as a diplomatic problem. One significant issue was how to deter the Soviet Union from marching across Western Europe. Although the Soviets had captured most of the German industry and scientific areas from their occupation of East Germany, several feared a westward expansion by Stalin. In order to prevent such action, the U.S. explored two courses of action. One solution was to greatly expand the U.S. conventional force capability through Universal Military Training (UMT). The idea was that males would serve a mandatory two years in the military creating a large standing army that would deter Soviet expansion. The issue with UMT was the cost and the implementation of a draft so soon after World War II. The other option was to create a force of strategic bombers and atomic weapons that would serve as a deterrent to feared Soviet expansion. The latter option was preferred by policy makers, and the Air Force tasked SAC with creating a force that could ‘kill nations.’⁶

When the nation looked to SAC for a deterrent, they found a command in need of an overhaul. Hearing of low morale and readiness, General Hoyt S. Vandenberg, the Air Force Chief of Staff, asked Charles Lindberg, of *Spirit of St. Louis* fame, to fly with SAC aircrews and report on their readiness. Lindberg’s findings were enough to convince Vandenberg that Kenney had to be relieved of command. Upon taking office, Vandenberg had spoken to outgoing Chief of Staff, Carl Spatz, about the possibility of replacing Kenney. Both men agreed that the best bomber general in the Air Force should be the next SAC commander . . . General LeMay.

SAC Adapts to a New Environment: Building a Deterrent Force

When General LeMay took over SAC, his mission was to transform SAC into a command that could not only execute the independent strategic bombing mission, but could also serve as the main deterrent against Soviet expansion. To turn SAC around, Gen LeMay had to show SAC that they were not mission ready. LeMay assumed command in October of 1948 and planned the first command wide exercise for January of 1949. For the January exercise, LeMay picked out a target no aircrew in SAC had seen before in Dayton, Ohio on Wright Field. Every bomber in the command was to fly at combat altitudes, find the target, and bomb the target. Not one bomber in SAC successfully completed the mission. Gen LeMay lamented, “*this is the darkest day in American aviation history.*”⁷

Having shown SAC Airmen how inept their training had been, LeMay now had the attention of those under his command. The transformation of SAC could begin. Turning SAC into a fighting force meant giving the command a new operating mentality. LeMay told SAC’s members they were no longer preparing for war, but they

6. For a complete recounting of this debate see A. L. Friedburg, *In the Shadow of the Garrison State: Anti-Statism and Its Cold War Strategy* (Princeton: Princeton University Press, 2000).

7. LeMay’s initial actions in SAC are found in Deaile, *Always at War*, *op. cit.*, Chapter 4, and P. Meilinger, “How LeMay Transformed Strategic Air Command,” *Air & Space Power Journal* (March-April 2014): 77-86.

were 'at war' everyday they came to work. This new 'SAC mentality' would dovetail with LeMay's planned air campaign should the Cold War ever turn hot. The SAC commander convinced the Air Force, and the Joint Staff, that the best use of nuclear weapons in a conflict was an all out 'air atomic offensive' that would see SAC bombers use a majority of the nation's atomic weapons at the outset of hostilities.⁸ The strategy was to cripple the Soviet Union so much that the communist nation would have very few resources to mount a counter-attack. Preparing SAC for such a mission meant more than a new mindset; LeMay had specific coherent actions that dovetailed with the proposed nuclear war plan.

Building a deterrent force that could keep the Soviet Union's ambitions for Western Europe at bay required SAC to train everyday like war was eminent. LeMay's training plan drew on several of the tactics he perfected while commanding bombing operations in World War II. The first thing LeMay implemented was standard operating procedures. During World War II, he realized that aircrew needed to know what each member of the crew was doing during the different phases of flight. Standard operating procedures helped orchestrate crew actions and kept aircraft procedures predictable. Nuclear operations, with the nation's most destructive weapons, required the same precision. Gen LeMay also believed in 'hard crews;' this reflected his belief that crews should not be changed for the sake of change. If a crew flew well together, then that crew should remain together even if it meant moving together.⁹

Realistic training formed another pillar of LeMay's strategy to operationalize deterrence. The only way for an aircrew to perfect their wartime mission was to fly 'the mission' every time they were scheduled to fly. If the crew's mission to Russia and back was 20 hours, then that crew flew the wartime profile of 20 hours bombing cities in America that resembled their Russian target. Building a deterrent force also meant creating in the mind of the adversary the belief that SAC could execute its mission on a moment's notice. Part of training and fielding a deterrent force meant keeping the entire force 'on its toes.' To do this, LeMay instituted 'no-notice' inspections. The SAC commander believed that no staff officer should ask a unit within SAC to do anything the staff wasn't willing to do; therefore, the staff flew, which included LeMay. The general had his own crew and was famous for canceling his planned flight and landing at a SAC base unannounced. Security forces would greet the unplanned aircraft and LeMay would await the wing commander's arrival. When the wing commander arrived to greet the SAC Commander, LeMay would order the wing to execute its war plan. The wing commander's job depended on his unit's ability to execute its assigned mission.

A final aspect to LeMay's threefold plan for operationalizing deterrence was com-

8. How America and the U.S. Air Force built an atomic air offensive is recounted in E. Kaplan, *To Kill Nations: American Strategy in the Air-Atomic Age and the Rise of Mutually Assured Destruction* (Ithaca: Cornell University Press, 2015).

9. To understand LeMay's command in the Pacific see Deaile, *Always at War*, *op. cit.*, Chapter 2, and James M. Scott, *Black Snow: Curtis LeMay, the Firebombing of Tokyo, and the Road to the Atomic Bomb* (New York: W. W. Norton and Company, 2022).

petition. The deterrence dilemma is that commanders want to create a force so lethal that the enemy is deterred from acting believing the cost of the action outweighs the benefit. At the same time, commanders do not want to unleash the power of the most destructive weapons on earth. To keep his airmen ready for the fight, LeMay pitted them against one another. Competition assured SAC's skills were honed and ready for possible employment. Outside of SAC's Headquarters was a totem pole that displayed each wing ranked from top to bottom based on a number of factors from bombing scores to venereal disease rates. Every day LeMay walked into SAC HQ he saw how well his wings were performing.

LeMay also pitted units against one another in the annual SAC bombing competition. Select units from wing would compete against one another to see who had the best overall performance on bombing and tactics. Those crews that won were typically rewarded with a 'spot promotion' meaning they would instantly assume the next higher ranks. As LeMay convinced the Air Force of the need for a new approach to atomic warfare, he also argued that the 'only' command in the Air Force at war with the enemy was SAC. Therefore, LeMay was granted the ability to award high performing SAC Airmen with a promotion 'on the spot.' The one caveat was that SAC Airmen retained their spot promotions as long as they kept their 'mission ready' status. A failed check ride, for example, could cause one member of the crew to go non-mission ready, which could cause the entire crew to lose their spot promotion. Such stress in the organization caused SAC to have the highest divorce rate among all the major Air Force commands.¹⁰

In the midst of LeMay's plan to build a capable, lethal, and responsive deterrent force, the Korean War broke out. In response to the North Korean invasion, LeMay deployed bombers to the Far East to help repel the communist invaders. Within three months, SAC had executed all strategic targets in the theater. Despite having the Air Force's newest bomber at his disposal, the *B-36*, LeMay only sent *B-29s* to fight the Korean War. He also restricted which electronic countermeasures his deployed fleet could employ. All of these actions helped SAC preserve SAC's true capability. SAC feared the actual enemy, the Soviet Union, could learn of U.S. capability by observing its actions in Korea. *B-29s* would fly at night to mitigate losses because the bombers had little luck evading the jet aircraft that appeared during the Korean War, specifically the *MiG-15*. LeMay and SAC would eventually field two all jet bombers – the *B-47 Stratojet* and the *B-52 Stratofortress* – that the command believed would fare better against jet fighter aircraft. When the war ended, Air Force leaders viewed the Korean War as an anomaly, believing that the atomic conflict would still determine the Cold War victor. Vietnam would test those presumptions.¹¹

10. LeMay's strategy of realistic training, no-notice inspections, and competition is recounted in Deaile, *Always at War*, *op. cit.*, Chapters 4 and 5.

11. U.S. Air Forces performance in the Korean War and the anomaly argument are captured by C. Crane, *American Airpower Strategy in Korea, 1950-1953* (Lawrence: University of Kansas Press, 2000). Crane details the movement of nuclear weapons to the theater. The President would be the only person to decide on nuclear weapon use. General LeMay ordered that if nuclear weapon employment was greenlighted then a SAC general in theater would oversee the operation.

Adapting to Changes in Technology

On October 4, 1957, the Soviet Union launched *Sputnik*. The artificial satellite orbited the earth, but, more importantly, with one act the Soviet Union ushered in the space age and the intercontinental ballistic missile age (ICBM). Prior to *Sputnik*, the conventional wisdom was that an atomic war would be fought with aircraft dropping nuclear weapons on target. To protect against an air attack, the United States tried to push its radar net as far out as possible to warn of impending attack.¹² With missiles, however, a nuclear attack could come in a matter of minutes not hours. SAC would need to respond to changes in the strategic environment that *Sputnik*'s demonstration brought.

Eisenhower's Bold Move

In order to assume a more delegative posture, to reduce SAC's response time, U.S. policy had to change in addition to SAC's tactics and procedures. Following Hiroshima and Nagasaki, President Truman established the Atomic Energy Commission (AEC) to handle custody of the nuclear weapons. After reports from the two atomic attacks in World War II reached Truman's desk, the President felt that only civilians should have custody of these weapons. Operating under this guidance, when SAC bombers would generate, the aircrew had everything needed for weapons employment except the special nuclear material to make the bomb fully operational. That last piece of the bomb puzzle would have to be obtained from an AEC person on the base or the bomber would have to fly to an AEC site to get it. Increasing SAC's posture and response time would mean giving custody of the weapons to the military.

President Eisenhower elected to give custody of nuclear weapons to the military primarily because these were officers he served with during his service, especially in World War II. His trust in the military helped ease any concerns about placing the powerful weapons in the world in the hands of those who would employ them. Assuming a more delegative posture where aircrew have the codes and targets to reduce response time requires a nation has good civil-military relations, which the U.S. had given the President's trust in his officers.¹³

By the time the Soviet Union launched *Sputnik*, General Curtis LeMay had moved to Washington, D.C. to serve as the Air Force Vice Chief of Staff. While still in charge of SAC, LeMay had SAC study the prospect of alert aircraft. Gen Thomas Power, LeMay's handpicked successor, ran SAC after LeMay's historic eight plus years as the organization's commander. Gen. Power plan was to put one third of

12. The story of how SAC got to 15 minute alert and the fate of one of these radar platforms is recounted in L. D. Keeny, *15 Minutes: General Curtis LeMay and the Countdown to Nuclear Annihilation* (New York: St. Martin's Griffin, 2012).

13. The account of Truman and Eisenhower's approach to nuclear weapon custody is recounted in P. Feaver, *Guarding the Guardians: Civilian Control of Nuclear Weapons in the United States* (Ithaca: Cornell University Press, 2001).

SAC's forces on nuclear alert three days before *Sputnik's* launch. Although he felt short of the goal, roughly 10 percent of SAC's bomber forces and associated tankers were on alert three days prior to *Sputnik's* launch.¹⁴ Launching that many aircraft off a runway in less than fifteen minutes required new tactics in addition to the new nuclear custodial arrangement placing the weapons in SAC Airmen position. Bomber aircraft performed MITOs (Minimum Interval Takeoff) that required them to get airborne with no less than 15 second spacing. Furthermore, bomber aircraft used assisted takeoffs to generate the thrust required to get a bomber fully loaded with nuclear weapons and fuel into the air. *B-47s* Stratojets used rockets strapped to the aircraft (jet assisted takeoffs or JATO) while *B-52s* injected distilled water into the intake of the jet engines to improve takeoff performance. The process produced more than just thrust; the *B-52* on takeoff produced a thick black exhaust trail showing that SAC could make 'water burn.'



B-47 using JATO (1954).

© "[Boeing B-47B](#)," National Museum of the USAF.

Aircraft sitting on the ground ready to launch within fifteen minutes was not a sufficient posture in Gen Power's view. SAC would have to find another way to increase its response posture.

14. For a history of ground alert and airborne alert see Deaile, *Always at War*, *op. cit.*, Chapter 7.

Airborne Alert Arrives

General Power felt the best way to enhance SAC's response time was to have aircraft on alert in the air as well as a percentage of the fleet on ground alert. From 1959 to 1968, the SAC Commander demonstrated the concept after receiving congressional money to prove his concept. While President Eisenhower felt the move unnecessary, Congress sided with Power and funded the new SAC tactic. In two years, SAC flew close to six thousand sorties and showed the validity of the concept. Nicknamed "*Chrome Dome*" by SAC Airmen for the fact that flying that these long sorties could cause a crewmember to go bald from the increased helmet wear. Once the concept proved viable, SAC flew airborne alert until 1968. Typically, the airborne alerts bombers flew to the 'fail safe' point, and, unless executed, returned along similar routing to their home station receiving multiple air refuelings enroute. The increase flight time came at a cost. Two accidents brought the age of airborne alert to an end. The first happened in 1966 when a *B-52* flying a *Chrome Dome* mission collided with its air refueling *KC-135*. As the *B-52* broke up in flight, its payload of thermonuclear weapons fell to the earth. Some of those weapons landed on Spanish soil near the town of Palomares. The impact with the ground caused some of the explosives in the weapon to detonate. Although the weapons did not produce a nuclear yield, the explosion spread nuclear material across the Spanish countryside and resulted in a U.S. led clean effort.¹⁵ The second accident happened in 1968. Following a *B-52* crash in Thule, Greenland, SAC discontinued *Chrome Dome* operations. A functioning space-based early warning capability also contributed to the elimination of *Chrome Dome* as the U.S. could be assured of early warning from a missile attack anywhere in the world.

Missile Folded in SAC

Alerted bombers were one response to the beginning of the ballistic missile age. The other option to increase response was for the U.S. to field an ICBM capability of its own. Under the Eisenhower administration, the hydrogen bomb and the ICBM became top priorities. General LeMay knew the importance of strategic missiles although he and Gen. Power both viewed these unmanned strategic bombers with skepticism. While bombers took longer to get to their targets, they were recallable, retargetable, and a visual sign of deterrence. What the ICBM brought to deterrence was a rapid response capability. It should be noted that the first ICBMs delivered to SAC were liquid fueled missiles, which required more maintenance. Eventually, SAC would field solid rocket fuel missiles providing an even faster response time. In fact, ICBMs are the fastest response leg of the U.S. strategic triad.

15. The U.S. nuclear accidents are recounted in E. Schlosser, *Command and Control: Nuclear Weapons, the Damascus Accident, and the Illusion of Safety* (London: Penguin Press, 2013).



Test of a LGM-25C Titan II in the 1960s.

© "[Missile – Définition](#)," *Techno-Science*.

Cuban Missile Crisis Proves SAC's Alert Concept

The Cuban Missile Crisis put SAC's readiness to the test. When the Soviet Union covertly placed nuclear capable missiles in Cuba, SAC became the frontline force to deter the pending nuclear war. Bombers dispersed to multiple airfields to complicate the enemy's targeting while ICBMs stood alert ready to launch within minutes. At the same time, bombers were airborne flying their alert routes demonstrating the resolve of the United States. SAC had to generate 75 B-52 sorties a day as well as 133 tanker sorties to support airborne alert. 183 B-47s conducted bomber dispersal while 132 missiles stayed alerted around the clock. This show of force coupled with

President Kennedy's strategic messaging and quite diplomacy demonstrated what today many are calling 'integrated deterrence.' It took the full alerted capability of SAC synchronized with other government actions to convince the Soviet Union to remove its missiles from Cuba.¹⁶

Post Vietnam: The Third Adaptation

The history of SAC shows that despite common perceptions the Cold War rarely remained 'static.' SAC's mission to provide deterrence required adaptation to changes in policy, technology, and the strategic environment. The final case study examined here is SAC's adaptation following the Vietnam War. As previously noted, Air Force leaders (who were primarily bomber generals at this point) saw the Korean War as an anomaly and still believed 'atomic war' would be the most likely way the Soviet Union and the United States would confront one another. The war in Vietnam stressed SAC's ability to provide conventional capability in this hybrid fight. SAC not only had to stop supplies from reaching the Viet Cong (VC) in South Vietnam, but also had to aid in repelling invasions by the North Vietnam Army (NVA). During the conflict, SAC aircrews lost aircraft and airmen to strategic surface-to-air (SAM) missiles. Following the Vietnam War, SAC put considerable effort into training for the conventional fight, to include an emphasis on low-level flight, as well as fielding new standoff conventional weapons that would increase the employment distance from SAMs. This SAC adaptation would be tested in *Desert Storm*.

SAC in Vietnam

Covering all of SAC's contributions in the Vietnam War is beyond the scope of this work. However, it is worth noting that the Vietnam Air Campaign consisted of three distinct phases where SAC had an impact. The first air campaign was Rolling Thunder, conducted from 1964 to 1968. The *B-52*, despite being a strategic bomber, main objective in *Rolling Thunder* was to interdict the flow of material to the Viet Cong in South Vietnam as well as attack NVA near the demilitarized zone. President Johnson felt allowing the *B-52s* to go further north would be too provocative and put a vital strategic access at risk. During the initial air campaign, *B-52s* flew 141 *Rolling Thunder* missions (nicknamed "*Arc Light*").

The second noted air campaign in the Vietnam War was Linebacker I. In response to the NVA Easter Offensive, launched on 30 March 1972, U.S. forces conducted air operations in an attempt to repel the NVA invaders. *B-52s* would go North to hit supply and industrial areas in and around Hanoi. In a provocative move by President Nixon, *B-52s* would also mine Haiphong harbor. After the NVA's failed Easter Offensive, President Nixon's administration attempted to conduct peace talks with North Vietnam. North Vietnam's refusal to continue peace talks led to *Linebacker II*, the final recognized air campaign of the Vietnam War. For 12 days, from 18-29 December 1972, *B-52s* conducted over 200 sorties and dropped 20,000 tons of bombs

16. SAC's response in the Cuban Missile Crisis is further detailed in Deaile, *Always at War*, *op. cit.*, Conclusion.

on military and industrial targets in and around Hanoi.



B-52 in Vietnam dropping M117

© "[B-52 – Aircraft](#)," *Britannica*.

While the bombings achieved their objectives of bringing North Vietnam to the negotiating table, the cost of the operation was 16 *B-52* bombers. SA-2s (strategic surface-to-air- missiles) positioned around Hanoi were primarily responsible for bringing down the strategic bombers. In the aftermath of Vietnam, SAC would examine new tactics and weapons for possible future conventional fights.¹⁷

It is worth noting that fighter pilots would receive a lot of combat time in Vietnam and do most of the combat flying in North Vietnam. Those missions led to more recognition for the fighter pilots and, consequently, more leadership positions. The rise of the fighter ‘Generals’ would eventually replace the bomber ‘mafia’ that had led the Air Force since its inception. The last bomber Chief of Staff of the Air Force (CSAF) would be Lew Allen. General Charles A. Gabriel would become the first true fighter CSAF in 1982.¹⁸

17. U.S. air power in Vietnam is detailed in M. Clodfelter, *The Limits of Air Power* (New York: The Free Press, 1989), and M. E. Weaver, *The Air War in Vietnam* (Lubbock: Texas Tech University, 2022).

18. The ascension of the fighter pilot to Air Force leadership is further detailed in M. R. Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945-1982* (Maxwell AFB: Air University Press, 1998).

SAC Tactics and Weapons School

SAC put considerable emphasis into developing tactics and techniques for countering the SAM threat in the aftermath of Vietnam. The first thing SAC had to do was create a cadre of tactics experts. In the 1980s, SAC stood up its version of a “Weapons School” (similar to the well known Navy Top Gun program) that would train select aircrew on the best ways to employ the *B-52* in combat.¹⁹ The next step was to train the entire force on how to fly, fight, and win in a future conventional conflict.

In 1989, SAC stood up the Gen Curtis LeMay Strategic Warfare Center (SWC) at Ellsworth AFB, South Dakota. The mission of the center was to teach aircrews how to ‘get the most’ out of their aircraft. Weekly crews would deploy to the school, fly low-level bombing missions, take courses, and debrief the results with tactical experts. Using radar scoring as well as radar tracking, crews could see how well they fared against SAMs.²⁰

Increasing the Conventional Standoff Capability

Besides increased emphasis on low-level tactics and working on integration with other combat aircraft, SAC began to field conventional weapons that increased the standoff range of the *B-52*.²¹ Increased standoff range would keep bombers outside the lethal range of SAMs. One of the systems SAC pursued for the *B-52* was the Popeye, a missile equipped with a seeker that was data linked to an operator in the *B-52*. Using a television type targeting system, the *B-52* operator could guide the Popeye (later Have Nap) missile to its final target. Although not employed in combat under SAC, the Have Nap marked one of SAC’s initial attempts to increase conventional capability and standoff range.

The second effort to increase conventional capability and standoff range did debut in combat under SAC. The AGM-86, or Air Launched Cruise Missile (ALCM), was initially designed to penetrate enemy air defenses and deliver a nuclear payload to critically important targets. The weapon system would increase standoff capability of the bomber, but in the nuclear fight... initially. In 1986, President Reagan ordered Operation *Eldorado Canyon*, a punitive strike on Libya for its role in the suspected bombing of a West Berlin discotheque. Although successful in attacking Libya, the operation took a considerable amount of planes, support, and planning time. Having a rapid standoff conventional capability option would decrease planning as well as the number of aircraft required. This was the genesis of the AGM-86C (C for “conventional”). Converting the existing nuclear payload in the AGM-86 to a conventional warhead would give

19. When SAC disbanded in 1992, the Tactical Air Command (soon to become Air Combat Command) would stand up *B-52* and *B-1* divisions of the USAF Weapons School.

20. For further insight on SAC’s tactical program see Jeffrey Rhodes, “SAC’s New Graduate School,” *Air Force Magazine* (December 1989): 48-55.

21. SAC did have nuclear weapons with a standoff capability, but the Have Nap and CALCM were designed to improve conventional standoff capability.

the nation a weapon system capable of delivering a 1000-pound blast-fragmentation warhead at a considerable distance from the target.



AGM-86C attached under one of the B-52 pylons

© "[@masao_dahlgren](#)," X.

The Air Force and SAC kept the program highly secret for several reasons. First, since the AGM-856C had a nuclear twin, the U.S. did not want the weapons existence to deter any arms control talks. Secondly, the Global Positioning System (GPS) needed for the AGM-86C's guidance system was only beginning to approach worldwide operational capability. The missile would make its debut on night one of *Desert Storm*.

Desert Storm: The Test of the Third Adaptation

The invasion of Kuwait by Iraq under the leadership of Saddam Hussien led to the biggest combined military operation since Vietnam. Recounting the entire operation is once again beyond the scope of this paper; however, it is important to note how the initial use of force in Desert Storm proved the success of SAC's post-Vietnam adaptation. SAC bombers actually began the operation from Barksdale Air Force in Bossier City, Louisiana when seven planes loaded with the secretive standoff weapon (AGM-86C) took off on the east bound leg of their standoff bombing mission. After several air refuelings and considerable time over the ocean, the 'Secret Squirrels' (this was the nickname given to the mission) launched 35 of the 39 CALCMs the

seven bombers were carrying. The mission accomplished over 80% of its objectives.²² Coincidentally, SAC forward deployed *B-52s* in theater on the island of Diego Garcia. A particular flight from that forward operating base saw two *B-52s* fly under cover darkness at 300 feet to strike a runway in Wadi Al Kirr airfield in Iraq. The low-level operation allowed the *B-52s* to evade Saddam and Iraq's considerable integrated Air Defense (IAD) capability. For the first three days of the war, SAC bombers would fly night low-level missions evading Iraq's SAMs. Once the air defenses were down, *B-52s* returned to their high-level mission and continued dropping bombs for the remaining 30+ days of the air campaign. In total, SAC bombers would fly 1 740+ mission dropping some 27,000 tons of bombs on Iraqi production, air defenses, troop depots, and troop emplacements. Decades of training on conventional capabilities proved valuable in *Desert Storm*.

Conclusion

In 1989, the Cold War came to an official end. Three years later, SAC, the command responsible for deterrence in that war, would be disbanded in favor of a different Air Force organization that reflected the 'new world order' that existed after the Cold War and America's success in *Desert Storm*. To many, the Cold War represented a period of static deterrence between the two nuclear superpowers. SAC, the Air Force command responsible for operating two legs of the strategic triad, demonstrated that maintaining deterrence is anything but easy. As demonstrated above, there were at least three times that SAC had to adjust operations, tactics, capabilities, or all three to maintain its credible deterrent posture. SAC's history provides insight into the constant adaptation a military organization must make to provide credible deterrence in a rapidly changing world.

22. The 'Secret Squirrel' mission was told by J. Tirpak, "The Secret Squirrels," *Air and Space Forces Magazine* (1 April 1994). The name "*Secret Squirrel*" was a moniker highlighting the secret nature of the conventional cruise missile kept secret since its inception.

AIR NUCLEAR COMPONENTS
History of Aerial Thinking

Pierre Marie Gallois (1911 - 2010): Aviator and Theorist of Atomic Weapons

Patrick Bouhet



“[Pierre Marie Gallois](#),” Dassault Aviation.

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In the beginning, Pierre Marie Gallois¹ did not intend to pursue a career as a military professional, in aeronautics, nor to become a strategist, thinker, or geopolitologist. Instead, his education background was in law and history. At one time, he

1. There are two main sources for tracing the career and development of the thinking of Pierre Marie Gallois: his memoirs (*Le sablier du siècle [The Sword of the Century]* (Lausanne: L'Âge de l'Homme, 1999): 564) and his biography written by Christian Malis (*Pierre Marie Gallois, Géopolitique, Histoire, Stratégie [Pierre Marie Gallois: Geopolitics, History, Strategy]* (Lausanne: L'Âge de l'Homme, 2009): 750). The author had the opportunity to talk to General Gallois on numerous occasions between 1989 and 2010, the year of the General's death. Some of the analyses in this article are based on those conversations.

also dedicated himself to the fine arts and has never lost his appreciation for them. Testament to this is the *trompe-l'œil* fresco he painted in the courtyard of his building on Rembrandt Street in Paris, along with the collection of medieval statues he amassed in his secondary residence in the Vexin region. Nevertheless, despite his original intentions, Gallois fulfilled all these roles truly impressively. He was also known for his engagement in much public debate in a both polemical and, at times, highly incisive manner.

Gallois joined the French Air Force (FAF) as much out of an interest in aeronautics² as because he had a premonition that war with Germany was imminent. In 1931, at the age of 20, he learned to fly with the help of state scholarships and subsequently became a reserve officer in the FAF. On the eve of the Second World War, he was assigned to a “Saharan” squadron in North Africa.³ Indeed, from the onset, Gallois was drawn to tactical innovations, demonstrating his independence of thought and his desire to assert his positions. This, however, led to tensions with his superiors and most importantly, with the Vichy government. Namely, he criticised and deplored it for its defeatism and its collaboration with the adversary.

Unsurprisingly, this led to him joining the Free French Forces in November 1942 thanks to Operation *Torch*. From then on, Gallois participated in many bombing missions carried over France and Germany with the Royal Air Force (RAF) Bomber Command. Specifically, he served as a navigator captain aboard a *Halifax* bomber in the 2/23 “*Guyenne*” group (346 Squadron RAF).

It can be said that for Gallois, this was a period that was conducive to creating or strengthening his existing networks as he met new acquaintances and forged new friendships. Yet, this was also a time where lasting enmities were fostered – ones that remained sensitive for many years later on.⁴ Truly, iconic as he was, he even became the inspiration for a character in a novel written by Jules Roy, who was also an aviator and shared living quarters with him at the time.⁵

After the war, Gallois continued his career and was quickly regarded as an expert in transport aviation. From this point onward, he gradually established himself as a “man of letters” by authoring numerous articles that were published either in specialised or

2. He made his first flight at Le Bourget on a *Breguet 19* of the 34th aviation regiment where his brother-in-law served, a few months after Charles Lindbergh crossed the Atlantic (20-21 May 1927); J. Lorient, P. M. Gallois, *Le sablier du siècle*, op. cit., 13.

3. Special units created between the wars to operate in North Africa. The young Gallois was assigned to Saharan squadron 590. Refer to *SHD AI/8/Z/145*, Archives Gallois – Interviews of 10 May and 22 June 1979.

4. Pierre Marie Gallois used to recount with humour and irony that the meeting he had with General Bailly, Chief of Staff of the French Air Force, with a view to being given a command that he never actually obtained. As a result, he left the Air Force in February 1957 with the rank of brigadier general. It turns out that the two men had served together in Bomber Command and that friction had arisen on that occasion...

5. J. Roy, *La vallée heureuse* [*The Happy Valley*] (Paris: Charlot, 1946): 289. The book was awarded the Prix Renaudot for 1940, *Guerre oblige* [*Obligated War*]. In this book, the character of Chevrier is the author himself, while that of Morin is inspired by Gallois. He dies at the end of the story, with the agreement of the general according to his testimony.

institutional press. These notably included the *Forces Aériennes Françaises* magazine, along with other mainstream newspapers. In doing so, he expressed his views and revealed some of the debates taking place within the Ministry of Armed Forces and across civil aviation. This was, of course, not without causing some friction within the military institution, as well as amongst industrialists and technical directors.

Rebuilding French Air Power and the Atomic Actuality

Gallois's career then entered into the plane of policymaking as he began his service as a cabinet minister. From 1948 to 1953, he worked alongside Charles Léchères, Chief of the Air Force General Staff. After August 1953, he was subsequently assigned to René Pleven, then Minister of National Defence and Armed Forces. In these two positions, Gallois was heavily involved in rebuilding the national air forces, including the industrial and technological base that would later become its foundation.⁶

In parallel, after this period, he held two positions: one at the ministry and the other within the North Atlantic Treaty Organization (NATO). Additionally, he was assigned to the Supreme Headquarters Allied Powers Europe (SHAPE), where he skillfully used his ability to build trust with the U.S. leaders, notably General Lauris Norstad, and British leaders, including Field Marshal Montgomery. This was particularly due to his excellent command of the English language.

It was starting from this time that Gallois became more specifically involved in matters relating to the study of nuclear. He developed certain concepts and shared them by, sometimes, circumventing the usual hierarchical chain. This interest was expressed as early as 15 September 1945, when he dedicated an article to the bombings of Hiroshima and Nagasaki in the journal *La France libre*.⁷ Entitled “*À propos de la désagrégation de l'atome*” (About the Disintegration of the Atom), this piece is structured around five main points.

The first point stresses the discontinuity that was emerging in the definition of power and how the atom henceforth represented a rupture from the past. Secondly, Gallois raises the question of how the emergence of atomic weapons affected the phenomenon of war. However, he does so without commenting on the possibility of their elimination as a means of settling conflicts between states. The third and fourth points deal with the need to adapt doctrine and the economic, financial, and industrial base in order to develop this type of weapon. Finally, he argues that the new weapon allows the full and complete application of the theories of Italian general Giulio Douhet.

This article, published one month after the first atomic operational bombing in history, demonstrates Gallois's immediate interest in the subject. He begins with known technical factors, as he constructs an operational, doctrinal, and strategic re-

6. On this subject, see in particular C. Malis, *Pierre Marie Gallois...*, *op. cit.*, 153-398 and C. Carlier, *L'aéronautique française 1945 - 1979 [The French Aeronautics 1945 - 1979]* (Paris: Lavauzelle, 1983): 645.

7. P. M. Gallois, *Écrits de guerre [Letters of War]* (Lausanne: L'Âge de l'Homme, 2001): 149 (56-67).

flection by outlining certain principles that he subsequently develops. For instance, in his view, mass and number no longer possess the intrinsic quality they previously held. In addition, with the advent of the atomic weapons, an “absolute” strategic weapon then emerged which *de facto* fundamentally disrupted the system of international relations. Thus, it could enable France, which had been outstripped technically and politically downgraded by the war, to regain at least a significant rank in the concert of nations, if not its former prestige.

While Pierre Marie Gallois continued his interest in the nuclear issue in the years that followed, it was not part of his primary area of activity. It was only when he joined NATO as a member of the New Approach Group (NAG), that he became fully re-involved in reflections about the operational use of the atomic weapon.

Gallois arrived at SHAPE in Rocquencourt (Yvelines) in July 1953. In September 1953, the NAG was created and comprised four colonels: two U.S. officers, Andrew J. Goodpaster of the U.S. Army and future SACEUR⁸ and Robert C. Richardson of the U.S. Air Force (USAF); British officer James McDonald of the Royal Army; and finally, Colonel Gallois himself for France. They were soon nicknamed the “*Hot Colonels*” and reported directly to General Alfred Gruenther⁹ of SACEUR (1953-1956), General Lauris Norstad¹⁰ who was SACEUR’s deputy air chief, and Field Marshal Bernard Montgomery,¹¹ who was responsible for ground forces.

Broadly speaking, the Alliance’s issue at this time was how to oppose a Soviet offensive, based on clear conventional superiority.¹² The proposed solution integrated nuclear weapons. The halt of the Communist forces was achieved using atomic weapons, which slowed, channelled, and then destroyed the concentration of the attacker’s troops. As a result, all previously accepted conceptual frameworks were shattered. The objective was no longer to form continuous defensive lines, occupied by groups of forces that would risk being the target of nuclear strikes. Rather, it was now a matter of building a structure with light, mobile, and dispersed forces that would act on an adversary already weakened by friendly strikes or dispersed to avoid them. According to the plans elaborated by the four colonels, this war would extend over a limited duration, beginning with the initial movements of the Warsaw Pact and the massive counterattack by NATO forces.

8. Supreme Allied Commander in Europe.

9. Alfred Gruenther, 1899 - 1983, general in the U.S. Army, as well as SACEUR from July 1953 to November 1956.

10. Lauris Norstad, 1907 - 1988, general in the U.S. Army Air Forces (USAAF) and later the USAF, deputy air chief of SACEUR from July 1953 to November 1956.

11. Bernard Montgomery, 1887 - 1976, British field marshal, as well as SACEUR’s deputy from 1951 to 1958.

12. Two key sources are available on the NATO Archives website (<https://archives.nato.int/1954-17>): “[Item MC 0048 - Report by the Military Committee to the North Atlantic Council on the Most Efficient System to be Adopted for the NATO Military Force for the Next Few Years](#),” *North Atlantic Military Committee* (18 November 1954): 31; and “[Item MC 0048-FINAL - North Atlantic Military Committee Decision on M. C. 48 - A Report by the Military Committee on The Most Effective Pattern of NATO Military Strength for the Next Few Years](#),” *North Atlantic Military Committee* (22 November 1954).

The objective to be achieved was defined as follows:

“... *we must convince the soviets that:*

a. *They cannot quickly overrun Europe.*

b. *In the event of aggression, they will be subjected immediately to devastating counter-attack employing atomic weapons.**

... * *The term ‘atomic weapons’ whenever appearing is understood to mean atomic and thermonuclear weapons and, as appropriate, includes those delivered by aircraft, guided missiles, rockets and artillery.”*¹³

Indeed, nuclear weapons were at the heart of this plan, the conception of which led Colonel Gallois to study at length the ways in which they could be used, including the potential effects they could induce. To this end, he used data, to which very few had access, that was specifically circulated only within the French general staff. On 5 May 1955, he notably attended a test in the Nevada desert. In his memoirs, he wrote:

“*The novice observer is so surprised by such a spectacle [the explosion] that he has difficulty memorising the multiple sequences of this mobile architecture. I was so fascinated – and so were the other observers on the NATO mission – that we did not expect the shock and the sound wave that reached us 35 seconds after the detonation...*”¹⁴

On that day, Gallois moved away from his primarily theoretical, bookish reflections towards a concrete, tangible experience. His opinions on the unique nature of the atomic weapon, both in terms of use and its military or political effects, were undoubtedly reinforced.

Gallois: The Promoter of Nuclear Deterrence

Concurrently to working on policy, he nevertheless kept to his original career path as an Air Force officer. Colonel Gallois submitted a “thesis” as part of the 12th graduating promotion of the *École supérieure de guerre aérienne* (Superior School of Air Warfare).¹⁵ This document is indeed presented in the following pages of this issue of *Vortex*. His thesis was defended on 14 December 1954 in front of Generals Bisson and Challe, Colonel de Fouquières, and *Lieutenant-Colonel* Layné. It begins with a contextual introduction, followed by an analysis of the facts and technical data, and then discusses the political and, above all, military implications of the emergence of nuclear weapons. Finally, it draws operational and organisational conclusions for the French armed forces.

13. “Item MC 0048 – Report by the Military Committee,” *op. cit.*, 2.

14. P. M. Gallois, *Le sablier du siècle*, *op. cit.*, 343. Publisher’s translation.

15. P. M. Gallois, “*Des incidences de la généralisation des armes nucléaires sur les formes de la guerre, l’organisation, l’équipement et l’emploi des forces armées [The Impact of the Generalisation of Nuclear Weapons on the Forms of Warfare, and on the Organisation, Equipment, and Use of Armed Forces]*,” Gallois collection, Bibliothèque de l’École militaire (September 1954): 59.

The main points to be retained from this work are as follows:

1. Europe is considered indefensible if atomic weapons are not employed.
2. If an adversary goes on the offensive with full knowledge of the facts and possesses a nuclear arsenal of their own, it is likely they will use it in a decisive surprise attack in the early stages of their operations.
3. A “classic” war, with a build-up period followed by operations over a long period of time, is no longer imaginable in these conditions.
4. The aggressor’s primary objective will be to destroy the defender’s means of retaliation. The defender must organise, disperse and protect its forces and infrastructure (passive defence) in order to be less susceptible to atomic strikes.¹⁶
5. Within this framework, the primary role is assigned to the air forces, while the roles of the naval and ground forces are reduced.
6. The miniaturisation of the atomic weapon [and] its unitary power blurs the importance of the vehicle in favour of the explosive.¹⁷
7. The organisation of land forces needs to adapt and avoid heavy formation.
8. Naval forces, particularly bases and convoys, are particularly sensitive to nuclear strikes.
9. It is in France’s interest to participate in Europe’s atomic defence.

In this work, Gallois in particular presents some of his essential conceptions, regarding the radical shift in paradigm brought about by the emergence and threat of employing atomic fire. These principles were later elaborated even further in 1960 in his book *Stratégie de l’âge nucléaire* (Strategy of the Nuclear Age).¹⁸

The work conducted at NATO coupled with Gallois’s personal reflections, made him particularly well placed to present the results to French decision-makers. This was especially crucial at a time when the decision to pursue nuclear armament became a fundamental debate for both the political class and the military institution.

In his memoirs,¹⁹ Pierre Marie Gallois recounts this period when, at the instigation of General Norstad and with his personal authorisation and charts,²⁰ he toured and visited numerous offices. He met with Prime minister, Guy Mollet, and his Minister of State, Jacques Chaban-Delmas, on 14 March 1956. The very next day, he

16. This is reminiscent of the foundations of the Agile Combat Employment (ACE) concept and the *Mise en Œuvre Réactive de l’Arme aérienne* (MORANE or in English, Reactive Implementation of Aerial Weaponry) concept of the French Air Force.

17. P. M. Gallois, “*Des incidences de la généralisation...*”, *op. cit.*, 57.

18. P. M. Gallois, *Stratégie de l’âge nucléaire. Préface de Raymond Aron* [Nuclear Age Strategy, Preface by Raymond Aron] (Paris: Calmann-Lévy, 1960): 256.

19. P. M. Gallois, *Le sablier du siècle*, *op. cit.*, 350-414.

20. A demonstration method based on drawings and graphic representations, which became common at the time for NATO work. A forerunner of the chronic use of presentation software, which is an indispensable part of meetings in all institutions today.

met with the Minister of National Defence at the time, Maurice Bourgès-Maunoury. He also personally met with General Charles de Gaulle, who had not yet returned to power as of then, on 2 April 1956 at the Hôtel La Pérouse. This was an episode he particularly enjoyed recounting. He also held a seminar for the entire hierarchy of the Ministry of National Defence on 4 July 1956.

The fact that Gallois was in contact with so many personalities and decision-makers and took part in numerous debates might lead to an overestimation of the actual level of personal influence he exerted particularly regarding to the conception and implementation of the national deterrence doctrine. Nonetheless, what is certain is that he did play a very significant role.

This contribution may seem excessive given his rank and position in the hierarchy of the Air Force and the Ministry. However, this would overlook the unique character that is Pierre Marie Gallois. The influence he can exert cannot be ignored, thanks to the positions he held close to decision-makers and the use he makes of the media to present and defend his views. In fact, his personality seems to be the opposite of that of Camille Rougeron²¹ for example, who, despite his original writings, had little real or perceptible influence on the conceptions of the French Navy or Air Force – particularly before the Second World War. Rougeron was hampered by his modest, reserved, and timid nature, his social background, as well as his professional trajectory. He primarily used publishing, rather than television or radio, to disseminate his ideas. He did not publicly confront his ideas with those of other thinkers, strategists, nor politicians. He is, one could say, neither a “man of systems”, nor a “man of networks”. Rougeron, unlike Gallois, preferred to remain in the shadows.

Sovereignty and France’s Place in the Concert of Nations

Firstly, General Gallois’s thinking was profoundly marked by the two cataclysms of the first half of the 20th century. To start, the First World War had left him with the image of a hard-won victory. His admiration also bursted and grew for a man whose actions, character, and steadfastness he revered: Georges Clemenceau. The defeat of 1940, on the other hand, led him to question the very foundations of power, the inertia, or even the blindness of institutions. Furthermore, he questioned the hesitations and capitulations of politicians when faced with threats – either political or military – that he had sensed even before fully analysing them.

General Gallois was thus driven by a fierce determination to equip France with the indispensable resources it needed to regain its rightful place and avoid at all costs another catastrophe leading to the occupation of its territory and the subjugation of its population.

21. Camille Rougeron, 1893-1980, a naval construction engineer and then technical director of the French Air Force. After leaving the institution, he began a career as a journalist and author on military and technical subjects. See on this subject: C. Abzac-Epezy, “La pensée militaire de Camille Rougeron : innovations et marginalité [The Military Thinking of Camille Rougeron: Innovations and Marginality],” *Revue française de science politique*, vol. 54, no. 5 (2004): 761-779.

This experience reinforced in him a more or less virulent Germanophobia, which notably manifested when the subject of the European project was raised politically. He often contrasted what he considered to be the French vision, based on the nation, its sovereignty, and the place France must maintain or even reconquer, with the very different vision of German or Anglo-Saxon federalism. Nevertheless, it would be misleading to simply regard Pierre Marie Gallois as a conservative, or even a reactionary. Rather, he carried an ambition to defend and an objective to achieve.

It must also be noted that Gallois did not close himself up in a conceptual and theoretical ivory tower, working in isolation from the outside world. On the contrary, he benefited quite a bit from a period of intellectual effervescence, which was characterised, quite exceptionally, by the contributions of diverse French thinkers. Specifically, they all differed considerably in terms of backgrounds, cultures, and education.

One of them was French Navy officer, Admiral Raoul Castex.²² He was the first to strongly emphasise the change of an era brought on by the emergence of nuclear weapons. As early as October 1945 – only two months after the bombings of Hiroshima and Nagasaki – he authored a widely circulated article published in the *Revue de Défense Nationale* (National Defence Review).²³ This publication highlighted the significance of the episode. Indeed, the admiral was already outlining the kind of relationship between the weak and the strong States that would be moulded out of this new weapon.²⁴ Additionally, in the United States, Bernard Brodie²⁵ published a seminal collective work the following year, titled *The Absolute Weapon: Atomic Power and World Order*,²⁶ which, also very early on, laid out several of the principles of deterrence.

Another French thinker who has already been mentioned early, Camille Rougeron, also produced personal reflections on this topic. Notably, he published *Guerre nucléaire, armes et parades* (Nuclear War: Arms and Parades) in 1962. Three Army officers also stood out for the pertinence of their reflections: Generals Charles

22. Raoul Castex, 1878 - 1968, French admiral and military theorist. Author of various works on strategy, including *Théories stratégiques* [*Strategic Theories*] (1929). He also founded the *Institut des hautes études de défense nationale* (IHEDN, or in English, Institute of Higher Education on National Defence).

23. R. Castex, "Aperçus sur la bombe atomique," *Revue de Défense Nationale*, vol. 11, no. 17 (1945): 466-473.

24. Gallois recognised the intellectual debt he also owed to Castex.

25. Bernard Brodie, 1910 - 1978, U.S. historian and political scientist. From 1946, he was in contact with Gallois, with whom he maintained regular relations.

26. B. Brodie, F. S. Dunn, A. Wolfers, P. E. Corbett, W. T. Rickert Fox, *The Absolute Weapon: Atomic Power and World Order* (Indiana University: Harcourt – Brace, 1946): 214.

Ailleret,²⁷ André Beaufre,²⁸ and Lucien Poirier.²⁹ Furthermore, a civilian, who was a philosopher by training, complements this list of exceptional thinkers: Raymond Aron.³⁰ He had met Gallois in London during the war but later opposed him quite harshly on the issue of the independence of national nuclear strategy.

Looking Back for Lessons Learnt

The question now remains is what can be retained from General Gallois's illustrious career and his contribution to French strategic thinking. Firstly, his thinking was not an isolated phenomenon. Rather it was nourished by exchanges, contributions, and even polemics with other strategists and intellectuals of his time. Secondly, as is often the case, a powerful institution, such as a ministry or an armed force, whose effectiveness and functioning may be based on a form of traditionalism, or even conservatism to a certain degree (which is to some extent indispensable), is difficult to transform from within. The result is an internal debate that is often circumvented or even carried *via* the media, public opinion, as well as external and parallel networks. These may at times clash with that of an institution, which is usually characterised by its hierarchical and essentially vertical *modus operandi*.³¹

It is also worth noting that in 1954 and the years that followed, Colonel Gallois studied only one type of warfare and did not show the same level of interest in other conflicts of his time. In particular are the wars of decolonisation in Indochina and Algeria (which have since been classified as asymmetric conflicts). On the contrary, rather, Gallois only endeavoured to find a *single* solution to a *single* issue. He did not devise a flexible, adaptable doctrine that could be adjusted according to the type of war and operation. His thinking only evolved when he became involved in strategic

27. Charles Ailleret, 1907 - 1968, general of the French Army. In 1951, he took command of the Army's "special weapons" then became joint commander of "special weapons" in 1958. He directed the operations that led to France's first nuclear test at Reggane in February 1960. He served as Chief of Staff of the French Armed Forces from 1962 until his death. He authored *L'aventure atomique française – Comment naquit la force de frappe* [The French Atomic Adventure - How the Strike Force Was Born] (1968).

28. André Beaufre, 1902 - 1975, general of the French Army, author of *Introduction à la stratégie* [Introduction to Strategy] (1963) and *Dissuasion et stratégie* [Deterrence and Strategy] (1964).

29. Lucien Poirier, 1918 - 2013, French brigadier general, and author of *Stratégies nucléaires* [Nuclear Strategy] (1977), *Stratégie nucléaire* (1988) and *La réserve et l'attente: l'avenir des armes nucléaires françaises* [The Reserve and the Wait: The Future of French Nuclear Weapons] (2001). General Poirier was involved in the nuclear debate from 1965 onwards – after Gallois had left the institution – and can nevertheless be seen as continuing the work of his predecessors, following or contradicting some of them.

30. Raymond Aron, 1905 - 1983, philosopher, academic and journalist. Author of *Paix et guerre entre les nations* [Peace and War between Nations] (1962) and *Penser la guerre: Clausewitz* [Reflecting on War: Clausewitz] (1976).

31. This is also what characterises the careers of other thinkers and innovators who used the press, as well as political and industrial contacts to publicise and even impose their ideas, particularly in the field of military aeronautics. These include Colonel Jean Baptiste Eugène Estienne (Major General, 1860-1936), who was one of the founding fathers of French military aviation and later of the armoured arm; U.S. General William 'Billy' Mitchell (Major General, 1879-1936), an apostle of air power, and Colonel John Richard Boyd (Colonel, USAF, 1927-1997), an independent non-conformist and often impertinent strategist and designer.

and geopolitical work after leaving the military. It was then that he began to participate in the debates of the late 20th century. As a result, he contributed significantly to the development of the Air Force's capabilities after joining the Dassault group as an adviser to its founder. In particular, he contributed to the development of the *Mirage IV*, the first operational carrier of France's atomic weapons.

Upon the passing of General Gallois, a notable tribute came from Henry Kissinger. His comments also revealed more about the kind of person Gallois was. In particular, it was the view of how his contemporaries perceived him: "*It will be a long time before we find such a passionate spirit, such a vast intelligence, such a capacity for analysis. His integrity, his vision and his passionate love of his country set him apart.*"³²

Beyond his person, what is certainly most important is Pierre Marie Gallois's methodology. He starts with an analysis of the general context and technical factors – or "*objective indicators*," as Gallois coins them – and then meticulously constructs a comprehensive corpus of work to support his reasoning. This extensive work is subsequently presented, discussed, and scrutinised in various publications, either professional or targeted for the public. In all cases, he unwaveringly defended a cold rationalism and the application of a technicist method. To some, his approach, however, may have been disconcerting, irritating, or even frightening.

A case in point was Gallois's stance on the infrastructures for a passive protection of the civilian population, which was still uncertain in 1954. This was due in part to the resources available for use at the time, which was sufficient enough to give advance warning for response.³³ In 1989, however, his position solidified. Gallois vehemently opposed the idea for reasons that were of a technical nature. He argued that advance warnings in the event of an exchange of nuclear ballistic missile launches had become so short that it was impossible to shelter the entire population of a megalopolis.³⁴

P. M. Gallois shows us the indispensable path to follow, seeking to marry technicality and conceptual reflection. However, the military institution has too often tended to favour one over the other at certain moments in its history, often with catastrophic results. For instance, an example is the inadequacy of the army model and doctrine in 1870, another is the emphasis on morale over technical realities and increased firepower in 1914, and finally, a third is the methodical battle combined with insufficient consideration of technical evolutions favouring manoeuvre in 1940.

Nevertheless, it is essential to avoid allowing a doctrine, even one based on this method, from becoming a dogma by inverting the proposition. That would involve

32. Quoted by C. Malis, "Général Pierre Marie Gallois," *Revue historique des armées*, No. 262 (9 February 2011).

33. The need to provide passive defence infrastructures for civilians was mentioned in the study, as was the assumption that the population would demand such facilities; P. M. Gallois, "*Des incidences de la généralisation...*," *op. cit.*, 24-25.

34. P. M. Gallois in *L'arme nucléaire et ses vecteurs, stratégies – armes – vecteurs* [*Nuclear Arms and Its Vectors: Strategies – Arms – Vectors*] (Paris: CHAE/IHCC, 1989): 373-374.

twisting the facts to fit the doctrine. In other words, as Napoleon might have said, in war, it is about using common sense, not ideology.³⁵ Pierre Marie Gallois, although one of strong convictions and sometimes firmly rooted principles, was not an ideologue. Today, in a world with rapidly changing realities, he remains a source of inspiration, both for his methodology and way of thinking, as well as for his doctrinal works.

35. Napoléon Bonaparte – *Summary of military events during the first six months of 1799.*

The impact of the generalisation of nuclear weapons on the forms of warfare, and on the organisation, equipment, and use of armed forces

Pierre Marie Gallois

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The following article is a reproduction of Colonel Gallois' dissertation, defended in September 1954 as part of his year's training at the *École Supérieure de Guerre Aérienne* (ESGA, or in English, Superior School of Aerial Warfare).

Outline of study

- A.** The Possible Use of Nuclear Weapons.
- B.** The Effects of Nuclear Weapons.
- C.** The Impact of the Use of Nuclear Weapons on the Conditions and Forms of Conflict.
- D.** National Defence and Nuclear Weapons.
- E.** The Impact of the Existence of Nuclear Weapons on Air Forces.
- F.** The Impact of the Use of Nuclear Weapons on Ground and Naval Forces.
- G.** Overall Conclusions.

A. The possible use of nuclear weapons

1. The defence of the European continent is an ever-recurring concern. Questions arise, putting forth the idea of whether Europe could be protected by relying on the atomic arsenal or not. The other proposition considers whether the nuclear stockpiles of the two belligerent groups being neutralised would revert the war for Europe's defence to so-called conventional forms – that is, without recourse to atomic weapons. The answer to these questions can be explored through the following considerations:

1.1. Since the advent of atomic weapons, it has been implicitly accepted that Europe “deserved” to be defended by the United States. This defence was either to deter Soviet aggression or, if necessary, to retaliate by annihilating the sources of Soviet political and military power. Since 1945, the non-communist world has been divided into two categories of nations. Some, like certain European nations, were deemed “deserving” of a U.S. atomic commitment. Others, such as the peoples of Asia, were considered “unworthy” of such a commitment and the risk of a generalised conflict. This stance by the United States prompted the USSR to shift its aggressive policies to Asia (Korea, Indochina, and Formosa) after initially attempting them in Europe (Greece and Berlin). Today, it is accepted across both the East and the West that Western Europe would be defended atomically. However, due to political reasons (the attitude of Western Europe itself) and technical reasons (such as the increased autonomy of airborne equipment or the development of considerably long-range missiles) – or more likely, a combination of these factors, this policy could be revised in the future.

1.2. The study of Europe's defence against invasion and occupation – even if temporary – shows that the imbalance of conventional forces is too significant for defence to be achieved by conventional means alone. The political systems on either side of the Iron Curtain are too different for Western European nations to build up and maintain sufficient conventional forces. These forces would be required to deter aggression potentially led by some 200 divisions that are kept on a constant war footing. Furthermore, given the numerical advantage and the initiative held by the adversary, Western Europe can only adopt a strictly defensive position. Considering these factors, the adversary faces a stark choice. Firstly, because Europe is defended atomically, any aggression against it inevitably escalates the conflict to a general level, thereby triggering an atomic war with devastating effects on both sides. Secondly, through skilful political manoeuvring, the adversary might succeed in isolating Western Europe from the United States. This could, perhaps, persuade the United States that an atomic commitment to defend Europe presents greater risks than the potential benefits of a neutralist or politically uncertain Europe. In the latter case, the conflict would be reduced to a conventional level, at which point the 200 or so divisions of the Soviet bloc would regain decisive importance. In this context, the swift inclusion of Western European nations into the Soviet system could potentially be determined. Consequently, the defence of Western Europe appears feasible only with the aid of atomic weapons. This implies, in other words, U.S. involvement and, by default, a generalised conflict.

1.3. Aware of this situation, Allied Command made no secret of its plans in this respect. General Alfred Gruenther and Field Marshal Bernard Montgomery¹ have publicly stated that any kind of Soviet aggression against a sector of the European theatre, under their defence responsibility, would trigger an atomic response.² It was even specified that this atomic response would be launched automatically, regardless of the form of the enemy attack, atomic or otherwise. At present, the enemy would certainly not deprive itself of the benefit of an initial atomic attack, since in any case, the Allies would retaliate using the stockpile of projectiles at their disposal.

1.4. In the air – if not on the ground and one the sea, the Allies have adapted to this situation. The Strategic Air Command, for instance, bases its power on a relatively small number of aircraft compared to the numbers at the end of the last conflict. Similarly, the Royal Air Force plans to maintain a very limited “Bomber Command” in terms of aircraft numbers. This is especially the case in comparison to the 1,100 aircraft in service back in 1945. As such, the very structure of certain air force subdivisions has long reflected a decision to rely on explosives with very high destructive power. This would then include the corresponding forces organised and equipped accordingly.

1.5. The reasoning above is of an absolute schematic nature. Other situations, whether politically, militarily, or technically driven, might arise, thereby creating different conditions under which the above thesis may not hold. For example, it has been suggested that a conflict could take a limited, imprecise form, and subsequently prevent either side from using atomic projectiles. In this context, the adversary would intentionally abstain from exploiting its vast numerical superiority in conventional means (a case in point is the Finnish war). Nevertheless, it seems unlikely that the existence of atomic weapons could allow either belligerent to refrain from using them. This is particularly the scenario in the event the battle turned against them. Given the existence of atomic weapons, it is probable that in a high-stakes conflict, these weapons would be employed either at the outset or during the course of the battle. Later on below, a discussion of the advantages of initial action using atomic means will be explored in more depth.

2. Conclusions:

2.1. Europe can only be defended at the military level if its defenders have recourse to atomic weapons.

2.2 As for the Allied side, certain services and weapons were adapted to this form of conflict.

2.3. The defence of Europe involves the whole of the Western world, and in particular the United States, in a generalised conflict. In the past, it was possible to achieve a balance of forces by combining military resources of Allied nations in the

1. In 1954, the U.S. General Alfred Gruenther was Supreme Allied Commander of NATO, while the British Field Marshal Bernard Montgomery was his deputy.

2. These are strictly military positions that have not been publicly confirmed by any government decision.

West. Today, either the existing nuclear stockpile guarantees the entirety of Western Europe, or it cannot be defended at a military level.

2.4. For the time being, therefore, it seems necessary to study the problem of the defence of Europe in the context of a conflict. This would thus involve:

- atomic energy, and
- the whole of the Western world in terms of its scale.

B. The effects of nuclear weapons

General considerations

1. Only “mechanical” effects of these weapons will be mentioned here, without considering psychological effects such as the reactions of the masses to the threat of an atomic attack and the aftermath of such an attack.

2. The data utilised here were published by the U.S. Atomic Energy Commission³ on the effects of projectiles used in Nagasaki and Hiroshima, along with extrapolations from the same document. Additionally, the study by Colonels Reinhardt and Kintner,⁴ including that of articles published by Colonel Ailleret have provided essential information for this analysis.

3. In the absence of definitive information, hypotheses have been formulated regarding the practical effects of atomic projectiles. The conditions of the use of these weapons that appear to be the most advantageous to the adversary have been listed.

4. The three effects of nuclear projectiles (shock, heat, and radiation) are summarised in the table below for typical “calibres”, ranging from 10 kilotonnes (fission weapons) to 10,000 kilotonnes (fusion weapons).

FISSION WEAPONS

	A: 10 KT	A: 100 KT	A: 200 KT
Shock (overpressure of 0.4 kg per cm) ²	1,500 m	3,000 m	4,000 m
Heat (9 Cal/cm) ²	1,500 m	3,800 m	4,500 m
Radio activity (400 r)	1,000 m	1,500 m	1,750 m

3. The Effects of Atomic Weapons.

4. Atomic Weapons in Ground Combat.

FUSION WEAPONS

	5,000 KT	10,000 KT
Radius of total destruction	5,500 m	6,500 m
Surface totally destroyed	95 km ²	130 km ²
Radius for disabling uncovered personnel	25,000 m	32,000 m
Surface area for disabling personnel in the open	2,000 km ²	3,250 km ²

Note: These figures are approximate. In addition to the imprecision due to their theoretical nature, factors such as terrain relief and atmospheric conditions (for heat effects) can significantly alter their numbers. These figures pertain to aerial explosions triggered under conditions of maximum effectiveness in regard to the size of the affected area. This maximum effectiveness would theoretically be reached for the following explosion altitudes:

Power	10 KT	20 KT	100 KT	5,000 KT	10,000 KT	20,000 KT
Altitude of explosions	400 m	600 m	900 m	4,000 m	4,800 m	6,000 m

5. The effects of low-level or underground explosions are not known with any clear precision. However, it is understood that an explosion close to the ground, produced by a 20 KT projectile, would be sufficient to destroy all the superstructures of a standard NATO airfield. If the same projectile exploded on the ground, the resulting crater would render the airfield permanently inoperative.

An H-bomb of 10,000 KT, exploding approximately 30 metres above ground, would create a crater of 1,600 metres in diameter and up to 50 metres deep. Roughly speaking, the hit terrain would have a projected volume of 600 million cubic metres.

6. In practice, atomic projectiles would have the following effects on personnel and equipment in the open:

20 KT projectile

Total destruction of substantially heavy equipment (tank)	250 m
Total destruction of medium equipment (light field artillery)	325 m
Soldiers buried in an open trench would be killed (radiation)	1,000 m
Destruction of light vehicles	1,200 m
Destruction of light military buildings	1,700 m
Disabling a soldier exposed to the effects of a projectile	1,820 m
Destruction of delicate equipment (aircraft instruments and control surfaces, transmission equipment)	2,000 m

These distances can vary considerably, depending on the height of the explosion (assumed here to be 600 metres), the nature of the terrain, atmospheric conditions, and the protection provided to the elements listed above.

7. The general data given above illustrate that:

- fusion weapons, due to the size of the surface they cover, could be used primarily on the battlefield (aerial explosion) or for the demolition of major buried structures due to the size of their craters (underground explosion).
- conventional airfields can be largely destroyed by 10 to 100 KT fission projectiles.
- fusion projectiles are powerful enough to destroy most existing military (and civilian) installations during peacetimes – consider, for example, any situation that occurs before dispersal measures can be taken (assuming that there is a surprise attack).

8. By combining the effects of nuclear weapons with the performance of the means of transport or delivery, the following table summarises the possible conditions on the use of nuclear weapons:

Means of launch or transport	Distance to basic objectives	Travel speed	Launch altitude	Accuracy ⁵ (in probable deviation)	Necessary atmospheric conditions	Comments
Lightweight bomber	Up to 1,800 km	+ 850 k/h	Below 10,000 m	500 m	Independent for certain purposes	With fire radar
Heavy Bombar-dier	Up to 5,000 km	+ 750 k/h	Below 12,000 m	700 m	Independent	
Bombardier very heavy	Up to 8,000 km	+ 650 k/h	Below 15,000 m	1 000 m	Independent	
Fighter-bomber	Up to 1,500 km	+ 900 k/h	Very low altitude	200 m	Good	
Hunter (on a one-way mission)	250 km	+ 900 k/h	Very low altitude	200 m	Good	The <i>MiG-15</i>
V2 ground-to-ground machine	400 km	-	-	From 4 to 16 km depending on guidance	Independent	With or without guidance
<i>Matador</i> ground-based system	600 km	-	-	500 m	Independent	With fixed guide installation
Ground-to-air vehicles	Depends on the carrier aircraft	The opposite applies	The opposite applies	The opposite applies	The opposite applies	
Submarine-launched craft	300 km	-	-	-	Independent	Coastal attack
Atomic mines	-	-	-	-	Independent	Use in a defensive position
280 m/m guns	Around 25 km	-	-	-	Independent	

5. On easy-to-identify targets for radar or line-of-sight launches.

Examination of this table leads to the following conclusions:

- In a zone 400 to 600 km wide from the Iron Curtain, active defence, as currently equipped, would be ineffective against a surprise attack by atomic warheads.
- For targets located within a zone of around 300 km from the coast, the combination of underwater devices could pose a similar threat.
- The capabilities of these machines are limited only by their degree of precision.
- The hypothesis of an attack carried out by fighter aircraft decommissioned from their primary function (as is the case with the *MiG-15* in the near future) and conducting “one-way missions”, would offer significant advantages to the adversary. This is in particular in terms of precision, thereby making it a plausible threat. Against such a surprise attack, active defence would be virtually powerless. The adversary would be more limited by the autonomy of their aircraft and the difficulty of navigating close to the ground and at high speed than by the intervention of active defence resources. For example, anti-aircraft artillery is not permanently deployed and, under current conditions, would only be mobilised after the initial enemy strike, as in, it would be too late.
- Last but not least, there would be minimal interference from atmospheric conditions. The combination of light and heavy bombers with missiles would enable the enemy to conduct their atomic offensive even in less than ideal weather conditions.

C. The impact of the use of nuclear weapons on the conditions and forms of a conflict

1. Since Hiroshima, the destructive power per unit of explosive – be it by per projectile or, more generally, per explosive unit – has far surpassed most contemporary human constructions in terms of its effects. A single small projectile of modest weight can cause decisive damage over areas larger than the largest cities or the most imposing structures ever built by human manpower. It is estimated that a high-power thermonuclear projectile would be sufficient to annihilate the largest installations essential for the life and organisation of modern communities. Its effects would potentially extend over an area of more than 2,000 km² (refer to Chapter B: The Effects of Nuclear Weapons). On a military level, the same holds true when comparing the potential of thermonuclear projectiles with the most extensive defences. These defences, particularly, would be designed to mitigate their impact while maintaining functional effectiveness.

2. The first consequence of the existence of such means of destruction is that the concepts on which international relations have been based until now have had to be reassessed. The possession of significant atomic stocks (according to the standards of the time) confers on certain Powers a role and responsibilities. Such are inevitably contested by countries that have neither the possession nor the possible use of these

projectiles to ensure their own defence. As an expression of modern military power, atomic weapons impose the shape of political groupings and alliances. This then leads to clearer discrimination between nations than in the past. The gap between the hierarchy of atomic powers and that of countries without nuclear explosives is greater than it ever was, specifically in comparison to the days of when only conventional weapons existed.

3. A similar reassessment is needed in the military field. The conditions and form of a conflict, as well as the structure, organisation, and equipment of the armed forces, are significantly modified by the possible use of nuclear weapons. This revision is all the more difficult to study in the absence of direct experience. Only the major Powers possessing atomic projectiles can undertake certain experiments to explore these changes. However, even for these Powers, the psychological effects of these weapons are particularly difficult to assess. As a result, any study of the impact of these new weapons remains largely within the realm of hypothesis.

4. Indeed, if nuclear weapons were to be used, it would be difficult to envisage the continuation of organised hostilities for the span of a substantial number of months. Studies indicate that if an atomic “exchange” were to occur, the challenges of population control, order transmission, evacuation and care, epidemic control, and managing panic would quickly overwhelm governments. This is especially the case right now, considering how nations are currently organised. Val Petersen, Chief of the Passive Defence Service of the United States, estimated that a single atomic attack on major U.S. centres could result in 30 million wounded and 9 million killed. Losses on such a scale – either inflicted simultaneously or over a short period of time – would likely preclude the mobilisation of human and industrial resources. Should the will to fight persist, or if the national community can still demonstrate the resolve to continue the war, it is probable that conflict would take a different form from past wars. Specifically, it would lean more towards guerrilla warfare rather than the successive deployment of large reserve units as seen in previous conflicts. The implications of the brevity of mass destruction operations will be examined in detail later in this article. For the European continent, these considerations underscore the critical importance of active industrial forces. They also highlight, more generally, the prioritisation of forces and means that are immediately available before the onset of atomic hostilities.

5. From a political stance, the potential for almost instantaneous destruction over vast areas has led to a new form of hostility between the two blocs. Specifically, these hostilities manifest as localised wars. From 1945 onwards, it became apparent that the United States would base its defence, and that of its Allies, primarily on the potential use of the rapidly growing atomic stockpile across the Atlantic. As for the Soviet Union, it was also evident that weakening their adversaries could be achieved through the initiation of conflicts. These conflicts, in particular, would be significant enough to exhaust and divide the Western world. However, the stakes would be too low to provoke a general conflagration. This conflagration could only be atomic given the “monovalence” that characterises the armed forces of the United States. A

case in point is the conflict in Korea, and to a certain extent, the development of the war in Indochina after 1952.

6. As far as Western Europe was concerned, it was implicitly accepted⁶ that its territories were “guaranteed” by U.S. atomic weapons. Moreover, any aggression against Europe would automatically lead to a response based on the massive use of nuclear weapons. It follows that the adversary would be obliged to strike simultaneously at all military, political, and economic resources of the Allies. Wherever these resources were located, the adversary would primarily seek to annihilate the Allied retaliatory forces to avoid suffering the effects in turn. This situation underscores the interdependence of the member nations within a common defence organisation against atomic aggression. It is evident that the multiplicity of bases and points where response forces are stationed, and their dispersion over a vast geographical area, make it challenging, if not impossible, to destroy them in a surprise atomic attack. This, in turn, helps to maintain the “*status quo*.”

7. In military terms, the existence of significant quantities of atomic projectiles creates the technical conditions necessary to launch a massive attack. Such would be powerful enough to destroy both the means and the will to resist of the targeted party. While a few years ago it was impossible to simultaneously neutralise a country’s armed forces and obliterate its major political, demographic, and industrial centres, an operation of such calibre is feasible today. This is, that is to say, at least in terms of the destructive power available. In 1941, a “Pearl Harbour” with conventional projectiles provided the aggressor a momentary advantage. Today, not only could such an attack potentially decide the outcome of the conflict, but it would also have to do so to prevent the aggressor from experiencing the retaliation it had unleashed.

8. In order to comprehensively assess all the consequences of this new possibility and to estimate its degree of probability, it is essential to take into account the specific political system of the USSR. While the size of the military forces of the Allied nations is dependent on the attitude of their adversary, the USSR can simultaneously increase its forces and adopt a conciliatory external attitude. In other words, although the international situation had a direct impact on the military budgets of Western nations, it could have no effect on the military policy pursued by the USSR. With the ability to accelerate the build-up of their forces without adopting a more combative diplomacy, the Soviet Union met one of the conditions necessary to carry out a surprise attack. This, on a technical aspect, would be greatly rewarding if it were based on the massive use of nuclear weapons.

9. The second condition is adequately provided by the sheer size of the forces under arms that the Soviet Union maintains and the probable brevity of atomic operations (see para/C.4). It is unnecessary for them to resort to any form of mobilisation, which allows them to benefit from a total surprise, as their offensive action can be launched without raising the alarm. Neither an atomic air attack nor the deployment of large ground units requires significant mobilisation measures. Indeed, they could

6. No U.S. commitment in this respect has been revealed to the public.

begin the day immediately after the initial atomic attack. The numerical superiority of Soviet forces would guarantee them the necessary “cushion of time” between the start of operations and the eventual arrival of ground reinforcements – should these be mobilised and still proved to be useful.

10. Since Western nations were, by definition, in a strictly defensive position, the initiative to attack was left to the adversary. Analysis indicates that, if executed by surprise and under particularly favourable conditions for the aggressor, such an attack would initially meet with little opposition from the Allies. Consequently, the Allies had to organise themselves to “absorb” the effects of this initial attack and also be capable of retaliation after it. This article asserts that this is the essential characteristic of a possible generalised conflict. If the adversary possesses a high probability (as discussed below) of neutralising a significant proportion of the Allied atomic retaliation resources where they are stationed, they can certainly attempt an attack. Conversely, such an attack, even with total surprise, is likely to leave sufficient means of retaliation for the attacked nation(s). As such, the latter will then be able to inflict greater destruction on the initial aggressor than could be “absorbed” without the latter losing control of their subsequent operations. Should this be the case, then atomic aggression is fraught with risks. Hence, it is doubtful the initial aggressor would resort to an attack of this type.

11. To unravel further details, the preceding paragraph must be developed and clarified. This is due to the fact that it encapsulates the fundamental hypothesis on which the conditions and forms of an atomic conflict between the two opposing groups of nations are based. Specifically, if the following points are accepted:

- one party adopts and maintains a purely defensive stance,
- the existence of a large stockpile of nuclear weapons at the disposal of the other party could permit a “Pearl Harbour” decisive enough to determine the conflict’s outcome,
- such an atomic aggression could be launched without any preparatory actions capable of raising alarm, thus benefiting from total surprise, and
- the initial attack would primarily target the other party’s means of response to avoid suffering retaliatory effects that could also be decisive and lead to the victory of the attacked party,

then such an attack is only feasible if the perpetrator is assured that they have:

1° – neutralised, at their bases, a sufficient percentage of the response means available to the party being attacked,

2° – stopped, through its defensive organisation, an adequate proportion of the enemy’s atomic retaliation resources that escaped the initial attack, and

3° – “absorbed” the effects of the residual response means (for example, the means that escaped the initial attack and penetrated the active defence) through a particularly effective passive defence organisation (such as the multiplication of tar-

gets to “saturate” the enemy’s residual atomic capabilities, dispersion, camouflage, burial, deception, and *etc.*).

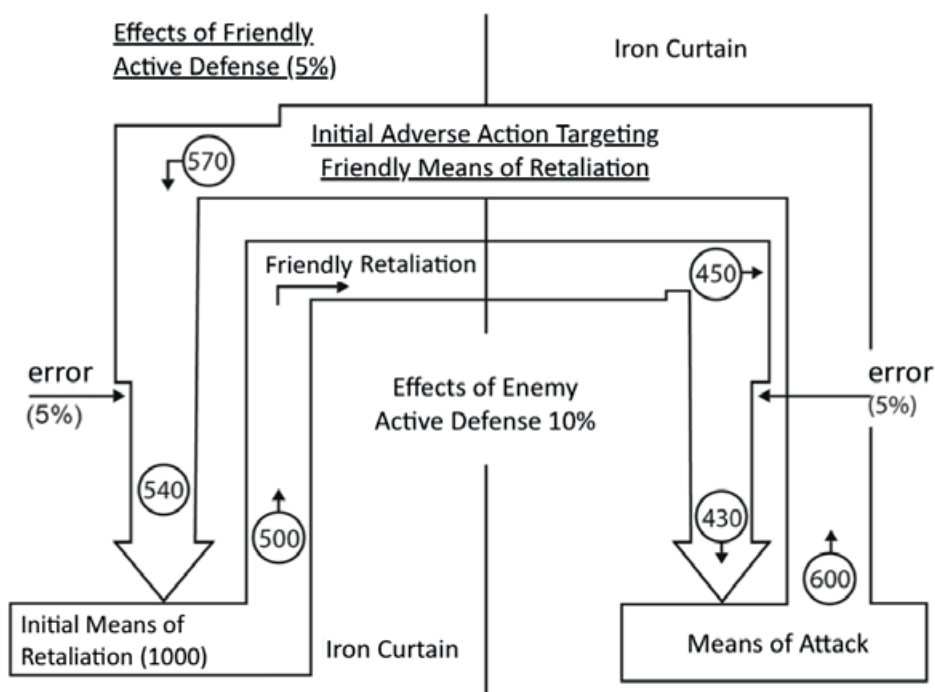
Theoretically, before mounting an offensive operation against friendly means of retaliation (blue), the aggressor (red) should have the assurance of being able to verify the following inequalities:

(1) Effect of the red party’s offensive resources – the red party’s offensive resources destroyed by the blue party’s defence + the red party’s operational errors > the blue party’s residual resources needed to ascertain any inequalities (2)

(2) Effects of the blue party’s residual resources – the blue party’s residual resources destroyed by the red party’s defence + the blue party’s operational errors > the red party’s “absorption capacity”.

All the conditions of these inequalities are variables that are difficult to assess. This is because, for both parties, they depend on the characteristics and number of offensive resources, the effectiveness of the defence, the dispersion of objectives, the duration of the alert, as well as the protective, burial, and deception measures adopted by the blue and red parties, *etc.*

SCHEMATIC CONDITIONS OF ATOMIC AGGRESSION



The purpose of this sketch is to highlight – in an ever schematic manner – the relationship between the respective atomic resources, the possibilities of the initial attack and its subsequent response, and finally, the “atomic absorption” factor of the two parties.

From this schema, a specific example can be drawn (see circled figures). Consider a situation where the red party can allocate 600 atomic projectiles for the initial destruction of the blue party's means of retaliation. 5 percent of the air vehicles carrying these projectiles are expected to be shot down by the blue party's defence. Additionally, another 5 percent are presumed to be lost due to operational errors. This only leaves 540 projectiles to reach their targets. In subsequence, these 540 projectiles are anticipated to destroy 50 percent of the blue party's response potential. Conversely, envision that the retaliation mission is carried out by 500 air vehicles. Ten percent of these are intercepted, and 5 percent are lost through errors. The problems that the initial aggressor – the red party – must consider are as follows:

- whether the first given figures are deemed acceptable,
- whether it can “absorb” the response attack and retain the means to win the war, and lastly,
- what the effects of the subsequent operations would be, as the element of surprise is no longer present.

To specify without recanting, this hypothesis must be taken with the consideration that the percentages presented above may change due to variables. Considering so, the “feedback” effects of these modifications must thus be analysed.

The accompanying sketch (fig. C.1), drawn using theoretical figures, serves to illustrate the reasoning outlined above.

12. The military implications of this hypothesis on the likely conditions under which a generalised – and therefore atomic – war might be launched are as follows:

- The atomic stockpile available to the aggressor should exceed the number of targets deemed decisive. This is to both force the adversary into submission and to guarantee the effects of the response attack. As the size of the atomic stockpile grows, these decisive targets must be multiplied through fragmenting and dispersing the atomic arsenal, or by protecting them via means of burial.
- The initial atomic attack, and possibly its corresponding response, can only be executed by air. The destruction of aircraft carrying nuclear warheads – for those that are on the ground as well as in flight – is the primary objective. This is the case for both the aggressor in order to prevent a response, as well as for the defender for the purpose of mitigating the results of the former's aggression.
- The air vehicle, which includes both piloted aircraft and guided or autonomous craft, is considered as the central instrument in an atomic conflict. The availability of these air vehicles in sufficient numbers, along with their performance capabilities, is crucial for facilitating atomic aggression. However, the more invulnerable these air vectors are on the ground and in the air, the greater the risks become for the aggressor. Consequently, the likelihood of a widespread conflict diminishes as a result.

- The role of ground and naval forces is then deemed as secondary. This is both in terms of timing and overall importance. The initial atomic air “exchange” must accomplish decisive results. This would be either to determine the outcome of the conflict outright or to redirect subsequent developments away from traditional warfare.
- In the current standoff between the West and the East, a generalised conflict initiated by the USSR appears unlikely in the even that:
 - the West possesses powerful retaliatory capabilities,
 - such means of response are not highly vulnerable to a surprise atomic attack and can penetrate enemy defences, and finally,
 - the West organises itself to limit the losses during the initial attack to a “tolerable level.”

13. In consideration of the preceding paragraphs, the terms “absorption factors” (C.10.) and “tolerable loss levels” (C.12.) have very specific meanings within the context of an atomic conflict. The term “absorption factor” pertains to the capability of a country’s military and civil organisation – or that of a group of Allied nations – to “absorb” a specific number of atomic projectiles. This is all while retaining the moral and physical capacity to continue combat operations effectively. Moreover, this concept also encompasses the ability to initiate a retaliatory action both swiftly and with sufficient intensity to thwart the adversary’s efforts to launch a decisive offensive. The “level of tolerable losses” is intrinsically linked to this definition. By adopting a resolutely defensive stance, the West must organise its forces in such a way that, even if they are unable to prevent the initial attack, they can at least avoid total annihilation. Indeed, the size and effectiveness of the remaining forces after the first strike would not only determine the outcome of an atomic conflict, but they could also serve as a significant deterrent to any further atomic aggression. If the adversary understands that it is virtually impossible to completely paralyse the response, it is highly unlikely they will undertake such an endeavour from the onset.

14. In the era of atomic weapons, adopting a resolutely defensive attitude implies that:

- a) the threat of a powerful air response, equipped with means that, when on the ground during an enemy aggression, are not highly exposed and vulnerable, and when in the air during retaliatory action, are considered sufficient enough to deter any potential attacks.
- b) if the adversary chooses to disregard such a threat, the existing military organisation must be adequately adapted to atomic warfare. This adaptation should ensure that its forces can “survive” the initial attack and retain a decisive retaliatory capability to strike back effectively.

As of present day, the first condition has been somewhat met to a certain extent by the Strategic Air Command. Nonetheless, due to the proximity of opposing bases, the second condition is particularly relevant to the armed forces of Western Europe,

especially those of the air forces. Indeed, in the event of a surprise attack, the effectiveness of active defence is greatly reduced. Therefore, the armed forces must seek to avoid initial destruction through how they organise and structure themselves during peacetime. This requirement entails extending passive defence measures to a much broader extent than was previously necessary. Today, this is no longer in relation to minor provisions for protection against conventional air attacks, but rather in regard to implementing entirely new measures targeting the structure, organisation, employment, equipment, and armament of the armed forces. The objective of these measures is in order to protect themselves from atomic projectiles without significantly reducing their functional effectiveness.

In the past, passive defence measures were simply added to the existing organisation without any substantial alterations being made to it. Today, however, such necessary measures have the potential to lead to significant changes in the structure and organisation of armed forces. In particular, this study insists that, given the most likely form of a generalised conflict, such passive defence measures would yield more substantial results during the initial phase of hostilities than active defence measures would. Specifically, active defence becomes effective only during a subsequence of operations. This is in regard to after the alert has been raised and the first shock has been absorbed. If the initial aggressor relies heavily on the effects of a massive surprise attack, it is clear – in particular within Western Europe – that active defence will be largely inoperative. Therefore, armed forces will only avoid destruction to the extent that their peacetime posture protects them against atomic destruction.

From the moment when one party adopts a resolutely defensive policy, its forces must be organised accordingly. This thus would result in a different structure from that of its adversary. In the current conflict between the West and the East, the West has nothing to lose by organising its military forces according to its defensive policy. On the contrary, it stands to gain much, as this defensive posture rather protects against the effects of aggression. This, as such, renders such aggression unlikely.

15. In conclusion:

15.1. The atomic factor currently determines the status quo in international politics and shapes alliance systems. Indeed, the previous hierarchy of forces in place has changed. In the military sphere, however unpleasant it may be, the notion of satellite forces is becoming ever more prominent.⁷

15.2. It is deemed, henceforth, imperative to revise traditional ideas about the conditions and forms of a possible generalised conflict and to re-evaluate the organisation and armament of the armed forces.

15.3. If atomic hostilities were to break out, then the scale of destruction could render an organised, long-term conflict impossible.

15.4. Should precautions not be taken, this destructive power enables the aggressor to achieve decisive effects with solely a surprise initial attack.

7. See the last chapter, Overall Conclusions, for a study on the specific case of France.

15.5. The defensive attitude adopted by the West, the Soviet regime, as well as the military organisation and the forces assembled by the East make a surprise general atomic attack technically feasible.

15.6. The essential objective of this attack can only be the Allies' means of response. Rationally speaking, such an attack could only be launched if the adversary was certain of destroying a sufficient percentage of these means of response, in order to ensure that the remaining forces would not decisively impact the conflict's outcome.

15.7. For the forces of Western Europe – and due to the proximity of this threat – it is crucial to avoid such a surprise attack. Because active defence is limited in effectiveness against an unannounced offensive using atomic projectiles, protection must first be sought through organisation and peacetime deployment of the West's forces.

D. National defence and nuclear weapons

1. The potential effects of the proliferation of nuclear weapons on the armed forces are detailed in Chapter E: The Impact of the Existence of Nuclear Weapons on Air Forces and Chapter F: The Impact of the Use of Nuclear Weapons on Ground and Naval Forces. The new capabilities offered by weapons of mass destruction have significant implications for national defence and, more broadly, for the organisation and economies of states.

2. If these weapons were to be used, the psychological effects of them, as well as the legitimate fear and panic that their use might induce, have political implications previously discussed (refer to para. A1.1 – A1.5). These psychological consequences will also influence the distribution of funding allocated to national security. For instance, there could likely be a substantial increase in budgets initially allocated to “passive defence” of civilian populations. In Western Europe, an atomic attack on major industrial centres may not seem entirely necessary to the enemy. Indeed, it is highly probable that the disadvantages of such an attack would outweigh the potential benefits. An aggressor aiming at the “absorption” of Western Europe might decide to forgo – unless absolutely necessary – the destruction of cities. This is due to their subsequent reconstruction being exceedingly burdensome. Additionally, their atomisation would foster lasting resentment that could be difficult to overcome, thereby making such a course of action less appealing to the aggressor. Regardless of such, it has been shown that the primary objective must be the total annihilation of retaliatory forces. Once these forces are neutralised – if that is achievable, it is difficult to see how victory could be contested. Nevertheless, this line of reasoning is precarious as it dangerously speculates about the enemy's intentions and overlooks the possibility of significant policy errors. Moreover, this inherent uncertainty fails to reassure the public, who demand, and will continue to demand, guarantees for their protection through special measures. Importantly, current spending on passive defence in the United Kingdom has already exceeded 70 billion pounds/dollars.

3. As the protection of civilian populations gains increased importance, some measures will inevitably extend to the armed forces themselves (see para. C.14.). With Allied nations adopting a strictly defensive policy, they must organise themselves in such a way as to “absorb” the initial shock. Therefore, the concept of passive self-protection for armed forces and military installations will be strongly emphasised and detailed throughout the following chapters.

4. The suddenness of an atomic attack and its potentially decisive effects in a short time frame underscore the importance of forces and defensive means available in peacetime. The current structure of armed forces, which is heavily reliant on reserve capabilities, thus requires reassessment.

5. Industrial mobilisation risks are as impractical as staff mobilisation, particularly if it targets resources that are excessively exposed to attacks.

6. All studies conducted to date have concluded the necessity for forces with reduced vulnerability through increased mobility, and therefore lightness. This concept has significant consequences for:

- the structure of these units,
- command, which is more decentralised, imposing heavy burdens on subordinate levels (reinforced supervision),
- equipment (development of transmissions, lighter and more mobile equipment, and greater protection against the effects of atomic weapons),
- logistical support (which must be less vulnerable and accommodate to a greater extent the operational mobility of combat units),
- the role of reserves, which can only be used if they are specially prepared for action in conditions of greater isolation,
- peacetime deployment, which must be similar, or close, to that of wartime.

7. The issues of care, evacuation, and psychological control of personnel thus become increasingly critical as units become more isolated and the destruction more terrifying.

Conclusion

8. The problem of national defence should be reconsidered as a whole, with emphasis on:

- passive defence of the “front” and “rear”,
- the impact of short operations triggered with extraordinary suddenness,
- the virtual identity of peacetime and wartime forces,
- limiting the contribution that can be expected from industrial mobilisation,
- a new unit structure, and
- the importance of medical and psychological factors.

E. The impact of the existence of nuclear weapons on air forces

I. Technical data

1. Two facts have a decisive impact on the use and armament of combat aviation.

a) The first fact is inherent in atomic weapons since their inception: the destructive power of a single projectile, which can, theoretically at least, match or exceed the destructive capacity of thousands of projectiles, each with a unit charge of one tonne of TNT.

The second aspect, which is currently being verified, concerns the significant “miniaturisation” of atomic weapons. The 280 mm shell of the U.S. atomic cannon is a well-known example of this miniaturisation of a nuclear weapon. Since then, the information in current possession strongly suggests that aerial fission projectiles of similar dimensions have been both built and tested. A similar miniaturisation effort, albeit more necessarily limited in its effects, has also been undertaken for air-launched fusion projectiles.

2. This miniaturisation effort has resulted in the development of guided or self-directed atomic warhead missiles.

3. According to available information, atomic stockpiles appear to be substantial, with between 1,000 and 5,000 projectiles available on both sides.

4. The technology that is currently used to manufacture nuclear weapons enables the creation of projectiles with varying power levels, thus providing virtually unlimited destructive potential at the upper end of the range. This technological advancement allows the destructive power to be precisely tailored to the nature and size of the targets. As such, it is highly likely that standardisation has been actively pursued, and the range of projectiles manufactured has been determined based on a detailed study of various targets that could be attacked with an atomic bomb.

5. In addition to atomic warheads, aircraft-launched projectiles, and the 280 mm shell, other uses for nuclear explosives have been rigorously researched, including nuclear mines and anti-aircraft defence using nuclear projectiles. For aircraft-launched projectiles, both underground and underwater explosions have been thoroughly studied and subsequently developed.

II. The impact of nuclear weapons on fighter aircraft technology

6. The “miniaturisation” of the atomic weapon (refer to para. 1b above) could have the following consequences:

a) The volume and weight formerly required to carry conventional explosive projectiles can now be devoted to carrying fuel. In the weight specifications of a bomber, the projectile has become a negligible quantity.

b) Consequently, only range (and, to a certain extent, the desired speed) determines the tonnage of bombing aircraft, which should no longer be calculated based on the combination of fuel and bombs, but solely on fuel. Theoretically, this means that only two types of aircraft are conceivable: a large aircraft with a long range and a smaller aircraft with a shorter range, both of which use the same atomic explosive.

c) Today's conventional fighter, such as the *MiG-15*, *F-86* or *Mystère IV*, is a potential bomber. At the extreme, a very light aircraft could also function as a bomber with the same destructive power as a substantially large machine. For "underground" attacks, *i.e.*, those with a delay, a light aircraft flying at an extremely low altitude could become a formidable weapon. The permanence of the action, *i.e.*, the ability to operate in all weather conditions, is of greater importance to the design of the equipment than the constraints of bombing.

d) The "miniaturisation" factor, which allows atomic projectiles to be carried on board considerably small aircraft capable of causing considerable destruction, reduces the warning time provided by existing detection systems. Additionally, the ability of these aircraft to carry out some of their attacks at low altitude makes detection even more uncertain, significantly reduces warning times, and necessitates the establishment of an additional permanent lookout system. As a result, the effectiveness of this system is particularly doubtful, especially in the case of a surprise attack, which is considered possible by the Intelligence Services.

7. The destructive power of a single nuclear projectile (consider para. 1a above) has the following consequences:

a) Since a single air vehicle, whether it is an aircraft or missile, can cause more destruction than a large formation using conventional projectiles, the quantitative problem in terms of aircraft is effectively solved.⁸ Hence, the "vehicle" factor becomes secondary to the "projectile" factor. For an attacker launching an all-out surprise attack, the scale of the attack no longer depends on the number of existing aircraft but much more on the stock of atomic projectiles that have been built up. Therefore, the quantity of airborne equipment becomes relevant only to the extent that significant losses are expected from destruction on the ground.

b) Due to the capacity of an air vehicle-atomic bomb unit alone being decisive without reliance on other units, both the means and the aim of an attack can only be the air weapon. The primary goal of an atomic attack is therefore the destruction of the opposing party's air force. This would be first at rest on its bases, then in flight, during its retaliatory operations. This priority given to air weapons has two consequences:

8. For the adversary, the use of obsolete fighters, such as the *MiG-15* as bombers, cannot be ruled out.

- Qualitatively, it necessitates the study and deployment of a retaliatory air force that is minimally exposed on its stationing sites. The same applies to missile units.
- Quantitatively, it implies that an estimate must be made of the losses that will inevitably be suffered in the event of an atomic attack carried out by surprise, so that the equipment held in reserve is sufficient to ensure an atomic response. It is thus evident that the lower the initial level of destruction, the smaller the reserve will be. This estimate will be made taking into account the resources needed to carry out a decisive response (see diagram C.1).

III. The impact of nuclear weapons on the organisation and importance of air weapons

8. The combination of air vehicles and nuclear missiles is an ideal instrument of surprise aggression. In the specific case of a conflict triggered by the USSR, this aggression could be carried out using the following means:

Non-European zone:	European zone:	
	Within range of enemy craft	Out of range gear
Large aircraft operating at high altitude	Attack by atomic war-heads	Medium and light aircraft attacking at high, low and very low altitude.

9. The study indicates that, while attacks on targets outside Europe can be detected in sufficient time to provide a brief warning, this is not the case in the European zone. In the forward European zone, not only is it impossible to provide adequate warning, but there is also currently no active protection against missile fire. In the European rear zone, however, the warning time could be zero unless certain permanent surveillance and detection measures are implemented. Therefore, until special techniques reduce the vulnerability of aviation on its bases – such as vertical take-off and the use of unprepared terrain – no air unit should be deployed in this forward area. In the rear zone of Western Europe, the deployment strategy should aim to constantly “saturate” the enemy’s atomic capabilities, thus ensuring a more robust defensive posture. This air deployment should meet the following two conditions:

- Be sufficiently fragmented (and protected) so that the amount of material exposed to the effects of an atomic projectile does not “justify” the use of these projectiles.
- Be divided into a number of units that exceeds the quantity of projectiles the enemy could allocate to their destruction, considering the other missions they need to accomplish.

It goes without saying that the system adopted must evolve over time, accounting for increases in the enemy's atomic stockpile and improvements in the range and precision of the "vehicles" they use. Ultimately, this evolution leads to the concept of a retaliatory air force permanently buried (or in the air), at least for a certain essential percentage of this air force required to execute the retaliatory mission.

10. Faced with an atomic attack carried out by surprise, the possibilities of active defence are extremely limited, particularly in the European zone. If the adversary decides to launch a massive atomic attack during a period of international détente, and if this attack were carried out at a favourable time for the aggressor – such as at night or during a day off for personnel, it is difficult to see how effective the existing means of active defence would be. This includes both fighters and anti-aircraft artillery. Because of the proximity of the enemy bases and the possibility of low-level attacks, it is likely that, in the current situation, the air force would suffer considerable losses. It is only to oppose a second attack that active means would be effective, and even then, only to an extremely limited extent because of the forms that these attacks would take. A key example is isolated aircraft saturating the possibilities of control.

11. In an atomic conflict, it is therefore necessary to distinguish between two extremely different phases. The first concerns the initial atomic aggression, the second the subsequent operations. If the table in paragraph 8 above is repeated and completed, taking account of these two phases, the following result is obtained:

	Non-European zone	European zone	
		Within range of enemy craft	Out of range of enemy craft
1. Enemy offensive	Large aircraft operating at high altitude	Attack by atomic warheads	Medium and light aircraft attacking at high, low and very low altitude
2. Friendly defensive possibilities 1st phase	low	void	Extremely low, and in any case out of proportion to the damage caused by enemy forces reaching their objective
3. Phase (subsequent attacks)	good	void	Weak because of the forms of atomic attack
4. Friendly response options	Depending on the passive protection measures taken before the outbreak of hostilities (resources that have "survived" the attack) and the enemy's defensive capabilities, which are comparable to those of the Allies but with the added advantage for the enemy of being able to choose the moment of aggression.		

12. In terms of air defence, it follows from the above that the notion of an “air war of attrition,” which has prevailed until now, no longer possesses any sense of rationality. In the pre-atomic era, an active defence capable of inflicting 5 to 10 percent losses on each large enemy offensive formation could be considered effective. The enemy would not have been able to sustain such losses indefinitely, in terms of both personnel and equipment. However, if the initial attack was intended to be decisive for the adversary, and if, in any case, organised hostilities could only be of short duration, then this 5 to 10 percent loss rate essentially loses all meaning.

13. Due to the suddenness of the attack, which was initially envisaged as the most favourable hypothesis for the adversary, such a percentage could not be achieved against the first attack. Furthermore, the fact that this attack could be carried out by a large number of isolated aircraft, operating at all altitudes and largely “saturating” possibilities of control as it is equipped today, clearly underscores the limitations of active defence. Moreover, the problem of the “survival” of air forces and, more generally, of atomic response resources – which are considered the adversary’s primary targets – is more or less solely a matter of self-protection of these resources through their deployment. Thus, they should be extensively dispersed and buried in peacetime.

14. In terms of air offence – and for the Allies, in terms of response – a new unit structure seems necessary. These units must meet three imperatives:

- a) To “survive,” *i.e.*, to be shielded from atomic destruction through dispersion, distance, burial, almost instantaneous take-off, camouflage, deception, *etc.*
- b) To respond as quickly as possible.
- c) To be organised and equipped to carry out a counter-attack effectively, regardless of weather conditions and despite an opposing defensive organisation ready to intercept.

For air forces based in Europe, the primary target for retaliation is the enemy air force deployed against Europe and the encirclement of the European theatre of operations. As a result, friendly retaliatory air forces must balance survivability and near-instantaneous retaliation by finding a compromise between vulnerability and remoteness. A rear or peripheral deployment can only be effective if it does not allow the adversary sufficient time to execute a second massive attack on targets located in Western Europe. Hence, European retaliatory aviation must be relatively close to opposing air bases, particularly in the European rear zone, but must be organised and deployed according to general characteristics listed above.

With regard to organisation and equipment (refer to para. 14b), the concept of a small offensive “task force” emerges from the very conditions of use of this retaliatory aviation. In place of the homogeneous squadrons of the past, this task force should comprise:

- a “pathfinder” aircraft with the equipment needed to attack in all weather conditions,
- a small number of disappointment devices, and later
- a “countermeasures” device.

For certain targets to be destroyed *a priori*, and if atmospheric circumstances allow, the isolated aircraft formula would be used.

15. For the retaliation mission, the role of aerial reconnaissance and, more broadly, intelligence is absolutely crucial. The nature of nuclear projectiles and their vast destructive effects necessitate precise control over their use and perfect knowledge of the “value” of the targets they are meant to attack.

Consequently, the importance of Allied intelligence is further increased by the “hermetic” nature of Soviet territory and the lack of domestic “assistance” similar to that which the enemy could find in Europe. Furthermore, the mobility of enemy forces and, in the case of the air force, the vast number of platforms available, require significant reconnaissance resources. Therefore, aircraft capable of gathering intelligence under any atmospheric conditions should be used, such as high-definition radars similar to those on certain U.S. bombers or even some civilian long-haul aircraft.

Nevertheless, the greatly increased mobility of air and ground forces, which is a direct result of atomic threat, necessitates a much faster exploitation of intelligence. Forces will also seek “survival” by anticipating the exploitation of intelligence through the speed of their movements. Consequently, both decentralising the use of atomic projectiles and implementing comprehensive intelligence gathering processes will need to be thoroughly studied and carefully developed.

16. While awaiting the dual effect of the retaliation mission:

- By destroying the opposing air force at its bases and encircling the theatre, and
- By destroying the enemy’s combat potential through strategic action and producing effects in the forward area, friendly air-ground forces will have the mission of containing and subsequently driving back enemy surface forces (see Chapter F: The Impact of the Use of Nuclear Weapons on Ground and Naval Forces). This air-ground mission will require specially adapted aircraft, using both atomic and conventional projectiles. If the enemy adapts to the characteristics of atomic warfare, he will endeavour not to “present targets worth an atomic attack” and will thus dilute his forces as much as possible. This “dilution” can only be addressed with conventional projectiles. Therefore, an air force capable of almost instantaneous intervention in the forward zone must be able to attack many small targets (conventional targets) and participate in the mission of atomic encirclement of the theatre. It should be based, in peacetime, close to the chosen line – or zone – of resistance, and thus be, by design, as little vulnerable as possible to the enemy’s initial atomic action.

17. The table below shows the conditions of intervention, deployment and means of protection for combat air units in Western Europe in the event of an atomic conflict:

	Aviation and retaliation devices	Aviation and defence equipment	Tactical aviation	Reconnaissance aircraft
Priority in the opponent's list of objectives	1	3	2	1
Priority friendly missions	Retaliatory attack on enemy air deployment, atomic encirclement of the theatre	Protection of the Western European air zone. Defence of sensitive points.	Intervention in ground battle, close encirclement of the atomic and conventional theatre	Intelligence gathering for retaliation aviation (and tactical aviation)
Chronological order of intervention (initial phase)	1	2	3	1
Functional deployment	Western Europe rear zone	Depending on the areas to be covered	Front area	<i>Dito</i> "retaliatory" aviation
Protecting "survival" resources	Relative distance. Local dispersion. Local protection.	Dispersion. Local protection	"Crumbling" by splitting up units. Local protection	<i>Dito</i> "retaliatory" aviation

This table shows that, in all these cases, dispersion is imperative and that the air arm should be adapted to intervene effectively from extremely "diluted" peacetime parking points, particularly for units that must be deployed in the forward zone and subject to an attack by missiles.

18. Other forms than organic dispersion and local protection can be combined with these protective measures in order to contribute to the survival of the air power. These measures include:

- detection and rapid alert transmission,
- the instant mobility of flying scales,
- setting up a plan for using all existing platforms, both civil and military.

By adopting these strategies, it is possible to reduce the vulnerability of the air forces. These measures gain importance as they can be transitional until new equipment and a new unit structure enable genuine organic dispersion.

19. Conclusions:

19.1. The air vector (vehicle and pilot aircraft) is both the enemy's (initial attack) and the Allies' (retaliatory action) No. 1 instrument and target.

19.2. In the event of a surprise offensive targeting airborne response instruments, active defence measures are likely to be ineffective. The "survival" of the air weapon must be ensured through organisation, equipment, and deployment.

19.3. While retaining the possibility of immediate intervention, the air weapon must seek by its "crumbling" to constantly "saturate" the adversary's atomic possibilities.

19.4. This "crumbling" involved the design and production of new equipment, capable of being used on terrain that was unprepared or poorly prepared. It meant setting up new, lighter units and installing the necessary supplies on a large number of sketchy sites.

19.5. Until new equipment and an adequate organisation are in place, the survival of the air power can be achieved by enhancing detection permanence, organising immediate alert transmission, increasing unit mobility, and preparing a comprehensive plan to utilise all current infrastructure resources. This strategic approach aims to saturate the enemy's atomic capabilities and provide diversionary opportunities for units that have taken off on alert.

19.6. The "survival" of air forces therefore is closely linked to the permanence of detection and immediate alert exploitation. Developing and maintaining ground-based detection networks is of considerable importance.

19.7. The response, *i.e.*, the atomic air offensive – initially directed against enemy air deployment – requires the deployment of small, specially organised and equipped units.

19.8. A new organisation and new intelligence-gathering equipment are necessary to account for the speed with which the adversary must be located and the friendly air command informed.

19.9. The role of support aviation remains crucial in an atomic conflict. It must adapt to the scale of the threat and reduce its ground vulnerability.

F. The impact of the use of nuclear weapons on ground and naval forces

Note: As a supplement to the preceding chapters, only general considerations on the effects of atomic weapons in ground and naval battle are given here. These considerations are discussed below only insofar as they have a bearing on air forces.

1. From the foregoing, the air power is an essential instrument both of aggression and of discouragement of such aggression by the threat it poses of retaliation. Whereas it used to be combined with ground and naval forces, whose operations it facilitated and enabled, air power is now the essential weapon, with surface forces providing support.

I. Ground forces

2. If the atomic weapon combined with air vehicle is the essential weapon for an offensive action, the studies and experiments carried out to date tend to show that, in the context of an atomic conflict, ground defence has certain advantages over the offensive.

3. In the present conception, the active ground forces, which constitute roughly 30 percent of the total forces mobilised in the short term by Allied nations for the defence of Western Europe, play the crucial role of covering forces and gain the necessary time for mobilisation. The destructive potential of atomic weapons, the relative ineffectiveness of active air defence, and the likelihood of an atomic attack by surprise no longer seem to allow the one to two months needed to set up reserve units. Either the outcome of the war is decided before this period expires, or because of the destruction, the conflict takes a different form in which the commitment of large units, formed according to the principles still in force, seems uncertain.

4. Therefore, it was decided that ground forces would have to fulfil the following two missions:

- to protect friendly territory from invasion during the initial period and while waiting for the effects of strategic, theatre encagement and possibly tactical air actions to be felt in the contact zone.
- ensure the destruction of enemy ground forces in the second phase of the battle - if it is not over - by actions closer to guerrilla warfare than to "organised" conflict, because of the chaos caused by massive atomic bombing.

For the execution of the first of these missions – and considering the strictly defensive nature of Allied strategy – studies and experiments show the great possibilities of a ground force adapted to atomic action if this ground force has a specially equipped territory at its disposal. In other words, if the territory to be defended is equipped with the means necessary for defence in atomic warfare, this defensive action is indeed possible, even with relatively small numbers of troops compared with those of the aggressor's forces.

5. This "equipment" of the territory to be defended would have the following aims:

Providing the defending forces with protection while the enemy, in an offensive position, is necessarily on the move and therefore in the open.

- a) Ensuring the defence forces have the necessary protected supplies, while the enemy depends on the movement of its supplies to advance.

- b) Creating protected points of resistance, forcing the enemy into concentrations vulnerable to friendly atomic action (artillery or atomic aircraft).
- c) Installing obstacles and demolitions (nuclear mines) to channel enemy forces or destroy them at crossing points.
- d) Implementing means to supplement aerial intelligence (*e.g.*, devices similar to the road counting system, but buried, activating a transmitting device).
- e) Pre-installing batteries of missiles and atomic artillery capable of targeting enemy passage areas.

6. Thus this approach results in an organised surface territory that, using natural or artificial obstacles, and combining both with all available technology, protects, informs, and supplies friendly forces while forcing enemy forces into vulnerable concentrations and movements justified by atomic fire. These structures and devices must be permanently guarded (*i.e.*, by active forces) due to the potential form of enemy attacks.

7. Such a strategy would involve:

- Constructing major underground and semi-underground facilities in an area 200 to 300 km deep, extending from the Iron Curtain,
- Setting up special static units to guard and service these facilities in peacetime,
- Creating highly mobile units, manoeuvring in the “gaps,” relieved of any internal support, because they would be “hooked up” for supplies to the pre-installed and protected resources,
- Ensuring close coordination between ground-based defence and friendly atomic action, whether ground-based (missile batteries, atomic guns) or air-based,
- Training reserves either to supply the two types of forces listed above or to provide the manpower necessary for a different form of struggle in a later phase of the conflict (considering the dislocation of communication systems, the destruction of major centres, and possibly the loss of control of governments and command).

8. Conclusion:

8.1. The adaptation of ground forces to atomic warfare leads to even more profound upheavals than in the air forces.

8.2. The air force becomes an essential instrument in such a conflict, with other branches of the military supporting it.

8.3. A new defensive strategy appears possible in Europe. For ground forces, this strategy aims first to gain the time needed for the effects of atomic action from the air to be felt.

8.4. This defensive strategy requires close coordination of air and ground forces.

II. Naval forces

1. Like ground forces, naval forces can participate in the atomic battle. However, they lack the mobility and “reach” of ground-based air forces.

2. The small number of large aircraft carriers, along with their ease of location, their relatively limited mobility, and their extreme vulnerability to atomic blasts, currently minimise the role of onboard airborne resources. In the future, however, the development of new techniques, such as vertical take-off and long-range missiles, by modifying the current constraints that are imposed by tangential take-off and landing, could potentially restore the importance of sea-based air vehicles to a significant extent.

3. While the contribution of naval forces to offensive operations appears disproportionate to the investment they require, the conditions under which they are used as a means of transport need to be reviewed.

4. If the hypothesis of a general conflict characterised by a violent initial atomic exchange is accepted, the role of surface fleets changes significantly. In the traditional battle for Europe, navies were expected to transport forces and equipment that had been mobilised beyond the direct reach of the adversary to the continent. However, this concept may have to be abandoned. Convoys of troops and equipment that are reaching Europe more than 30 days after the outbreak of hostilities would no longer play the same role as they did in the past. Either the conflict would already be over, or the scale of the destruction would impose a very different form of struggle, one that could not rely on a powerful technical organisation that is very likely to be destroyed by atomic attacks.

5. The vulnerability of convoys is considerably increased. Studies show that it is difficult to find a satisfactory compromise between concentration, which provides a degree of protection against submarine attack but facilitates atomic attack, and dispersion, which reduces its effects but increases the possibilities of the submarine threat. In any case, increasing the dispersion of convoys inherently increases the number of means of protection. Consequently, this leads to the use of detection devices, such as “Sonar,” with much greater ranges and capabilities. This ensures that enhanced detection and protection measures are implemented to counteract the elevated risks associated with increased dispersion.

6. The concentration of ships in ports, which used to offer convoys a degree of protection, has now become impossible. Between submarine threat at sea and atomic threat at anchor, the destruction of a large number of isolated vessels is preferable to the destruction of an even greater number of ships gathered in a port, whose installations would also be destroyed in the process.⁹

9. The condemnation of port concentrations has, as a corollary, the necessary revision of the naval bases policy. Bases such as Midway or Hong Kong are extremely vulnerable to atomic action. Therefore, they should be replaced by larger territories where dispersion and burial would be possible. This strategy aims to reduce their vulnerability significantly. The interest of territories like Formosa lies in

7. It follows from the above that the port concentration required for loading and unloading should be replaced by “linear mooring,” with the specific naval and ground constraints that such a transformation would entail, such as transshipment and hoisting facilities. Additionally, a comprehensive ground network for unloaded personnel and equipment would be necessary to support the new mooring strategy.

8. These new considerations have a significant impact on the air force:

- a. The self-protection of convoys against atomic air attack seems highly uncertain. The means of detection and interception of air defence should contribute more directly than in the past to the protection of convoys. The routes offered to these convoys should consider the possibilities of this protection.
- b. The defence of current port facilities needs to be reassessed. These port facilities:
 - in the majority of cases, do not present “atomically valid” targets before the convoys arrive there. In the first phase of a conflict, at least in Europe, they might not be attacked;
 - cannot be effectively defended against air attack because of the “permeability” of air defence,
 - can be effectively destroyed by an atomic mine,
 - if they are of great interest, can be rendered unusable from the outset using, for example, “merchant ships” carrying nuclear explosives in their holds, which would be detonated remotely at the time of the enemy’s general attack.

It follows that the allocation of conventional means of active defence to the protection of port installations could hardly prevent the adversary from destroying them if he deemed it necessary. In this area too, where possible, self-protection should be sought through dispersion, *i.e.* by replacing the port concentration of the past with linear coastal mooring.

9. Conclusions:

9.1. The spread of nuclear weapons is changing:

- The role once played by naval forces. The suddenness of destruction could reduce the purely military importance of sea transport.
- The equipment and conditions of use of naval forces at sea, requiring a balance between submarine danger and atomic danger.
- The organisation and resources allocated to anti-aircraft defence of current port facilities need reassessment in light of the new threat.

their capacity to provide such dispersion and burial options, thus making them more suitable and safer replacements for traditional naval bases.

G. Overall conclusions

1. In the present situation, the possession of atomic stocks and “vehicles”, or the means necessary to launch or use them, determines the state of international relations.

2. As the stockpile of nuclear weapons grows, as their destructive power increases, and as the means of delivering these weapons evolve, the stakes of a generalised atomic conflict will have to be higher and higher, and the “opportunities” to come to “only localised conflicts” will have to be more and more frequent.

3. The possession by the USSR and the United States of large stocks of nuclear weapons has practically led to the classification of nations into three distinct categories:

- The nations with large nuclear stockpiles,
- The nations who seek their security by adhering to one or the other of these two “atomic systems,” and whose attack by the opposing “system” could trigger an atomic retaliation by the other, consequently leading to a generalised conflict,
- The nations, which base their security on active neutrality, their importance being great enough for their independence to be mutually guaranteed, with neither of the two principal adversaries being able to admit a rupture of equilibrium by the absorption of one of these nations by one of them (a case in point is India).

4. From a military point of view, the more we study the possible consequences of an atomic conflict, the more we try to fathom the unknown realm of the effects that would be produced by the massive use of these weapons, the more we are led to believe that in order for such a war to occur, one of the following two conditions would have to be met:

a. One of the two Powers possessing atomic force finds itself directly threatened by the other, and it appears that an atomic attack is the condition of its survival in the face of this threat.

b. Secondly, the means of atomic retaliation available to one of the two major adversaries would be vulnerable to an aggression carried out by surprise and whose objective – with a good chance of being achieved – would be simply to deprive the other party of an instrument of retaliation of sufficient power.

5. If these hypotheses hold true, the defence of Europe is guaranteed only if Europe is considered vital by the United States, which owns the Western atomic stockpile.

6. The foregoing discussion has highlighted two particularly important factors:

- The first factor to consider is the “quantity” factor. The number of atomic projectiles available can have a significant impact on the form and purpose of alliances (see para. G.2.), and it has a decisive effect on the organisation and

equipment of forces. Their “fragmentation” needs to increase in direct correlation with the increase in atomic stocks.

- The second factor is the geographical dispersion factor. Two forces of dispersion appear necessary. One is local, designed to avoid “presenting” an objective and to “dilute” as much as possible the elements eligible for atomic action. The other is general or strategic. By general dispersion, we mean the deployment of major military resources, particularly retaliatory forces, over as vast a geographical area as possible. This approach aims to make it materially impossible for them to be destroyed simultaneously by an atomic attack carried out by surprise, thus ensuring their continued operational capability.

7. Applied to the national problem, the preceding considerations call for the following observations:

a. Regardless of the resources that France could normally allocate to the production of nuclear weapons, the delay it has already incurred, combined with the current limitations of its production apparatus, compels it to base its security on a collective defence organisation centred on the atomic stockpiles of the United States for an as yet undetermined period. This situation will persist until such limitations are overcome and France reaches a sufficient level of self-sufficiency in the production of nuclear weapons.

b. Within this collective organisation, France can have access to the necessary aerial “vehicles” essential for transporting nuclear weapons allocated to theatre containment missions or close intervention missions. However, in the event of a conflict, it does not have the assurance of being able to participate in the atomic retaliation upon which the defensive strategy of the West is fundamentally based and which is crucial for maintaining overall security.

c. France is less likely to participate in the atomic response since it does not possess, like Great Britain, the nuclear weapons that facilitate technical exchanges with America and thereby reduce secrecy. While the quantity of nuclear weapons is dominant on a purely military level, possessing even just a few projectiles would lift the secrecy clause and consequently allow participation in the Anglo-Saxon atomic response.

d. The form, equipment, and organisation of units involved in an Allied retaliatory action would depend on this effort, requiring the necessary airborne equipment and trained personnel for launching nuclear projectiles.

e. While a national effort to produce nuclear weapons could certainly be essential, it is important to recognize that France already has a significant advantage in the geographical dispersion of its territories. If an adversary were to launch an atomic attack, the first target would undoubtedly be the Allied atomic retaliation forces. The mobility of these retaliatory forces indicates that the adversary can only destroy them by attacking simultaneously and without prior

warning. Consequently, the greater the geographical dispersion of the launch or flight points of the retaliatory atomic forces, the less likely such simultaneous attacks become. The geographical dispersion of its territories, facilitated through the French Union, strategically positions France as a crucial element in the dispersion and self-protection of Allied retaliatory forces. This strategic advantage reinforces France's role in maintaining the balance and effectiveness of Allied retaliatory capabilities.

f. Whatever decisions may ultimately be made, and even if the nation's armed forces were unable to participate in the atomic response mission, their adaptation to the threat of nuclear destruction would still have to be undertaken. If it is accepted that, in the event of a conventional conflict, the imbalance of forces is too great for an effective defensive organisation to be set up, it will be recognized that the defence of Europe can only be based, for the time being, on the use of atomic weapons. Consequently, it follows that the adaptation of the country's armed forces to the conditions of atomic warfare does not present any risk despite the profound upheavals it entails, because, in any case, conventional forces would not be able to accomplish their intended mission. Therefore, the shift to atomic defence is not only necessary but also unavoidable under these circumstances.

g. The widespread use of nuclear weapons, the vast extent of their devastation, and the range of vehicles used to transport them significantly underline the global nature of a conflict involving nuclear weapons. Consequently, alliances take on new meaning, as they imply a commitment to share risks of an opposing atomic attack. As a result, the military advantage of alliances notably increases the ability of Allied nations to disperse geographically, thereby limiting the chances of an adversary neutralising friendly atomic means of retaliation at their bases or stations. Consequently, the interdependence of the space and territories of each coalition is firmly affirmed. The atomic battle is singular in its nature and targets the totality of atomic means, regardless of their worldwide distribution. Therefore, the strategic importance of alliances becomes even more pronounced in this context.

h. The above developments clearly illustrate the critical importance of the political factor. If international policy is, to a large extent, decided according to the possibilities of nuclear weapons, then it consequently follows that the military policy of nations depends on the nature and form of the alliance to which they have subscribed. At present, unless there is a technical or scientific innovation, the nations of Western Europe, including the United Kingdom, have a closely interdependent military policy. To a certain extent, their security is based more on the assurance of an atomic defence than on their own capabilities. However, in turn, this assurance is provided only to the extent that the political, economic, or military power of each of these nations, or of the collective whole that they represent, decides that the United States should "guarantee them atomically." Thus, in the final analysis, the security of the

nations of Western Europe always depends on themselves, since it can only be based on their will to power.

Final remarks

1. Possible use of nuclear weapons

- At the military level, it is strikingly clear that Western Europe is indefensible with only conventional means. Either Europe is protected by its atomic arsenal and, consequently, cannot be attacked, or this guarantee no longer exists, thus rendering it wholly defenceless. In this latter scenario, it is absorbed with virtually no military demonstration. Hence, Europe is either defended by atomic means, or it is simply indefensible.
- By being keenly aware of this critical situation, and if the adversary felt confident enough to ignore the threat of reprisals, he would undoubtedly seize the opportunity to benefit from an atomic attack carried out by surprise. Indeed, such an attack could very well have the profound and far-reaching effects of a decisive Pearl Harbour on the continuation of operations.

2. Effects of nuclear weapons

- Their destruction zone extends from 1.5 km to 30 km depending on the “calibres” used.
- The means of “transporting” these projectiles are increasingly efficient in terms of speed, precision and independence from atmospheric conditions.

3. Impact on the forms of conflict

There is a high probability of a surprise attack with enough “pay-off” to paralyse the adversary in a matter of days, if not hours.

- No long-term “organised” war is imaginable.
- The No. 1 objective of the opposing attack can only be the destruction of the opposing means of response wherever they may be (currently spread across the northern hemisphere).
- The role of ground and naval forces is considerably limited.
- Having to “absorb” the first shock, the West had to organise its forces accordingly, as no effective response was possible against a surprise atomic attack.

4. National defence and nuclear weapons

- Increased emphasis on “passive defence”.

- Protection of forces – and in particular means of response – ensured more by passive measures (not presenting a target worth an atomic projectile) than by active means (flak, hunting, *etc.*) effective only after the outbreak of hostilities and “absorption” of the enemy’s initial atomic shock.
- Limiting the role of reserves, and in Europe, of industrial mobilisation.

5. Impact of nuclear weapons on air forces

- The “miniaturisation” of the atomic weapon and its unitary destructive power blur the importance of the “vehicle” in favour of the explosive.
- Any device or flying machine will be a possible atomic vehicle.
- Against an attack by a large number of isolated aircraft, the current active defence organisation is ineffective.
- The retaliatory air force, and more specifically the combat air force in general, must be “crumbled” at its bases so as not to present a “paying” target.
- The “survival” of the air weapon is linked to the operation of a “hemispheric” warning system covering all the friendly means of response against a simultaneous attack.

6. Impact of the use of nuclear weapons on ground and naval forces

Ground forces

- Limiting mobilisation support.
- Importance of active forces ready for D-Day-1.
- Role of stopping ground forces (until the effects of the atomic retaliation are felt in the front).
- Police and surface defence role in the rear and forward areas, after the atomic exchange.
- Defence of Central Europe:
- The stop role is only possible with the combination:
 1. equipping the forward territory (Federal Germany) with a sort of “Siegfried surface” (buried supplies, obstructions, strong points, *etc.*),
 2. a fortress force holding this “Siegfried surface” (protected by burial),
 3. an ultra-mobile force, connected for logistical support to the equipped territory (protected by mobility).
 - It is operated by mobile power.

Naval forces

- Vulnerability of convoys (which could only be used in the second phase of the conflict).
- Abandonment of port concentrations and adoption of linear landing and transhipment.
- Adaptation of convoy routes to anti-aircraft defence possibilities.

7. Conclusion

- The global nature of a widespread conflict.
- Europe's protection is ensured by its policy and its will to be powerful, rather than by the development of conventional military resources.
- France's interest in participating in atomic defence.
 - Statistically: by the extent of its territories (strategic dispersion).
 - Dynamically: by units capable of taking part in the atomic mission.

AIR NUCLEAR COMPONENTS
Testimonial

“There I Was...”

A Tale of the Longest Bomb Run in U.S. History¹

Melvin Deaile²

Dr. Melvin G. Deaile is the Director of the School of Advanced Nuclear and Determine Studies and an Associate Professor in the Department of International Studies at Air University's Air Command Command and Staff College. He is a retired Air Force Colonel, where he served two tours in the B-52 Stratofortress and a tour in the B-52 Spirit. He has flown combat operations as part of Operation Desert Storm and Operation Enduring Freedom, including a record setting 44.3 hour combat mission.

Over 22 years ago, America suffered a homeland attack unparalleled in its history. As the debris and dust settled from the collapse of the Twin Towers, President Bush made it clear America would respond.

Standing atop a pile of rubble at ground zero 13 days after the attack, President George W. Bush told first responders, *“I can hear you, the rest of the world can hear you and the people who knocked these buildings down will hear all of us soon.”*

A week later, President Bush addressed Congress saying: *“Whether we bring our enemies to justice or bring justice to our enemies, justice will be done.”* At the same time President Bush was making his comments about the response for 9/11, at Whiteman Air Force Base in Missouri, the home of the *B-2* stealth bomber, preparations were already underway for whatever military action the president commanded.

Whiteman AFB is about an hour east of Kansas City. The closest town to the base is the one-stoplight town of Knob Noster, Missouri. Since 1993, the *B-2 Spirit* claimed Whiteman AFB as the permanent home for America's entire fleet of *B-2 Spirit* bombers. Initially, the Air Force planned to purchase 132 *B-2* bombers; how-

1. A previous version of this account from my life was published over a decade ago in *On Patrol* (The Magazine of the USO), Volume 6, Number 4, Winter 2014-2015. This updated version provides additional details as well as discussing the emergence of the *B-21*.

2. The views in this work are solely those of the author and do not reflect the views of the Department of Defense, the U.S. Air Force, or Air University.

ever, the end of the Cold War reduced that purchase to just 21 aircraft. Each bomber has a tail number, but it also has a nickname. The first 20 *B-2s* were named after a state in the union. For example, the first *B-2* named was the “*Spirit of Missouri*”, recognizing the home of America’s most advanced aircraft. The second *B-2* was named the “*Spirit of California*”, the state where most of the assembly and testing of the aircraft had been performed. The last *B-2* entered operation in 2000 and was simply named the “*Spirit of America*”.

The *B-2* has a unique design. Jack Northrop originally conceived of the flying wing design, but the *B-2* has three computers working in parallel to operate its highly complex fly-by-wire design. While the *B-52* and *B-1* bombers have crews of five and four people respectively, the *B-2*’s digital cockpit design and redundant navigation system reduced the crew to just two people. Furthermore, the *B-2* was the only aircraft initially capable of delivering the Joint Direct Attack Munition (JDAM)³. In 1999, the *B-2* made its combat debut in the skies of Yugoslavia during Operation *Allied Force*. Two years later, the *B-2* would again lead the fight in a different part of the world.

When the Twin Towers and Pentagon were attacked, the majority of the operational *B-2* fleet was taking part in a Strategic Command exercise. Aircrews were, by serendipity, sitting in their jets monitoring radios. Just when the crews expected a radio call terminating the exercise, the opposite happened. Aircrews were ordered to assume a higher state of readiness and remain at their jets. Word spread throughout the fleet that a jet had hit one of the World Trade Center towers. With news of the second plane hitting the other tower, the entire force knew the implication. America was under attack.

For the next two days, *B-2* crews remained with their jets ready to respond. The exercise eventually ended, but preparations did not. The 509th Bomb Wing identified six crews, if the wing was called upon, that would fly the initial missions. For the next three weeks, these crews flew simulators practicing procedures and crew coordination. During his speech to Congress, Bush said, “*The Taliban must act and act immediately. They will hand over the terrorists, or they will share in their fate.*” Holding true to his word, the President ordered operations over Afghanistan, which began on October 7, 2001, less than a month after 9/11.

I came to the *B-2* program in 1998 after completing my second tour in the *B-52*. In 1999, I completed *B-2* initial qualification training and served as a *B-2* wing weapons officer until 2000. In 2001, I was a *B-2* instructor pilot and assistant director of operations in the 393rd Bomb Squadron.

The other pilot on the mission, Brian “Jethro” Neal, came to the *B-2* program having flown a tour in the *F-16 Falcon* at Hill Air Force Base.

3. The JDAM is a guidance tail kit that converts existing unguided gravity bombs into accurate, adverse weather smart munitions. It contains an inertial navigational system and a global positioning system guidance control unit.

On October 6, 2001, we both came to the base expecting our normal routine. We would review the mission, conduct simulator training, debrief, go home to return the next day. That night was different. Upon arrival, word spread that the first *B-2s* were to launch. Brian and I got the spare aircraft readied the first night, meaning that if one of the first two aircraft broke, we would have an aircraft ready for the primary crews to take into combat. When the first two aircraft got airborne, we went home knowing the next night would be our turn.

We arrived at the base the next night to lead the formation for the second night of attacks in Afghanistan. After the mission brief, we went to our aircraft where another crew already had the plane started and ready to go. We strapped in and taxied out to the runway with operators and maintenance folks lining the taxi route to salute the aircraft, knowing that these aircraft would soon be bringing justice to our enemies. Once airborne, I looked at Brian and asked: “*What jet do we have anyway?*” Looking at the aircraft maintenance logs, he replied: “*The Spirit of America.*”



B-2 “Spirit of America” takes off from Whiteman AFB (MO) during Red Flag 12-3.

© C. Heaton, “[Northrop Grumman B-2A Spirit – USA – Air Force](#)”, *Airliners*, 2012.

Four hours into the mission, the *Spirit of America* approached the California coast for its first air refueling. Operational security and overflight concerns drove the decision to fly the *B-2s* across the Pacific Ocean and to their ultimate targets in Afghanistan. The sun was just starting to rise on the east coast as we approached the *KC-135* refueling aircraft. After about an hour, we filled the *B-2*’s fuel tanks and settled in for the next leg of our mission, which was a four-hour flight to Hawaii, where we would meet our next airborne tanker. While the *B-2* is a two-person aircraft, operating rules require two people to be in the seats during critical phases of flight: takeoff, air refu-

eling, landing and, of course, bombing. Between refuelings, Brian and I took turns trying to nap on the modified “cot” in the small space behind the two ejection seats.

The pattern of meeting a much-needed gas station in the air happened three more times en route to Afghanistan. Our formation met tankers over Guam, through the Straits of Malacca, and in the Indian Ocean, close to Diego Garcia. Crossing the Pacific took more than 24 hours testifying to its expanse. Since the sun was coming up in the east as we started our voyage west, we traveled in daylight throughout the first 20+ hours of the mission. The air refueling over the Indian Ocean was the last before we reached Afghanistan. From there, we turned north and headed up the coast of India to our destination.

Two things happened as our aircraft approached the Pakistani coast. First, the sunlight that had been with us thus far started to fade. Fighting off the release of melatonin as the sun set became a priority. Fortunately, the flight doctor had given each crew member an approved “pick me up pill” so I would be alert going into combat. Second, 70 percent of the targets changed. Fighting an adaptive enemy requires flexibility. Target changes meant entering new coordinates into the *B-2*’s targeting system for a majority of the 16 JDAMs that filled the two bomb bays. On the second night of operations over Afghanistan, we conducted bombing runs on multiple targets. As with every operation, the first mission was to secure air superiority for air forces that would conduct subsequent attacks. During some bomb runs, we used the *B-2*’s onboard synthetic aperture radar to put eyes on target in order to refine target coordinates before releasing our JDAMs. After spending about two hours over enemy territory, we put Afghanistan behind us and planned to rendezvous with the last tanker that would give us the gas for the trip to Diego Garcia. That was the plan except a radio call came over secure communications that the Air Operations Center wanted us to head back into country since we had four JDAMs remaining. We accepted the mission.



B-2 from the 325th Bomb Squadron (Whiteman AFB, MO) drops a GBU-31 Joint Direct Attack Munition (JDAM) during an exercise in 2002.

© “[USAF B-2A Stealth Bomber](#),” *Picryl*.

With gas running low, we orbited in the Arabian Sea waiting for the reserve tanker that would give us the fuel necessary for our return to Afghanistan. While Brian got the fuel, I programmed the mission. With fuel onboard and a mission loaded, we began another strike mission into Afghanistan. After 90 minutes, we left Afghanistan a second time, and for good, to find a waiting tanker to provide the fuel we needed to reach Diego Garcia, our final destination.

It took another four hours to reach our final destination. After being airborne for 44 hours, we were both ready to get our plane on the ground. As we approached the u-shaped island, the *B-52* that landed immediately before us had an emergency upon landing forcing us to “go around.” After having been airborne for 44 hours, we reluctantly added another 15 minutes to our flight time.

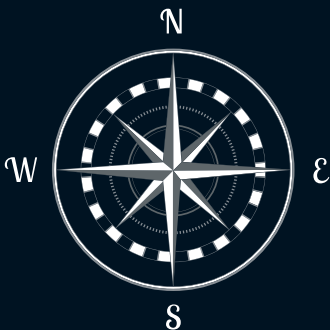
We touched down after being 44.3 hours in the air. For Brian and I, the mission was over, but not for the “*Spirit of America*”. We unloaded our gear, while maintenance troops put oil into the running engines of the *B-2*. Two fresh *B-2* pilots got on board and within 45 minutes the stealth bomber was airborne for its 30-hour journey back to Missouri. We flew more than 44 hours on our mission, the “*Spirit of America*” and five other *B-2*s operated for more than 70 hours without stopping. Not one aircraft broke or encountered engine trouble during the first three days. This remains a testament to the incredible engineering and design of the aircraft.

The “*Spirit of America*” continues to serve the country from its home in Knob Noster, Missouri and will do so for some time until the production of the *B-21 Raider*, the new Air Force sixth generation stealth bomber, eventually replaces the *B-2*.

Of all the aircraft that could have flown the longest combat mission in aviation history, perhaps it was serendipity or providence that it was the *Spirit of America* that made that journey. The aircraft that represented the country showed that America will fly any distance, cover any ground, and overcome any obstacle to bring justice to its enemies when she is attacked.

Operation *Crescent*

Mission of 44 hours and 20 minutes –



1 000 km

Wind – October 2001

More than 30,000 kilometers traveled



B-2 "Spirit of America" of Major Melvin G. Dealle and Captain Brian Neal – 509th Bomb Wing



3 4 5

Air-refueling sequence carried out by KC-10s and KC-135s of the 349th and 60th Air Mobility Wing

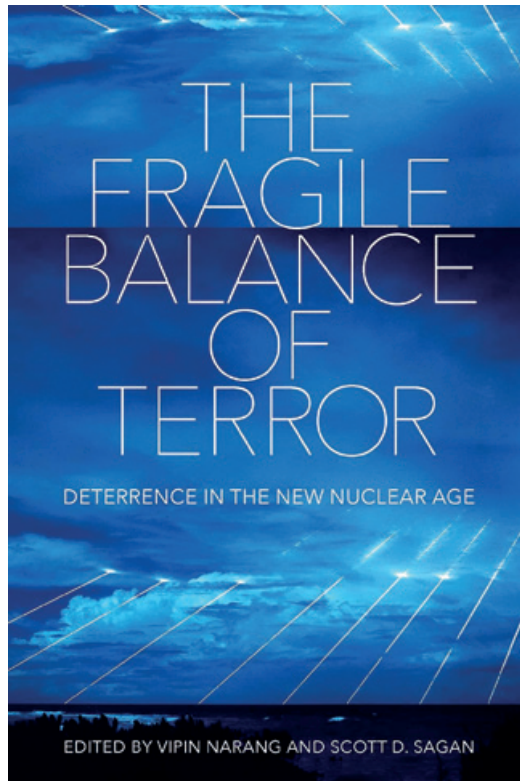


← Flight path

REVIEWS

The Fragile Balance of Terror: Deterrence in the New Nuclear Age

V. Narang et S. D. Sagan (eds.)



Read by David Pappalardo

The logics of deterrence never remain fixed in time: they evolve at the pace of strategic competition, along with balances of power, their understanding by others and the greater or lesser propensity to risks. Yet international relations are increasingly characterised by the disinhibition of actors, disorganisation of institutions and the relative *de-Westernization* of the world, raising the question of the “*fragile balance of terror in the new nuclear age*.”¹

1. V. Narang, S. D. Sagan (eds.), *The Fragile Balance of Terror: Deterrence in the New Nuclear Age* (London: Cornell University Press, 2022): 263 p.

Vipin Narang and Scott D. Sagan, two experienced professors and leading experts in theories of deterrence, have brought together some of the most brilliant American thinkers in the subject to attempt to answer this question in a remarkably well-edited book published in 2022, just before the beginning of the war in Ukraine.² Although Vipin Narang was still professor at the Massachusetts Institute of Technology when this book was published, he went on to become Principal Deputy Assistant Secretary of Defense for Space Policy, in charge of deterrence policy until August 2024.³

Towards the erosion of the stabilising power of nuclear weapons

The main theory of this book is far from comforting: “*The theoretical foundations that gave us any confidence that nuclear weapons would continue to be effective deterrents with minimal risk of accidents or intentional use are all eroding.*” In other words, the theoretical framework of deterrence that prevailed throughout the Cold War is no longer adapted to today’s challenges which include nuclear multipolarity, the “*risk of nuclear contagion,*” the disinhibition of narcissist autocrats or populist leaders, new technologies and the misuse of social media. In the authors’ view, the United States is unprepared (both materially and intellectually) and should therefore doubt its ability to deter a state that would want to use nuclear weapons to prevail in a conflict.

The challenges of the new nuclear age

The book refers to the notion of nuclear age, already explored by others such as Admiral Vandier in France.⁴ The first nuclear age began on the 6th August, 1945 and lasted throughout the Cold War. Nuclear weapons were considered above all as putative weapons (which is still de case nowadays) and nuclear order was marked by the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The second nuclear age began with the end of the Cold War and was characterised by the revival of the ambition for a definitive and total ban of nuclear weapons. As Admiral Vandier points out in his book, the hopes nurtured during this period fizzled out, bringing out a third nuclear age.

During this one, nuclear crises are likely to multiply and intensify. The main hot spots are the Korean peninsula, the Indian subcontinent and the Persian Gulf. This age is characterised both by the emergence of new risks (presented in the first part of the book) and the persistence of older ones exacerbated by the new context (second part of the book).

Four new challenges have been identified. The first concerns the emerging nuclear multipolarity both on the strategic level (United States, China, Russia) and on the

2. Giles David Arceneaux, Mark S. Bell, Christopher Clary, Peter D. Feaver, Jeffrey Lewis, Rose McDermott, Nicholas L. Miller, Vipin Narang, Ankit Panda, Scott D. Sagan, Caitlin Talmadge, Heather Williams, Amy Zegart.

3. Scott D. Sagan holds the Caroline S. G. Munro Professor of Political Science at Stanford University and co-director of Stanford’s Center for International Security and Cooperation. Specialist in nuclear issues, he is best known for his work on the organizational risks associated with the decision to use nuclear weapons.

4. P. Vandier, *La dissuasion au troisième âge nucléaire* (Paris: Éditions du Rocher, 2018).

regional one. North Korea not only complicates Washington's calculations regarding China but also casts a doubt on the credibility of the extended deterrence towards American allies.⁵

The second challenge relates to the behaviour of political decision-makers, whose calculations are dominated more by emotion, revenge and narcissism than rational cost-benefit analysis. In his contribution "Psychology, Leaders, and New Deterrence Dilemmas" (38-62), McDermott argues that this is not just the case for dictators in authoritarian regimes such as North Korea ("*personalist dictator*"), but also for those whom the authors describe as "*aspiring personalist strongmen*" (233) – while taking a swipe in passing at former U.S. President Donald Trump and Indian Prime Minister Narendra Modi.

The third challenge is about the information environment (X, WhatsApp, *etc.*), which is likely to push leaders towards escalation, either through disinformation and manipulation or the dangerous use of these channels for strategic signalling purposes.⁶

Finally, Amy Zegart highlights the risks that OSINT⁷ pose for nuclear deterrence. Admittedly, this new tools can make it possible to reveal or monitor the development of a clandestine programme, but they also encourage proliferating countries to better conceal their nuclear agendas. Furthermore, OSINT has a destabilising potential when it deconstructs a political and diplomatic narrative whose objective was, on the contrary, de-escalation (by fanning the flames of national pride, for example). Narang and Sagan offer a good example here:

*"Imagine if there had been OSINT analysts and tools during the Cuban Missile Crisis – would exposing the extent of the Soviet deployment have raised pressure for U.S. preventive action, or would evidence that the United States removed Jupiter missiles from Turkey as a quid pro quo have undermined the perception of Kennedy's handling of the crisis?"*⁸

What does the future hold for deterrence in this new nuclear age?

Beyond these new risks, the foundation of nuclear stability are ultimately undermined by the pressure of interrelated technological and structural factors that call into question the future of deterrence (not just for the United States).

The first question is how to size a country's nuclear arsenal to preserve its deterrent potential.⁹ This is particularly relevant in the current context, where, for the first time in its history, the United States faces the challenge of growing competition with two other powers with nuclear parity (Russia) or near-parity (China). Alongside these dynamics, other players are complicating the strategic environment ("*the wildcards*"), starting with North Korea, which has succeeded in developing an operational nuclear force, and Iran, which is on the threshold of acquiring nuclear

5. Read Chapter I by C. Talmadge, "Multipolar Deterrence in the Emerging Nuclear Era," 13-38.

6. On this point, read Chapter III: H. Williams and V. Narang, "Thermonuclear Twitter," 63-89.

7. Open Source Intelligence.

8. V. Narang, S. D. Sagan, "Conclusion," 236

9. "'How much is enough' to achieve a nuclear weapons capability that can achieve a state's deterrent goals?," *Ibidem*.

weapons. In an essential chapter,¹⁰ Jeffrey Lewis and Ankit Panda argue that nuclear stability depends not only on the acquisition of a second-strike capability – contrary to popular belief – but also on a shared belief: “*Instead, it requires both rivals to believe, with high confidence, that both they and their rivals have such capabilities. And those beliefs must be widespread within the governments, otherwise some senior decision-makers may advocate for preventive war and others for caution.*”¹¹

The second major question is the survivability of arsenals in the face of the increasing range of counterforce strategies,¹² whether nuclear, conventional or cyber. Admittedly, Christopher Clary is skeptical about the chances of success of current counterforce strategies (“*Survivability may still be easier and cheaper to obtain and maintain than it is to threaten*”¹³). Nevertheless, he does not rule out that doubts about the survivability of one’s own nuclear forces could prompt a country to make rapid use of its arsenal in the event of a crisis, because of the fear of losing it – *a fortiori* if that arsenal is reduced. In other words, these countries are prey to the “*use them or lose them*” dilemma. Similarly, the USA is naturally reluctant to accept any form of mutual vulnerability *vis-à-vis* regional rivals – such as North Korea. The combination of these two parameters, coupled with improved counterforce technologies, thus becomes a major factor of instability, running counter to classic deterrence theories on the stability/strategic equilibrium of nuclear weapons.¹⁴

The sizing of the nuclear arsenal and its survivability determine the nature of the command, control and communication architecture (NC3)¹⁵ for the use of nuclear weapons. Giles D. Arcenaux and Peter D. Feavern invite us to go beyond the classic centralization/delegation dichotomy, which they consider too static and simplistic. Even if autocratic leaders have a natural tendency to keep decision-making strictly for themselves, any doubts they may have about the survivability of their arsenal in the event of conflict will necessarily push them towards greater delegation at tactical level, with all the risks of unintentional escalation that this posture implies.

Finally, Mark Bell and Nicholas Miller argue that the new nuclear states are not seeking to learn from past crises in order to reduce the risk of nuclear escalation. On the contrary, they no longer see nuclear weapons as a means of preventing wars (deterrence) but as a means of winning them (compellence):

“New nuclear states may not seek to avoid crises but to win them. In the Cold War, Thomas Schelling famously identified a solution to the problem of how to make nuclear threats credible given the danger of escalation calling for “the threat that

10. J. Lewis, A. Panda, “How Much Is Enough? Revisiting Nuclear Reliability, Deterrence, and Preventive War,” 123-153.

11. *Ibidem*.

12. Counterforce strikes are aimed to disarm the adversary, *i.e.* eliminating all its nuclear capabilities and thus avoiding second-strike retaliation, or destroying the bulk of its conventional capabilities. Counter-value strikes, on the other hand, follow a different logic: they target what the adversary considers to be of value, and which he would regard as unacceptable damage.

13. *Ibidem*, 238.

14. Particularly those formulated during the balance of terror period of the Cold War. See on this subject K. N. Waltz, “[The Stability of a Bipolar World](#),” *Daedalus*, Vol. 93, no. 3 (1964): 81-90.

15. NC3: Nuclear Command, Control and Communication.

leaves something to chance.” *The problem, of course, is that the threat that leaves something to chance leaves to chance. Do we want to face a future with such risks hanging over us? Do we have a choice?*”¹⁶

What measures for nuclear risk reduction?

Faced with the growing difficulty of preventing nuclear risks, the authors of this book sketch out a number of proposals along three lines for minimizing their consequences. Firstly, they argue – without really believing in it, given the current context¹⁷ – that new arms control mechanisms and confidence-building measures need to be devised.

In addition, they call for the implementation of a genuine non-proliferation policy for competitors (*via* sanctions) but also Allies through the extended deterrent. South Korea is mentioned here several times.

Finally, Washington must not refrain from conducting counter-proliferation operations before it’s too late, notwithstanding the risks involved. According to the authors, we must not repeat with Iran what the United States allowed to happen with North Korea.

Although the book was published before February 24, 2022, the Russian Federation’s unprovoked and unjustified military aggression against Ukraine gives it particular resonance, as does North Korea’s increasingly uninhibited nuclear behavior. However, despite Moscow’s aggressive nuclear rhetoric for the purposes of coercion, the dikes have not yet yielded. Proof, perhaps, that while nuclear weapons are still relevant for preventing a strategic attack against a state’s vital interests, they have not yet proven to be very effective for coercing an adversary’s behavior through intimidation.

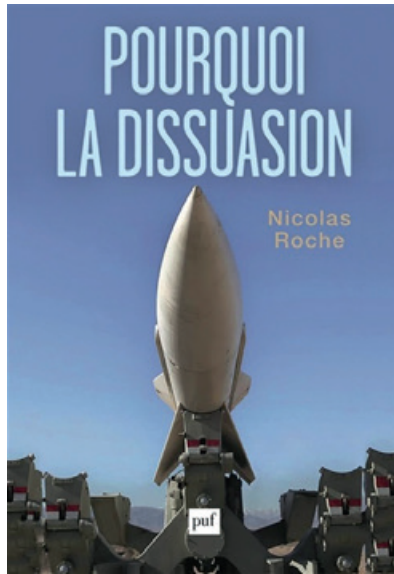
In any case, this book remains an essential reading for anyone wishing to understand the current debates and reflections in Washington on the exercise of deterrence in the new nuclear age.

16. In V. Narang, S. D. Sagan, “Conclusion,” 239.

17. For example: expiry of the Intermediate-Range Nuclear Forces Treaty in 2019, departure of the United States (2020) and Russia (2021) from the Treaty Open Skies, President Putin’s speech on the “suspension” of the New START Treaty in February 2023...

Pourquoi la dissuasion

Nicolas Roche



Read by Hugo Caste

Before his current role as French Ambassador to Iran, Nicolas Roche served as the Director of Strategic Analysis in the Military Applications Division of the French Atomic and Alternative Energy Commission (CEA). In this position, he established the Interdisciplinary Center for Strategic Studies (ICSS or CIENS in French) at the *École normale supérieure*, creating a teaching platform that significantly contributed to the intellectual rearmament of French universities regarding nuclear strategic studies.¹ The book he published with PUF in 2017 entitled *Pourquoi la dissuasion* is based on one of the lectures he gave there.

The author aimed to create a comprehensive conceptual inventory of nuclear deterrence. This goal has been successfully achieved, as his book has become a key reference in the field, rekindling the interest of researchers after over two decades of relative neglect.

1. N. Roche, *Pourquoi la dissuasion* (Paris: Presses Universitaires de France, 2017): 552 p.

Nicolas Roche dedicates the first part of his book to France's nuclear deterrence. In a Western analytical landscape often dominated by American or NATO perspectives, this focus on the specifics of French nuclear power was typically missing. Writing during a tense international backdrop – marked by Russia's annexation of Crimea in 2014 and the ongoing Syrian civil war – Roche underscores the consistent reliance of France's national defense and security policy on nuclear deterrence, emphasizing its continued relevance. His foresight is commendable, as subsequent events have validated his perspective.

Roche examines the power of nuclear strategy, highlighting its most critical aspects. He underscores the importance of understanding the theoretical elements surrounding the subject. In this regard, *Pourquoi la dissuasion* serves as a compendium of the “grammar” of deterrence, explaining all the key concepts essential for understanding the logic of a weapon designed for non-use (*arme de non-usage*). Nicolas Roche challenges the more commonly accepted expression “non-use” (*arme de non-emploi*), arguing that nuclear weapons are permanently used as a tool of deterrence, but that their very purpose is not to be eventually employed.

In fact, deterrence is based on the premise that the aggressed can threaten the aggressor with damage out of all proportion to the expected gains. From this stems the *equalizing power of the atom*, or the *deterrence of the weak against the strong*, i.e. the idea that it is possible to effectively deter, with nuclear weapons, a much greater conventional military power – this is, for example, Pakistan's position with respect to India.

To limit proliferation, a country can make a nuclear protection commitment to another country in the event of an attack – this is the case for the United States vis-à-vis Europe via NATO, and vis-à-vis South Korea, Japan and Australia. This is known as *extended deterrence*. In this context, the “protected” country can participate more or less directly in nuclear mission. It happens in NATO, with certain European crews who fly dual-capable aircraft that can carry American nuclear weapons under double-key. This is a very strong guarantee, but one that creates a situation of dependence and requires constant reassurance measures. The nation benefiting from the extended deterrence may also feel freer to carry out destabilizing actions, for example against another state that it deems deterred from attacking it in return.

The imperative of limiting strategic uncertainty prompts the “nuclear-weapon states” and “possessors”² to draw up and disseminate a nuclear doctrine, whether in declarations or documents. For example, a state may pledge never to use its nuclear weapons unilaterally unless it has already been the target of a nuclear attack. This is known as the non-first-use principle. China and India adhere to this doctrine, as did the USSR and later Russia from 1983 to 1993. This self-imposed constraint has significant operational implications: it requires an assured second-strike capability,

2. The former are the nuclear powers recognized under the NPT (USA, Russia, France, UK, China). The latter are those which have – or are suspected of having – nuclear weapons after 1967: Israel, India, Pakistan and North Korea.

meaning nuclear forces and decision-making centers must survive a first strike in sufficient numbers.

Countries following this doctrine can choose a widely dispersed land component, as China does, or an ocean-based component. Multiple hardened command centers are necessary. The USSR even developed an automated second-strike system, called Perimetr, to ensure retaliation if the political system was decapitated. However, this doctrine may lack credibility for several reasons: the possibility of a disarming first strike or decapitation, threats to vital interests other than a nuclear first strike, and the prospect of massive retaliation after a tactical nuclear attack. The non-first-use principle is closely linked to the “sole purpose” doctrine, which states that the sole purpose of nuclear weapons is to deter a nuclear attack.

Another important declaratory aspect is negative security assurances, where a nuclear state guarantees a non-nuclear state that it will not face nuclear threats under certain conditions. China, consistent with its unconditional non-first-use doctrine, has provided absolute negative security guarantees. The United States, France, and the United Kingdom also issued such guarantees in 1995 under UN Security Council Resolution 984 to non-nuclear-weapon states complying with non-proliferation obligations. These guarantees do not undermine their inherent right to self-defense, as enshrined in Article 51 of the UN Charter. Positive security guarantees, on the other hand, are less binding and involve an obligation to consult and refer to the Security Council in the event of a nuclear attack or threat, as seen with the 1994 Budapest Memorandum.

In addition to these conceptual aspects, Nicolas Roche also addresses other issues.³ Already deeply involved in the Iranian nuclear issue in 2017, Nicolas Roche emphasizes the critical importance of delivery systems, often overlooked despite being essential to a nuclear program’s operational implementation and credibility. At a time when Russia’s withdrawal from the Comprehensive Nuclear Test-Ban Treaty (CTBT) threatens the non-proliferation framework, Roche’s review of the international legal context for military nuclear power sheds light on recent developments in Russia’s aggression in Ukraine. The broader aspects of his book are particularly relevant as Russia uses nuclear warnings as a weapon of war, such as placing its strategic forces on “*special alert*” on February 27, 2022, and announcing the deployment of tactical nuclear weapons in Belarus in 2023.

Drawing on his diplomatic career, Roche proposes two approaches to understand global nuclear deterrence challenges: the deep Russian-American relationship and regional balance. He goes beyond the quantitative aspect – where the U.S. and Russia hold nearly 90% of the world’s nuclear warheads – to show how this relationship has historically shaped nuclear arms control norms. He also examines the critical proliferation crises in Iran and the Asia-Pacific region, maintaining the relevance of these chapters for understanding current crises.

3. He was at some point Director of Strategic Affairs, Security and Disarmament at the Ministry of Europe and Foreign Affairs.

While Roche does not neglect these aspects, a contemporary author might argue that the U.S.-China deterrence relationship is now more pivotal. Similarly, the need to credibly deter both Moscow and Beijing is increasingly significant for Washington.

To stimulate nuclear thinking, Roche explores various extensions of the deterrence concept in three chapters on biological and chemical weapons, missile defense, cyber and space, providing valuable insights into contemporary conflicts.

In a field rich with recent developments, it's impressive that this book remains relevant despite being published in 2017. The fundamentals of deterrence have not changed, and Roche's clear insight into the importance of nuclear issues compensates for what contemporary readers might see as shortcomings. This observation is a proof of the book's quality.

In today's context, strategists and international relations analysts, even those who aren't specialists, must consider the nuclear dimension, which has become unavoidable once again. This book's strength lies not only in its status as a milestone in nuclear studies but also in its broad appeal. It belongs to the bookshelf of a specialist, a professional in international relations, and even a curious newcomer eager to understand this crucial issue.

PAINTINGS

Artist: Damien Charrit

Self-taught graphic designer and illustrator, he draws his inspiration from the air and the waters. Boat, train, car all subjects fascinate him but it is especially with aircrafts he expresses himself and he has made it his playground. Made with a computer and a drawing tablet, his works are 100% digital. Strongly influenced by 1940s advertising illustrations, they are executed using modern tools but always with the same passion.



Title: *Mirage IV*, a nuclear bomber for France.

Artist: César Cépéda

A plane coming to a stop at the end of the runway, landing gear retracted, that was my first vision of aviation. I was five years old, it leaves an impression. A career in the French Air Force as an aircraft mechanic in the Strategic Air Forces on *Mirage IV* and *C-135*, in rigor and precision, so that these flying machines function well. A brush, pencils and colors replace the screwdriver and tools. I wish for the same precision in my works, so that “*my metal birds*” glide silently on the canvas and through other people’s eyes they are shared.



Title:*Mirage IVA and Mirage IVP* (100 x 80 – acrylic).

Artist: César Cépéda



Title: Backlight *Mirage* (80 x 60 – acrylic).

Artist: César Cépéda



Title: *Boeing C-135F* in the Pacific (110 x 90 – acrylic).

Artist: César Cépéda



Title: *Mirage IV* ready for refueling (100 x 80 – acrylic).

Artist: Olivier Montagnier

Mirage IV A in a hangar on Base aérienne 115 Orange-Caritat during a nuclear alert.

Cover of the book *New history of the French Air and Space Force* published by Pierre De Taillac Editions.

The atmosphere of the tarmac, hangars, war missions or aerial combats, are inexhaustible sources of inspiration. Self-taught, Olivier Montagnier transcribes the emotions between men and machines in his painting, with a constant concern for detail.



Title: “Alerte nucléaire !” (46 x 62 cm – Gouache on Canson colored paper).





**MINISTÈRE
DES ARMÉES
ET DES ANCIENS
COMBATTANTS**

*Liberté
Égalité
Fraternité*



**ARMÉE DE L'AIR
& DE L'ESPACE**