1. Nuclear weapons

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I. Introduction

The year 1988 was the first in history in which both the United States and the Soviet Union destroyed modern nuclear weapon systems under a disarmament treaty, the Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles (the INF Treaty). In the first part of the year the Treaty was ratified by both countries and then entered into force during the Reagan–Gorbachev summit meeting on 1 June. In the remaining seven months of the year nearly 700 missiles were physically destroyed.

Although all five acknowledged nuclear weapon states (the USA, the USSR, the UK, France and China) continued to develop new weapon systems, all have been beset by technological, political and fiscal problems that may slow or alter the pace of the arms race.

Political relations among the nuclear weapon nations have markedly improved, thus lowering the incentives for military competition. Two summit meetings were held in 1988 between Presidents Reagan and Gorbachev, and both nations signed an agreement to notify each other of their strategic ballistic missile launches (see appendix 1A).[1] Gorbachev's announcement at the United Nations on 7 December that the Soviet Union would cut and restructure its military forces will have a wide-ranging impact. The USA and the USSR continue to negotiate about large reductions of their strategic nuclear forces. Conventional arms control negotiations in Europe are imminent and will include the military forces of all the nuclear states except China. However, as in past years, the momentum of nuclear weapon developments continues, seemingly oblivious to changing political realities and future opportunities.

The USA has nearly completed the first phase of its strategic modernization plan outlined in October 1981, and a second phase is about to begin. Economic constraints at the beginning of the year led the Pentagon to reduce its own budget by $30 billion before submitting it to Congress. These pressures are likely to continue during the Bush Administration. Furthermore, portions of the US nuclear weapon production complex came to a virtual standstill in 1988 because of serious safety, health and environmental problems caused by years of mismanagement and lack of oversight. These problems have caused serious chemical and radioactive pollution and at least a temporary halt to the production of tritium.

Despite Gorbachev's many proposals and new initiatives, the Soviet Union continued to modernize its nuclear forces. However, there were signs that weapons were being produced and deployed at lower rates than previously estimated. Mobile SS-24 and SS-25 intercontinental ballistic missile (ICBM)

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deployments were modest during the year. Long-range SS-N-21 sea-launched cruise missile (SLCM) deployments do not appear to be significant. Short-range SS-21 missile production and deployments may have halted, a possible indication of the restructuring of European-based Soviet forces announced by Gorbachev on 7 December and of the potential elimination of battlefield nuclear forces. None the less, the strategic and non-strategic bomber force continued to grow in capability, as did fighter aircraft.

The year saw Britain step back from a possible joint air-to-surface missile project with France and move closer to one with the USA. The Trident submarine and missile programme proceeded as the cost estimate dropped. France continued to articulate its independent position as it pursued a host of new missile, aircraft and submarine programmes. Budget pressures are starting to force delays in some programmes. During the year China apparently detonated a neutron bomb and successfully fired a submarine-launched ballistic missile (SLBM) from one of its newest submarines.

The tables showing the nuclear forces of all five nations as of January 1989 (tables 1.1–1.8) appear in section III of this chapter.

II. US nuclear weapon programmes

The first phase of the Reagan strategic modernization programme, spelled out in October 1981, is almost complete, and a second phase is about to begin. With the introduction of these new forces, a new Single Integrated Operational Plan (SIOP-7)—the nuclear war plan—will be implemented in 1989.[2]

At the end of the year, US strategic forces were comprised of 1000 ICBMs with 2450 warheads, 608 SLBMs with 5312 warheads, and 349 bombers with 5238 air-to-surface weapons. For the first time since 1981 the US strategic arsenal did not grow quantitatively. Although almost 600 new warheads were deployed, an equal number were retired.

A budget summit between the White House and Congress was held in late November 1987 resulting in an amended budget for fiscal year (FY) 1989. The year thus began with the submission of a military budget for an amount agreed to beforehand by the executive branch and the Congress, the first such co-operation under the Reagan Administration. Unlike past practice this led to an orderly disposition of the budget. Congress did not cut the overall size of the budget but did reallocate funds for certain programmes. As in past years Congress included several arms control initiatives in the FY 1989 Defense Authorization Bill, in part causing President Reagan to veto it on 3 August. This veto was a political manoeuvre to assist candidate George Bush's presidential campaign, borne out by his signing a virtually identical bill on 30 September 1988.

ICBMs

In 1988 the last of 50 MX missiles were deployed in modified Minuteman silos at F. E. Warren Air Force Base (AFB), Wyoming. By the end of the year, all the missiles were declared operational.

Development continued on the rail-garrison basing mode for the MX missile, the fourth scheme the Reagan Administration has officially endorsed. The Strategic Air Command's formal Statement of Operational Need document was validated by Air Force Headquarters in March 1988. On 10 May 1988 the Defense Acquisition Board recommended that the rail-garrison programme proceed to full-scale development. The Secretary of Defense approved both that recommendation and $328.7 million in contracts.[3]

Further details about how the rail-garrison concept would work were revealed during the year in studies and government reports.[4] The seven-car baseline train (supplemented by additional cars) would have a crew of 29, consisting of 3 civilian railway personnel, 1 train commander, a combat missile crew of 4, a maintenance team of 6, and a security team of 15. The main operating base at F. E. Warren AFB would be the primary location for the assembly, integration, major maintenance and operations support of the missile system. The garrison at each base would be a secured area of approximately 150 acres (60 hectares) enclosed by a double chain-link fence. Inside the area would be a Train Alert Shelter (TAS) for each train. Each TAS would consist of an 800 foot (240 m)-long earth-covered igloo and a 400 foot (120 m)-long attached shelter. The MX missiles would be assembled in their launch cars at F. E. Warren AFB and subsequently deployed at an operating base. The Air Force estimates that the basing programme will cost $7.4 billion plus another $3.2 billion for the additional missiles. Preliminary findings indicate that approximately 125 000 miles (201 125 km) of US railway track would be available for use by rail-garrison trains.

The rail-garrison testing programme would comprise a series of 10 or more canister-launched tests using a simulated missile, followed by five live Basing Verification Missile (BVM) flight-tests The first BVM flight-test is scheduled for June 1991 and the last for May 1992. The Initial Operational Capability (IOC), for one train on alert with two missiles, plus one spare train at F. E. Warren AFB, is scheduled for December 1991. Full Operational Capability (FOC) is scheduled for late 1993. Annual operating and support costs are estimated at $200 million, and military construction costs for the seven-year period FYs 1988–94 are estimated at $944 million.[5]

In congressional testimony, and in a letter to Senate Armed Services Committee Chairman Sam Nunn, Secretary of Defense Frank Carlucci stated that MX missiles now housed in underground silos should be removed and deployed in the rail-garrison basing mode.[6] This would mean 100 missiles on 50 trains, with up to six trains at F. E. Warren AFB and at as many as 10 other installations.

The high cost of acquiring and maintaining a Small ICBM (SICBM) force has been a difficult issue for the Department of Defense, the Air Force and the Congress since the inception of the programme. In the revised FY 1989 Department of Defense (DOD) budget the Secretary of Defense recommended terminating the programme, but kept $200 million (and $700 million from FY 1988) in the budget to continue development so as to let the next Administration decide the issue.

Throughout the year Congress, the Administration and the Pentagon

wrestled with how to proceed with both types of ICBM. In the final bill the next President was directed to submit a report to Congress by 15 February 1989, only three weeks after the presidential inauguration, on how funds for the SICBM and MX rail-garrison programmes will be obligated for the rest of FY 1989. Because of these delays, the IOC date for the SICBM has now slipped to mid-1994.[7] A report by the House Armed Services Committee suggested that the SICBM could be used as a silo-based replacement for the Minuteman II.[8] The Air Force is also studying a single-warhead Minuteman IV and a double-warhead Minuteman V.

Strategic submarine programmes

Nine Trident II SLBM flight-tests were conducted in 1988 by the Naval Ordnance Test Unit from Cape Canaveral, Florida.[9] This brings the total number of flight-tests to 17. Two more land-based tests are scheduled for early 1989, to be followed by nine at-sea missile launches from the *USS Tennessee*, which will take place from March to July. The tests in January and July 1988 were failures, and although the missile in the September test was destroyed it was later revealed that this was due to a mistake by the range safety officer.

The latest cost estimate of the Trident II SLBM programme is $34.9 billion for 843 missiles.[10] The FY 1989 budget included funds to purchase 66 missiles, bringing the number bought so far to 153. The budget also included $1.26 billion for the sixteenth Trident submarine. The submarine base at Bangor, Washington, now supports the first eight Trident submarines. Beginning with the *USS Tennessee*, which was commissioned on 17 December, Trident submarines equipped with Trident II missiles will be based at the King's Bay Naval Submarine Base, near St Mary's, Georgia. Eventually, as the first eight submarines are retrofitted with Trident II missiles, the Bangor base will be modified to support them. During the summer of 1988 the *USS Alabama* (SSBN 731) completed the 100th Trident patrol. (The first Trident patrol was completed on 10 December 1982 by the *USS Ohio* (SSBN 726).)

A little noticed aspect of changes in strategic forces during the past few years has been the removal of Poseidon ballistic missile submarines. The reasons are a combination of not enough money to overhaul them and congressional desires to remain near the SALT Treaty ceiling of 1320 MIRVed (with multiple independently targetable re-entry vehicles) missiles and heavy bombers modified to carry air-launched cruise missiles (ALCMs). Five Poseidon submarines have been deactivated or decommissioned since 1985, and two more are scheduled to be removed by September 1989.[11] On 1 April 1988 the *USS Andrew Jackson* (SSBN 619) began to be deactivated, and deactivation of the *USS John Adams* (SSBN 620) began on 1 October 1988. With the planned removal in September 1989 of the *USS Henry Clay* (SSBN 625) and the *USS James Monroe* (SSBN 622) more than 1100 W68 warheads will have been retired and dismantled so that their plutonium, uranium and tritium can be recycled for use in new warheads.

Strategic bomber programmes

There were several major developments in the US strategic bomber force during the year. On 1 October four non-ALCM B-52G squadrons (69 aircraft) were removed from the SIOP and assigned strictly conventional missions.[12] The special (nuclear) weapons storage areas (WSA)—at Mather AFB, California; Andersen AFB, Guam; and Loring AFB, Maine—were deactivated, and the WSA at Barksdale AFB, Louisiana, was reduced. B-52H bombers continued to be modified to carry cruise missiles and by the end of the year 72 of the 96 were completed, leaving the final 24 for 1989.

From the moment the B-1B bomber entered service it has been plagued by problems; 1988 proved to be no exception. Two B-1Bs crashed during the year, reducing the inventory to 97. The first crash occurred on 8 November near Dyess AFB in Texas, and the second on 17 November near Ellsworth AFB, South Dakota. During the year there were continuing problems with the ALQ-161A defensive avionics system as well as an overall lack of spare parts. In July and August the seriousness of these problems came to light largely through House Armed Service Committee Chairman Les Aspin, who, with the committee, have been the bomber's severest congressional critics.

After years of secrecy the B-2 stealth bomber was first seen in public during its roll-out on 22 November, revealing some basic facts about its design. Earlier, on 20 April, the Air Force had released an artist's conception of the Northrop B-2 showing a flying wing. The news release which accompanied the drawing stated that the aeroplane would fly in the autumn. In early August the Air Force announced that it is 69 feet (21 m) long, 17 feet (5.18 m) high with a wingspan of 172 feet (approximately 52.43 m). The B-2 will have a crew of two (with provisions to add a third at a later date) and be powered by General Electric F-118 engines. Several articles fleshed out other important characteristics[13] and discussed the rationale of its mission.[14] The Air Force Chief of Staff stated that the fleet of 120 operational B-2s would carry about 2000 nuclear warheads, or about 16 weapons per plane.[15] It was also learned that the bomber underwent a major redesign in 1984 which caused it to fall behind schedule by eight months.[16] The changes strengthened the airframe and made the flying wing more aerodynamically efficient. In 1982 an examination of potential problems added a year to the programme schedule. Various estimates were given for how much the aircraft would eventually cost. The General Accounting Office put the cost for 132 aircraft at $68.8 billion or $522 million each, or almost twice as much as a B-1B bomber. The Air Force estimate was approximately the same.[17] The first B-2s are scheduled to be delivered to Whiteman AFB, Missouri, in mid-1991, after approximately two years of flight-testing. The first batch of 10 planes was to have been bought with funds in the FY 1990 budget although this has been reduced to five. With fewer aircraft bought in the early years and more bought in the later years the fleet of 132 would be complete by mid-1995, according to the Air Force.[18]

The secret Advanced Cruise Missile (ACM) AGM-129 programme continues to have problems and is at least three years behind schedule.[19] House Armed Services Committee Chairman Aspin called it a 'procurement disaster',

adding that 'there have been serious problems with quality control and contractor discipline during missile assembly'.[20] In 1986, Congress demanded that at least six successful ACM test-flights be conducted before full-scale production could begin. As of spring 1988 only three successful test-flights had been accomplished: in June 1987, January 1988 and February 1988. The ACM was originally scheduled to be deployed sometime in FY 1988. The cost has now risen to $5 billion for 1400 missiles, $2 billion more than the original projection. The first base scheduled to receive the 2500-mile (4000-km) range missile is K. I. Sawyer AFB, Michigan, followed by Minot AFB, North Dakota.

Work continued on the SRAM II missile which will replace the SRAM-A on B-52 and B-1B bombers and will arm the B-2. The first test-flight is scheduled for September 1990. Initial, low-rate production would begin in March 1991, followed by full-rate production in July 1992 to meet an IOC of April 1993.[21] Early in the year the Lawrence Livermore National Laboratory-designed W89 warhead was chosen for the missile. The missile will have a range of 250 km and be three times as accurate as the SRAM-A for 'efficient hard target kill'. The Air Force plans to purchase 1633 missiles for an estimated $2.7 billion. The total cost of the programme including some 1200 nuclear warheads will be over $3 billion.

Theatre nuclear forces

Implementation of the 1987 INF Treaty had an impact on theatre nuclear forces in Europe during 1988. Following hearings in the US Congress and a vote in the Senate, the instruments of ratification were exchanged at the Moscow summit meeting on 1 June 1988 and the Treaty entered into force.[22] The new US On-Site Inspection Agency began work in February 1988. After the USA and the USSR held initial inspection visits, missiles began to be removed to elimination sites where they were to be destroyed. The first Pershing missiles were destroyed on 8 September at Longhorn Army Ammunition Plant in Karnack, Texas. The first ground-launched cruise missiles (GLCMs) were destroyed at Davis-Monthan AFB, Arizona, on 18 October. By the end of the year, 70 Pershing 1A missiles, 18 Pershing II missiles and 84 GLCMs had been destroyed, approximately 20 per cent of the eventual total.

In a report to Congress, Secretary of Defense Carlucci called for the modernization of certain non-strategic weapon systems,[23] many of which were already under way. The main elements are:

1. Development of a Follow-on to Lance (FOTL) surface-to-surface missile with increased range and improved accuracy. Almost $15 million was requested in the FY 1989 budget for the FOTL although Congress cut the request to $8 million. The estimated cost to develop and procure 1000 missiles is $1.2 billion.[24] The Pentagon wants Congress to lift the restriction on using the Army Tactical Missile System (ATACMS) as the FOTL.

2. Development of a stand-off Tactical Air-to-Surface Missile (TASM). A 400-km TASM was approved for development at the 1983 NATO meeting of

ministers in Montebello, Canada. The TASM would provide US and allied aircraft the capability of attacking high-value, heavily defended targets. During 1988 the Air Force revealed that its preference for the TASM was the SRAM II (now designated SRAM-T) which could meet the IOC of 1995.[25] The DOD has decided not to dismantle the W85 Pershing II warheads or the W84 GLCM warheads.[26] With some adaptation the warheads could be used for SRAM-T and/or FOTL missiles.

3. Modernization of NATO's Artillery-Fired Atomic Projectiles (AFAP). Three types of AFAP are currently deployed with the ground forces of eight NATO countries. After many delays the replacement for the 155-mm W48 warhead is nearing production. The Lawrence Livermore National Laboratory-designed W82 warhead is scheduled to enter production in February 1990,[27] probably for introduction into service later that year. The Pentagon wants a congressional restriction lifted that now limits the number of new AFAPs (8-inch W79 and 155-mm W82) to 925.

4. Continuation of NATO's dual-capable aircraft and nuclear bomb modernization programme. The F-15E is a new, long-range interdiction fighter-bomber variant of the F-15 fighter, which is scheduled to enter the force in the early 1990s. The Air Force intends to purchase 392 to equip five Tactical Fighter Wings. Thirty-six were purchased in the FY 1989 budget. Throughout the 1980s new B61-3 and B61-4 bombs have been replacing older nuclear bombs in Europe and elsewhere.

On 10 November the US Air Force disclosed the existence of an operational stealth fighter aircraft, officially known as the F-117A.[28] A picture of the single-seat, dual-engine Lockheed-built aircraft was also released. Although nothing has been specifically stated, it is conceivable that the F-117A could have a nuclear mission. The aircraft first flew in June 1981 and has been operational since October 1983. It is assigned to the 4450th Tactical Group at Nellis AFB, Nevada, and is based at the Tonopah Test Range Airfield. Of the 59 procured, 52 have been delivered.

The Belgian Defence Ministry announced in a statement on 24 October that the nuclear warheads for its Nike Hercules missiles had been given back to the United States in the preceding few months. By the end of 1988, virtually all of the nuclear warheads associated with the obsolete Nike Hercules were withdrawn, except for a small number with West German units. It is expected that they, too, will be withdrawn in the near future.

Naval nuclear weapons

The Navy's efforts to modernize US non-strategic naval nuclear forces have not fared well. After years of congressional criticism and budget cuts the nuclear version of the Standard-2 surface-to-air missile (SM-2[N]) to replace the Terrier has been cancelled. The Navy is planning to replace the SUBROC anti-submarine rocket-propelled nuclear depth charge with the Sea Lance missile. A decision on whether to arm the Sea Lance with a nuclear warhead has been deferred until at least December 1990.

The Tomahawk sea-launched cruise missile (SLCM) programme continued at a steady rate.[29] Over half of the planned 3994 SLCMs have been purchased. In the period FYs 1980–89, 2021 missiles of four types were procured; 385 were the Tomahawk land-attack missile-nuclear (TLAM-N) version, 179 for surface ships and the rest for submarines. During FY 1988, 295 Tomahawk missiles were delivered to the Navy, 51 of which were the TLAM-N. Modification of naval ships to carry Tomahawks proceeds at a rate of about five surface ships and 10 submarines per year. By the end of the year there were 27 Tomahawk-capable surface ships and 37 Tomahawk-capable submarines.

The Navy is working on a classified Advanced Sea-Launched Cruise Missile (ASLCM) now in 'concept development', which incorporates stealth features.[30]

Problems with the nuclear weapon production complex

Long-standing problems with the Department of Energy (DOE) complex that manufactures US nuclear weapons burst into public view during the year. In the aftermath of the Chernobyl accident in 1986, panels were formed in the USA to examine DOE reactors, especially those making plutonium and tritium for nuclear weapons, and the safety procedures at various US facilities.[31] The General Accounting Office produced a score of reports that described a pattern of poor management, inadequately trained personnel, poor maintenance, deficient safety procedures and a record of mishaps. As a consequence the N Reactor at Hanford was shut down in January 1987, and the power levels were turned down at the Savannah River Plant (SRP) reactors in March 1987. On 16 February 1988 the DOE announced that it would not restart the N Reactor, saying that plutonium requirements could be met through SRP and recycling the existing stockpile. By August all three reactors at SRP were shut down. Beginning in October the *New York Times* initiated a series of major, mostly front-page, articles which examined the complex in detail.[32] The impact of this was to focus a great deal of attention on two sorts of problem.

The first is the extensive radioactive and chemical pollution that has been generated by the manufacture of some 60 000 US nuclear weapons since the Manhattan Project in the 1940s. The scope of the contamination and the cost of cleaning it up are enormous. The estimates range up to $150 billion.[33] A report, known informally as the 2010 Report, delivered to the House and Senate Armed Services Committees in January 1989 recommends that $81 billion (in 1990 US dollars) be spent over the next 21 years to modernize the complex, and clean up some of the more contaminated sites.[34] Of that amount $52 billion would go to close, relocate and refurbish the complex while $29 billion would be for cleaning up the environment. The report proposes closing the Fernald and Rocky Flats Plants and building four reactors at the Idaho National Engineering Laboratory and one at Savannah River.

The second sort of problem stems from the incapacity of the current, potentially dangerous, complex to produce materials and components for new nuclear weapons. As Secretary of Energy Herrington stated, 'this country's ability to produce and maintain a nuclear weapons stockpile is in serious

jeopardy'.[35] Despite such a prognosis, the USA does not face a bout of unilateral disarmament because its tritium production has been halted. The DOE view is based on the assumption that there will be no changes in the plan to build many new nuclear weapons in the coming years, an assumption that is doubtful given the budgetary and arms control constraints that are already in effect. Through various actions and decisions, the USA could maintain its stockpile of nuclear weapons for several years without restarting tritium production at Savannah River.[36] This would provide enough time to re-assess US tritium production needs without racing to restart dangerous reactors.

III. Soviet nuclear weapon programmes

The modernization of Soviet strategic offensive forces during 1988 was steady, with no surprises except for the slow introduction of the new solid-fuel SS-24 and SS-25 mobile ICBMs. At the end of the year Soviet strategic forces comprised 1378 ICBMs with 6860 warheads, 926 SLBMs with 3602 warheads, and 170 bombers with 1100 warheads. Although the net number of launchers remained the same during the year (owing to equal deployments and retirements), the number of warheads increased by approximately 300. According to the US DOD, the Soviet Union spends about $20 billion annually on strategic offensive nuclear forces.[37]

Growth in strategic nuclear forces reflects continued MIRVing of the submarine missile force as well as expansion of bomber capabilities. 'By the 1990s', according to the US DOD publication *Soviet Military Power 1988*, 'assuming the continuation of the current modernization tempo, the Soviets will be in a position to field over 15,000 warheads.'[38] None the less, a number of systems are nearing the end of their production runs. 'The lower level of SLBM production since the early 1980s is due primarily to the production phase-out of older missiles and to the slower production of two new missiles [SS-N-20 and SS-N-23].'[39] In early 1988 the US DOD also reported that series production of fourth-generation Soviet ICBMs had ended.[40]

ICBMs

During 1988 the USSR deployed approximately 25 new road-mobile single-warhead SS-25s and some 15 additional 10-warhead SS-24s. The SS-25 Sickle, which joined operational Strategic Rocket Forces regiments in 1985,[41] increased to about 150 launchers during the year. The rail-mobile SS-24 Mod. 1 Scalpel, which began deployment in August 1987 near Arkhangelsk in the northern Soviet Union, has been much slower to emerge, with only 20 launchers (and 200 warheads) deployed at the end of the year.[42] According to some analysts, the missile is still in the 'shakedown phase' prior to Full Operational Capability. On 12 May an explosion in a Soviet factory in Pavlograd may have impaired the production of rocket motors for the SS-24. What may prove to be an improved SS-24 Mod. 2 is also reported to be in development.[43] During 1988 and in previous years, as new SS-24 and SS-25

missiles were deployed, the USSR retired SS-11, SS-17 and SS-19 ICBMs to keep within the SALT Treaty limits.

In addition to the SS-24 Mod. 2 missile, a modification of the SS-18 ICBM (SS-18 Mod. 5) with increased accuracy is reported to be under development. This new missile, labelled TT-09 during flight-testing (and once thought to be earmarked for designation as the SS-X-26), had its first successful flight-test in December 1986, after two failures.[44] Flight-testing continued during 1987–88, and 'preparations for deployment of this missile are already underway'.[45] A third new ICBM—possibly a MIRVed version of the SS-25—reported to be under development in early 1987, has not progressed.[46]

Strategic submarine programmes

Five Typhoon Class and four Delta IV Class ballistic missile submarines are estimated to be operational at the end of 1988, while the fifth unit of the Delta IV Class was launched in early 1988. One or two additional Typhoons are thought to be under construction. None of the Delta IV submarines has gone on patrol, but the system is considered by the USA to be operational.[47]

Table 1.1. US strategic nuclear forces, 1989

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)	Warhead × yield	Type	No. deployed
ICBMs						
Minuteman II	450	1966	11 300	1 × 1.2 Mt	W56	450
Minuteman III (Mk 12)	200	1970	13 000	3 × 170 kt	W62	600
Minuteman III (Mk 12A)	300	1979	13 000	3 × 335 kt	W78	900
MX	50	1986	11 000	10 × 300 kt	W87	500
Total	**1 000**					**2 450**
SLBMs						
Poseidon	224	1971	4 600	10 × 50 kt	W68	2 240
Trident I	384	1979	7 400	8 × 100 kt	W76	3 072
Total	**608**					**5 312**
Bombers[a]						
B-1B	97	1986	9 800	ALCM	W80-1	1 614
B–52G/H	193	1958/61	16 000	SRAM	W69	1 140
FB-111A	59	1969	4 700	Bombs	[b]	2 484
Total	**349**					**5 238**
Refuelling aircraft						
KC-135	615	1957	. .	. .	. .	. .

[a] Bombers are loaded in a variety of ways, depending on mission. B-1Bs and B-52s can carry a mix of 8-24 weapons, and FB-111s can carry 6 weapons, excluding ALCMs and B53 and B28 bombs.

[b] Bomber weapons include six different nuclear bomb designs (B83, B61-0, -1, -7, B57, B53, B43, B28) with yields from sub-kt to 9 Mt, ALCMs with selectable yields from 5 to 150 kt, and SRAMs with a yield of 170 kt.

Sources: Cochran, T. B., Arkin, W. M. and Norris, R. S., *Nuclear Weapons Databook, Volume 1: US Forces and Capabilities*, 2nd edn (Ballinger: Cambridge, Mass., 1989); Joint Chiefs of Staff, *United States Military Posture for FY 1989*; authors' estimates.

Table 1.2. US theatre nuclear forces, 1989

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)	Warhead × yield	Type	No. in stockpile
Land-based systems:						
Aircraft[a]	2 250	. .	1 060–2 400	1–3 × bombs	Bombs[a]	1 800
Missiles						
Pershing II	111	1983	1 790	1 × 0.3–80 kt	W85	125[b]
GLCM	250	1983	2 500	1 × 0.2–150 kt	W84	325[b]
Pershing 1A	72	1962	740	1 × 60–400 kt	W50	100[c]
Lance	100	1972	125	1 × 1–100 kt	W70	1 282
Nike Hercules	27	1958	160	1 × 1–20 kt	W31	75[c]
Other systems						
Artillery[d]	3 850	1956	30	1 × 0.1–12 kt	[d]	1 540
ADM (special)	150	1964	. .	1 × 0.01–1 kt	W54	150
Naval systems:						
Carrier aircraft[e]	1 100	. .	550–1 800	1–2 × bombs	Bombs[e]	1 450
Land-attack SLCMs						
Tomahawk	200	1984	2 500	1 × 5–150 kt	W80-0	200
ASW systems						
ASROC	. .	1961	1–10	1 × 5–10 kt	W44	574
SUBROC	. .	1965	60	1 × 5–10 kt	W55	285
ASW aircraft[f]	710	. .	1 160–3 800	1 × <20 kt	B57	897
Naval SAMs						
Terrier	. .	1956	35	1 × 1 kt	W45	290

[a] Aircraft include US Air Force F-4D/E, F-16A/B/C/D and F-111A/D/E/F. Bombs include four types (B28, B43, B57, B61) with yields from sub-kt to 1.45 Mt.

[b] Warheads will likely be placed in inactive reserve in the US stockpile.

[c] Missiles are deployed with non-US NATO forces. Warheads are in US custody.

[d] There are two types of nuclear artillery (155-mm and 203-mm) with four different warheads: a 0.1-kt W48, 155-mm shell; a 1- to 12-kt W33, 203-mm shell; a 0.8-kt W79-1, enhanced-radiation, 203-mm shell; and a variable-yield (up to 1.1 kt) W79-0 fission warhead. The enhanced-radiation warheads will be converted to standard fission weapons.

[e] Aircraft include Navy A-6E, A-7E, F/A-18A/B and Marine Corps A-4M, A-6E and AV-8B. Bombs include three types with yields from 20 kt to 1 Mt.

[f] Aircraft include US Navy P-3A/B/C, S-3A/B and SH-3D/H helicopters. Some US B57 nuclear depth bombs are allocated to British Nimrod, Italian Atlantic and Netherlands P-3 aircraft.

Sources: Cochran, T. B., Arkin, W. M. and Norris, R. S., *Nuclear Weapons Databook, Volume 1: US Forces and Capabilities*, 2nd edn (Ballinger: Cambridge, Mass., 1989); Joint Chiefs of Staff, *United States Military Posture for FY 1989*; authors' estimates.

The US DOD reported that two new Soviet SLBMs were under development and predicted that they 'should be well into developmental flight testing before 1990'.[48] A modified version of the SS-N-20 missile 'may begin at-sea flight testing' in 1988, and a 'modified version of the SS-N-23 missile will probably complete testing in 1988'.[49] There has been no additional information during 1988 about a new class of ballistic missile submarine which was reported in 1987 to be under construction.[50]

Table 1.3. US nuclear warheads in Europe, 1965–92

Type	May 1965	Dec. 1981	Dec. 1988	After INF (1992)[a]
Artillery				
8-inch	975	938	738	240
155-mm	0	732	732	750
Tactical SSMs				
Lance	0	692	692	692
Pershing 1A	200	293	100	0
Pershing II	0	0	90	0
Honest John	1 900	198	0	0
Sergeant	300	0	0	0
Nike Hercules SAMs	990	686	75	0
Bombs	1 240	1 729	1 400	1 400
B57 NDB	–	192	192	192
ADMs	340	372	0	0
GLCMs	0	0	256	0
Total	**5 945**	**5 832**	**4 318**	**3 274**

[a] TASM/SRAM-T and FOTL are planned for deployment in the mid-1990s.

Source: Authors' estimates.

Retirement of Yankee Class submarines continues, with one submarine retired in 1987 and one retired in 1988. This brings the Yankee deployment level down to eight submarines each in the Northern and Pacific Fleets.[51] The US Navy reported in March that Yankee Class submarine patrols off the US coasts had ceased in late 1987, but intermittent patrols in the central Atlantic resumed in June 1988.[52] Although some have speculated that the shift in patrols was to compensate for SS-20 missiles eliminated by the INF Treaty, the US Navy stated in June that the patrol reduction could be attributed primarily to 'deployment patterns as units of that class, and their older missile systems, reach the end of their active operational lives'.[53]

Strategic bomber programmes

The Soviet intercontinental bomber force continues to improve and may play a more central role in the strategic force structure. Three bomber types were in production in 1988: Bear G (a modification of older Bear B/C aircraft), Bear H and Blackjack.

Older Bear B/C bombers continue to be modified to the Bear G model to carry the dual-capable, supersonic AS-4 Kitchen air-to-surface missile (ASM) rather than the nuclear-only AS-3 Kangaroo subsonic ASM. About 45 Bear Gs were operational at the end of 1988. The Bear G bombers, curiously enough, have also been reassigned to a theatre and maritime role, rather than continuing a strategic intercontinental bomber role. The bombers are assigned to the Irkutsk Air Army, which includes 25 Bear B/Cs and about 45 Bear Gs.[54]

Table 1.4. Soviet strategic nuclear forces, 1989

Weapon system					Warheads	
Type	NATO code-name	No. deployed	Year deployed	Range (km)	Warhead × yield	No. deployed
ICBMs						
SS-11 Mod. 2	Sego	160	1973	13 000	1 × 1.1 Mt	160
Mod. 3		210	1973	10 600	3 × 350 kt (MRV)	630[a]
SS-13 Mod. 2	Savage	60	1973	9 400	1 × 750 kt	60
SS-17 Mod. 2	Spanker	120	1979	10 000	4 × 750 kt (MIRV)	480
SS-18 Mod. 4	Satan	308	1979	11 000	10 × 550 kt (MIRV)	3 080
SS-19 Mod. 3	Stiletto	350	1979	10 000	6 × 550 kt (MIRV)	2 100
SS-24	Scalpel	20	1987	10 000	10 × 550 kt (MIRV)	200
SS-25	Sickle	150	1985	10 500	1 × 550 kt	150
Total		**1 378**				**6 860**
SLBMs						
SS-N-6 Mod. 3	Serb	240	1973	3 000	2 × 1 Mt (MRV)	480[a]
SS-N-8 Mod. 1/2	Sawfly	286	1973	7 800	1 × 1.5 Mt	286
SS-N-17	Snipe	12	1977	3 900	1 × 1 Mt	12
SS-N-18 Mod. 1/3	Stingray	224	1978	6 500	7 × 500 kt	1 568
Mod. 2			1978	8 000	1 × 1 Mt	
SS-N-20	Sturgeon	100	1983	8 300	10 × 200 kt	1 000
SS-N-23	Skiff	64	1986	7 240	4 × 100 kt	256
Total		**926**				**3 602**
Bombers						
Tu-95	Bear A	15	1956	8 300	2 bombs	30
Tu-95	Bear B/C	25	1962	8 300	4 bombs or 1 AS-3	100
Tu-95	Bear G	45	1984	8 300	4 bombs and 2 AS-4	270
Tu-95	Bear H	75	1984	8 300	8 AS-15 ALCMs or bombs	600
Tu-160	Blackjack	10	1988	. .	6 AS-15 ALCMs and 4 bombs	100
Total		**170**				**1 100**
Refuelling aircraft	. .	140–170	. .	. .	. .	. .
ABMs						
ABM-1B	Galosh Mod.	32	1986	320	1 × unknown	32
ABM-3	Gazelle	68	1985	70	1 × low yield	68
Total		**100**				**100**

[a] SS-11 and SS-N-6 MRV warheads are counted individually.

Sources: Authors' estimates derived from: Cochran, T. B., Arkin, W. M., Norris, R. S. and Sands, J. I., *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons* (Ballinger: Cambridge, Mass., 1989); US Department of Defense, *Soviet Military Power*, 1st, 2nd, 3rd, 4th, 5th, 6th, 7th edns; NATO, *NATO–Warsaw Pact Force Comparisons*, 1st, 2nd edns; Berman, R. P. and Baker, J. C., *Soviet Strategic Forces: Requirements and Responses* (Brookings Institution: Washington, DC, 1982); US Defense Intelligence Agency, *Unclassified Communist Naval Orders of Battle*, DDB-1200-124-85, Dec. 1985; Congressional Budget Office, *Trident II Missiles: Capability, Costs, and Alternatives*, July 1986; Collins, J. M. and Victory, B. C., *U.S./Soviet Military Balance*, Library of Congress/Congressional Research Service, Report No. 88–425–S, 15 Apr. 1988; Background briefing on DOD, *SMP 1986*, 24 Mar. 1986; SASC/SAC, *Soviet Strategic Force Developments, Senate Hearing 99–335*, June 1985; Polmar, N., *Guide to the Soviet Navy*, 4th edn (US Naval Institute: Annapolis, Md., 1986).

Table 1.5. Soviet theatre nuclear forces, 1989

Weapon system					Warheads	
Type	NATO code-name	No. deployed[a]	Year first deployed	Range[b] (km)	Warhead × yield	No. deployed[a]
Land-based systems:						
Aircraft						
Tu-26	Backfire A/B/C	180	1974	4 000	1–3 × bombs or ASMs	360
Tu-16	Badger A/G	250	1954	3 100	1–2 × bombs or ASMs	250
Tu-22	Blinder A/B	120	1962	6 500	1–2 × bombs or 1 ASM	120
Tactical aircraft[c]		4 050	. .	700–1 300	1–2 × bombs	3 230
Missiles						
SS-20	Saber	405	1977	5 000	3 × 250 kt	1 215
SS-4	Sandal	65	1959	2 000	1 × 1 Mt	65
SS-12	Scaleboard	135	1969/78	900	1 × 500 kt	405
SS-1c	Scud B	620	1965	280	1 × 1–10 kt	1 370
SS-23	Spider	239	1985	500	1 × 100 kt	90
. .	FROG 7	370	1965	70	1 × 1–25 kt	200
SS-21[d]	Scarab	130	1978	120	1 × 10–100 kt	1 100
SSC-1b	Sepal	100	1962	450	1 × 50–200 kt	100
SAMs[e]	. .	7 000	1954–80	40–300	1 × low kt	4 000
Other systems						
Artillery[f]	. .	6 760	1973–80	10–30	1 × low kt	2 000
ADMs	. .	?	?	?	?	?
Naval systems:						
Ballistic missiles						
SS-N-5	Sark	36	1963	1 400	1 × 1 Mt	36
Aircraft						
Tu-26	Backfire A/B/C	140	1974	4 000	1–3 × bombs or ASMs	280
Tu-16	Badger A/C/G	170	1955	3 100	1–2 × bombs or ASMs	170
Tu-22	Blinder A	30	1962	6 500	1 × bombs	30
ASW aircraft[g]	. .	375	1966–82	. .	1 × depth bombs	400
Anti-ship cruise missiles[h]						
SS-N-3 b/a,c	Shaddock/Sepal	228	1960	450	1 × 350 kt	120
SS-N-7	Starbright	90	1968	65	1 × 200 kt	44
SS-N-9	Siren	208	1969	280	1 × 200 kt	78
SS-N-12	Sandbox	200	1976	550	1 × 350 kt	76
SS-N-19	Shipwreck	136	1980	550	1 × 500 kt	56
SS-N-22	Sunburn	80	1981	100	1 × 200 kt	24
Land-attack cruise missiles						
SS-N-21	Sampson	4	1987	3 000	1 × 200 kt	16
SS-NX-24	?	0	1989?	<3 000	1 × n.a.	0
ASW missiles and torpedoes						
SS-N-15	Starfish	400	1973	37	1 × 10 kt	400
SS-N-16	Stallion		1979	120	1 × 10 kt	
FRAS-1	. .	25	1967	30	1 × 5 kt	25
Torpedoes[i]	Type 65	575	1965	16	1 × low kt	575
	ET-80		1980	>16	1 × low kt	
Naval SAMs						
SA-N-1	Goa	65	1961	22	1 × 10 kt	260
SA-N-3	Goblet	43	1967	37	1 × 10 kt	
SA-N-6	Grumble	33	1981	65	1 × 10 kt	

[a] For missile systems, the number is for operational or deployed missiles on launchers (see the Memorandum of Understanding of the INF Treaty, in *SIPRI Yearbook 1988*, appendix 13B).

[b] Range for aircraft indicates combat radius, without refuelling.

[c] Nuclear-capable tactical aircraft models include MiG-21 bis Fishbed L, MiG-23 Flogger B/G, MiG-27 Flogger D/J, Su-7B Fitter A, Su-17 Fitter C/D/H, and Su-24 Fencer A/B/C/D/E.

[d] Includes SS-21s in GDR and Czechoslovakian units.

[e] Nuclear-capable land-based surface-to-air missiles probably include SA-1 Guild, SA-2 Guideline, SA-5 Gammon and SA-10 Grumble.

[f] Nuclear-capable artillery include systems of the three calibres: 152-mm (D-20, M-1976, 2S3 and 2S5), 203-mm (M55, 2S7 and M-1980) and 240-mm (2S4 and M-240). Some older systems may also be nuclear-capable.

[g] Includes 95 Be-12 Mail, 45 Il-38 May and 60 Tu-142 Bear F patrol aircraft. Land- and sea-based helicopters include 115 Ka-25 Hormone and 60 Ka-27 Helix models.

[h] Based on an average of 2 nuclear-armed cruise missiles per nuclear-capable surface ship, except for 4 per Kiev and Kirov Class submarine, and 4 per nuclear-capable cruise missile submarine, except for 12 on the Oscar Class.

[i] The two types of torpedo are the older and newer models, respectively, with the ET-80 probably replacing the Type 65.

Sources: Cochran, T. B., Arkin, W. M., Norris, R. S. and Sands, J. I., *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons* (Ballinger: Cambridge, Mass., 1989); Polmar, N., *Guide to the Soviet Navy*, 4th edn (US Naval Institute: Annapolis, Md., 1986); Department of Defense, *Soviet Military Power*, 1st, 2nd, 3rd, 4th, 5th, 6th, 7th edns; NATO, *NATO–Warsaw Pact Force Comparisons*, 1st, 2nd edns; Joint Chiefs of Staff, *United States Military Posture for FY 1989*; interviews with US DOD officials, Apr. and Oct. 1986; 'More self-propelled gun designations', *Jane's Defence Weekly*, 7 June 1986, p. 1003; Handler, J. and Arkin, W. M., *Nuclear Warships and Naval Nuclear Weapons: A Complete Inventory*, Neptune Paper no. 2 (Greenpeace/Institute for Policy Studies: Washington, DC, 1988).

The new production variant of the Bear bomber, the Tu-95 Bear H, has been deployed since late 1984, and 75 were deployed at the end of 1988. The Bear H, based at Dolon in Central Asia, is air-refuellable and carries the 1600-nautical mile (3000-km) range AS-15 Kent ALCM in internal bomb-bays. Production of the Bear H will probably be phased out in 1989–90. Routine intercontinental training missions and long-range anti-shipping operations by Bear G and Bear H bombers continued in 1988.[55] A new long-range aerial refuelling tanker, the Il-76 Midas, became operational in 1987, and may be used to increase the range of strategic bomber missions.

The Blackjack A supersonic bomber was declared operational in mid-1988, after about a decade in development, and some three years behind the schedule anticipated by the USA. In an important move as part of *glasnost* and improved US–Soviet relations, Secretary of Defense Carlucci and other US officials inspected a Blackjack bomber on 2 August during their visit to Kubinka Air Base, 40 miles (64 km) west of Moscow.[56]

The Blackjack seems capable of carrying up to 6 AS-15 ALCMs and 4 bombs in two internal bomb-bays, and may eventually carry the AS-X-16 short-range attack missile (SRAM) or AS-X-19 supersonic ALCMs under development. The bomber inspected by Secretary Carlucci was equipped with six ALCMs in the forward bomb-bay; the aircraft is currently believed to be equipped with a combination of six ALCMs and four bombs.[57] According to *Soviet Military Power 1988*, 'Blackjack can cruise subsonically over long ranges, perform high-altitude supersonic dash, and attack utilizing low-altitude, high subsonic

Table 1.6. British nuclear forces, 1989[a]

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)[b]	Warhead × yield	Type	No. in stockpile
Aircraft						
Tornado GR-1	220[c]	1982	1 300	1–2 × 400/200 kt bombs[e]	WE-177A/B	155–175[f]
Buccaneer S2B	25[d]	1962	1 700	1 × 400/200 kt bomb	WE-177A/B	
SLBMs						
Polaris A3-TK	64	1982[g]	4 700	2 × 40 kt	MRV	128
Carrier-based aircraft						
Sea Harrier FRS.1[h]	42	1980	450	1 × 10 kt bomb	WE-177C	
ASW helicopters						
Sea King HAS 5	56	1976	–	1 × 10 kt depth bomb	WE-177C	25[i]
Lynx HAS 2/3	78	1976	–	1 × 10 kt depth bomb	WE-177C	

[a] British systems certified to use US nuclear weapons include 31 Nimrod ASW aircraft based in the UK, and 20 Lance launchers (1 regiment of 12 launchers, plus spares) and 135 artillery guns in 5 regiments (120 M109 and 15 M110 howitzers) based in FR Germany.

[b] Range for aircraft indicates combat radius, without refuelling.

[c] Some formerly nuclear-armed Buccaneer and Jaguar aircraft, withdrawn from bases in FR Germany and replaced by Tornado GR-1, may still be assigned nuclear roles in the UK.

[d] Plus 18 in reserve and 9 undergoing conversion, probably the remainder from FR Germany.

[e] The US Defense Intelligence Agency (DIA) has confirmed that the RAF Tornados 'use two types of nuclear weapons, however, exact types are unknown'. The DIA further concludes that each RAF Tornado is capable of carrying two nuclear bombs, on the two outboard fuselage stations.

[f] The total stockpile of WE-177 tactical nuclear gravity bombs is about 180–200, of which 155–75 are versions A and B. All three weapons use the same basic 'physics package', and the yield is varied by using different amounts of tritium.

[g] The Polaris A3-TK (Chevaline) was first deployed in 1982 and has now completely replaced the original Polaris A-3 missile (which was first deployed in 1968).

[h] The US DIA has concluded that the Sea Harrier is not nuclear-capable, even though every British Defence White Paper since 1981 states that it is.

[i] The C version of the WE-177 bomb is believed to be assigned to selected Royal Navy (RN) Sea Harrier FRS.1 aircraft and ASW helicopters. The WE-177C exists in both a free-fall and depth bomb modification, by varying the fuzing and casing options. There are an estimated 25 WE-177Cs, each with a yield of approximately 10 kt (possible variable yield).

Sources: British Ministry of Defence, *Statement on the Defence Estimates*, 1980–88 (Her Majesty's Stationery Office: London, annual); Campbell, D., 'Too few bombs to go round', *New Statesman*, 29 Nov. 1985, pp. 10–12; US Defense Intelligence Agency, *Ground Order of Battle: United Kingdom*, DDB-1100-UK-85 (secret, partially declassified), Oct. 1985; Nott, J., 'Decisions to modernise U.K.'s nuclear contribution to NATO strengthen deterrence', *NATO Review*, vol. 29, no. 2 (Apr. 1981); International Institute for Strategic Studies, *The Military Balance 1988–89* (IISS: London, 1988); US Defense Intelligence Agency, various reports released under the Freedom of Information Act; Urban, M., *The Independent*: including Urban, M., 'Outdated nuclear bomb's credibility in question', *The Independent*, 16 May 1988, p. 5; Urban, M., 'Clarification', *The Independent*, 17 May 1988; authors' estimates.

penetration maneuvers'.[58] According to one naval intelligence specialist, the bomber may also have a maritime role.[59]

According to the US DOD, 'The Soviets are developing reduced-signature technologies and may be testing these technologies in aircraft and other military systems. They may soon begin limited operational deployment of some

Table 1.7. French nuclear forces, 1989

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)[a]	Warhead × yield	Type	No. in stockpile
Aircraft						
Mirage IVP/ASMP[b]	18	1986	1 500	1 × 300 kt	TN-80	20
Mirage 2000N/ASMP	15	1988	1 570	1 × 300 kt	TN-81	15
Jaguar A[c]	45	1974[d]	750	1 × 6–8/30 kt bomb	AN-52[e]	50
Mirage IIIE[c]	15	1972[d]	600	1 × 6–8/30 kt bomb	AN-52[e]	35
Refuelling aircraft						
C-1325F/FR	11	1965	. .	. .	. .	. .
Land-based missiles						
S3D[e]	18	1980	3 500	1 × 1 Mt	TN-61	18
Pluton	44	1974	120	1 × 10/25 kt	AN-51[f]	70
Submarine-based missiles						
M-20	64	1977	3 000	1 × 1 Mt	TN-61	64
M-4A	16	1985	4 000–5 000	6 × 150 kt (MIRV)	TN-70[g]	96
M-4B[g]	16	1987	6 000	6 × 150 kt (MIRV)	TN-71	96
Carrier-based aircraft						
Super Etendard	36	1978	650	1 × 6–8/30 kt bomb	AN-52[e]	40

[a] Range for aircraft indicates combat radius, without refuelling, and does not include the 100- to 300-km range of the ASMP air-to-surface missile (where applicable).

[b] On 1 July 1988, the last Mirage IVA bomber squadron was disbanded, the EB 2/94 'Marne' at Saint-Dizier. This left just two bomber squadrons operating the Mirage IVP aircraft, the EB 1/91 at Mont de Marsan and EB 2/91 at Cazaux. These Mirage IVPs are armed with the ASMP missile and will remain in service until 1996, when they will be disbanded.

[c] The Mirage IIIE and Jaguar A aircraft were first deployed in 1964 and 1973, respectively, although they did not carry nuclear weapons until 1972 and 1974, respectively.

[d] S3D ('Durcie') is the designation for the hardened S3 missile. The original S3 missile was deployed in 1980.

[e] Gravity bombs for these aircraft include: the AN-52 warhead (incorporating the same basic MR 50 charge as that used for the Pluton SSM), reported to have 25- and 30-kt yields by CEA and DIA, respectively; and an alternate low-yield (6–8 kt) gravity bomb.

[f] Warheads for the Pluton include the AN-51 (incorporating the same basic MR 50 charge as the AN-52) with a yield of 25 kt, and a specially designed alternate warhead of 10 kt.

[g] The *Inflexible* will be the only SSBN to receive the TN-70. All subsequent refits of the M-4 into Redoutable Class SSBNs will incorporate the improved TN-71 warhead. The M-4As of the *Inflexible* will eventually also be changed to hold the TN-71, dockyard space and budgets permitting.

Sources: Commissariat à l'énergie atomique (CEA), 'Informations non classifiées sur l'armement nucléaire français', 26 June 1986; CEA, 'Regard sur l'avenir du CEA', *Notes d'Information*, Jan.–Feb. 1986, p. 7; CEA, *Rapport Annuel 1987*, pp. 77–79; US Defense Intelligence Agency (DIA), *A Guide to Foreign Tactical Nuclear Weapon Systems under the Control of Ground Force Commanders*, DST-1040S-541-83, 9 Sep. 1983, with CHG 1 and 2 (secret, partially declassified), 17 Aug. 1984 and 9 Aug. 1985; 'Dissolution', *Air Actualitées*, no. 407, Feb. 1988, p. 8; *Rapport fait au nom de la Commission des Finances, de l'Économie Générale et du Plan sur le projet de loi de finances pour 1988 (no. 941)* (Assemblée Nationale: Paris, 9 Nov. 1987), Report no. 960, Annex 39: Défense Title V et VI, p. 18; *Jane's Fighting Ships*, 1988–89, p. 166; authors' estimates.

"stealth" technologies. The Soviets are believed to have built several test facilities to support their research and development activities'.[60] There was also one report during 1988 that the USSR might develop a long-range supersonic

Table 1.8. Chinese nuclear forces, 1989

Weapon system				Warheads	
Type	No. deployed	Year deployed	Range (km)	Warhead × yield	No. in stockpile
Aircraft[a]					
B-5 (Il-28 Beagle)	15–30	1974	1 850	1 × bomb[b]	15–30
B-6 (Tu-16 Badger)	100	1966	5 900	1–3 × bombs	100–130
Land-based missiles					
DF-2 (CSS-1)	30–50	1966	1 450	1 × 20 kt	30–50
DF-3 (CSS-2)	75–100	1970	2 600	1 × 1–3 Mt	75–100
DF-4 (CSS-3)	~10	1971	4 800–7 000	1 × 1–3 Mt	10
DF-5 (CSS-4)	~10	1979	13 000	1 × 4–5 Mt	10
Submarine-based missiles[c]					
JL-1 (CSS-N-3)	24	1983	3 300	1 × 200 kt–1 Mt	26–38

[a] All figures for these bomber aircraft refer to nuclear-capable versions only. Hundreds of these aircraft are also deployed in non-nuclear versions.

[b] Yields of bombs are estimated to range from below 20 kt to 3 Mt.

[c] Two missiles are presumed to be available for rapid deployment on the Golf Class submarine (SSB). Additional missiles are being built for new Xia Class submarines.

Sources: Joint Chiefs of Staff, *Military Posture (annual report) FY 1978, 1982, 1983*; Department of Defense, *Annual Report for 1982*; Defense Intelligence Agency, *Handbook on the Chinese People's Liberation Army*, DDB-2680-32-84, Nov. 1984; Defence Intelligence Agency, 'A guide to foreign tactical nuclear weapon systems under the control of ground force commanders', DST-1040S-541-83-CHG 1 (secret, partially declassified), 17 Aug. 1984; US Congress, Joint Economic Committee, *Allocation of Resources in the Soviet Union and China* (annual hearing) 1976, 1981, 1982, 1983; Anderson, J., 'China shows confidence in its missiles', *Washington Post*, 19 Dec. 1984, p. F11; Lewis, J. W. and Xue, L., *China Builds the Bomb* (Stanford University Press: Stanford, Calif., 1988); Jencks, H. W., 'PRC nuclear and space programs', in ed. R. Yang, *SCPS Yearbook on PLA Affairs, 1987* (Sun Yat-sen Center for Policy Studies: Kaohsiung, Taiwan, 1988), chapter 8; authors' estimates.

cruise missile platform derived from the Tu-144 transport that could carry either the AS-15 or the AS-X-19.[61]

Strategic defence developments

The anti-ballistic missile (ABM) system around Moscow has now been upgraded from 64 old, reloadable, above-ground Galosh launchers, into a two-layer system that includes 100 improved silo-based Galosh exo-atmospheric missiles and new silo-based Gazelle high-acceleration endo-atmospheric missiles, plus a modernized array of early-warning, acquisition and battle-management radars.[62] Modernization of modified and new missiles, with hardened silos, should be completed around 1989.[63]

New nuclear-capable surface-to-air missile (SAM) forces continued to be deployed. The SA-10 Grumble, first introduced in 1980, continued in production and was deployed both around Moscow and in the Far East,

replacing the SA-1, SA-2 and SA-3 SAMs. The SA-X-12B Giant mobile SAM continued in testing but was still not deployed. According to the US DOD, both the SA-10 and the SA-X-12B have some capability against cruise and ballistic missiles.[64]

Cruise missile programmes

During 1988, there was a significant downgrading and shift in the Soviet long-range cruise missile programme.[65] First, two ground-launched missiles under development, the subsonic SSC-X-4 and the supersonic SSC-X-5, were banned by the INF Treaty, and their development was halted.[66] This will undoubtedly affect the cost of their air- and sea-launched counterparts, the AS-15 Kent and SS-N-21 Sampson, respectively, which are deployed and continued in production during 1988. Fewer than 100 SS-N-21s and 660 AS-15s are estimated to have been deployed by the end of 1988. Two additional missiles, the sea-launched SS-NX-24 and the air-launched AS-X-19, continued under development. They are the supersonic counterparts to the SSC-X-5

The SS-N-21 Sampson, with a maximum range of 1600 nautical miles (2960 km), is capable of being launched from Akula, Sierra, Victor III and converted Yankee Notch Class attack submarines, and is believed to be operational in all but the Victor III.[67] The Yankee Notch Class submarine, a conversion from a former Yankee I Class ballistic missile submarine, was deployed in 1988. The larger supersonic SS-NX-24 will be flight-tested from another converted Yankee Class submarine (designated a cruise missile submarine, SSGN, rather than an attack submarine). The missile is 'expected to be operational in the next few years'.[68] The air-launched counterpart of the SS-NX-24, the AS-X-19 ALCM, continues under development for eventual deployment on the Blackjack, and possibly the Bear H. A new short-range attack missile for attacking terminal defences, and designated AS-X-16 by the West, is also in the early stages of development.

Soviet deployment of shorter-range cruise and anti-ship missiles continued at a steady rate during 1988. New naval platforms armed with the newer 550-km range SS-N-12 Sandbox, the 550-km range SS-N-19 Shipwreck and the 100-km range SS-N-22 Sunburn SLCMs were deployed during the year. These included Kirov and Slava Class cruisers, Udaloy and Sovremennyy Class destroyers, and the Oscar I Class cruise missile submarine. There were numerous reports during the year of a new nuclear-capable short-range tactical air-to-surface missile assigned to fighter aircraft, particularly the Su-24 Fencer. Although little information is available, the weapon may be either the AS-11 Kilter anti-radiation missile or the AS-14 Kedge.[69]

Non-strategic nuclear forces

During the year the Soviet Union destroyed 525 missiles of four types, approximately 28 per cent of the 1846 total planned for elimination under the INF Treaty. Specifically, these included: 102 SS-20 Sabers (of 654), 304 SS-12M

Scaleboards (of 718), 39 SS-4 Sandals (of 149) and all 80 SSC-X-4 ground-launched cruise missiles. No SS-5 or SS-23 missiles were destroyed.

The elimination of the SS-20, SS-4, SS-12, SS-23 Spider and SS-20 follow-on missiles under the INF Treaty will have a significant impact on the structure of Soviet non-strategic nuclear forces. The 23-year-old SS-1c Scud missile, currently assigned to Army formations, will take on a more important role as 'the ground force's primary nuclear fire support means'.[70] Over 600 Scud launchers are deployed.[71] The Scud missile will be augmented by the newer SS-21 Scarab, which began replacing FROG missiles in Soviet divisions in 1978, but has been deployed in far fewer numbers than the 660 FROG launchers. In 1988, a total of about 140 SS-21 launchers were deployed, an increase of only 10 over the number deployed in 1987.[72] While initially the SS-21 was being deployed in Soviet divisions in the German Democratic Republic and Czechoslovakia to replace the FROG, the latest indications are that 'division-level SS-21 battalions are being consolidated into brigades in Soviet armies in [the GDR]'.[73] The SS-21 will therefore probably replace the Scud in the forward area. Over the long term, however, both the FROG and the Scud will probably have to be retired, as they are reaching obsolescence and will be 25 years old in 1990.

During 1988, the US DOD reported an increased number of refire missiles deployed in Eastern Europe by Soviet ground forces for their short-range missiles not constrained by the INF Treaty.

> The refires for these launchers are estimated to have been increased by between 50 and 100 percent over the past several years. Consequently, the Pact has been able to plan on using these missiles, armed with non-nuclear warheads, to strike NATO air defenses, airfields, and command-and-control nodes without sacrificing their ability to plan on using the same missiles, if needed, in theater nuclear strikes.[75]

Other systems may not be ideal to compensate for reductions under the INF Treaty. Long-range sea-launched cruise missiles have not yet been deployed in large enough numbers to indicate clearly whether they will have a future theatre strike role. Although there have been shifts in Yankee Class ballistic missile submarine patrols (see above), indications are that the Yankee continues to be retired as it has reached technological obsolescence. One of 12 Golf II Class ballistic-missile submarines assigned to regional missions was retired in 1987, and indications are that the remainder will be denuclearized and retired within a few years.[75] Soviet land-based ICBMs could be called upon for theatre missions. In fact, *Soviet Military Power 1988* points out that the SS-17 and SS-19 ICBMs are 'capable of flexible targeting: they can hit Eurasian as well as transoceanic targets'.[76] This, of course, has been the case for some 10 years.

The USSR continues to build about 30 Backfire C medium-range bombers per year and assign them to the Strategic Air Armies (SAA) and Soviet Naval Aviation (SNA). Some 320 Backfires are deployed, and the aircraft continue to replace Badger bombers in the Smolensk and Irkutsk Air Armies and SNA.[77] Most if not all of the Badger bombers will probably be replaced by Backfire bombers in the 1990s.[78] The number of more capable Backfires will be lower

than for the Badger, and individual Backfire regiments will be smaller than Badger regiments.

The Su-24 Fencer, the Soviet equivalent to the US F-111 fighter-bomber, also continues in production. At the end of 1988, some 850 Fencers had been deployed, assigned to the Legnica and Vinnitsa Air Armies and the Air Forces of the Military Districts/Groups of Forces.[79] Fencer E reconnaissance fighter-bombers have also been assigned to SNA since 1985.

Besides Backfire and Fencer, the emphasis in aircraft production continues to be non-nuclear fighter interceptors, with look-down, shoot-down capability and improved avionics and armaments systems: principally the MiG-29 Fulcrum A, MiG-31 Foxhound A and Su-27 Flanker B. The number of nuclear-capable fighter-bombers increased from 2100 in 1981 to 2900 in 1988, mostly Fencers, but also including some Fitters and Floggers.[80] Production of the Flogger ended in the mid-1980s, and production of the Fitter was 'cut drastically over the past several years'.[81] The single-seat, twin-engine MiG-29 Fulcrum air-superiority fighter, first deployed in 1984 and similar to the US F-16 and F/A-18, may have a nuclear capability. Regiments have been activated in the GDR and Hungary.

Continued Soviet deployment of heavy, longer-range self-propelled artillery, replacing towed artillery and mortar systems, together with conversion of artillery battalions from six to eight batteries, is beginning to receive increased attention in the West.[82] Production of nuclear-capable self-propelled artillery, according to the DOD, is at 'an all-time high'.[83] Towed artillery systems have now been completely replaced with self-propelled 122-mm 2S1 and 152-mm 2S3 guns in tank and motorized rifle divisions in the Western Theatre of Military Operations (*Teatr Voennykh Deistvii*, TVD), and newer 152-mm 2S5, 203-mm 2S7 and 240-mm 2S4 self-propelled guns are replacing older towed models in Front and Army artillery divisions and 'high power' brigades.[84] Although much of this development is related to providing greater protection and mobility for artillery crews on the battlefield, the larger-calibre, longer-range guns are also believed to possess a vastly improved nuclear capability. There is no evidence, however, of any greater Soviet emphasis on nuclear fire-support. On the contrary, conventional artillery tactics and munitions are receiving increased attention.

Naval nuclear forces

Three different classes of nuclear-powered attack submarine (SSN) were in production in 1988—Akula, Sierra and Victor III—as well as Kilo Class diesel-powered submarines.[85] All of the new nuclear-powered submarines are capable of firing both nuclear anti-submarine warfare weapons and torpedoes, and the SS-N-21 SLCM. New production of submarines, however, has been offset numerically by retirement of a significant number of diesel-powered submarines during the 1980s.[86] The third Akula Class submarine was launched in 1988. However, the submarine is still not fully operational. The first Akula hull, launched in 1984, was still undergoing sea trials in early 1988.[87] The Sierra Class, a follow-on to the Victor III, is now in series production. A single

Yankee Class SSN, converted from a ballistic missile submarine in 1983, is operational; with its updated fire control and sonar systems, it can 'launch a wider variety of weapons'.[88]

The fourth and last of the Kiev Class aircraft-carriers, the *Baku*, was deployed in 1988. One notable change in the configuration of the ship is the absence of the SUW-N-1 launcher for the nuclear-armed FRAS-1 anti-ship/anti-submarine ballistic rocket. The *Baku*, which spent much of its first cruise at anchor north of Tunisia in the Mediterranean Sea, has a phased-array radar and an improved command and control suite which is much improved over the other ships of the Kiev Class.[89]

Preparation of the first Soviet large-deck aircraft-carrier continues. The *Tbilisi* (formerly designated *Leonid Brezhnev* and *Kremlin*) continues to be fitted out and is expected by the USA to commence sea trials in 1989. Owing to problems of integrating and perfecting the catapult and arresting-gear system for use by conventional take-off and landing (CTOL) aircraft, the carrier is now accepted in the West as being 'designed for ramp-assisted aircraft launch',[90] and will accommodate vertical/short take-off and landing (V/STOL) aircraft. The Su-27 Flanker fighter interceptor is considered the prime candidate for CTOL, while a follow-on Yak-41 V/STOL jet aircraft is currently under development.

Four nuclear-capable major surface combatant types continued in production in 1988: the Slava and Kirov Class cruisers, and the Udaloy and Sovremennyy Class destroyers. The Ka-27 Helix helicopters, also nuclear-capable, 'are rapidly replacing' the Ka-25 Hormone on board Soviet ships.[91]

One of two Soviet wing-in-ground-effect vehicles under development—a turbofan-powered, aircraft/hovercraft—the Utka Class, has been mentioned as a potential coastal defence nuclear-capable platform in the future.[92] The Utka Class may be capable of launching the SS-N-22 SLCM.

The Soviet military and *perestroika*

On 7 December 1988, President Gorbachev told the United Nations General Assembly that Soviet armed forces would be unilaterally cut by 500 000 soldiers and 10 000 tanks by 1991. In his speech, Gorbachev announced a number of specific and general changes, including: (*a*) removal of six tank divisions from the GDR, Czechoslovakia and Hungary, and the removal of 50 000 men and 5000 tanks from Eastern Europe; (*b*) removal of assault-landing and river-crossing troops and their equipment from Eastern Europe; (*c*) reduction of 5000 tanks in the western Soviet Union; (*d*) reduction of 8500 artillery guns; (*e*) reduction of 800 combat aircraft; (*f*) 'restructuring' of the remaining forces in Eastern Europe into a defensive posture; (*g*) removal of 'a major portion' of forces from Mongolia; and (*h*) conversion of two or three defence plants from military to civilian use in 1989.

Despite immediate scepticism expressed in the media that the cut-backs would involve relocation of troops rather than demobilization and that the destruction would only be of old military equipment, Maj. Gen. Yuri V. Lebedev, Deputy Chief of the General Staff Legal Directorate, stated that the divisions will be disbanded, and the military hardware, including 'the most

up-to-date tanks', and modern equipment would be destroyed.[93] General Vladimir Lobov, Deputy Chief of Staff of the General Staff, further stated on 14 December that one-fifth of the personnel cuts, amounting to 100 000 men, would be of professional officers, while the remainder would be conscripts.[94]

In terms of diminishing the short-warning threat to Central Europe, the withdrawal of six Category One divisions from Eastern Europe (2040 tanks), and the armoured inventory equivalent to some nine additional tank divisions (3000 tanks) is most significant. The withdrawal of virtually all of the tanks of 14 forward-based tank divisions, as well as assault bridging equipment, seems to confirm Gorbachev's stated intention to 'restructure' Soviet forces to emphasize a defensive rather than an offensive posture.

The new defence posture, and the unilateral cuts, follow the adoption of a new military doctrine by the Soviet Union. In his 27th Party Congress speech in February 1986, Gorbachev espoused a new concept of military 'reasonable sufficiency', a concept which has come to mean achieving 'parity at a lower level'.[95] The concept of reasonable sufficiency as a new military doctrine was formally unveiled at a meeting of the Warsaw Treaty Organization on 28–29 May 1987 in East Berlin.[96] The new doctrine was advanced as purely 'defensive', with forces to be maintained that are sufficient for defence to 'reliably repel' aggressors. While continuing to call for a 'counteroffensive' in the face of attack,[97] it includes a pledge not to be the first to use military force. During Marshal Akhromeyev's visit to the United States in 1988, he 'insisted that the new doctrine means the Soviet Union will initially remain on the defensive for about twenty days while trying to negotiate a peace. If that fails, Soviet forces will have to launch a "counteroffensive".'[98] The doctrine also identified no specific enemy and introduced a major new component—'a system of basic views on the prevention of war'—an aim not mentioned in previous doctrines and considered to belong to the sphere of foreign policy.[99]

The concept of a military doctrine has a strict and serious meaning in the Soviet Union,[100] yet the reaction of many Western Soviet observers and the US DOD has been one of great scepticism. In the DOD's *Soviet Military Power 1988*, for instance, it was stated that 'there is no reason to conclude that "reasonable sufficiency" represents a renunciation or even an alteration of the inherently offensive Soviet military strategy'.[101] Retired US Army General William E. Odom, former Director of the National Security Agency, wrote that 'Akhromeyev's concept of a defensive phase for a few weeks followed by counteroffensive is not a change of doctrine. It is a change of war plans.'[102] These views were not shared by another US analyst of the Soviet military, retired Maj. Gen. Edward B. Atkenson, the former National Intelligence Officer for general-purpose forces, who wrote:

> This is no casual event . . . We in the West, having no comparable unified theory underlying our strategic decisions, tend to be a bit cavalier in dismissing such changes as just more Marxist mumbo jumbo . . . [Soviet] military doctrine is the entire body of knowledge regarding the nature of war and the requirements of a state for the preparation of its people and armed forces . . . By no means could the paper adopted by

the Warsaw Pact PCC [Political Consultative Committee] be construed as a succinct statement of the entirety of the new doctrine; instead, it was a commentary on the doctrine.[103]

The newly announced troop cuts and force restructuring flow from the adoption of a new military doctrine that emphasizes defence and war prevention, but Gorbachev has taken a number of other important steps which are indicative of concrete changes in the Soviet military.[104] He has: (*a*) implemented an 18-month unilateral moratorium on nuclear weapon testing; (*b*) accepted the US 'zero option' INF proposal, made concessions on the exclusion of British and French nuclear forces, added Soviet shorter-range missiles to the INF Treaty, and agreed to significant assymetrical reductions and extensive on-site inspections; (*c*) agreed to make deep cuts in land-based long-range strategic nuclear missiles in concert with the United States; (*d*) agreed to and actually withdrew Soviet forces from Afghanistan; (*e*) presided over the opening of the national security policy debate to civilian scholars from think-tanks and non-governmental organizations; (*f*) made available a front-line MiG-29 Fulcrum fighter for observation and photography in Finland and at the Farnborough Air Show in the UK in September 1988; (*g*) opened Soviet bases to Western observers, including ABM installations around Moscow, an SS-11 missile silo, the Semipalatinsk nuclear test site, the Shikany chemical warfare centre and the Krasnoyarsk radar installation;[105] (*h*) opened Soviet bases to Western government inspectors, including Secretary of Defense Carlucci, who visited the Soviet Union on 1–3 August;[106] (*i*) succeeded in a major shake-up of Politburo members on 30 September 1988, including the retirement of President Andrei Gromyko, and the reorganization of the Central Committee from 22 Departments to six Commissions; (*j*) reduced naval deployments to the Caribbean, and arms deliveries to Nicaragua and Angola; and (*k*) reshuffled the Soviet military high command in July 1987 following the Cessna aircraft incident in Red Square, including the retirement of Defence Minister Sokolov.

In addition, Gorbachev has retired powerful military officers with their own followings, most notably Admiral Sergey Gorshkov, Commander-in-Chief of the Navy from 1956, and Marshal Nikolai Ogarkov, the former General Staff Chief, and Western Theatre Commander-in-Chief. In addition, there have been no promotions to the rank of Marshal since Gorbachev became the Soviet leader. Following the retirement of Marshal Sergey Akhromeyev as Chief of the General Staff, Gorbachev appointed a relatively junior officer, Col. Gen. Mikhail Moiseyev, to the position.[107] Gorbachev's greatest deed, in fact, has been reinforcing the subordination of the Soviet military to Party and civilian control, and forcing limits on defence spending and overall influence in Soviet society by the military establishment. These developments clearly show that the changes in the Soviet military are internal in nature and not designed primarily for external propaganda purposes, as some in the West have claimed.

IV. British nuclear weapon programmes

During 1988 Britain's two main nuclear weapon systems remained deployed, while plans continued for their replacements. In the mid-1990s the Polaris SLBM/Chevaline A3-TK warhead system is scheduled to be replaced by the Trident II submarine and missile system. In the late 1990s the WE-177 tactical nuclear gravity bomb is scheduled to be replaced by a nuclear air-to-surface missile. While there was much discussion during the year about co-operative defence projects with France, all of these British nuclear weapon systems are being developed with the assistance of the USA.

British–French nuclear co-operation

In an attempt to forge a more European identity in the defence and security field, Britain and France discussed a number of proposals for greater bilateral military co-operation. In 1987 and early 1988 there were discussions about a possible British–French co-operative effort to develop an air-to-surface nuclear missile, perhaps based on a future version of the existing French Air-Sol-Moyenne-Portée (ASMP) tactical ASM, called the Air-Sol-Longue-Portée (ASLP). These talks were hailed as a promising sign of a new era of defence co-operation in Western Europe.

At the Anglo-French summit meeting in London on 29 January 1988 a number of other proposals were discussed. Accords were reached permitting British troops to use French lines of transportation (ports, airports, railways and highways) during reinforcement exercises of the British Army of the Rhine,[108] and permitting French nuclear missile submarines to call at British ports.[109] However, progress was limited on two other matters to which the French attached particular importance. One concerned the co-ordination of nuclear targeting by the two nations' nuclear-powered ballistic-missile submarine (SSBN) fleets; the other, the joint development of the ASLP missile.

Since the January 1988 summit meeting, the UK has become increasingly ambivalent towards the idea of co-operating with France on the development of the ASLP missile. Although a final decision by the UK will not be made until 1989, some sources claim that the proposed joint project is all but dead.[110] Officials in both countries have balked at the cost and complexity of modifying the ASMP to meet the British Royal Air Force (RAF) requirements of increased range (500 km) and accuracy, and stealth features.[111] However, the commander of the French Strategic Air Force, Lt Gen. Philippe Vougny, stated on 26 January 1988 that France and Britain were looking at a modified ASMP with a range of 800–1000 km, 'without degrading its stealthiness and its terminal accuracy'.[112]

The seeming demise of the joint ASLP project, and the failure to co-ordinate nuclear targeting by the two navies, appear to be due to political and strategic factors rather than to technological ones. British Prime Minister Margaret Thatcher is known to be concerned that a proliferation of special arrangements outside of NATO's formal structures could end up fragmenting the Alliance

and loosening the UK's connection to the USA.[113] In the past Britain has been reluctant to undertake joint nuclear weapon programmes with France, which is not part of the military structure of NATO, preferring instead bilateral co-operation with the USA.

The WE-177 tactical nuclear bomb and its replacement

It has been known for some time that Britain's stockpile of some 180–200 tactical nuclear WE-177 gravity bombs is scheduled for replacement. The WE-177, first deployed in the late 1960s, will have exceeded its service lifetime by the late 1990s. On 16 May 1988, British Defence Secretary George Younger confirmed that the WE-177s would be replaced by a 'stand-off' air-to-surface missile, in part because improved Soviet air defences challenge aircraft that must penetrate the WTO airspace to strike targets at long range.[114]

Of the approximately 180–200 WE-177 bombs originally manufactured, the majority have been allocated to the RAF strike/attack aircraft assigned tactical nuclear missions. Currently the RAF Tornado GR-1 is the primary aircraft in this category, nine squadrons of which are stationed in the FRG and Britain. A limited number of WE-177s are allocated to RAF Buccaneer S2B aircraft, two squadrons of which are in Britain. Tornado and Buccaneer aircraft can carry two versions of the WE-177 bomb, reportedly called A and B, with 400-kt and 200-kt yields, respectively.[115]

A third version of the WE-177 bomb is reportedly the C,[116] and is a nuclear depth bomb carried by select Royal Navy carrier-based Sea Harrier FRS.1 strike aircraft and anti-submarine warfare (ASW) helicopters.[117] There are an estimated 25 WE-177s of the C version, each with a yield of approximately 10 kt.[118]

Britain's choices are really only two: either the ASLP missile to be developed with France (discussed above), or the US-made SRAM-T. Since co-operation with France now seems unlikely, and it would be too expensive for the UK to develop a missile by itself, especially in small numbers, this would leave some form of co-operation with the USA as the only real alternative.

Trident

Prime Minister Thatcher announced in March 1988 that the first Trident will enter service in 1993–94.[119] Two of the eventual four Trident SSBNs have been ordered thus far. The official estimate of the cost of the Trident programme, covering the period 1980–2000, is £9.043 billion (at 1987–88 prices), 17 per cent lower than the original estimate of November 1981.[120] Approximately £3.229 billion will be spent in the USA.[121] Britain is currently spending at a rate of about £933 million per year. As of May 1988 £3.5 billion had been committed and £1.5 billion spent.[122]

The most severe problem of the Trident programme concerns production facility A90, at Aldermaston, which is to be used for production of plutonium and uranium fissile material for Trident warheads. Following reported delays in the construction of the A90 production facility in January 1988,[123] there have

been further revelations concerning this facility. It has now been confirmed that the A90 plant will not start production of warhead components until 1992, at least two years later than planned. As a result more fissile material will have to be made in the old facilities at Aldermaston, which, as they are less efficient, will lead to delays and further increases in cost. This raises the possibility of the first two Trident submarines being put to sea with fewer than 100 warheads each.[124]

Britain and arms control

Since the December 1987 US–Soviet summit meeting the British Government has made several official statements about its independent nuclear forces, indicating a reluctance to have its warheads included in the START negotiations, based upon its claim of a small British strategic arsenal.

The British position on the role of its nuclear forces in strategic arms negotiations remains that, if Soviet and US strategic arsenals were to be very substantially reduced, that is, by much more than 50 per cent, and if no significant changes occur in Soviet defensive capabilities, then 'we would want to consider how we could best contribute to arms control in the light of the reduced threat'.[125] The British Government considers that the priority in strategic arms negotiations must thus be reductions in US and Soviet arsenals, which amount to 'some 95% of the world-wide total'.[126]

The UK stated in 1988 that it should not have its SLBM warheads included in any arms control forum because, 'even after a 50% Soviet reduction in strategic warheads, and the introduction of Trident, the British deterrent would still represent a smaller proportion of Soviet strategic offensive warheads than did Polaris when it entered full operational service in 1970'.[127] A February 1988 statement by British Foreign Secretary Geoffrey Howe said that the British Polaris force represented about 3 per cent of the 'Soviet deterrent capability' in 1970.[128]

V. French nuclear weapon programmes

Since the US–Soviet INF Treaty of December 1987, France has gone to great lengths to advertise the importance of its nuclear forces. According to the official publication *Revue Aérospatiale*, an indirect effect of the INF Treaty has been to 'upgrade the French nuclear deterrent, since the American withdrawal leaves France as the only European power with a comprehensive "pre-strategic" and strategic nuclear armament', giving France an 'enhanced political role'.[129]

As part of this self-perceived role, France has attempted to create a European identity in the defence and security field. The French Minister of Foreign Affairs, Jean-Bernard Raimond, stated that France 'cannot . . . confine herself within her frontiers and behave like a "nuclear Albania" in Europe'.[130] France has thus renewed security agreements with the FRG and has attempted to forge a level of nuclear co-operation with the United Kingdom, including the proposed joint development of a nuclear air-to-surface missile.

France has also become more forthcoming with details of its nuclear forces. Included in this new openness have been extensive statements to the press during 1988 by the commanders of France's various nuclear commands. For example, the commander of the ballistic missile submarine force (FOST, see below) declared in September that 'the [SSBN] system works and it is in our interest to let everyone know it'.[131] Similar statements were made by other nuclear commanders during 1988. Additionally, breaking with past practice, the French Government has decided henceforth to announce at the end of each year the number of nuclear tests it has conducted during the previous 12 months (see also chapter 2).[132]

Defence budget

Even though the proposed 1989 defence budget calls for a 4.6 per cent increase in overall spending, it has also become increasingly apparent that France cannot afford the ambitious modernization plans set forth in the 1987–91 five-year budget. Instead of cancelling programmes outright, France has stretched out the expenditures over a longer period of time, which delays the introduction of a number of major nuclear weapon programmes.

Of the systems planned for the 1990s, heavy emphasis and resources are being placed on a new generation of ballistic missile submarines (Triomphant Class), considered the heart of French nuclear forces. According to Defence Minister Jean-Pierre Chevenement, the cost of the Triomphant programme will begin to have an impact upon the 1989 military budget and future ones. The new submarine will be financed to the detriment of other programmes, in particular the S4 land-based missile programme, temporarily suspended and no longer considered a 'major priority'.[133] Other programmes have also been delayed, including the M-5 SLBM and the *Charles de Gaulle* nuclear-powered aircraft-carrier.

Force Océanique Stratégique

It is estimated that the six French ballistic missile submarines have completed some 223 operational patrols since the first SSBN entered service in 1971.[134]

During 1988, the commander of the Force Océanique Stratégique (FOST), Vice Admiral Michel Merveilleux de Vignaux, disclosed details on the availability and deployment of French submarines. Speaking during a visit to the FOST base at Ile Longue, he stated that during the month of September the SSBNs *Redoutable, Tonnant* and *Inflexible* were on patrol, with a fourth, *Foudroyant*, at dockside for repairs at Ile Longue, but able to join the other three SSBNs at two days' notice.[135] Vice Admiral de Vignaux further disclosed, for the first time, details of French SSBN patrol areas. In reference to the above three SSBNs, he stated that the patrol areas included the North Atlantic, the Mediterranean and the Norwegian Sea.[136]

In other developments, a third SSBN, *L'Indomptable*, is expected to be refitted with the M-4 missile (replacing M-20s), and put to sea in July 1989. In 1987 the French Atomic Energy Commission (CEA) began the fabrication of

the TN-71 warheads for *L'Indomptable*.[137] This will give the French SSBN force a total of 336 warheads and an estimated total yield of 91.2 Mt.[138] An unexpected 19 per cent increase in research costs for the six Triomphant Class submarines has caused the IOC to slip from 1994 to 1996.[139]

The initial missile to be carried by the first two Triomphant Class submarines is to be a modified M-4 missile.[140] The CEA has been researching the new TN-75 warhead for this missile for some time,[141] and work continued through 1988.[142] The 1989 budget will fund work on this modified M-4 missile, now referred to as the M-45 SLBM,[143] recently defined by Defence Ministry officials as an interim step between the M-4 and M-5 missile systems. The M-45 will incorporate the propulsion stages of the M-4 missile and new penetration aids planned for the M-5.[144] Owing to financial constraints, the M-5 SLBM programme is also being delayed by two to three years, according to defence officials.[145] Although the M-5 is not scheduled for introduction until the year 2002, it is still planned to be deployed on the third submarine of the Triomphant Class.

S4 IRBM

Development of the S4 intermediate-range ballistic missile (IRBM) continued in 1988, although its future remains uncertain. The S4 IRBM had been expected to enter service in 1996, replacing S3D missiles currently in silos in south-eastern France.

On 26 January 1988, Lt Gen. Philippe Vougny, commander of the French Strategic Air Force, gave some indication of the eventual yield of the S4 when he said that 'the estimated firepower of 18 S4s will be at least equivalent to the combined firepower of the present 18 S3Ds and 18 Mirage IVP bombers armed with ASMP missiles'.[146] This would mean that the yield of 18 MIRVed S4s would be at least 23 Mt.[147] Although the number of warheads the missile will carry is not known, the CEA did disclose its designation, the TN-35, stating that it was still being designed.[148]

In April 1988, the French Minister of Defence awarded Aérospatiale the contract for the initial development phase of the S4, although the final decision has not been made on whether it will be mobile or placed in existing S3D silos.[149]

In September Defence Minister Chevenement revealed that the S4 programme was temporarily suspended, owing to financial constraints on the proposed 1989 defence budget. Since then the French Defence Ministry has been considering more economical alternatives, such as an S4 multiple-warhead land-based missile derived from the M4 SLBM. In 1985 Defence Minister Charles Hernu proposed a land-based M4 instead of the mobile S4.[150] The fate of the S4 project will most likely be decided in the spring of 1989.

'Pre-strategic' weapons

When deployed, the Hadès short-range ballistic missile (SRBM) and ASMP missiles will provide French land and air forces with greater operational

flexibility. The Hadès and the ASMP, scheduled to replace the Pluton missile, and AN-52 and AN-22 bombs, respectively, will provide a significant increase in range and accuracy. According to French Prime Minister Jacques Chirac these new tactical weapons will 'broaden our strategy'.[151] France considers pre-strategic forces to be used as a 'specific, efficacious and limited' nuclear warning,[152] but the new weapons will 'allow for in-depth use'[153] and be able to 'penetrate the adversary's capabilities as deeply as possible'.[154]

Development of the Hadès continued in 1988 with the first flight-test conducted on 22 November 1988.[155] The 500-km range Hadès will replace the 120-km Pluton and is expected to enter service in 1992. The French Army plans to purchase 180 Hadès missiles. The missile is dual-capable and could carry a 10- to 25-kt nuclear warhead, an enhanced-radiation warhead (ERW, or neutron bomb), a conventional warhead or, potentially, chemical agents.

France has been developing an ERW warhead since the early 1980s, purportedly for use on the Hadès missile. Once again in 1988, President François Mitterrand stated that France fully understands the technical secrets of the ERW, and that if he gave the order to manufacture it, 'we can do it'.[156] According to Mitterrand, 'there is no prohibition [concerning the ERW] . . . this weapon must join the French armoury if the threat grows more definite'.[157]

French politicians have tried to make the ERW more palatable by referring to it as a 'limited collateral effects weapon', or 'weapons having minor side-effects'. President Mitterrand stated: 'its capacity . . . is much more akin to those artillery bombardments we experienced in the other wars than to a nuclear-type explosion'.[158] This, of course, is not true; even very-low-yield ERW warheads are vastly more destructive than any conventional artillery systems. Mitterrand also stated that he 'would not rule out' a review of the project if other countries began negotiating on short-range nuclear forces,[159] assuming he 'approve[d] of the terms on which disarmament would materialize'.[160]

Mirage 2000N

During 1988 Mirage 2000N aircraft entered operational service with the Tactical Air Force (FATAC). The first 11 Mirage 2000N aircraft arrived at Luxeuil AB on 30 March 1988 and officially entered service with l'Armée de l'Air on 1 April 1988. The first 15 Mirage 2000N aircraft went on operational alert with the Dauphiné squadron of the 4th Fighter Wing at Luxeuil Air Base (Haute-Saône) on 1 July 1988, replacing Mirage IIIE aircraft armed with the AN-52 gravity bomb.[161] Eventually the Mirage 2000N will replace 75 Mirage IIIE and Jaguar A aircraft in five squadrons in the tactical nuclear role.

The Mirage 2000N nuclear attack aircraft is a two-seat derivative of the basic Mirage 2000 fighter and incorporates a terrain-following electronics package for all-weather, low-altitude, high-speed penetration. The aircraft is also 'hardened' against nuclear effects. The primary armament of the Mirage 2000N is the ASMP supersonic medium-range air-to-surface nuclear missile. The CEA began manufacturing the TN-81 warheads for these ASMP missiles in 1987.[162]

The remaining four squadrons will be converted to Mirage 2000Ns, at the rate of one a year. The next one will be converted during 1989: the Luxeuil-based La Fayette squadron now flying the Mirage IIIE.[163] The most recent plan appears to be that only 45 Mirage 2000Ns will be armed with ASMPs.[164] The remaining Mirage 2000Ns could carry nuclear gravity bombs or even 'smart' conventional munitions.[165]

Naval aviation

Eventually 24 Super Etendard carrier-based aircraft will be equipped with the ASMP missile. The aircraft-carrier *Foch* (which went to sea on 1 June 1988 following a 16-month overhaul) was converted to 'handle and store' the ASMP for its Super Etendard aircraft.[166] The ageing aircraft-carrier *Clemenceau* will not be converted to carry the ASMP missile,[167] although it is still equipped to handle the AN-52 bomb. The new nuclear-powered carrier *Charles de Gaulle*, being built at Brest, will be able to 'handle and store' the ASMP for carriage by Super Etendard aircraft beginning in 1997.[168]

France and arms control

France continues to refuse to participate in any nuclear arms control negotiations. In March 1988 French Minister of Defence André Giraud made it clear that in any possible arms control agreements, 'nuclear weapons should be the last to go, and it is from Europe that they should go last'.[169]

With reference to the possibility of the inclusion of any French weapons in an INF-type arms reduction agreement, French Prime Minister Jacques Chirac has stated that 'there is obviously no question of [France's] prestrategic weapons being brought up in any discussion whatsoever'.[170]

France also refuses to participate in the START negotiations. According to Giraud, the USSR and the USA together account for 98 per cent of the world strategic nuclear stockpile, so that even a 50 per cent cut in the superpowers' strategic armaments levels would leave them with about 96 per cent of the total stockpile.[171] Thus, according to President Mitterrand, 'even a 50% reduction in strategic arms . . . would not be enough' to convince France to put its weapons on the negotiating table.[172]

VI. Chinese nuclear weapon programmes

The most significant nuclear weapon-related development of 1988 in China was the prospect of improved relations with the USSR. Chinese relations with the USSR took a notable turn for the better in early December when Chinese Foreign Minister Qian Qichen went to Moscow to meet with Foreign Minister Eduard Shevardnadze. Both sides discussed, *inter alia*, a number of security and arms control topics and agreed to have another meeting in early 1989 in preparation for the first Sino-Soviet summit meeting in some 30 years.[173] President Gorbachev is scheduled to travel to Beijing in May 1989 to meet with Deng Xiaoping, Chairman of the Central Military Commission and China's

paramount leader. This improvement in Sino-Soviet relations—which have at times been bitterly strained during the past two decades—could help to relax regional military tensions and competition and thus to obviate incentives for China to proceed with some nuclear weapon programmes. The USSR has been China's major military adversary since the late-1960s, and it is believed that most, if not all, Chinese nuclear weapons are targeted on the Soviet Union.[174]

Nevertheless, China proceeded with a number of nuclear weapon-related developments in 1988 that suggest no lack of interest in continuing to modernize its nuclear forces. Most prominent among these developments were a nuclear weapon test believed to be its first of a neutron bomb and a test of a submarine-launched ballistic missile. The most significant events of 1988 are described below.

Nuclear test

On 29 September 1988, China conducted a nuclear explosion at its Lop Nur test site in Xinjiang Province. It was estimated by foreign seismic experts to be a very-low-yield explosion, perhaps below 1 kt and well below 5 kt. This test was similar in size to the Chinese test of 19 December 1984, but unlike previous nuclear weapon tests this explosion was reported in the Western press to be of an enhanced-radiation or so-called neutron bomb design.[175] If this is true it would confirm the existence of a Chinese effort to develop distinctly tactical nuclear weapons that could be used, for example, against adversary armour and troop formations. This would mark a considerable departure from the visible thrust of Chinese nuclear weapon programmes that have previously concentrated on relatively long-range weapon delivery systems (above 1000 km) that would be targeted on foreign territory, most likely against cities. It would also tend to belie Chinese assertions that China wants to have only a minimal nuclear force.[176] Tactical nuclear weapons could be delivered by existing aircraft or missile systems, or possibly by future systems under development in China.

SLBM test

On 27 September 1988, China launched a ballistic missile on a test-flight from a nuclear-powered Xia Class ballistic-missile submarine to a target area in the East China Sea.[177] The missile flew about 1400 km to the SLBM impact area 400 km south-east of Shanghai and 400 km north-west of Taiwan. This is the second known submarine launching of an SLBM since 1982, when a CSS-N-3 missile was first launched from a submerged Golf Class training submarine. (An SLBM test launch on 15 October 1985, probably a CSS-N-3 launched by a Xia Class SSBN, was barely reported by official Chinese sources, although the test personnel were reportedly commended by Deng Xiaoping for increasing the missile's range and 'multiple targeting ability'.[178] Given the notably small publicity it received, the 1985 test may have been considered a failure.[179]) The SLBM launched in 1988, which Chinese officials heralded as a great success, is presumed to be a CSS-N-3—the missile designed for the Xia Class submarine

and China's only known SLBM. In 1988 several official Chinese sources reported that China is working on a new SLBM, variously saying that the Navy is 'developing new submarine-carried strategic missiles' and 'developing a new type of submarine-launched strategic missile'.[180]

Although China has claimed for some years that its SSBN force was operational,[181] the fact that a Xia Class submarine had not been credited with a single SLBM launch may have led to doubts that China's strategic submarines *were* in fact operationally deployed. For example, in his testimony to the US Congress in March 1988, Admiral William Studeman, Director of Naval Intelligence, stated that the USSR would perceive a threat from 'Chinese SSBNs *when* they become operational'.[182] Since an operational test launch of an SLBM can be considered the major and final milestone in developing a working missile submarine fleet, the successful test launch in September should demonstrate that China's SSBNs are capable of operation. According to a Chinese radio broadcast, a senior officer of the Second Artillery Corps, China's nuclear weapon command, told reporters in January 1988 that 'many successful firing practices were proof that China's strategic missile corps already had a fair-sized nuclear retaliatory capacity'.[183] And the *People's Daily* reported in August that 'the Chinese Navy is now armed with both tactical guided missiles and strategic nuclear missiles'.[184]

China announced on 7 September 1988 that it would conduct carrier rocket tests during the period 14 September–3 October, and urged governments to keep their ships and aircraft out of the usual target area for SLBM test launches—an area centring on 123.53° N and 28.13° E with a 35 nautical-mile (65 km) radius—from 10:00 until 17:00 every day.[185] The test launch was well publicized, as reporters from the official Chinese news agency Xinhua and radio services were apparently permitted to observe and report on the launch from an observation ship and from the submarine itself.[186] These reports devoted considerable detail to the description of the launch procedure and missile performance. The commander-in-chief of the test launch was quoted as saying, 'Compared with the 1982 submarine launch of a carrier rocket, this successful underwater launch of the carrier rocket by a nuclear submarine has made a great technological breakthrough, marking a new leap in modernization of China's national defense'.[187]

Nuclear exercises

Although the Government of China has lately de-emphasized the risk of nuclear war, the Chinese military (the People's Liberation Army, or PLA) seems determined to keep practising for nuclear combat. A considerable number of exercises have recently been described as being conducted 'under nuclear conditions'. These exercises usually include at least one simulated nuclear explosion and have taken place over land and, more recently, at sea—mostly in short-range tactical combat situations.

In 1988 several such nuclear exercises were reported by official Chinese sources. In late June, a navy exercise at an unnamed navy base in the East China Sea began with a 'huge simulated mushroom cloud' followed by mock

nuclear and chemical bombing attacks by 'enemy' air forces on the base.[188] This exercise was specifically intended to 'study and discuss the characteristics and rules of defensive war under nuclear conditions'. A report from aboard a frigate, probably during the same exercise, described the nuclear decontamination procedure used after a simulated nuclear attack.[189] The vessel is reportedly designed to withstand nuclear fall-out and chemical agents. Given that the Chinese political and Communist Party authorities have officially declared their belief that nuclear war seems very unlikely for the remainder of the century,[190] it is interesting to note the military emphasis on training for nuclear war.

Missile and rocket developments

China achieved considerable notoriety in 1988 for its sale of ballistic missiles to Saudi Arabia and for reports that it offered a shorter-range missile to other nations (see also chapter 7). It was revealed in March that China had previously concluded an agreement to transfer dozens of DF-3A ballistic missiles to Saudi Arabia. These missiles, known in the West as the CSS-2, were originally developed for and deployed with nuclear warheads by China, so there was considerable international concern about the nuclear proliferation (and other) dangers of such a deal.[191] China reportedly told the USA that the missiles had been modified to carry conventional warheads, thus reducing their range, and that China does not transfer nuclear weapon technology to other nations.[192] Saudi Arabia felt compelled to disavow any interest in nuclear weapon capabilities and announced that it would sign the Non-Proliferation Treaty (NPT), which it did on 3 October (see also annexe A). The missile agreement came as a surprise to many nations because Saudi Arabia did not even have diplomatic relations with China prior to the deal.

The sale of the DF-3A missiles demonstrates that these missiles were considered expendable to China, because they had either been removed from operational service or taken from undeployed stockpiles.The DF-3 has been the backbone of China's nuclear missile force since the mid-1970s and still forms the bulk of its nuclear weapon capacity. China is apparently moving towards replacing some of its ballistic missiles. One Chinese source stated in July that 'China will develop a new generation of strategic and tactical missiles'.[193]

Another case involving the potential transfer of Chinese ballistic missiles concerned reports that China was planning to sell to Syria—and possibly to other Middle Eastern nations—short-range missiles known in the West as the M-9.[194] The M-9 has been under development for several years, and it is believed to be intended both for the Chinese military and for export.[195] The domestic version is considered in the West to be a nuclear missile. Selling the missile overseas would help offset the cost of developing and deploying a Chinese version. It was reported that the missile was still under development and had not been sold to any nation. A number of senior US officials discussed the issue of ballistic missile proliferation with Chinese leaders in Beijing during the summer and autumn of 1988.[196] The result of these meetings seemed to

satisfy the USA that China understood US concerns and would not act in a manner that destabilized the region.

Aerospace developments

During 1988, China achieved a number of important results in aerospace endeavours that are linked to its military and nuclear weapon programmes. In recent years China has devoted increasing resources to economic modernization, and space industry is one of its leading technology sectors. While most of the space-related programmes are outwardly commercial, many are directly applied to military research, development and operations that are central to the nuclear weapon programme.

On 7 September, China launched a new rocket—the Changzheng 4, or CZ-4—that delivered China's first weather satellite into orbit (see also chapter 3).[197] Although this rocket is being marketed for commercial purposes—launching foreign satellites—the technology it uses is the same as for intercontinental ballistic missiles. In fact, the rocket's predecessor was developed from a Chinese ballistic missile, as are all Chinese rockets, thus demonstrating an interesting 'spin-off' cycle from the military to civilian fields and now possibly back to the military. The CZ-4 is said to be suitable for multiple satellite launches, a capability which would permit some research into multiple re-entry vehicles (MRVs) or even multiple independently targetable re-entry vehicles for Chinese ballistic missiles without an overt MIRV programme. The high reliability of China's space launch vehicles suggests that its ballistic missiles must also be considered quite reliable.

The 'experimental meteorological satellite' Fengyun 1 (FY-1) launched by the CZ-4 will provide China with its first indigenous satellite weather monitoring and forecasting capability.[198] The improved weather information will be valuable to China's nuclear forces since it is crucial for nuclear operations to have the most accurate weather data possible. The State Council and the Central Military Commission sent congratulations to the civilian and military specialists who developed, tested and launched the satellite.

As part of its increased space launch and missile test activities, China completed the modernization of its two astronautic survey ships in 1988. These two Yuanwang Class ships were built to monitor and track ballistic missile flights, track satellites in orbit and monitor satellite launches such as the FY-1 launch. They have formed the core of China's first ocean-going fleet, since they must sail several thousand kilometres to observe ICBM test-flight re-entry. The first ship-borne satellite communication terminals were installed on the ships, thus permitting direct communication between the ship and command centres on the mainland.[199] One Chinese expert called the ships 'combat worthy'.[200]

While none of these programmes has the outward appearance of any relationship to China's nuclear weapon programme, each will be an important component of any future modernization of China's nuclear forces.

Notes and references

[1] Further indications of improved relations were a variety of meetings between high military officials. These have included: (*a*) a Dec. 1987 visit by Marshal Sergey Akhromeyev to the Pentagon hosted by Chairman of the Joint Chiefs of Staff Admiral Crowe; (*b*) on 16–17 Mar. 1988 Secretary of Defense Carlucci and Soviet Defense Minister Dmitri T. Yazov met for 10 hours in Bern, Switzerland; (*c*) Secretary Carlucci and Minister Yazov met again during the Moscow summit meeting in May; (*d*) Marshal Akhromeyev made a six-day visit on 6–11 July to military facilities in the USA, culminating in an announcement that steps would be taken to avoid unintended military confrontations. In addition a two-year programme of US–Soviet military exchanges were worked out; and (*e*) Secretary Carlucci visited military facilities in the Soviet Union on 1–4 Aug.

[2] Adams, P.,'Planners draft new nuclear war tactics', *Defense News*, 20 June 1988, p. 1; Halloran, R., 'U.S. revises its war plan for new age', *New York Times*, 2 Nov. 1988, p. A7.

[3] Wilson, G. C., 'Rail-mobile MX is pressed by Carlucci', *Washington Post*, 19 May 1988, p. A1. A contract of $167 million was awarded to Westinghouse Electric Marine Division of Sunnyvale, California, to develop the launch car by mid-1992, and a contract of $161.7 million went to Rockwell International Autonetics Electronics Systems of Anaheim, California, for a launch control system.

[4] US Congress, House Armed Services Committee (HASC), *MX Rail Garrison and Small ICBM: A Program Review*, Committee Print No. 10, 21 Mar. 1988 (US Government Printing Office: Washington, DC, 1988); Department of the Air Force, *Draft Environmental Impact Statement: Peacekeeper Rail Garrison Program*, June 1988; Fridling, B. E. and Harvey, J. R., 'On the wrong track? An assessment of MX rail garrison basing', *International Security*, winter 1988/89, pp. 113–41.

[5] US Congress, House Appropriations Committee (HAC), *Military Construction Appropriations for FY 1988*, Hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, 100th Congress, 1st session (US Government Printing Office: Washington, DC, 1987), Part 4, p. 339.

[6] US Congress, Senate Foreign Relations Committee (SFRC), *The INF Treaty*, Hearings, 100th Congress, 2nd session, Senate Hearing 100–522 (US Government Printing Office: Washington, DC, 1988), Part 2, p. 66; Letter, Frank Carlucci to Sam Nunn, 3 Mar. 1988.

[7] US Congress, House Appropriations Committee (HAC), *Hearings on Department of Defense Appropriations for FY 1989* (hereafter cited as HAC, FY 1989 DOD), Part 1, p. 63.

[8] HASC (note 4), p. 2.

[9] The tests were held on 21 Jan., 7 Apr., 28 Apr., 25 May, 7 July, 27 Aug., 19 Sep., 7 Nov. and 16 Dec. See General Accounting Office (GAO), *Navy Strategic Forces; Trident II Proceeding toward Deployment*, GAO/NSIAD–89–40, Nov. 1988.

[10] The GAO estimated that the total life-cycle cost for the acquisition, operation and support of a 19-submarine programme (including the refitting of the Trident I submarines to Trident II), through their retirement in the year 2032 is about $155 billion; GAO (note 9), p. 29.

[11] On 16 Sep. 1985 the *USS Sam Rayburn* (SSBN 635) was taken out of service. It has been converted to a dockside training submarine for nuclear propulsion plant operators. On 3 Nov. 1986 the *USS Nathan Hale* (SSBN 623) was decommissioned, and on 16 Dec. 1986 the *USS Nathanael Greene* (SSBN 636) was decommissioned.

[12] US Congress, Senate Appropriations Committee (SAC), *Hearings on Department of Defense Appropriations for FY 1989* (hereafter cited as SAC, FY 1989 DOD), Part 2, p. 221.

[13] Adam, J. A., 'How to design an "invisible" aircraft', *IEEE Spectrum*, Apr. 1988, pp. 26–31; Halloran, R., 'Stealth bomber takes shape: a flying wing and crew of 2', *New York Times*, 16 May 1988, p. A1; Browne, M. W., 'Will the stealth bomber work', *New York Times Magazine*, 17 July 1988, pp. 24–31.

[14] Brower, M., 'Why the B-2 will bomb: the problems stealth can't hide', *Arms Control Today*, Sep. 1988, pp. 17–22; Pike, J. and Bourns, D. 'The case against the stealth bomber' (Federation of American Scientists), 16 Nov. 1988.

[15] Wilson, G. C., 'Stealth called nuclear deterrent', *Washington Post*, 17 May 1988, p. A10.

[16] Dornheim, M. A., 'Air force cites 1984 B-2 redesign as major reason for schedule lag', *Aviation Week & Space Technology*, 7 Nov. 1988, p. 20.

[17] Cushman, J. H., 'U.S. confirms 16% rise in cost for secret bomber', *New York Times*, 16 Sep. 1988, p. A23; Halloran, R., 'Air force raises cost estimate of stealth bombers to $68.1', *New York Times*, 17 Dec. 1988, p. 12.

[18] Morrocco, J. D., 'Budget constraints force one-year delay in peak production of B-2', *Aviation Week & Space Technology*, 19 Dec. 1988, pp. 24–25.

[19] Smith, R. J., 'Cruise missile reported late, over budget', *Washington Post*, 21 Apr. 1988, p. A37.

[20] *Congressional Record*, 21 Apr. 1988, p. E1161.

[21] HAC, FY 1989 DOD, Part 7, p. 285.

[22] The Senate Foreign Relations Committee held 20 days of hearings between 25 Jan. and 22 Mar.; SFRC (note 6), Parts 1–5; Senate Foreign Relations Committee Report, *The INF Treaty*, Senate Executive Report 100–15, 14 Apr. 1988 (US Government Printing Office: Washington, DC, 1988). The Senate Armed Services Committee held 13 days of hearings between 25 Jan. and 23 Feb.; US Congress, Senate Armed Services Committee (SASC), *NATO Defense and the INF Treaty*, Hearings, 100th Cong., 2nd sess., Senate Hearing 100–493, Parts 1–4 (US Government Printing Office: Washington, DC, 1988); Senate Armed Services Committee Report, *NATO Defense and the INF Treaty*, Senate Report 100–312, 1 Apr. 1988 (US Government Printing Office: Washington, DC, 1988). On 15 May the INF Treaty was brought to the floor of the Senate. After floor debate the Senate voted 93 to 5 on 27 May to approve the INF Treaty.

[23] Department of Defense (DOD), *Support of NATO Strategy in the 1990's*, 25 Jan. 1988.

[24] HAC, FY 1989 DOD, Part 1, p. 673.

[25] HAC, FY 1989 DOD, Part 7, pp. 312, 334.

[26] HAC, *Energy and Water Development Appropriations for 1989*, Hearings, Part 6, pp. 769, 776–77.

[27] Lawrence Livermore National Laboratory, *Energy and Technology Review*, July–Aug. 1988, p. 4.

[28] Office of the Assistant Secretary of Defense for Public Affairs (OASD/PA), News Release no. 553–88, 10 Nov. 1988.

[29] HAC, FY 1989 DOD, Part 6, pp. 148–64.

[30] US Cruise Missiles Project, US DOD, 'Tomahawk Cruise Missile Facts', Washington, DC, undated mimeograph, p. 5.

[31] Six nuclear materials are used in the production of nuclear weapons: uranium-235, plutonium-239, tritium, deuterium, lithium-6 and uranium-238. In recent years the USA has produced only plutonium and tritium for weapons, having ample stocks of the other materials on hand. More recently, the DOE has indicated that there is sufficient plutonium in the US stockpile to obviate any need to continue producing it; therefore, only tritium is considered to be in short supply.

[32] Lanouette, W., 'The half-life of the tritium story', *Deadline*, Jan./Feb. 1989, p. 1; Randolph, E., 'New York Times crusade focuses attention on weapons plants', *Washington Post*, 9 Jan. 1989, p. A3.

[33] US Department of Energy (DOE), *Environment, Safety and Health Report for the Department of Energy Defense Complex*, July 1988; GAO, *Dealing with Problems in the Nuclear Defense Complex Expected to Cost Over $100 Billion*, GAO/RCED-88-197BR, July 1988; DOE, *Environmental Survey: Preliminary Summary Report of the Defense Production Facilities*, Sep. 1988.

[34] Schneider, K., 'U.S. pessimistic on reactors' role in atomic arsenal', *New York Times*, 27 Dec. 1988, p. A1; Smith, R. J., '$50 billion sought for weapons plants', *Washington Post*, 11 Dec. 1988, p. A1; DOE, *Nuclear Weapons Complex Modernization Report*, Dec. 1988.

[35] Peterson, C., 'Energy Secretary warns of new arms-plant cuts', *Washington Post*, 18 Dec. 1988, p. A1.

[36] See Cochran, T. B., Norris, R. S. and Arkin, W. M., 'The Department of Energy's Savannah River Plant reactors and US requirements for tritium and plutonium for nuclear weapons', Background Paper (Natural Resources Defense Council: Washington, DC, 19 Oct. 1988).

[37] US Department of Defense (DOD), *Soviet Military Power 1988* (hereafter cited as DOD, SMP 1988), p. 44. It should be noted that this, as most sources of information about Soviet nuclear weapon programmes, is an official US source. Despite *glasnost*, very little information from the Soviet Union about its nuclear weapons has been made publicly available, except for the data exchanged in compliance with arms control agreements, as in the SALT II Treaty and the INF Treaty.

[38] DOD, SMP 1988, p. 47.

[39] DOD, SMP 1988, p. 40.

[40] DOD, SMP 1988, p. 39.

[41] DOD, SMP 1988, p. 47.

[42] DOD, SMP 1988, p. 15, for instance, reports about 10 SS-24 Mod. 1 missiles operational as of Mar. 1988. See also Zaloga, S. J., 'Land-based logic drives Soviet mobile ICBM effort', *Armed Forces Journal International*, Nov. 1988, pp. 27–28.

[43] DOD, SMP 1988, p. 101.

[44] Gertz, B., 'Soviets successfully test missile that will be largest in arsenal', *Washington Times*, 7 Jan. 1987; 'Failure of Soviet missile report by U.S. experts', *Baltimore Sun*, 18 Sep. 1986; Cannon, L., 'Missile test by Soviets goes astray', *Washington Post*, 16 Sep. 1986.

[45] DOD, SMP 1988, pp. 4, 47.

[46] US Department of Defense (DOD), *Report of the Secretary of Defense Frank Carlucci to the Congress for FY 1988* (annual report), (hereafter cited as DOD FY 1988), p. 25; US Air Force, *Report of the Secretary of the Air Force to Congress for FY 1988*, p. 15.

[47] Rear Admiral Studeman, W. O., US Navy, Director of Naval Intelligence, Statement before the HASC, 1 Mar. 1988, p. 33.

[48] DOD, SMP 1988, p. 40.

[49] DOD, SMP 1988, p. 48; DOD, SMP 1987, p. 35.

[50] DOD, SMP 1987, pp. 27, 34.

[51] DOD, SMP 1988, p. 48. This includes one Yankee II submarine in the Northern Fleet.

[52] 'Soviet "Yankees" resume US patrol', *Jane's Defence Weekly*, 30 July 1988, p. 154; Black, N., 'Soviet nuclear subs resume patrol off U.S. east coast', *Washington Post*, 8 Aug. 1988, p. 13.

[53] US Department of Defense (DOD), response to a *New York Times* inquiry of June 1988, undated memorandum.

[54] DOD, SMP 1988, pp. 51, 79.

[55] 'Bear-H mission details reported', *Jane's Defence Weekly*, 16 Apr. 1988, p. 756.

[56] Morrocco, J. D., 'Soviet Union unveils Blackjack bomber', *Aviation Week & Space Technology*, 8 Aug. 1988, pp. 14–15; North, D. M. and Morrocco, J. D., 'Blackjack shares aspects of U.S. B-1B and XB-70', *Aviation Week & Space Technology*, 15 Aug. 1988, pp. 16–18.

[57] North and Morrocco (note 56).

[58] DOD, SMP 1988, p. 50.

[59] Rear Admiral Sheafer, E. D., Jr., 'An intelligence overview: the threat expands, expands', *Wings of Gold*, summer 1988, p. 18.

[60] DOD, SMP 1988, p. 149.

[61] *Aviation Week & Space Technology*, 28 Mar. 1988, p. 15.

[62] DOD, SMP 1988, p. 15.

[63] DOD, SMP 1988, Preface, pp. 44, 55–56.

[64] The SA-12A Gladiator variant, intended for deployment in non-strategic forces, is already being fielded.

[65] DOD, SMP 1988 did not even mention cruise missiles until p. 40 of the report.

[66] It is interesting to note that, since the USSR did not include any SSC-X-5 missiles or support equipment in the INF Treaty data exchange for verification, it is unlikely that prototypes of the missile had been produced as of Nov. 1987.

[67] Sheafer (note 59); DOD, SMP 1988, p. 53.

[68] DOD, SMP 1988, p. 53.

[69] DOD, SMP 1988, p. 79.

[70] DOD, SMP 1988, p. 55.

[71] DOD, SMP 1988, p. 55.

[72] DOD, SMP 1987, p. 55; DOD, SMP 1987, p. 66.

[73] DOD, SMP 1988, p. 55.

[74] DOD, SMP 1988, p. 109.

[75] DOD, SMP 1988, pp. 15, 33.

[76] DOD, SMP 1988, p. 46.

[77] DOD, SMP 1988, pp. 15, 79.

[78] DOD, SMP 1988, p. 79.

[79] DOD, SMP 1988, p. 79.

[80] DOD, SMP 1988, p. 80.

[81] DOD, SMP 1988, p. 39.

[82] Crutchley, M. J. and Milam, J. H., 'Warsaw pact artillery modernization—a quantitative advantage', *Military Technology*, no. 11 (1987), pp. 49–63; DOD, SMP 1988, pp. 55, 68; Adams, P., 'Defense board probing Soviet artillery gains', *Navy Times*, 2 May 1988; 'Key role of self-propelled guns', *Jane's Defence Weekly*, 3 Dec. 1988, pp. 1418–21.

[83] DOD, SMP 1988, p. 38.

[84] DOD, SMP 1988, p. 75; 'Soviet revive heavy artillery formations', *Jane's Defence Weekly*, 16 Mar. 1988, pp. 534–35.

[85] Sheafer (note 59); DOD, SMP 1988, p. 38. Eleven of the 20 Kilo Class submarines built through mid-1988 were in the Soviet fleet; the remainder had been exported to India, Poland, Romania and Algeria. The Mike Class SSN, launched in 1983, is a test-bed submarine, and only 1 prototype was built.

[86] DOD, SMP 1988, p. 129.
[87] DOD, SMP 1988, Preface, p. 85.
[88] DOD, SMP 1988, p. 85.
[89] 'Analysis of changes to the Baku', *Jane's Defence Weekly*, 6 Aug. 1988, p. 225.
[90] DOD, SMP 1988, Preface.
[91] Sheafer (note 59).
[92] Sheafer (note 59) DOD, SMP 1988, p. 134.
[93] Keller, B.,'Soviet military wary of arms cuts', *New York Times*, 23 Dec. 1988, p. 3; see also 'Soviet to recycle tank engines', *Washington Times*, 23 Dec. 1988, p. 3; 'This is not just a matter of tactics', *Newsweek*, 19 Dec. 1988, pp. 31–32.
[94] Dobbs, M., 'Soviet officers vent unease at cutbacks', *Washington Post*, 16 Dec. 1988, p. A37.
[95] DOD, SMP 1988, pp. 9, 12.
[96] Meeting of the Political Consultative Committee of the Warsaw Treaty Organization, 'On the military doctrine of the Warsaw Treaty member states', *Pravda*, 30 May 1987.
[97] Defense Minister Yazov explained that 'sufficiency in that sphere presupposes a quantity and quality of armed forces and armaments capable of reliably ensuring the collective defense of the socialist community . . . The armed forces of the allied countries are maintained in a state of combat readiness sufficient not to be taken unawares. In case of an attack against them, they will deal the aggressor a crushing rebuff'; *Pravda*, 27 July 1987; quoted in Institute of World Economy and International Relations (IMEMO), *Disarmament and Security: Yearbook 1987* (Novosti: Moscow, 1988), pp. 219–20.
[98] Odom, W. E., 'Soviet military doctrine', *Foreign Affairs*, winter 1988/89, p. 130.
[99] IMEMO (note 97), p. 215; see also Goure, L., 'The Soviet strategic view', *Strategic Review*, fall 1988, p. 83.
[100] IMEMO (note 97), p. 201. According to Alexei Arbatov, 'A military doctrine has two mutually related aspects: socio-political and military-technical. The first one reflects the relatively constant social system and political objectives of a state, as well as its geographical (geostrategic) situation and its probable adversaries. The second one directly relates to the military programs, technical equipment of the forces and their training, and the determination of the forms and methods to be used in the course of operations and the war as a whole. This aspect is very dynamic in the conditions of an intensive period of military and technological race; shifts in absolute and relative combat potentials of the armed forces of states as a result of the modernization of their weapons and combat equipment; qualitative changes and changes in composition and deployment of forces; and innovations in exercises and manoeuvres and systems of mobilized deployment'.
[101] DOD, SMP 1988, p. 12.
[102] Odom (note 98). See also Goure, L., 'A "new" Soviet military doctrine: reality or mirage?', *Strategic Review*, summer 1988, p. 26.
[103] Atkenson, E. B., Maj. Gen., 'The new Pact doctrine: implications for NATO', *Army*, Nov. 1988, p. 11.
[104] Taubman, P., 'Is the Soviet military on the Gorbachev diet?', *New York Times*, 7 Aug. 1988, p. E7; Atkenson (note 103), pp. 11–13.
[105] 'West benefiting from military openness', *Jane's Defence Weekly*, 5 Nov. 1988, p. 1157.
[106] Defense Secretary Carlucci inspected the exterior and interior of the newest Soviet strategic bomber—the Blackjack—at Kubinka Air Base, near Moscow, during this visit.
[107] Smith, R. J., 'Young, obscure officer is named leader of Soviet Armed Forces', *Washington Post*, 14 Dec. 1988, p. A37.
[108] A previous agreement provided for transit only in time of war; 'France permits BAOR exercise movements', *Jane's Defence Weekly*, 13 Feb. 1988, p. 254. British troops have not been allowed to exercise in France since France withdrew from NATO's integrated military structure in 1966.
[109] de Briganti, G., 'France, Britain agree to closer military links', *Defense News*, 8 Feb. 1988, p. 15; Markham, J. S., 'Meager arms progress by Britain and France', *New York Times*, 4 Feb. 1988, p. A7.
[110] Connell, J., 'Britain backs out of French missile deal', *Sunday Times*, 7 Aug. 1988, p. 1.
[111] Connell (note 110); Dickson, D., 'Anglo-French nuclear missile under study', *Science*, 12 Feb. 1988, pp. 720–21. The maximum range of the ASMP is 300 km.
[112] de Briganti, G., 'France, Britain mull joint development of longer range stand-off nuclear missile', *Defense News*, 1 Feb. 1988, p. 8.
[113] Markham, J. S., 'Meager arms progress by Britain and France', *New York Times*, 4 Feb. 1988, p. A7; Dickson, D., 'Anglo-French nuclear missile under study', *Science*, 12 Feb. 1988, pp. 720–21.

[114] Morrison, J., 'Britain plans to upgrade nuclear arsenal', *Washington Times*, 17 May 1988, p. 9.

[115] Urban, M., 'Clarification', *The Independent*, 17 May 1988.

[116] All three types use the same basic 'physics package'. The yield is varied by the amount of tritium introduced; Urban (note 115).

[117] The WE-177C can be used as a free-fall bomb or as a depth bomb by varying the fuzing and the casing.

[118] Author's interview with Mark Urban of *The Independent*, on 13 Oct. 1988.

[119] Prime Minister Thatcher, 'The NATO summit: the British view', press conference in Brussels, 3 Mar. 1988, reprinted by the British Information Services, New York, Policy Statement 12/88, 4 Mar. 1988, p. 4.

[120] British House of Commons, Defence Committee, *The Progress of the Trident Programme*, session 1987–88, 11 May 1988, pp. vi–ix.

[121] Most of this money is spent through the US Navy's Strategic Systems Program Office (SSPO). Since the inception of the Polaris Sales Agreement in 1963 through FY 1988, the UK has spent £2.37 billion through the SSPO on the Polaris, Chevaline and Trident weapon systems. The authors estimate that, as of Dec. 1988, roughly 80 per cent of this amount has been spent on Polaris and Chevaline, and 20 per cent on Trident.

[122] British Information Services, 'British defence policy', Policy Background Paper 7/88, 17 May 1988, p. 7.

[123] SIPRI, *SIPRI Yearbook 1988: World Armaments and Disarmament* (Oxford University Press: Oxford, 1988), p. 47.

[124] Urban, M., 'Aldermaston delays confirmed', *The Independent*, 31 Mar. 1988, p. 1; Urban, M., 'MPs hit at Trident "inaccuracies"', *The Independent*, 27 May 1988, p. 1.

[125] British Ministry of Defence, *Statement on the Defence Estimates 1988* (Her Majesty's Stationery Office: London, 1988), para. 222.

[126] Note 125, para. 223.

[127] Note 125.

[128] British Foreign Secretary Geoffrey Howe, 'The British foreign secretary's visit to the Soviet Union', interview on Soviet television 16 Feb. 1988, reprinted by the British Information Services, New York, Policy Background 1/88, 19 Feb. 1988, p. 3.

[129] 'Touring the Inflexible', *Revue Aérospatiale*, no. 44 (Nov. 1987), pp. 26–28.

[130] French Minister of Foreign Affairs Jean-Bernard Raimond, 'Prospects for East–West relations and disarmament negotiations', speech given at the Institute of Higher National Defence Studies (IHEDN), translated by the Service de Presse et d'Information of the French Embassy, London, 8 Mar. 1988, p. 1.

[131] Isnard, J., 'France claims SSBN advantage', *Jane's Defence Weekly*, 1 Oct. 1988, p. 746.

[132] French Foreign Minister Roland Dumas, statement before the UN Third Special Session on Disarmament, cited in French Embassy Press and Information Service, *News from France* (Washington, DC), 14 June 1988, p. 2.

[133] Lenorovitz, J. M., 'French boost 1989 defense budget for conventional, nuclear upgrades', *Aviation Week & Space Technology*, 26 Sep. 1988, p. 31.

[134] Authors' estimate to the end of 1988, based on: the 172nd patrol of the FOST began at the end of February 1986; SIPRI, *SIPRI Yearbook 1987: World Armaments and Disarmament* (Oxford University Press: Oxford, 1987), p. 32. 200 patrols had been conducted by Oct. 1987; Cornec, J.-P., 'Médecin à bord de SNLE: Un soutien indispensable', *Armées d'aujourd'hui*, no. 125 (Nov. 1987), p. 53.

[135] Isnard, J., 'France claims SSBN advantage', *Jane's Defence Weekly*, 1 Oct. 1988, p. 746.

[136] Note 135.

[137] Commissariat à l'énergie atomique, *Rapport Annuel 1987* (CEA: Paris, 1988), p. 18. The two SSBNs already armed with the M4 are the *Inflexible* (TN-70 warheads) and the *Tonnant* (TN-71 warheads).

[138] Authors' estimates.

[139] Schwartzbrod, A., 'French '89 defense budget gives priority to R&D and nuclear forces', *Armed Forces Journal International*, Nov. 1988, p. 32; 'Triomphant to cost 19 per cent more', *Jane's Defence Weekly*, 17 Dec. 1988, p. 1535.

[140] Both boats will be converted to carry the M5 SLBM early in the next century.

[141] See *SIPRI Yearbook 1988* (note 123), p. 51.

[142] Commissariat à l'énergie atomique, *Rapport Annuel 1987* (CEA: Paris, 1988), p. 18.

[143] In 1988, the French Defence Ministry provided a name for this new M4 variant—the M45. However, contrary to popular belief, the M45 was not a new missile; it had been in the planning stage for many years but did not have a name.

[144] Lenorovitz, J. M., 'French boost 1989 defense budget for conventional, nuclear upgrades', *Aviation Week & Space Technology*, 26 Sep. 1988, p. 31.

[145] Note 144.

[146] de Briganti, G., 'France, Britain mull joint development of longer range stand-off nuclear missile', *Defense News*, 1 Feb. 1988, p. 8.

[147] This figure is based on the following calculation: (18 × 1 Mt) + (18 × 300 kt) = 18 Mt + 5.4 Mt = 23.4 Mt.

[148] Commissariat à l'énergie atomique, *Rapport Annuel 1987* (CEA: Paris, 1988), p. 18. It was previously thought that the S4 would use the TN 75 warhead, the warhead planned for the M45 SLBM.

[149] 'Début de developpement du missile stratégique S4', *Air et Cosmos*, no. 1191 (21 May 1988), p. 42.

[150] Isnard, J., 'French looking at land-based M-4', *Jane's Defence Weekly*, 29 Oct. 1988, p. 1050.

[151] French Prime Minister Jacques Chirac, statements before a Diplomatic Press Association Luncheon, translated by the Service de Presse et d'Information of the French Embassy, London, 14 Dec. 1987, p. 5.

[152] French Prime Minister Jacques Chirac, speech given at the Institute of Higher National Defence Studies (IHEDN), translated by the Service de Presse et d'Information of the French Embassy, London, 12 Dec. 1987, pp. 5–6.

[153] French Minister of Defence André Giraud, 'France's Defense and European Security', speech given at Chatham House, London, translated by the Service de Presse et d'Information of the French Embassy, London, 22 Mar. 1988, p. 6.

[154] Note 152.

[155] 'Hades test flight success', *Jane's Defence Weekly*, 10 Dec. 1988, p. 1447.

[156] French President François Mitterrand, interview published in *Die Welt*, translated by the Service de Presse et d'Information of the French Embassy, London, 18 Jan. 1988, p. 6. Mitterrand said that he would give the order to manufacture the ERW if, 'instead of disarmament, there were to be a return to the hard line of the past four decades'; President Mitterrand, press conference in Hanover, translated by the Service de Presse et d'Information of the French Embassy, London, 22 Oct. 1987, p. 8.

[157] French President François Mitterrand, press conference in Hanover, translated by the Service de Presse et d'Information of the French Embassy, London, 22 Oct. 1987, p. 8.

[158] Note 157.

[159] 'France will keep up in arms race', *Jane's Defence Weekly*, 22 Oct. 1988, p. 1003.

[160] French President François Mitterrand, press conference in Hannover, translated by the Service de Presse et d'Information of the French Embassy, London, 22 Oct. 1987, p. 8. Another report stated that France was considering the postponement or even cancellation of Hadès as a good will gesture in disarmament negotiations; Isnard, J., 'French budget: 7550 jobs go, weapons go-ahead', *Jane's Defence Weekly*, 8 Oct. 1988, p. 845.

[161] 'Mirage 2000N', *Air Actualités*, no. 412 (July/Aug. 1988), p. 22. The 4th Fighter Wing was also the first FATAC wing to receive tactical nuclear weapons (AN-52) in 1972; 'A la 4e escadre de chasse, 150,000 heures de vol sur Mirage IIIE', *Air et Cosmos*, no. 1112 (11 Oct. 1986), p. 29.

[162] Commissariat à l'énergie atomique, *Rapport Annuel 1987* (CEA: Paris, 1988), p. 18.

[163] Guyot, H., 'La 4e escadre de chasse: un nouveau départ', *Air Actualités*, no. 412, July/Aug. 1988, p. 7.

[164] Isnard, J., 'France to update nuclear arsenal with ASMP', *Jane's Defence Weekly*, 30 July 1988, pp. 152–53.

[165] Note 164, p. 153.

[166] Prézelin, B., 'Les porte-avions', *Cols Bleus*, no. 1991 (4 June 1988), p. 7.

[167] Note 164, p. 153.

[168] Owing to financial constraints in the defence budget, the *Charles de Gaulle* will be delayed, with the sea trials to begin in 1996 (rather than 1995) and to become operational in 1997; Lenorovitz, J. M., 'French boost 1989 defense budget for conventional, nuclear upgrades', *Aviation Week & Space Technology*, 26 Sep. 1988, p. 31; Schwartzbrod, A.,'French '89 defense budget gives priority to R&D and nuclear forces', *Armed Forces Journal International*, Nov. 1988, p. 32.

[169] French Minister of Defence André Giraud, 'France's Defence and European Security', speech given at Chatham House, London, translated by the Service de Presse et d'Information of the French Embassy, London, 22 Mar. 1988, p. 5.

[170] French Prime Minister Jacques Chirac, interview published in *Le Point*, translated by the Service de Presse et d'Information of the French Embassy, London, 5 Oct. 1987, p. 2. In Mar. 1988 Giraud compared the process of reduction of nuclear weapons to that of a house of cards that has to

be dismantled without having it collapse. 'In our house of cards the topmost cards are those of conventional and chemical weaponry, followed by those of strategic nuclear weapons. The bottom-most cards, that is the cards that keep the whole edifice together, are those corresponding to pre-strategic nuclear weapons'; Minister of Defence Giraud, 'France's Defense and European Security', speech given at Chatham House, London, translated by the Service de Presse et d'Information of the French Embassy, London, 22 Mar. 1988, p. 5.

[171] Note 169, p. 1.

[172] French President François Mitterrand, 'Franco-British Summit', joint press conference with Prime Minister Thatcher in London, translated by the Service de Presse et d'Information of the French Embassy, London, 29 Jan. 1988, p. 1.

[173] 'A TASS interview with Eduard Shevardnadze', *Pravda*, 4 Dec. 1988, official English translation from *Daily Review* of Novosti Press Agency (APN), 5 Dec. 1988.

[174] See Fieldhouse, R., 'Chinese nuclear forces: an overview', SIPRI, *World Armaments and Disarmament: SIPRI Yearbook 1986* (Oxford University Press: Oxford, 1986), pp. 97–113.

[175] 'China detonates neutron bomb', *Washington Post*, 8 Nov. 1988, p. A23.

[176] See Jencks, H. W., 'PRC nuclear and space programs', in ed. R. H. Yang, *SCPS Yearbook on PLA Affairs 1987* (Sun Yat-sen Center for Policy Studies: Kaohsiung, Taiwan, 1988), chapter 9, p. 109.

[177] See Chinese reports translated in *Foreign Broadcast Information Service Daily Report—China* (hereafter cited as *FBIS-CHI-88-*) (National Technical Information Service (NTIS) of the US Department of Commerce: Washington, DC, daily) *FBIS-CHI-88-188*, 28 Sep. 1988, pp. 26–29.

[178] See *SIPRI Yearbook 1987* (note 134), p. 36.

[179] There is some confusion concerning the 1985 SLBM test launch. See Jencks (note 175), p. 111.

[180] Xinhua press release quoting the 6 Aug. overseas edition of *People's Daily*, translated as 'Navy armed with strategic nuclear missiles', in *FBIS-CHI-88-152*, 8 Aug. 1988, p. 32; and Shen, S., 'The Chinese navy forms a guided missile based attack force', translated in BBC *Summary of World Broadcasts*, Part 3, 10 Aug. 1988, reprinted in Institute for Defense and Strategic Analysis (IDSA), *News Review on East Asia*, Sep. 1988, p. 732.

[181] See *SIPRI Yearbook 1987* (note 133), p. 36.

[182] Note 47, p. 10. Emphasis added.

[183] 'Missile units have retaliatory capacity', translated and printed in British Broadcasting Corporation (BBC), *Summary of World Broadcasts* Part 3, 11 Jan. 1988, reprinted in Institute for Defense and Strategic Analysis (IDSA), *News Review on East Asia*, Feb. 1988, p. 112.

[184] 'Navy armed with strategic nuclear missiles', *FBIS-CHI-88-152*, 8 Aug. 1988, p. 32.

[185] The announcement appeared in a release from Xinhua, and appears in translation as: 'Announcement on experimental rocket launching', *FBIS-CHI-88-173*, 7 Sep. 1988, p. 22. See also *Beijing Review*, 25 Oct. 1982, p. 5.

[186] See Chinese reports translated in *FBIS-CHI-88-188*, 28 Sep. 1988, pp. 26–29.

[187] 'Xinhua "feature" on test', *FBIS-CHI-88-188*, 28 Sep. 1988, pp. 28–29.

[188] Wu, X. and Cao, G., 'Naval base conducts defensive exercise under the conditions of nuclear war', *Renmin Ribao*, 2 July 1988, p. 4, translated and reprinted in 'Navy exercise under nuclear war conditions', *FBIS-CHI-88-128*, 5 July 1988, p. 47; and 'Nuclear Notebook', *Bulletin of the Atomic Scientists*, Nov. 1988, p. 47. See also 'Sea fleet completes long-range exercises', *FBIS-CHI-88-006*, 11 Jan. 1988, pp. 37–38; and 'Navy exercise simulates nuclear war', *FBIS-CHI-87-235*, 8 Dec. 1987, p. 21.

[189] Wu, X. and Cao, G., 'Watching exercises aboard missile frigate no. 536', translated by BBC *Summary of World Broadcasts*, Part 3, 9 Aug. 1988, reprinted in IDSA *News Review on East Asia*, Sep. 1988, pp. 737–38. See also 'Chinese Navy shows its defects', *Jane's Defence Weekly*, 20 Aug. 1988, p. 295.

[190] See *SIPRI Yearbook 1988* (note 123), p. 52.

[191] See Cheung, T. M., 'China's bargain sale: bangs for a buck', *Far Eastern Economic Review*, 2 June 1988, pp. 22–23; 'Missile sales a test of US–Chinese relationship', United States Information Agency Wireless File, background article on briefing for Shultz's trip to China, 14 July 1988, USIA, Stockholm, Sweden.

[192] Chanda, N., 'The Third World race for ballistic missiles', *Far Eastern Economic Review*, 2 June 1988, pp. 22–24.

[193] Comments of Lin Zongtang, chief of the new Ministry of Aeronautics and Astronautics Industry, reported in *China Daily*, 6 July 1988, translated in IDSA, *News Review on East Asia*, Aug. 1988, p. 660.

[194] Sciolino, E., 'US fears Chinese may sell new missile', *International Herald Tribune*, 14 July 1988, p. 1.

[195] See *SIPRI Yearbook 1988* (note 123), p. 53.

[196] These included Secretary of State George Shultz in July, General William Burns, Director of the US Arms Control and Disarmament Agency (ACDA) in Aug., and Defense Secretary Carlucci in Sep. See Tyson, J. L., 'US tries again to staunch China arms flow', *Christian Science Monitor*, 4 Aug. 1988, p. 9.

[197] For descriptions of the satellite and CZ-4 launcher see *FBIS-CHI-88-173*, 7 Sep. 1988, pp. 22–24; and *FBIS-CHI-88-176*, 12 Sep. 1988, pp. 24–25.

[198] Note 197.

[199] Xu, Z., 'China's oceangoing astronautic survey fleet has reached an advanced level', *Liaowang* overseas edn, 12 Sep. 1988, pp. 14–15, translated in 'Liaowang praises astronautic sea fleet', *FBIS-CHI-88-181*, 19 Sep. 1988, pp. 30–31.

[200] Note 199, p. 31.

Appendix 1A. Agreement between the United States of America and the Union of Soviet Socialist Republics on Notifications of Launches of Intercontinental Ballistic Missiles and Submarine-Launched Ballistic Missiles

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties,

Affirming their desire to reduce and ultimately eliminate the outbreak of nuclear war, in particular, as a result of misinterpretation, miscalculation, or accident,

Believing that a nuclear war cannot be won and must never be fought,

Believing that agreement on measures for reducing the risk of outbreak of nuclear war serves the interests of strengthening international peace and security,

Reaffirming their obligations under the Agreement on Measures to Reduce the Risk of Outbreak of Nuclear War between the United States of America and the Union of Soviet Socialist Republics of September 30, 1971, the Agreement between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics on the Prevention of Incidents on and over the High Seas of May 25, 1972, and the Agreement between the United States of America and the Union of Soviet Socialist Republics on the Establishment of Nuclear Risk Reduction Centers of September 15, 1987,

Have agreed as follows:

Article I

Each Party shall provide the other Party notification, through the Nuclear Risk Reduction Centers of the United States of America and the Union of Soviet Socialist Republics, no less than twenty-four hours in advance, of the planned date, launch area, and area of impact for any launch of a strategic ballistic missile; an intercontinental ballistic missile (hereinafter 'ICBM') or a submarine-launched ballistic missile (hereinafter 'SLBM').

Article II

A notification of a planned launch of an ICBM or an SLBM shall be valid for four days counting from the launch date indicated in such a notification. In case of postponement of the launch date within the indicated four days, or cancellation of the launch, no notification thereof shall be required.

Article III

1. For launches of ICBMs or SLBMs from land, the notification shall indicate the area from which the launch is planned to take place.

2. For launches of SLBMs from submarines, the notification shall indicate the general area from which the missile will be launched. Such notification shall indicate either the

quadrant within the ocean (that is, the ninety-degree sector encompassing approximately one-fourth of the area of the ocean) or the body of water (for example, sea or bay) from which the launch is planned to take place.

3. For all launches of ICBMs or SLBMs, the notification shall indicate the geographic coordinates of the planned impact area or areas of the reentry vehicles. Such an area shall be specified either by indicating the geographic coordinates of the boundary points of the area, or by indicating the geographic coordinates of the center of a circle with a radius specified in kilometers or nautical miles. The size of the impact area shall be determined by the notifying Party at its discretion.

Article IV

The Parties undertake to hold consultations, as mutually agreed, to consider questions relating to implementation of the provisions of this Agreement, as well as to discuss possible amendments thereto aimed at furthering the implementation of the objectives of this Agreement. Amendments shall enter into force in accordance with procedures to be agreed upon.

Article V

This Agreement shall not affect the obligations of either Party under other agreements.

Article VI

This agreement shall enter into force on the date of its signature.

The duration of this Agreement shall not be limited.

This Agreement may be terminated by either Party upon 12 months written notice to the other Party.

DONE at Moscow on May 31, 1988, in two copies, each in the English and Russian languages, both texts being equally authentic.

For the United States of America: George P. Shultz.

For the Union of Soviet Socialist Republics: Eduard A. Shevardnadze.

Source: Arms Control Today, July/Aug. 1988.