1. Nuclear weapons

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Superscript numbers refer to the list of notes and references at the end of the chapter.

I. Introduction

Amidst sweeping proposals in 1986 by the United States and the Soviet Union to radically reduce and even abolish whole categories of nuclear weapons, both sides introduced at least one new strategic weapon system and continued to deploy a variety of existing nuclear weapon systems. After long research and development efforts the first MX intercontinental ballistic missiles (ICBMs) and B-1B bombers were declared operational and placed on 24-hour ('alert') duty in the USA, while the USSR fielded the SS-25 mobile ICBM and tested the new SS-NX-23 submarine-launched ballistic missile (SLBM). Deployments of nuclear weapons introduced in recent years continued at a steady pace. The USA and the USSR completed their deployment programmes for the Pershing II and SS-20 missile systems respectively, in late 1985; no more launchers were deployed, although additional missiles appear to be in production. In Britain, the keel of the first Trident Class submarine—the *Vanguard*—was laid. France deployed the first of a new generation of stand-off air-to-surface (ASMs), the ASMP, on Mirage IV aircraft. In addition France flight-tested an extended-range version of its M-4 SLBM, and placed orders for a new ballistic missile submarine and an aircraft-carrier. China conducted missile flight-tests during 1986 that appeared to be for developing multiple independently targetable re-entry vehicles (MIRVs) for China's ballistic missiles.

Directly bearing on current and future nuclear force structures were the year's developments in arms control. The USA and the USSR conducted three rounds of Nuclear and Space Talks in Geneva (see chapter 9), and a variety of other specially convened meetings took place. The most significant events were the US abrogation of the SALT II numerical limits, and the Reykjavik summit meeting in October. While some confusion still persists as to exactly what happened at Reykjavik there seemed to be, at least in principle, agreement between President Reagan and General Secretary Gorbachev to eliminate large categories of nuclear weapons. The translation of principle into reality remained a distant goal as the year ended.

In the United States, Congress took a more active role in influencing nuclear weapon and arms control policies. During the budget process, Congress cut funds for a number of nuclear systems, and the House of Representatives

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passed binding legislation to cut off funding for nuclear weapons that would break the SALT II Treaty ceilings and mandated a testing moratorium for all but the smallest nuclear tests. In the November elections the Democrats regained control of the Senate, and with it the ability to set an agenda that will strengthen these trends in 1987.

Many other events occurred during the year which had, or will have, an influence on nuclear weapon programmes. A large number of serious accidents during the year raised questions about sophisticated technological systems. Parallels were drawn between the Challenger explosion in January, the Chernobyl disaster in April (see chapter 13) and the sinking of a Soviet submarine in October on the one hand and the complex nuclear offensive systems of today and the potential defensive systems of tomorrow on the other hand.

The USA continued its Strategic Defense Initiative (SDI) programme during the year, although Congress cut funding for the second year in a row, from $4.8 billion to $3.2 billion. During the year, a number of countries (including the Federal Republic of Germany and Israel) signed memoranda of understanding (MOU) with the USA on joint SDI research and development programmes. The SDI programme continues to be the major bone of contention in US–Soviet nuclear arms control negotiations.

This chapter examines the nuclear weapon developments of the five nuclear weapon states in 1986.

II. US nuclear weapon programmes

During the year the USA fielded approximately 800 new strategic weapons and almost 200 new theatre and tactical weapons (see tables 1.1 and 1.2). These included: 100 warheads for the first 10 MX missiles, 200 warheads for the seventh Trident submarine, 300 air-launched cruise missiles (ALCMs) for the first squadrons of B-52H bombers, 200 gravity bombs for the first squadron of B-1Bs, 50 sea-launched cruise missile (SLCM) warheads, 80 ground-launched cruise missile (GLCM) warheads and several dozen new 8-inch nuclear artillery shells.

ICBMs

After 12 years of research and development (R&D) the first MX (LGM-118A) ICBMs were placed on alert at the end of the year. On 22 December the first 10 MX missiles attained initial operational capability (IOC) with the 400th Strategic Missile Squadron of the 90th Strategic Missile Wing at F.E. Warren Air Force Base (AFB) in Wyoming. This is the first new US ICBM deployment in 16 years. To install the MXs, the Air Force removed Minuteman III missiles, modified their silos, assembled the MX ICBMs, emplaced the warheads and placed the missiles in the (empty Minuteman III) silos. The first Minuteman III was removed from its silo on 6 January, with 8 removed by early August and 14 by early October. By early August the first 2 MXs had been inserted in silos.[1]

The Air Force conducted MX flight-tests numbers 11–15 in 1986. The 12th flight was the first to carry 10 Mk 21 re-entry vehicles. The MX schedule calls for 16 R&D flight-tests before IOC and 4 afterwards. The first phase of Operational Testing and Evaluation (OT&E) will begin in the fall of 1988, testing 24 missiles over a three-year period. During the second phase of OT&E a total of 83 missiles, approximately seven missiles a year, will be fired from Vandenberg AFB.[2]

The search for survivable MX basing modes continued, even though more than 30 schemes have been rejected in the past. Throughout 1986 the Air Force revived some of the older ideas in an effort to find an acceptable basing mode to justify the purchase of a second batch of 50 missiles, as required by Congress.

On 19 December the President announced that funds would be requested in the FY 1988 budget to design a basing scheme for deploying MX missiles on trains. In peacetime the missiles would be kept on military bases. Upon warning they would be dispatched on the US railway system. The idea of using trains to base the MX was among the eight concepts examined but was not among the four leading ones[3] until late in the year, when the 'rail garrison' mode began to be seriously discussed.[4]

The small ICBM (SICBM) continued to be a controversial weapon programme throughout the year. Concern increased about the number of missiles required, and their cost, size and basing mode.[5]

The Senate cut in half the fiscal year (FY) 1987 SICBM funding request of $1.4 billion, noting that this would delay the scheduled IOC of late 1992. A House-Senate conference compromise resulted in $1.2 billion for the programme.[6]

The FY 1986 Department of Defense (DOD) Authorization Act called for an independent review of the SICBM and its basing options to be conducted by the Defense Science Board. Their March 1986 report recommended that the weight of the SICBM be increased from 13 636 kg to 16 818 kg. 'The recommended additional weight permits full target coverage, penetration aids, and the capacity for future payload variations—including a Maneuvering Re-entry Vehicle (MaRV), or two warheads of smaller size than the baseline configuration of a single MK 21.'[7]

A heavier SICBM would require a heavier mobile launcher. The projected gross weight of a mobile launcher with a missile has already increased from 68 182–79 545 kg to 81 818–88 636 kg for the standard 13 636-kg missile. Every extra kilogram of missile would add 2 kg to the launcher. Thus a 16 818-kg missile would increase the launcher weight to 88 181–95 000 kg.

During the year Congress tried but eventually failed to entwine the fates of the MX and the SICBM. Congressional advocates of the SICBM, particularly those in the House, continued to argue the missile's merits on strategic and cost grounds.[8] The 1987 budget limited MX procurement to 12 missiles—9 fewer than the Administration request. A House-Senate conference defeated an attempt to tie progress on the SICBM to actual deployment of more MXs.

The preferred method of SICBM basing consists of hardened mobile launchers (HMLs) randomly dispersed on DOD and Department of Energy (DOE) installations. This operational concept envisions a practice of periodic

Table 1.1. US strategic nuclear forces, 1987

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)	Warhead × yield	Type	No. in stockpile
ICBMs[a]						
Minuteman II	450	1966	11 300	1 × 1.2 Mt	W-56	480
Minuteman III (Mk 12)	240	1970	13 000	3 × 170 kt	W-62	750
Minuteman III (Mk 12A)	300	1979	13 000	3 × 335 kt	W-78	950
MX	10	1986	11 000	10 × 300 kt	W-87	110
Total	**1 000**					**2 290**
SLBMs						
Poseidon	256	1971	4 600	10 × 50 kt	W-68	2 750
Trident I	384	1979	7 400	8 × 100 kt	W-76	3 300
Total	**640**					**6 050**
Bombers						
B-1B	18	1986	9 800	8–24	[b]	250
B–52G/H	263	1955	16 000	8–24[b]	[b]	4 733
FB-111	61	1969	4 700	6[b]	[b]	360
Total	**339**					**5 343**
Refuelling aircraft						
KC-135	615	1957	. .	. .	. .	. .

[a] The four Titan II ICBMs remaining at Dec. 1986 are scheduled to be deactivated by mid-1987.

[b] Bomber weapons include six different nuclear bomb designs (B-83, B-61-0, -1, -7, B-57, B-53, B-43, B-28) with yields from sub-kt to 9 Mt, ALCMs with selectable yields from 5 to 150 kt, and SRAMs with a yield of 200 kt. FB-111s do not carry ALCMs or B-53 or B-28 bombs.

Sources: Cochran, T. B., Arkin, W. M. and Norris, R. S., *Nuclear Weapons Databook, Volume 1: US Forces and Capabilities*, 2nd edn (Ballinger: Cambridge, MA, forthcoming); Joint Chiefs of Staff, *United States Military Posture for FY 1988*; authors' estimates.

Table 1.2. US theatre nuclear forces, 1987

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)	Warhead × yield	Type	No. in stockpile
Land-based systems:						
Aircraft						
[a]	2 000	. .	1 060–2 400	1–3 × bombs	[a]	2 800
Missiles						
Pershing II	108	1983	1 790	1 × 0.3–80 kt	W-85	125
GLCM	208	1983	2 500	1 × 0.2–150 kt	W-84	250
Pershing 1a	72	1962	740	1 × 60–400 kt	W-50	100
Lance	100	1972	125	1 × 1–100 kt	W-70	1 282
Honest John	24	1954	38	1 × 1–20 kt	W-31	132
Nike Hercules	27	1958	160	1 × 1–20 kt	W-31	75
Other systems						
Artillery[b]	4 300	1956	30	1 × 0.1–12 kt	[b]	2 022
ADM (special)	150	1964	. .	1 × 0.01–1 kt	W-54	150
Naval systems:						
Carrier aircraft						
[c]	900	. .	550–1 800	1–2 × bombs	[c]	1 000
Land-attack SLCMs						
Tomahawk	100	1984	2 500	1 × 5–150 kt	W-80-0	110
ASW systems						
ASROC	. .	1961	10	1 × 5–10 kt	W-44	574
SUBROC	. .	1965	60	1 × 5–10 kt	W-55	150
P-3/S-3/SH-3[d]	630	1964	2 500	1 × <20 kt	B-57	897
Naval SAMs						
Terrier	. .	1956	35	1 × 1 kt	W-45	290

[a] Aircraft include Air Force F-4, F-16 and F-111, and NATO F-16, F-104 and Tornado. Bombs include four types (B-28, B-43, B-57 and B-61) with yields from sub-kt to 1.45 Mt.

[b] There are two types of nuclear artillery (155-mm and 203-mm) with four different warheads: a 0.1-kt W-48, 155-mm shell; a 1- to 12-kt W-33, 203-mm shell; a 0.8-kt W-79-1, enhanced-radiation, 203-mm shell; and a variable yield (up to 1.1 kt) W-79-0 fission warhead. The enhanced radiation warheads will be converted to standard fission weapons.

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

[d] Some US B-57 nuclear depth bombs are allocated to British Nimrod, Italian Atlantique and Dutch 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,

random movement within a deployment area large enough to complicate enemy planning and targeting. During periods of increased tension the area of operation would double, and upon tactical warning of enemy attack the HMLs would disperse as far as possible. An average of eight square miles per missile would be needed for day-to-day operations, or 10 360 km² for a 500-missile force. A dispersed force would need 41 440 km².

A second basing concept is to put HMLs on alert at Minuteman missile bases where, upon tactical warning, they would disperse off site. A third concept combines the first two with some HMLs in random movement and some at Minuteman bases. A fourth alternative is the 'hard silo' in a patterned array basing mode, reminiscent of the 'dense pack' scheme for MX proposed in late 1982. During the year the number of candidate basing areas for possible SICBM deployment was reduced from 51 to 24, to be located in 14 states.[9]

By every account the SICBM programme will be costly. R&D costs (FY 1984–93) are estimated to be $12.7 billion. Total lifetime programme costs depend on which basing mode is chosen. Assuming 500 missiles are deployed, the costs range from $52.1 billion for the preferred random dispersal mode, to $44.8 for the Minuteman site option, to $47.0 for the mixed basing scheme.

Another SICBM development during the year was the apparent testing of an alternative candidate warhead to the baseline W-87 and W-88 warheads at the Nevada Test Site on 22 March (the Shot Glencoe test) sponsored by the Los Alamos National Laboratory.[10]

Deactivation of the Titan II missile force was almost completed during the year, with four missiles remaining at the end of the year and all Titan IIs expected to be deactivated by mid-1987.

Several new programmes have been initiated to enhance the targeting capabilities of US strategic nuclear forces against new Soviet mobile missiles and other 'strategic relocatable targets' (SRTs). The Air Force sought funding for a new R&D programme called Strategic Relocatable Target Capability in the amount of $985 000 for FY 1987 and $1.572 million for FY 1988. Two new Phase 1 warhead studies were initiated in March 1986 at the Los Alamos and Lawrence Livermore design laboratories to investigate warheads optimized for destroying such mobile targets. One design would use standard nuclear effects and the other advanced nuclear effects. Perhaps more complicated and more costly than the special warheads are the target acquisition problems associated with mobile missiles. The Air Force is considering special radars for this purpose for the Stealth and B-1B bombers.[11]

In a National Security Decision Directive, President Reagan ordered a study to investigate whether the USA should develop a MIRVed mobile missile about the size of the Minuteman, to augment or substitute for Midgetman.[12]

Strategic submarine programmes

Several strategic submarine programmes continued to be researched, purchased or deployed throughout the year. The FY 1987 budget authorized $1.52 billion for the 14th Ohio Class submarine (SSBN 739) and $1.124 billion for the first 21 Trident II missiles. On 16 August the *Nevada* (SSBN 733)

was commissioned, and on 13 December the *Tennessee* (SSBN 734) was launched.

Prior to commissioning on 28 May the *Nevada*, the eighth Trident submarine, began its sea trials. This forced the Reagan Administration to decide whether to remain within the SALT II MIRVed missile ceiling of 1200. Throughout the first months of the year the battle intensified over whether to adhere to the unratified (and as of 31 December 1985 expired) SALT II Treaty. (In June 1985, in a similar situation, President Reagan ordered that the *Sam Rayburn* be dismantled to remain under the same ceiling to compensate for the introduction of the *Alaska*.)

White House announcements in late April indicated that a tentative decision had been made to stay within the SALT limits by ordering the dismantlement of the two submarines.[13] In many quarters that decision was seen as final. Advisers Paul Nitze and Edward Rowney were sent abroad to inform and consult certain other nations. The NATO allies strongly favoured continued US compliance with the SALT II Treaty.[14] On 9 April, 52 Senators (including 14 Republicans) wrote to the President encouraging him not to exceed the SALT limits.[15] Nevertheless on 27 May the White House announced that the United States would no longer be bound by the provisions of the SALT Treaty. At the same time it was announced that two Poseidon submarines would be dismantled, which would keep the USA within the limit, although the rationale given was that it was for budgetary reasons. The two submarines chosen for dismantlement were the *Nathan Hale* (SSBN 623) and the *Nathaniel Greene* (SSBN 636). The *Nathaniel Greene* had run aground in the Irish Sea on 1 April and sustained major damage.[16]

The Administration was taken by surprise by the storm of criticism that resulted. Congress involved itself in the issue almost immediately. On 19 June the House of Representatives approved a non-binding resolution (House Concurrent Resolution 350) by a vote of 256 to 145 with 37 Republicans voting for the majority, stating that 'the President shall continue to adhere to the numerical sublimits of the SALT agreement as long as the Soviet Union does likewise'.[17] Stronger binding legislation introduced by Representative Norman D. Dicks during House consideration of the DOD Authorization Bill (HR 4428) in August, prohibited any spending for deployment of nuclear weapons that would exceed the SALT numerical limits. This passed on 12 August by a vote of 225 to 186, with 19 Republicans voting with the majority.

The Senate took several actions as well. On 19 June the Armed Services Committee attached a non-binding resolution to the DOD Authorization Bill by a vote of 10 to 9. Stronger Senate legislation was introduced by Senators Joseph R. Biden, Jr, and William Cohen which would have prohibited funding of weapon systems that would exceed SALT, but this amendment did not pass. Instead the Senate agreed to a non-binding, 'sense of the Senate' provision urging that the United States voluntarily comply with the central numerical sublimits provided that the Soviet Union does likewise. The Senate language was adapted in a House-Senate conference.

According to a poll conducted by the *Washington Post* and ABC News in late June, 61 per cent of the respondents felt that the USA should abide by SALT II

until a new accord is reached. Only 29 per cent agreed with Reagan's decision not to be bound by SALT.[18]

Strategic bomber programmes

After 16 years of development the first B-1B bombers were deployed. On 1 October 1986 the 337th Bombardment Squadron of the 96th Bombardment Wing reached IOC with the first B-1B placed on alert at Dyess AFB, Abilene, Texas. This is the first new heavy bomber for the USA since the Strategic Air Command (SAC) received its first B-52 in 1955. By the end of the year Dyess received the last of its allotted 29 aircraft, 14 of which will be used for training.[19] Ellsworth AFB, South Dakota, will have 35 aircraft in two squadrons by July 1987. One of the squadrons will be dedicated to conventional missions and one will maintain day-to-day nuclear alert.[20] Grand Forks AFB, North Dakota, and McConnell AFB, Kansas, will each get 17 aircraft by January and April 1988, respectively, if the schedule is met.

As the scheduled IOC approached, several problems developed, notably faulty electronic countermeasure equipment and leaky fuel tanks. It was also reported that the maximum altitude of the bomber with a full load of fuel and bombs was approximately 20 000 feet (about 6000 m).[21]

The B-1B will carry seven kinds of nuclear weapons: B-28, B-43, B-61 and B-83 gravity bombs, short-range attack missiles (SRAMs), ALCMs and eventually advanced cruise missiles (ACMs) in different combinations depending on the mission. The maximum payload capability is 56 818 kg. Internal loads can include up to 12 B-28 or B-43 bombs, 24 B-61 or B-83 bombs, and 24 SRAMS or 8 ALCMs on a rotary launcher. Externally the B-1B will be capable of carrying 14 additional ALCMs.

Some members of Congress continued to express concern about the growing number of classified military programmes that are not open to public scrutiny or discussion.[22] The Advanced Technology Bomber (ATB)—also called Stealth, under development by the Northrop Corporation—has long been in this category. On 3 June some cost estimates were released: research, development and procurement of 132 ATB aircraft are projected to cost $36.6 billion, or $277 million per aircraft (FY 1981 dollars).[23] In FY 1986 dollars the cost would be $50.3 billion or $381 million per aircraft. A secret DOD bomber study was delivered to Congress in the spring, affirming the Air Force position that it wants no more than 100 B-1Bs and 132 ATBs. No more B-52s are projected to be retired until after ATB deployment.[24]

With 98 B-52Gs already deployed with ALCMs, the Air Force began converting the B-52H force to carry ALCMs. By early January, 10 bombers had been modified. The pace and number of modifications were watched closely because the modification of the 131st B-52 would exceed the SALT II ceiling of 1320 MIRVed launchers and cruise missile-equipped bombers. The schedule changed over the year less for technical than for political reasons. In August it was reported that the Air Force schedule had slipped from the original date of 11 November to late December.[25] The 'delay' appeared to be an effort not to have the issue of breaching the SALT limit interfere with plans for

a possible summit meeting. Just before the Reykjavik summit meeting the timing issue arose again, with some in the Reagan Administration arguing that violating the numerical ceiling would improve Reagan's bargaining leverage.[26] On 12 November the 131st modified bomber was pushed out of a hanger at Kelly AFB, San Antonio, Texas, putting the USA in technical violation of the SALT ceiling of 1320 MIRVed missiles and cruise missile-carrying bombers. The Administration interpretation was that the limit would be broken when the bomber joined its operational unit. On 28 November the 131st bomber arrived for deployment at Carswell AFB with SAC's 7th Bombardment Wing.[27]

The Soviet Union stated on 5 December that it would abide by the treaty 'for the time being', but added that the US decision gave the Soviet Union 'all grounds to regard itself free from its commitments'.[28]

There is little doubt that arms control issues will be high on Congress's agenda in 1987, especially since the Democrats recaptured the Senate. On 9 December a resolution was passed by House Democrats which commits the Democratic leadership of the House to move as early as possible in 1987 to pass legislation requiring that treaty limits be maintained. On 15 December 57 Senators (including 10 Republicans) sent a letter to President Reagan urging him to reverse his decision.[29]

The Air Force is currently working on a new solid-fuel, rocket-propelled, supersonic short-range attack missile (SRAM II, designated XAGM-131A) to replace the current AGM-69A SRAMs now carried on B-52 and FB-111A bombers.[30] The new SRAMs would be carried on the B-1B and the ATB. Flight-testing is planned for the summer of 1989 with an IOC in the second quarter of 1992.

SRAM II is planned to be faster and twice as accurate, with a smaller radar cross-section and three times the range of the current version. One of the new missions of SRAM II would be to target hardened facilities in the Soviet Union in addition to its defence suppression role for attacking Soviet air defence systems to allow US aircraft to fly across the Soviet borders. It will also be smaller. The original plan called for modifications to the single rotary launcher in the bomb-bay to make it capable of holding 12 of the missiles instead of 8, but this was dropped for budgetary reasons. The programme calls for purchasing 1633 missiles at a cost of $3.064 billion. The Administration requested $164.7 million for R&D for FY 1987. A House amendment had contained a provision to limit the Air Force to either the SRAM II or the ACM but not both. Eventually Congress cut the SRAM request to $70 million and requested a report from the Secretary of Defense detailing SRAM costs, effectiveness and warhead alternatives, which will delay the awarding of full-scale engineering contracts which had been scheduled for January 1987.[31]

Theatre nuclear forces

At the end of 1986, 208 of 464 planned GLCMs were deployed at bases in Belgium, Italy, the Federal Republic of Germany and the UK, 80 more missiles than at the end of 1985.[32] Deployment of the first GLCMs to Wüschheim Air Station in FR Germany began in March, preparation of the Netherlands base at

Woensdrecht continued, and construction of the second British base began. The full complement of 108 Pershing II missiles were deployed in FR Germany by the end of 1985.

Overall, the number of US nuclear warheads in Western Europe continued to decline, in response both to the agreement reached by NATO Ministers at Montebello, Canada, in October 1983 to reduce the numbers of nuclear warheads in Europe (see *SIPRI Yearbook 1986*) and political and fiscal decisions resulting in numerous retirement and reduction programmes.[33] By end 1986, about 4600 warheads (see table 1.3) were deployed in Europe.

Table 1.3. US nuclear warheads in Europe, 1965–95

Type	May 1965	Dec. 1981	Dec. 1986	End modernization[a] (1992–95)
Artillery				
8-inch	975	938	900	~500 total
155-mm	0	732	732	
Tactical SSMs				
Lance	0	692	692	692
Pershing I	200	293	100	100
Pershing II	0	0	108	108
Honest John	1 900	198	0	0
Sergeant	300	0	0	0
Nike Hercules SAMs	990	686	75	0
Bombs	1 240	1 929	1 629	1 329
B-57 NDB	–	192	192	192
ADMs	340	372	0	0
GLCMs	0	0	208	464
Total	**5 945**	**6 032**	**4 636**	**3 385**

[a] Assuming there are no further reductions of nuclear warheads because of future arms control agreements.

Source: Authors' estimates.

Reductions since the original NATO modernization decision in December 1979 have now included: (*a*) withdrawal of all atomic demolition munitions (ADMs) from Europe (1985); (*b*) phased retirement of all Nike Hercules missile warheads (began in 1981, to be completed by 1988–89); (*c*) retirement of nuclear warheads used to arm Greek and Turkish Honest John tactical missiles (1985); and (*d*) 'significant reductions in the total of tactical bombs' since 1981 with the deployment of new B-61 bombs replacing older B-28 and B-43 bombs on a less than one-for-one basis.[34]

After numerous delays, it appears that US nuclear artillery modernization in Europe is moving forward (see *SIPRI Yearbooks 1985* and *1986* for further discussion). In mid-1986, it was reported that non-enhanced radiation versions of the new W-79 8-inch nuclear artillery projectile had been deployed in FR

Germany.[35] These warheads will replace older W-33 warheads, which will be gradually retired as new weapons are introduced. The enhanced radiation (ER) warheads produced between August 1981 and October 1984 for the short-range Lance missile and 8-inch artillery will most likely remain stored in the USA until such time as they are converted to non-enhanced radiation versions. According to one report, only 40 enhanced radiation versions of the W-79 were produced.[36]

Production of the W-79 8-inch projectile was completed in August 1986. Cut-off of production was in keeping with the NATO Supreme Allied Commander, Europe (SACEUR) plans of 'making the 155mm the principal NATO nuclear artillery system'.[37] The new 155-mm projectile (W-82) continues in development (in a non-enhanced radiation version), was scheduled to enter production engineering in May 1986, and will begin deployment in the early 1990s.

Defence Ministry officials of FR Germany said on 8 November that the West German Pershing 1As and NATO nuclear aircraft were no longer on 'quick reaction alert' (QRA).

Naval nuclear weapons

Although the Reagan Administration has been successful in its drive to build a '600-ship Navy' its efforts to acquire new tactical nuclear weapons for the Navy have largely failed.[38] Although the first nuclear-armed Tomahawk SLCM was deployed in June 1984, numerous anti-submarine, anti-air and anti-ship nuclear warhead programmes have been delayed or cancelled as a result of congressional actions. These actions include: (*a*) denial of funds by Congress for development of nuclear warheads for the Sea Lance, a submarine-launched anti-submarine rocket to replace SUBROC; (*b*) slowdown of the surface ship-launched anti-submarine version of Sea Lance to replace ASROC; (*c*) cancellation of the new nuclear-armed surface-to-air Standard missile (SM-2(N)) to replace the Terrier; (*d*) slowdown of the anti-submarine warfare stand-off weapon nuclear depth bomb (ASW SOW/NDB) to replace the B-57 depth bomb; and (*e*) cancellation of potential nuclear warhead development programmes for the Phoenix air-to-air missile, 'supersonic anti-ship missile', vertical-launch ASROC (VLA), and Harpoon anti-ship missile.

In spite of the production and deployment problems associated with the new warheads, the Navy is continuing to work on the nuclear anti-submarine and anti-aircraft systems. Operational improvements are being incorporated into Navy ships and submarines to increase launcher flexibility and reaction time. The Vertical Launch System (VLS/MK45) on board surface ships is undergoing Operational Evaluation and is planned to become operational in the spring of 1987. The first test vertical launch of a Tomahawk SLCM from a ship was in May 1985, from the *Norton Sound* (AVM-1).[39] The *Bunker Hill* (CG-52), the first VLS-equipped cruiser, was commissioned into active service on 20 September. The Capsule Launch System (CLS/MK45) on Los Angeles Class attack submarines (commencing with the *Providence* (SSN-719)) is undergoing full-scale development.[40] The *Pittsburgh* (SSN-720) has been fitted

with the CLS and is the test submarine for submerged testing of the Tomahawk SLCM.[41]

Deployment continues of the nuclear-armed version of the Tomahawk (TLAM/N). By the end of 1986, some 100 SLCMs had been deployed. According to the DOD, 'Tomahawk equipped submarines are now routinely deploying to several operational areas worldwide . . .'[42] The programme retains its goal of 3994 SLCMs, of which 758 will be the nuclear TLAM/N.

By the end of 1985, the Navy had certified 8 surface ships and 15 attack submarines to carry the Tomahawk, and had converted seven submarine tenders and three shore facilities to support submarine operations.[43] Six additional surface ships and 10 attack submarines are planned for SLCM certification in 1986, and the Naval Magazine, Guam will be upgraded to support SLCM operations.[44] As of March 1986, the planned Tomahawk platforms included 4 battleships, 5 nuclear-powered guided missile cruisers, 22 guided missile cruisers, 31 destroyers, and 29 guided missile destroyers for a total of 91 surface ships; and 68 Los Angeles Class and 39 Sturgeon Class attack submarines, for a total of 107 submarines.[45]

Operationally, Tomahawk SLCMs have been integrated into both the US Atlantic and Pacific Fleets. Its versatility and range (2400 km) allow it to be used to support tactical, theatre and strategic operations and contribute to what the Pentagon calls 'the Nuclear Reserve Force'.[46]

The Navy has begun phasing out the SUBROC submarine-launched anti-submarine stand-off weapon. Navy plans were approved by the DOD in January 1980 for a new Anti-Submarine Warfare Stand-Off Weapon (ASWSOW), now named Sea Lance, to replace the ageing SUBROC. Even though the development of a new missile was approved partly because it would emphasize a conventional warhead, in 1982 the Navy decided to pursue a nuclear depth bomb as the primary warhead and to deploy a conventional warhead two years after the initial deployment of a nuclear variant.[47] The ASWSOW, which has experienced numerous delays and funding cutbacks, was slated to begin full-scale engineering development in mid-1986,[48] but Congress eliminated funding for the weapon in the FY 1987 budget and decided to further delay the Sea Lance.

The Navy requested $1.6 million in the FY 1987 budget to begin development of an airborne ASW nuclear weapon—called the Nuclear Depth/Strike Bomb (NDSB)—to replace the B-57 nuclear bomb for delivery from patrol or carrier-based aircraft.[49] This weapon, which will serve both anti-submarine and tactical strike roles, will also replace B-43, B-61-2 and B-61-5 tactical strike bombs in the Navy.[50]

In May 1984, the Navy terminated its nuclear Standard Missile programme (SM-2(N)) owing to budget constraints. Four months later the Navy changed its mind, requesting reinstatement of funding based on the assessment that SM-2(N) 'is an essential part of the Navy's air defense capability for the 1990's'.[51] In FY 1986 the Navy requested $9.2 million for the programme, and Congress appropriated $3 million. In the FY 1987 budget, the Navy reduced the programme request itself from $23.9 to $9.2 million owing to 'program restructuring'. Congress deleted funds for the programme. Prior to congres-

sional action on the FY 1987 budget, the Navy estimated that the total research, development, test and evaluation (RDT&E) costs for the SM-2(N) would be $257.8 million.[52]

SDI and the new 'Strategic Concept'

Over the past two years some of the most important weapon and arms control developments concerned a system that does not yet exist. The US Strategic Defense Initiative influenced budget, treaty interpretation, strategic doctrine, domestic political and international geopolitical issues during 1986.

Funding for SDI comes from DOD and DOE budgets. For FY 1987 the Administration requested $4.8 billion and $603 million respectively. Final congressional action cut the budgets, to $3.2 billion and $317 million respectively, a 34 per cent cut. This decision indicates that SDI will not grow by billions of dollars a year as the Administration had planned, but rather by a few hundred millions of dollars a year.

The issue of what kind of research, development and testing can be done under the terms of the Anti-Ballistic Missile (ABM) Treaty continued to be disputed among different parts of the Reagan Administration and proved to be the central cause of the stalemate between President Reagan and General Secretary Gorbachev at their October Reykjavik summit meeting.

Memoranda of understanding about the nature and amount of SDI research to be done in various countries were signed during the year: on 6 December 1985 with the United Kingdom, on 27 March 1986 with the Federal Republic of Germany and on 6 May 1986 with Israel. The issue of SDI involvement has become an important and sometimes politically difficult one for certain allied governments, especially those which support continued compliance with the ABM Treaty.

SDI remained the major obstacle to progress at the Geneva negotiations. The Reagan Administration stuck firmly to the belief that the SDI programme offered promise and should continue. For the Soviet Union the issues of defensive and offensive forces are clearly linked, and any progress on reducing strategic arms could only be achieved if there were continued restrictions on defensive programmes.

After the Reykjavik summit meeting the disagreement over SDI focused on the issue of how long a period of time there could be before any deployment begins and what kind of research could be permitted during this period.

Although the goal of a non-nuclear defence has been stated often by President Reagan and Secretary of Defense Weinberger, the SDI programme has a rather large nuclear weapon component. The Reagan Administration has accelerated funding to examine five Nuclear-Driven Directed Energy Weapon (NDEW) concepts by the national laboratories at Los Alamos and Livermore. These concepts are: the X-ray laser, hypervelocity pellets, directed microwaves, particle beams and the optical laser.[53] Most attention has gone to the X-ray laser.[54] At least five nuclear tests from 1980–85 at the Nevada Test Site have involved the X-ray laser. One X-ray laser test was scheduled for 1986 and two are scheduled for 1987.[55]

The impact of the concept of defence in general and of SDI in particular is taking hold among Administration policy makers and analysts and nuclear war planners. This evolving idea is labelled the new 'Strategic Concept' or new 'Strategic Policy'.[56] It was drafted by Paul Nitze in mid-1984 and given official approval in National Security Decision Directive (NSDD) 153, signed by President Reagan in January 1985. It was also included in NSDD 165, which was the set of instructions given to the US negotiators before their negotiations at Geneva which began on 12 March 1985. The strategic policy is intended to be the basis for future military doctrine and a goal for arms control objectives. It envisions a shift from a national strategy based on offensive deterrence to one based on both offensive and defensive weapon systems.

III. Soviet nuclear weapon programmes

Like the United States, the Soviet Union continued to field new nuclear weapon systems and pursue a variety of R&D programmes during 1986. Additional systems were deployed in all three legs of the Soviet nuclear triad: ICBMs, SLBMs and bombers (see table 1.4). Although SS-20 deployments appear to have completed, shorter-range theatre nuclear forces proceeded with modernization and deployment in Eastern Europe (see table 1.5).

ICBMs

The year saw the continuing deployment of mobile ICBMs. SS-11 Mod. 1 missiles were deactivated and SS-25 (Soviet designation RS-12M[57]) were deployed. By October 1986, 72 SS-25s had been deployed in a road-mobile configuration similar to that of the SS-20 in 8 regiments of 9 missile launchers each, with a compensating reduction of 72 in the number of SS-11 Mod. 1 missiles. The SS-25 is thought to have a refire capability.[58]

Early in the year US intelligence estimates posited that the first 10 rail-mobile 10-warhead SS-X-24 (Scalpel) ICBMs could conceivably be deployed as early as late 1986, to be followed by a silo-based version.[59] Evidence that the first deployments would be rail-mobile rather than silo-based came from monitoring the Soviet test programme over the period 1985–86.[60] The information monitored apparently caused the USA to reassess the missile, estimating that it is less accurate than originally believed.[61] Preparations for the deployment of the SS-X-24 were under way at the beginning of the year at two locations in the European USSR. However, it had not been deployed by the end of the year.

The SS-18 (designated Satan by NATO) Mod. 4 modernization programme was finally completed during 1986. Some single-warhead SS-17 Mod. 2 and SS-19 Mod. 2 missiles and 8- or 10-warhead MIRVed SS-18 Mod. 2 missiles may still be deployed.[62]

Soviet R&D on future ICBMs continues. Activity at the Soviet ICBM test ranges indicates that three new or modified ICBMs have entered the engineering and flight-testing state of development.[63] A new liquid-fuelled,

silo-based heavy ICBM to replace the SS-18[64] was reportedly flight-tested three times in 1986. The first two tests were both failures. In the 2 April test the missile reportedly exploded shortly after emerging from its silo[65] at Tyuratam. During the second flight-test, conducted in mid-August, the missile exploded in mid-flight, perhaps as the first stage finished firing or when the second stage ignited. The failure was acknowledged by a Soviet Foreign Ministry spokesman, Boris D. Pyadyshev, at a news briefing—a new development in itself.[66] It was reported that the first successful flight-test of this SS-18 follow-on, which is expected to be designated SS-X-26 by NATO, took place from Tyuratam in mid-December.[67]

Other Soviet ICBM developments are mentioned in US documents, but with very little detail.[68] A possibly larger version of the SS-X-24 may 'begin flight-testing in the next few years'. There also could be a new version of the SS-25 with a MIRVed payload option. Modifications of the SS-18 and SS-19 will probably continue. According to an unofficial report, the USA expects the USSR to begin flight-testing an operational MaRV vehicle for its ballistic missiles, possibly by the end of the decade.[69]

Strategic submarine programmes

The Soviet Union continued its strategic submarine and SLBM programmes during the year. The SS-N-20 (Sturgeon) SLBM is now carried on four Typhoon submarines, of which as many as four more may be deployed by the early 1990s.[70] According to the Pentagon, developmental or prototype production of newer SLBMs is under way.[71] SS-N-20 production has reportedly been affected by a massive explosion at a Soviet missile fuel plant at Biysk, 80 km south-east of Novosibirsk.[72] It is possible that the Soviet Navy has begun using a two-crew system for the Typhoon Class submarine to reduce turnaround time between deployments.[73] Typhoon submarines, too large for existing strategic submarine base facilities at Polyarnyi, are reportedly based at Gremikha, some 300 km east of Severomorsk on the northern coast of the Kola Peninsula. According to these reports this base, in the final phases of completion, contains piers to specifically accommodate the Typhoon, and has hardened docking facilities in the surrounding granite cliffs.[74] Similar tunnels are also reported to be under construction at the Polyarnyi base and at the base near Vladivostok.[75]

The first two Delta IV Class submarines, each fitted with 16 of the long-range SS-N-23 (Skiff) missiles, are now in service. A third is probably on sea trials, and more are expected. The large, 10-warhead liquid-fuelled SS-N-23 has greater throw-weight, carries more warheads and is more accurate than the SS-N-18 (Stingray) currently carried on the Delta III submarines. After conversion Delta IIIs will probably carry the new missile as well.[76] Given past Soviet practice, it is likely that both the SS-N-20 and the SS-N-23 will be modified and improved.[77]

The USSR experienced a major nuclear weapon accident at sea in 1986. On the morning of 3 October a Yankee I submarine suffered an accident, killing at least three of the 120-man crew. The submarine was on routine patrol 880 km

Table 1.4. Soviet strategic nuclear forces, 1987

Weapon system					Warheads	
Type	NATO code-name	No. deployed	Year deployed	Range (km)	Warhead × yield	No. in stockpile[a]
ICBMs						
SS-11 Mod. 1	Sego	28	1966	11 000	1 × 1 Mt	29 – 56
Mod. 2		360	1973	13 000	1 × 1 Mt	380 – 720
Mod. 3		60	1973	10 600	3 × 250–350 kt (MRV)	190 – 360
SS-13 Mod. 2	Savage	60	1972	9 400	1 × 600–750 kt	63 – 120
SS-17 Mod. 2	Spanker	150	1979	10 000	4 × 750 kt (MIRV)	630 – 1 200
SS-18 Mod. 4	Satan	308	1979	11 000	10 × 550 kt (MIRV)	3 200 – 6 200
SS-19 Mod. 3	Stiletto	360	1979	10 000	6 × 550 kt (MIRV)	2 300 – 4 300
SS-X-24	Scalpel	. .	1987?	10 000	7–10 × 100 kt (MIRV)	. . . .
SS-25	Sickle	72	1985	10 500	1 × 550 kt	76 – 140
Total		**1 398**				**6 900 –13 000**
SLBMs						
SS-N-5	Sark	39	1963	1 400	1 × 1 Mt	41 – 47
SS-N-6 Mod. 1/2	Serb	288[b]	1967	2 400	1 × 1 Mt	450 – 520
Mod. 3			1973	3 000	2 × 200–350 kt (MRV)	
SS-N-8	Sawfly	292	1973	7 800	1 × 800 kt–1 Mt	310 – 350
SS-N-17	Snipe	12	1977	3 900	1 × 1 Mt	13 – 14
SS-N-18 Mod. 1/3	Stingray	224	1978	6 500	3–7 × 200–500 kt	710 – 1 900
Mod. 2			1978	8 000	1 × 450 kt–1 Mt	
SS-N-20[c]	Sturgeon	80	1983	8 300	6–9 × 350–500 kt	500 – 860
SS-N-23[c]	Skiff	32	1986	7 240	10 × 350–500 kt	340 – 380
Total		**967**				**2 400 – 4 100**
Bombers						
Tu-95	Bear A/B/C/G	100	1956	8 300	2–4 × bombs/ASMs	280 – 560
Tu-95	Bear H[d]	40	1984	8 300	8 × AS-15 ALCMs	320 – 640
Total[e]		**140**				**600 – 1 200**
Refuelling aircraft[f]		140–170				

ABMs						
ABM-1B	Galosh Mod.	32	1986	320	1 × unknown	32 – 64
ABM-3	Gazelle	68	1985	70	1 × low yield	68 – 140
Total		**100**				**100 – 200**

[a] Figures for numbers of warheads are low and high estimates of possible force loadings (including reloads). Reloads for ICBMs are 5 per cent and 100 per cent; and for SLBMs 5 per cent and 20 per cent extra missiles and associated warheads. Half the SS-N-6s are assumed to be Mod. 3s, and SS-N-18 warheads are assumed to be 3 or 7 warheads. Bomber warheads are force loadings and force loadings plus 100 per cent reloads. It is assumed that 40 Bear Gs are now deployed (4 warheads each). All warhead total estimates have been rounded to two significant digits. Warhead estimates do not include down-loading for single-warhead SS-17 Mod. 2, SS-19 Mod. 2 or SS-18 Mod. 1/3 missiles, which could be deployed, nor lower estimates for the SS-18 force, which could still include some Mod. 2 missiles with 8 or 10 warheads.

[b] It is not known whether the Soviet Union has already removed—or is planning to remove—from operational service an additional one or two Yankee Is during 1986 to make room for additional Typhoon and Delta IV Class submarines which may have entered sea trials. Alternatively, the USSR may have decided to wait to make these withdrawals until the USA exceeds the SALT limits.

[c] An additional Typhoon (20 SS-N-20 missiles) and Delta IV (16 SS-N-23 missiles) may be on sea trials and are thus included in the force totals. See note *b*.

[d] It is believed that, as of mid-1986, three squadrons of 12 Bear H aircraft each were in service. An additional squadron may have entered the operational force by the end of 1986.

[e] Excludes 30 MYA-4 Bison bombers which are under dispute. The USA believes that they remain SALT-accountable, while the USSR claims that they have been converted to refuelling tankers. Here they are included in the refuelling aircraft totals.

[f] Includes Badger and Bison A bombers converted to aerial refuelling and 15 confirmed new Bison conversions, with 30 possible new Bison conversions claimed by the USSR.

Sources: Authors' estimates derived from: Cochran, T. B., Arkin, W. M. and Sands, J. I., *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons* (Ballinger: Cambridge, MA, forthcoming); Arkin, W. M. and Sands, J. I., 'The Soviet nuclear stockpile', *Arms Control Today*, June 1984, pp. 1–7; Department of Defense, *Soviet Military Power*, 1st, 2nd, 3rd, 4th, 5th 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); 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 Cronin, P. M., *U.S./Soviet Military Balance*, Library of Congress/Congressional Research Service, Report No. 85-83 F, 15 Apr. 1985; Background briefing on *SMP, 1986*, 24 Mar. 1986; SASC/SAC, *Soviet Strategic Force Developments, S. Hrg. 99–335*, June 1985; Polmar, N., *Guide to the Soviet Navy*, 4th edn (US Naval Institute: Annapolis, MD, 1986); Joint Chiefs of Staff, *United States Military Posture for FY 1988*.

Table 1.5. Soviet theatre nuclear forces, 1987

Weapon system					Warheads	
Type	NATO code-name	No. deployed	Year deployed	Range (km)	Warhead × yield	No. in stockpile[a]
Land-based systems:						
Aircraft						
Tu-26	Backfire	144	1974	3 700	2–3 × bombs or ASMs	288
Tu-16	Badger	287[b]	1955	4 800	2 × bombs or ASMs	480
Tu-22	Blinder	136[b]	1962	2 200	1 × bombs or ASMs	136
Tactical aircraft[c]		2 885	. .	700–1 000	1–2 × bombs	2 885
Missiles						
SS-20	Saber	441	1977	5 000	3 × 250 kt	1 323–2 200[d]
SS-4	Sandal	112	1959	2 000	1 × 1 Mt	112
SS-12 Mod. 1/2	Scaleboard	~130	1969/78	800–900	1 × 200 kt–1 Mt	130
SS-1C	Scud B	690	1965	280	1 × 100–500 kt	690–1 400
SS-23	Spider		1985	350	1 × 100 kt	
. .	FROG 7	890	1965	70	1 × 10–200 kt	890–3 600
SS-21	Scarab		1978	120	1 × 20–100 kt	
SS-C-1B[e]	. .	100	1962	450	1 × 50–200 kt	100
SAMs[f]		n.a.	1956	40–300	1 × low kt	n.a.
Other systems						
Artillery[g]		<7 700	1974	10–30	1 × low kt	n.a.
ADMs		n.a.	n.a.	–	n.a.	n.a.
Naval systems:						
Aircraft						
Tu-26	Backfire	132	1974	3 700	2–3 × bombs or ASMs	264
Tu-16	Badger	220	1961	4 800	1–2 × bombs or ASMs	480
Tu-22	Blinder	35	1962	2 200	1 × bombs	35
ASW aircraft[h]		204	1965	. .	1 × depth bombs	204
Anti-ship cruise missiles						
SS-N-3	Shaddock/Sepal	264	1962	450	1 × 350 kt	264
SS-N-7	. .	96	1968	56	1 × 200 kt	96
SS-N-9	Siren	224	1969	111	1 × 200 kt	224
SS-N-12	Sandbox	120	1976	500	1 × 350 kt	120
SS-N-19	. .	112	1980	460	1 × 500 kt	112
SS-N-22	. .	44	1981	111	1 × 200 kt	44

Land-attack cruise missiles						
SS-N-21	. .	?	1986	3 000	1 × n.a.	n.a.
SS-NX-24	. .	12?	1986?	<3 000	1 × n.a.	n.a.
ASW missiles and torpedoes						
SS-N-14	Silex	314	1968	50	1 × low kt	314
SS-N-15	. .	n.a.	1972	40	1 × 10 kt	n.a.
SUW-N-1/FRAS-1	. .	10	1967	30	1 × 5 kt	10
Torpedoes		n.a.	1957	16	1 × low kt	n.a.
Naval SAMs[i]						
SA-N-1	Goa	65	1961	22–32	1 × 10 kt	65
SA-N-3	Goblet	43	1967	37–56	1 × 10 kt	43
SA-N-6	. .	33	1981	65	1 × 10 kt	33
SA-N-7	. .	9	1981	28–52	1 × 10 kt	9

[a] Estimates of total warheads are based on minimal loadings of delivery systems plus reloads for launchers which are deployed with reload weapons. Since many systems are dual-capable, these figures should not be viewed as precise. As a consequence, all figures (with exceptions for SS-20 and SS-4 missile force loading estimates since these systems only carry nuclear warheads) are rounded to two significant figures.

[b] There are some 360 Badger and Blinder strike variants, approximately two-thirds of which are Badgers.

[c] Nuclear-capable tactical aircraft models include MiG-21 Fishbed L, MiG-27 Flogger D/J, Su-7 Fitter A, Su-17 Fitter C/D/H, Su-24 Fencer and Su-25 Frogfoot.

[d] The number of reload missiles available for each regiment is a matter of dispute. It is estimated that there is one missile reload available for two-thirds of the launchers in each regiment.

[e] Land-based anti-ship missile.

[f] Nuclear-capable land-based surface-to-air missiles probably include SA-1 Guild, SA-2 Guideline, SA-3 Goa, SA-5 Gammon, SA-10 Grumble and SA-12 Gladiator.

[g] Artillery include some 3700 M-1981 2S5 152-mm SP guns, M-1976 152-mm T guns, M-1975 2S7* 203-mm SP guns and M-1975 2S4* 240-mm SP mortars. An additional 4000 M-1973 2S3 152-mm SP howitzers and older 152-mm towed guns may be nuclear-capable, although the status of crew certification for these systems is unknown. The 152-mm guns deployed on Sverdlov cruisers could also be nuclear-capable, although the status of the cruisers themselves is unclear.

[h] Includes 94 Be-12 Mail, 50 Il-38 May and 60 Tu-142 Bear F. Land- and sea-based helicopters—including the Ka-25 Hormone, Ka-27 Helix and the Mi-14 Haze—could also have a nuclear delivery capability.

[i] The SA-N-1, SA-N-3 and SA-N-6 are believed to have a definite nuclear capability and the SA-N-7 a possible nuclear capability. Number deployed is the number of launch arms (e.g., two twin launchers equal four launch arms) deployed on ships. Overall, there are more than 3300 SAMs of these four types deployed on 70 ships of 11 classes.

Sources: Cochran, T. B., Arkin, W. M. and Sands, J. I., *Nuclear Weapons Databook, Volume IV, Soviet Nuclear Weapons* (Ballinger: Cambridge, MA, forthcoming); Arkin, W. M. and Sands, J. I., 'The Soviet nuclear stockpile', *Arms Control Today*, June 1984, pp. 1–7; 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 edns; NATO, *NATO–Warsaw Pact Force Comparisons*, 1st, 2nd edns; Joint Chiefs of Staff, *United States Military Posture for FY 1988*; interviews with US DOD officials, Apr. and Oct. 1986; 'More self-propelled gun designations', *Jane's Defence Weekly*, 7 June 1986, p. 1003.

east of Bermuda and some 1914 km east of Cape Hatteras, North Carolina (31°11'N latitude, 55°14'W longitude) in the Atlantic patrol zone (a rectangular area some 1000–2000 km off the US east coast, known as 'The Box'). The accident apparently resulted from a fire and an explosion of the liquid-fuel propellant of the SS-N-6 (Serb) missile in the third port launch tube. The explosion blew off the missile door bending it back 'like a pretzel' and tore holes elsewhere in the hull which resulted in flooding.

After two attempts to move on its auxiliary diesel-electric engines, the submarine was taken in tow by one of the three Soviet merchant ships that had come to its rescue. These efforts did not succeed, and the submarine started to sink at about 12:20 hrs Eastern Daylight Time on 6 October and by 04:00 hrs had fully sunk.[78] The submarine remains Soviet property unless they declare it abandoned. Salvage attempts by either the USA or the USSR are unlikely given that it sank to a depth of 5625 m.

In another significant accident, on 11 September a SS-N-8 (Sawfly) SLBM fired from a Delta II submarine in the Barents Sea misfired and landed near the Amur river 290 km west of the Soviet city of Khabarovsk. The missile, more than 2400 km off course from its planned impact site on the Kamchatka Peninsula, carried a single dummy warhead weighing about half a ton. Missiles which malfunction are usually destroyed in flight, but a short circuit of the missile's electronic guidance system may have blocked the flight centre's destruction command. It is not known whether the missile landed on Chinese or Soviet territory.[79]

Strategic bomber programmes

There are some 140 Tu-95 Bear long-range bombers of five types assigned to the 36th (or Moscow) Strategic Air Army under the direct operational control of the Soviet High Command. All of the Bear bombers are capable of delivering a variety of conventional and nuclear gravity bombs. Three-quarters of the force were built in the 1950s, and two-thirds of these aircraft are configured to carry nuclear-capable air-to-surface missiles. The remaining one-quarter are new aircraft built in the 1980s to carry the new, nuclear-armed AS-15 air-launched cruise missile.

Bear H bombers can carry at least 8 and possibly as many as 12 AS-15 ALCMs internally in the bomb-bay and externally on pylons mounted under the wings. Integration of the ALCM into the Soviet bomber force is still progressing at a slow rate, with only three Bear H squadrons (approximately 40 aircraft) reportedly in service.[80] The Soviet Strategic Aviation forces have been increasingly simulating strategic stand-off cruise missile strikes against the Western continental land-mass with the Bear H in training and orientation flights. Soviet Bear H flights intercepted by the USAF Alaskan Air Command appear to indicate that some of the new aircraft are deployed in the Far East.[81]

The Soviet Union continues to reconfigure older Bear Bs and Cs to carry the supersonic AS-4 (Kitchen) missile instead of the subsonic AS-3 (Kangaroo). Several of these aircraft, known as Bear Gs, are operational.[82]

Five Blackjack A developmental aircraft are now reportedly in advanced flight-testing. A Pentagon official has said that the new bomber could be operational 'as early as 1988'.[83] The Blackjack is expected to carry AS-15 cruise missiles and nuclear gravity bombs.[84] The Blackjack will probably first replace Bear As, then Bear Gs, with all older Bear bombers replaced by the middle of the 1990s.[85]

A new, large air base under construction in the southern part of the Kola Peninsula may be used as an additional operating base in the region, supplementing the base at Olenegorsk. The length of the runway is 4600 metres (some 600 metres longer than Olenegorsk) and may be intended for the Blackjack bomber.[86]

A potentially significant development in 1986 was a specific statement made by Army General V. Shabanov, a Soviet deputy defence minister, about the 'chief component of our Armed Forces' combat might . . . the Strategic Missile Forces and the Strategic forces of the Navy and Air Force, which are in constant readiness to immediately inflict a retaliatory strike' as '*[t]his triad of strategic nuclear forces*' (emphasis added).[87] This statement, the first to use the word 'triad', could suggest that long-range bombers of the Strategic Aviation Armies may now be considered by the USSR to be on equal footing with the ballistic missile forces.

Strategic defence developments

The exact status and nature of the Soviet strategic defence programme continue to be an issue of some disagreement and contention in the West. Numerous Western reports gave few details of Soviet programmes involving lasers presumed to be for ASAT or strategic defence research purposes (see chapter 3).

The Moscow ABM system is now nearing the end of its modernization with updated Galosh missiles and new, dual-capable endo-atmospheric Gazelle missiles scheduled to begin operation in 1987.[88] The ranges of the new interceptor missiles are now estimated at 320 km and 70 km, respectively.[89] There is a report of Soviet stockpiling of Gazelle missiles. To some this is indicative of the Soviet tendency to overproduce, to others evidence of an intent for a more widespread ABM system.[90]

The supporting system of radars for detection, early warning, and target tracking and battle management is also being expanded and improved. Three Steelwork over-the-horizon backscatter (OTH-B) radars, in operation since the late 1970s, supplement the satellite-borne missile-launch detection network to provide about 30 minutes' warning of US or Chinese ICBM launches and determine the general origin of the missiles. Construction has begun on what appear to be three modern large phased-array radars (LPARs) of the type previously reported under construction at six other sites in the USSR, including the much-discussed LPAR at Abalakova near Krasnoyarsk. These three new sites would provide upgraded coverage against a missile attack from the Mediterranean and European approaches to Soviet territory.[91] By the end of the year it was reported that construction of buildings to house a large

new radar operations centre had been completed at Abalakova and that it could be operating within a year.[92]

Theatre nuclear forces

Little change occurred in Soviet intermediate-range nuclear forces (INF) during 1986. SS-20 (Saber) deployments remained at 441 launchers, and SS-4 (Sandal) missiles remained at 112, the same figures as for 1985.[93] The SS-20 production and deployment programme may be completed, as the number of launchers has remained the same since September 1985, and SS-25 deployments continue at bases previously associated with the SS-20. No reports were received in 1986 that indicated the continued retirement of the SS-4s, although it is assumed that they are being dismantled.

Contrary to US Government predictions, the USSR did not deploy a prototype SSC-X-4 ground-launched cruise missile during 1986, nor a ground-launched variant of the SS-NX-24 sea-launched cruise missile.[94]

Among theatre forces the most interesting developments occurred in short-range weapons—designated 'operational-tactical' and 'tactical' by the Soviet Union. The SS-12M (SS-12 Mod. 2), SS-23 and SS-21 continued to be deployed, replacing and augmenting older SS-12, Scud-B and FROG-7 missiles (see table 1.5, and see *SIPRI Yearbook 1986*, pages 57–8, for descriptions of the missiles). During 1986, the SS-23 was deployed with Soviet forces in Eastern Europe, and Syria became the first non-Warsaw Pact country to receive the non-nuclear version of the missile.[95] The SS-21 and SS-12M continued to be deployed in Eastern Europe as well. A larger number of the older missiles are being retained outside the USSR and on active duty than had been previously expected. A portion are being used for training or as foreign military transfer weapons.

With respect to nuclear artillery, it is reported that all 152-mm, 203-mm and 240-mm systems now in service have the capability to fire nuclear projectiles (see table 1.5, note g). When fully deployed, the current generation of large calibre guns is expected to exceed 10 000, all with a nominal nuclear capability.[96] However, it is doubtful whether older towed guns would be given any nuclear capability. It also seems questionable whether the USSR has actually produced and deployed three different sizes of nuclear artillery projectiles.

IV. British nuclear weapon programmes

Of all the developments in British nuclear forces during 1986 (see table 1.6), the one which will have the greatest future effect was the start of the Trident submarine programme. The UK has embarked on a course that is planned to result in four submarines that will carry as many as 512 highly accurate MIRVed warheads. No final cost estimates for the programmes have yet been made, but it is certain to cost well over £10 billion. The arms control impact of Britain's most ambitious nuclear modernization effort remains to be seen.

Table 1.6. British nuclear forces, 1987[a]

Weapon system				Warheads		
Type	No. deployed	Year deployed	Range (km)[b]	Warhead × yield	Type	Max. no. in stockpile[c]
Aircraft						
Buccaneer S2	25[d]	1962	1 700	1 × bombs	WE-177[e]	30
Tornado GR-1	190[f]	1982	1 300	1 × bombs	WE-177	195
SLBMs						
Polaris A3-TK	64	1982[g]	4 700	2 × 40 kt	MRV	128
Carrier aircraft						
Sea Harrier	23	1980	450	1 × bombs	WE-177	25
ASW helicopters						
Sea King HAS 2/5	61	1976	–	1 × depth bombs	?[h]	61
Wasp HAS 1	22	1963	–	1 × depth bombs	?	22
Lynx HAS 2/5	75	1976	–	1 × depth bombs	?	75

[a] British systems certified to use US nuclear weapons include 31 Nimrod ASW aircraft based in Britain, and 20 Lance launchers (one regiment of 12 launchers, plus spares), and 136 artillery guns in five regiments (120 M109 and 15 M110 howitzers) based in FR Germany.

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

[c] Some sources put the total number of nuclear warheads in the British stockpile as low as 185 warheads, comprised of: 80 WE-177 gravity bombs, 25 nuclear depth bombs and 80 Chevaline A3-TK warheads.

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

[e] The WE-177 is thought to be a tactical 'lay-down' type bomb, with a variable yield between 5 and 200 kt.

[f] Some Buccaneer and Jaguar aircraft already withdrawn from bases in FR Germany, and already replaced by Tornado GR-1, may still be assigned nuclear roles in the UK. Upon full deployment in the UK and FR Germany, there will be 220 British Tornado GR-1 aircraft available for the nuclear strike/attack role.

[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 RN nuclear depth bomb is believed to be a low-yield variation of the RAF tactical bomb.

Sources: UK Ministry of Defence, *Statement on the Defence Estimates*, 1980 through 1986 (Her Majesty's Stationery Office: London, annual); Rogers, P., *Guide to Nuclear Weapons 1984–85* (University of Bradford: Bradford, 1984); 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 1986–87* (IISS: London, 1986); authors' estimates.

However, political developments in 1986 place questions of British nuclear forces in a new context. Opposition political parties in the UK have all opposed the Trident programme, and the Labour Party is campaigning for a strictly non-nuclear British defence and has pledged to rid Britain of all nuclear forces, US and British, if elected. Therefore, a political change in the UK could bring major changes in Britain's nuclear forces.

Submarine forces

On 30 April the British Government signed a contract with Vickers Shipbuilding and Engineering Limited (VSEL) for its first Trident ballistic missile submarine. The keel of the first submarine, to be named *Vanguard* (SSBN 05), was laid in September. The British Ministry of Defence (MOD) also asked VSEL to bid for the construction of the second Trident submarine. The other SSBNs in this V-Class are to be called *Vengeance*, *Victorious* and *Venerable*. *Vanguard* is scheduled to enter service in the mid- to late 1990s. Vanguard Class submarines are expected to have a submerged displacement of 15 500 tons (twice that of the current Resolution Class SSBNs), a length of 152 metres, and room for 16 missile tubes. It is believed that each missile will carry a maximum of 8 British-designed and -built warheads dispensed from a US-supplied MIRVed bus.

The British Vanguard/Trident programme provides a good example of the close nuclear co-operation between the UK and the USA. Although the submarines and the warheads themselves will be essentially designed and built by the UK, many of the components will come from and depend on the USA, including: Trident II/D-5 missiles; launch tubes (for the Vanguard) and all missile compartments; fire control systems; navigation sub-systems; and guidance and targeting data for the missiles.

British dependence on US systems and technology requires close co-ordination between the two countries. To expedite the exchange of information about and to purchase products for the Polaris, Chevaline and Trident systems, the British Navy maintains 33 personnel permanently assigned to the US Navy Strategic Systems Project Office (SSPO), operating at locations throughout the continental USA. The staff is responsible for the following subjects: navigation and training equipment, weapon system operations, strategic communications, support/spares/logistics, submarine design and electrical installation.[97] Regular training is provided to British Royal Navy technicians, field engineers and officers by the SSPO and contractors at Dam Neck, Virginia, and Charleston Naval Base, South Carolina, on all aspects of SSBN operations.[98] Co-operation between British and US scientists is also accomplished through established Joint Working Groups (JWGs) for various technical areas. There are nine current JWGs between the SSPO and the British MOD,[99] and a number of JWGs between the MOD and other US Federal agencies, such as the Department of Energy and the Defense Nuclear Agency. Of the total expected cost of the Trident D-5 programme (roughly £10 billion, according to one official estimate), the British Government has spent or is contractually committed to spending £3 billion as

of December 1986. Of this amount, some £400 million has been spent on a new warhead production facility at Aldermaston.

All of Britain's four Resolution Class submarines have now been equipped with Polaris missiles incorporating the new Chevaline 'front end'. The last submarine to be equipped with Chevaline missiles, the *HMS Repulse*, is scheduled to go on operational patrol following the four Demonstration and Shakedown Operation (DASO) test launches expected in April and May of 1987. This modernization programme was started in 1974, with the first Chevaline-equipped submarine going on patrol in 1982. The Chevaline-equipped missiles, designated Polaris A3-TK, are intended to enable the Polaris missile system to penetrate Soviet ABM defences until the Trident D-5 missile system replaces Polaris in the mid-1990s.

The British Royal Navy is expected to complete installation of new engines on its Polaris missiles in 1987, at a total programme cost of £437 million.[100] The original engines for Britain's Polaris missiles were manufactured in 1967–68, so the missiles needed to be re-engined to enable the Polaris/Chevaline missiles to remain in working condition until they are replaced by the US Trident II D-5 missile system.

The US Naval Weapons Center (NWC) at China Lake, California, is responsible for static firings of the British Polaris A-3 Restart (A-3R) first- and second-stage engines. In February 1986 the last qualification test of the A-3R was conducted, and the performance evaluation test stage began a month later. As of January 1987 NWC China Lake has conducted 26 static tests in support of the British Polaris A-3R programme.[101] It is believed that the A-3R programme resulted in enough motors to equip no more than 80 operational missiles, which, following further tests, may result in insufficient missiles to equip all four Resolution Class SSBNs.[102]

The first submerged test launches of Polaris Production Evaluation Missiles fitted with the new engines took place in July 1986. The performance of the engines during the four launches over the US Eastern Space and Missile Center (ESMC) range met their specifications. Although one missile missed its intended target, it is believed to be because of guidance problems rather than engine malfunction.[103] If the schedule is kept, there will have been 48 test launches of British Polaris missiles over the ESMC range by mid-1987.[104]

Air Force

The Royal Air Force's (RAF) largest Tornado Wing was completed with the arrival at RAF Brüggen in FR Germany of Squadron 9 from RAF Honington on 1 October 1986.[105] This wing now comprises four squadrons of the nuclear-capable Tornado aircraft. Nine Tornado squadrons are now in service, of which seven are forward deployed in FR Germany. In addition, the Tornado Weapons Conversion Unit has 22 Tornados and in time of war would operate its aircraft as Squadron 45.

RAF Harrier GR5 aircraft are scheduled to enter service in 1987 with Harrier squadrons in FR Germany. The British MOD revealed in 1986 that there are no plans to provide GR5 aircraft with a nuclear strike role.[106] Until

this revelation, the Harrier GR5 had been assumed to be nuclear-capable, like its US counterpart the AV-8B.

The RAF expressed interest in a new nuclear air-to-surface missile to replace the ageing WE-177 gravity bomb.[107] This new missile would enable Tornado aircraft to perform stand-off missions from outside enemy territory, thus avoiding the risks of trying to penetrate heavily defended airspace. However, the British requirement for a long-range stand-off missile, documented in the Naval, General and Air Staff Target 1236, does not at present include a nuclear option.[108] No firm decision has yet been made on the design, warhead or production of this missile.

Future nuclear choices

All British nuclear weapon programmes, including Trident, must be seen in the context of opposition political party pledges against various aspects of the present Conservative Government's nuclear force policies. A general election is expected no later than mid-1988, and possibly as early as the autumn of 1987. The Labour Party has called for a non-nuclear defence policy and has pledged to dismantle all British nuclear weapons and to remove all US nuclear forces from Britain within three years of taking office.[109] Although some of the opposition political parties do not advocate the complete removal of British and US nuclear forces from the UK, all are firmly committed to terminating the Trident programme. The Trident programme thus appears to have a future only with a Conservative Government.

V. French nuclear weapon programmes

There were a number of important developments in French nuclear forces during 1986 (see table 1.7) that will have a profound effect on the character and composition of these forces until the end of the century. Among these developments were the deployment of the first in a family of aircraft-delivered nuclear missiles (ASMP), the preparation for the deployment of an improved SLBM in 1987, and the definition of the parameters of future nuclear systems.

The development in 1986 that will cause the most severe changes in the outlay and composition of the nuclear forces in 1987 and beyond was the introduction of the new five-year military programming law. Under this new law the majority of previously planned nuclear-related programmes have been accelerated, while the conception and development of new systems have been speeded up. However, this may result in slowing down deployment schedules, owing to financial pressures exerted on the entire French budget.

The defence budget

A review of French defence spending by the coalition government which took office in 1986 led to several changes in key procurement programmes. Defence Minister Giraud accused the previous Socialist Government of underfunding in

its 1983–88 defence plan, which, he claimed, led to serious procurement delays. As a result the government drew up a new five-year military programme act for the 1987–91 period, and on 13 November the National Assembly approved the budget. In the first year military expenditures are scheduled to rise by nearly 7 per cent (twice that of the previous year), with the capital budget rising by nearly 14 per cent.[110]

The strategic submarine force remains the highest priority, and the programme is apparently strengthened by the change of government. Plans include refitting improved M-4 SLBMs into the existing SSBNs, and developing a new generation of SSBNs to be equipped with two new types of SLBMs for the 1990s.

The new French Government, unlike its predecessor, favours the development of a mobile land-based strategic missile, planned for 1996. This missile system, the S4, previously known as the SX, would replace the last of the Mirage IVP aircraft and the S3 IRBMs.

Army

The Hadès tactical missile programme remains on schedule to be deployed in 1992, with a neutron warhead. In July 1986 the coalition government stated that it will not manufacture a neutron bomb now. On many occasions France has declared that it has mastered the complexities of the neutron bomb and has tested it several times. A decision to produce the warhead may be made as the Hadès deployment date approaches. The total number of launchers is still unclear but is believed to be between 90 and 120.

Following a meeting with West German Chancellor Kohl in February 1986, President Mitterrand stated, for the first time, that France would be willing to use tactical nuclear weapons to defend FR Germany. If time permitted, France would consult the Chancellor before using these 'prestrategic' weapons on West German soil.

Like NATO, France believes in coupling the use of conventional forces with the threat of resorting to nuclear weapons. France intends to deliver a nuclear warning to a potential aggressor 'at a place and time that will depend on the way the conflict develops'. This 'nuclear warning' will be designed not only to send an unequivocal sign to the aggressor but also to 'check the momentum of the aggressor', and will be 'diversified and graduated in strength'.[111] The nuclear hardware available for this 'unequivocal sign' includes 70 Pluton warheads (to be replaced by several hundred enhanced radiation warheads as part of the Hadès missile programme) as well as some 125 warheads assigned to aircraft of the tactical air force (FATAC) and the naval air arm.

Air Force

The first of two squadrons of Mirage IVP aircraft armed with the Air-Sol-Moyenne-Portée (ASMP) thermonuclear air-to-surface missile was declared operational at Mont-de-Marsan AB in France on 1 May 1986, followed by the second squadron at Cazeux AB on 1 December. Both

Table 1.7. French nuclear forces, 1987

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[c]	1 × 300 kt	TN 80[d]	18
Jaguar A	45	1974[e]	750	1 × 6–8/30 kt	ANT-52[f]	50
Mirage IIIE	30	1972[e]	600	1 × 6–8/30 kt	ANT-52[f]	35
Refuelling aircraft						
C-135F/FR	11	1965	. .	. .	. .	. .
Land-based missiles						
S3D[g]	18	1980	3 500	1 × 1 Mt	TN-61	18
Pluton	44	1974	120	1 × 10/25 kt	ANT-51[h]	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[i]	96
M-4 (modified)	16	1987	6 000	1–6 × 150 kt (MIRV)	TN-71[j]	<96
Carrier aircraft						
Super Etendard	36	1978	650	1 × 6–8/30 kt	ANT-52[f]	40

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

[b] It is assumed that the remaining Mirage IVA aircraft (those not converted to IVPs) will no longer operate in a nuclear strike/attack mode (see text).

[c] Range does not include the 80- to 250-km range of the ASMP air-to-surface missile.

[d] The TN-81, an improved warhead for the ASMP, is presently under development by the CEA. If deployed, this warhead will first be operational aboard the Mirage 2000N and Super Etendard aircraft in 1988. In addition, Aérospatiale is working on a longer-range supersonic variant of the missile itself.

[e] 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.

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

[g] S3D ('Durcie') is the designation for the recently completed hardening of the S3 missile. The original S3 missile was deployed in 1980.

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

[i] 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.

[j] To be deployed starting on the SSBN *Le Tonnant* in the latter half of 1987. The TN-71 warhead configuration has an improved range of 6000 km maximum. It is unclear how many warheads are involved, but it is expected to be less than or equal to the standard six. The TN-71 is known to be lighter and have a smaller 'surface-equivalent-radar' image than the original TN-70.

Sources: Commissariat à l'Energie 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 1985*, 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; DIA, *Air Forces Intelligence Study (AFIS): France*, DDI-1300-FR-77 (secret, partially declassified), Apr. 1977; DIA, *Military Capability Study of NATO Countries*, DDB-2680-15-85 (secret, partially declassified), Sep. 1985 and Dec. 1977; Laird, R. F., 'French nuclear forces in the 1980s and the 1990s', *Comparative Strategy*, vol. 4, no. 4 (1984), pp. 387–412; International Institute for Strategic Studies, *The Military Balance 1986/87* (IISS: London, 1986); authors' estimates.

squadrons will rotate aircraft on detachment to Istres and Orange Air Bases. Eighteen Mirage IVA aircraft have been modified (to IVP) to carry the ASMP missile, completing the programme. A few of these aircraft are used for training personnel at the Centre d'instruction des Forces aériennes stratégiques (CIFAS 328) at Bordeaux.[112]

The remaining unmodified Mirage IVA aircraft will probably be restricted to a training or reconnaissance role. The aircraft's nuclear strike/attack role derived chiefly from the AN-22 gravity bomb, which is due for retirement.[113]

The ASMP is a first for French nuclear forces and for French industry. It is the first French aircraft-delivered nuclear missile and the first missile powered by a ramjet using a solid-propellant booster.[114]

The 300-kt thermonuclear ASMP is designed to serve both strategic and so-called 'préstratégique' (tactical) purposes. In its strategic role it is deployed on Mirage IVP's, replacing the single 60-kt fission AN-22 gravity bomb.[115] In its 'préstratégique' role it will be deployed on Mirage 2000N and Super Etendard aircraft in 1988 replacing the ANT-52 gravity bomb. The first qualification flight of the ASMP from a Super Etendard aircraft was due at the end of 1986. All 53 aircraft are expected to carry the missile, some operating from France's two aircraft-carriers and others operating from land bases.

Operational evaluation of the ASMP for Mirage 2000N aircraft (to replace Jaguar and Mirage III aircraft), will begin in 1987 at the Centre d'Essais des Landes (CEL) test range.[116] The ASMP will be deployed on 75 Mirage 2000N aircraft (with 37 more in reserve). The planned IOC of the first squadron is mid-1988.[117]

Force Océanique Stratégique

On 4 March 1986 an improved M-4 SLBM with a new warhead was launched from a submarine submerged off the coast of Brittany. The announced range of the missile was 6000 km, 1600–2000 km longer than that of the first M-4As put on board the *Inflexible* in 1985.

This MIRVed M-4 SLBM was equipped with lighter, smaller warheads (the TN-71) than the deployed TN-70. The TN-71 warhead is said to be comparable to those of the better US ballistic missiles in terms of survival and penetration capability,[118] whereas the presently deployed TN-70 is comparable in terms of the weight/yield ratio.[119] The TN-71 version of the M-4 will first enter service in mid-1987 aboard the SSBN *Le Tonnant*. All M-4 SLBMs will eventually be fitted with these new warheads.

This particular M-4 was launched from the *Gymnote* experimental test submarine. It was the *Gymnote*'s 136th launch since it first began service test-firing the M-1 SLBM.[120] The *Gymnote* has been retired since October and will not be kept as a reserve SSBN, as was once believed.[121] It is not known which test submarine will be used for future SLBM flight-testing.

At the end of February the SSBN *Le Terrible* left on its 42nd operational patrol since entering active service in 1972. This was the 172nd patrol of the Force Océanique Stratégique (FOST) submarine force.[122] *Le Terrible* is third in line to be retrofitted with the improved M-4 SLBMs.

France and SDI

The French Government's Délégation générale pour l'Armement (DGA) armament agency recently sent a high-level delegation to the USA to discuss France's potential role in the US Strategic Defense Initiative programme.[123] The visit signals an increasing official interest in SDI by the French Government, which, in contrast to the governments of Britain and FR Germany, has not signed any SDI participation agreements.

Prior to this visit, President Mitterrand consistently opposed French participation in SDI on the grounds that it might compromise France's traditionally independent foreign policy. On the other hand, Prime Minister Chirac claims that France cannot afford not to be associated with SDI research, with the concomitant risk of being 'left on the sidelines of technological progress'.[124]

However, the French Government, although at odds over its official involvement, has never been opposed to participation in the programme by French companies, and has indicated that French and US industrialists should increase their co-operation in military high-technology fields.[125]

Executives of France's nationalized aerospace company Aérospatiale met in April 1986 with Strategic Defense Initiative Organization (SDIO) and US Army Strategic Defense Command officials in Washington. Discussions focused on the European anti-tactical ballistic missile (ATBM) programme and the potential role for an Aérospatiale weapon system in an ATBM segment of SDI. The French ATBM system would be directed at protecting France's strategic nuclear arsenal from Soviet intermediate-range ballistic missiles based in Eastern Europe.[126] Aérospatiale, in a joint venture with the French electronics firm Thomson-CSF and a US company, was selected as one of the seven industrial teams to participate in the architecture study of the ATBM programme.

Regardless of whatever strategic defences might emerge from the current US and Soviet research programmes, France has no intention of giving up its nuclear forces for defensive systems, as the United States has claimed as a long-term goal. In view of the possible reinforcement of terminal defence, the French reaction has been to 'increase without delay the capacity for penetration and destruction of our strategic missiles'.[127] Aérospatiale is currently designing effective countermeasures to enable France's M5 and S4 ballistic missiles to hit their targets once they are deployed and to remain operational through the early decades of the 21st century.[128]

Future nuclear choices

The first of a new class of French SSBN is expected to be ordered in early 1987[129] to enter service in approximately 1994. The 'New Generation' (NG) SSBN will use a new nuclear propulsion reactor, designated the K-15, which will enable the boat to be quieter and dive deeper than the present French submarines.

The development of yet another version of the M-4 SLBM was initiated

during 1986. The 'almost invisible' TN-75 warhead will be employed on the M-4 missiles of the first NG SSBN.[130] The M-4s on the NG SSBNs will in turn be replaced before the end of the century by the M-5 SLBM, equipped with 8–12[131] very light and compact[132] TN-76 warheads.[133]

The first of two nuclear-powered aircraft-carriers planned for the French Navy will be named the *Richelieu*. The 35 000-ton ship was ordered on 4 February 1986. The keel will be laid at Brest at the end of 1987, and the ship is expected to start sea trials during the first half of 1995. The *Richelieu* is scheduled to replace the *Clémenceau* at the end of 1996.[134] It too will use the new K-15 nuclear reactor. A decision to build the second carrier will not be made until about 1990.[135]

Funding for development of the new lightweight mobile S4 land-based ballistic missile will start in 1987. Weighing about 9 tons, the S4 is expected to carry multiple nuclear warheads and have a range of at least that of the present S3 IRBMs, or 3500 km.[136] The initial operational capability date is set for 1996, with a total of 30 truck-mounted missiles eventually replacing the current 18 S3 missiles based in silos on the Plateau d'Albion.[137]

The S4 is also to be based on the Plateau d'Albion, either at St Christol Air Base or, more likely, spread out over the same land now taken up by the S3s. This encompasses some 170 km^2 of the plateau and surrounding hillside. In time of crisis, however, the S4s could be dispersed further afield, by land or by air[138] to other military bases, such as the Mirage aircraft bases.[139]

VI. Chinese nuclear weapon programmes

Available evidence suggests that, with one notable exception, changes to China's nuclear forces in 1986 were qualitative rather than quantitative (see table 1.8). China's first SSBN, the most recent element of China's triad, was declared operational during 1986, although it was launched in 1981 and has been training since then. The Chinese military conducted missile tests that were reportedly intended to extend the range of its nuclear missiles and, for the first time, to develop missiles with multiple and/or MIRVed warheads. China continued its programme of military reform and modernization during 1986 and centralized several nuclear weapon activities of its military, the People's Liberation Army (PLA). In an important development, in March China became the last of the five nuclear weapon states to renounce atmospheric testing of nuclear weapons.

Missile forces

Perhaps the most important development for Chinese nuclear forces was the series of missile tests conducted from the autumn of 1985 until early 1986. It is believed that several CSS-2 IRBMs and at least one SLBM were tested.[140] If these tests were as successful as they were reported to be, China could be proceeding towards a small force of MIRVed ballistic missiles, particularly longer-range missiles such as IRBMs, ICBMs and SLBMs. The tests were also

Table 1.8. Chinese nuclear forces, 1987

Weapon system				Warheads	
Type	No. deployed	Year deployed	Range (km)	Warhead × yield	No. in stockpile
Aircraft[a]					
Il-28 Beagle (B-5)	15–30	1974	1 850	1 × bombs[b]	15–30
Tu-16 Badger (B-6)	100	1966	5 900	1–3 × bombs	100–130
Land-based missiles					
CSS-1 (DF-2)	40–60	1966	1 100	1 × 20 kt	40–60
CSS-2 (DF-3)	85–125	1972	2 600	1 × 2–3 Mt	85–125
CSS-3 (DF-4)	~ 10	1978	7 000	1 × 1–3 Mt	20
CSS-4 (DF-5)	~ 10	1980	12 000	1 × 4–5 Mt	20
Submarine-based missiles[c]					
CSS-N-3	26	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 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 Armed Forces*, Apr. 1976; Defense 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; Godwin, P. H., *The Chinese Tactical Airforces and Strategic Weapons Program: Development, Doctrine, and Strategy* (Air University: Maxwell AFB, AL, 1978); Washburn, T. D., *The People's Republic of China and Nuclear Weapons: Effects of China's Evolving Arsenal*, ADA 067350 (NTIS, 1979); 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.

meant to increase the ranges of ballistic missiles.[141] Deng Xiaoping, Chairman of the Central Military Commission, is reported to have commended the SLBM test personnel, saying that their work had 'led to increases in flying range, multiple targeting ability and operational flexibility' and that 'their work could be adapted to other strategic weapons'.[142] If China decides to develop MIRVed missiles, this would be a major change in force structure and could be one of the most significant Chinese nuclear weapon developments. MIRVed missiles would permit a rapid increase in the number of Chinese nuclear warheads without expanding the size of the missile force. They would also complicate any attempt by an adversary at ballistic missile defence against China's missiles. Furthermore, if ballistic missiles are given increased ranges, they will be able to operate from locations farther inland in China, away from the border with the Soviet Union.

On various occasions in 1986, official Chinese sources reported that China's only indigenously designed and -built nuclear-powered submarine had completed its training programme and had begun active operations. These were the first official confirmations, the latest of which included a photograph,[143] that China's Xia Class SSBN was in active service after five years of preparation. Two Xia Class submarines have been launched, and it has been assumed that both of them would be available in a crisis, although it was unclear if or when the submarines had become operational. The Xia Class submarines have 12 launch tubes for the CSS-N-3 SLBM, which is estimated to have a maximum range of 3300 km and a warhead yield between 200 kt and 1 Mt.[144] Similar official statements about Chinese submarines had been made in the past, without specifying what type of submarine was involved.[145] This led to some confusion since China has designed and built two types of nuclear-powered submarines—Han Class SSNs and Xia Class SSBNs. As a result, foreign news organizations did not initially report that it was an SSBN that had become operational until Chinese sources published a picture of the Xia Class submarine.

In accordance with its military modernization efforts, China opened several new training facilities during 1986. Two important institutions are the new National Defence University and a training academy for the Second Artillery Corps, the nuclear weapon command. Both these training facilities will be used to teach combined arms concepts and practices that will integrate nuclear weapons into the general training programme for officers. The new emphasis on joint operations and combined arms training that includes nuclear weapon planning is exemplified by China's Antichemical Warfare Corps, which is responsible for defence against nuclear and chemical attacks. According to an official Chinese news report, a military officer indicated that combined arms units have been given priority for nuclear and chemical defence.[146] The Corps has gained experience by participating in 'each of China's nuclear tests', and by 'handling radioactive and chemical leak accidents on many occasions'.[147]

Numerous details of China's nuclear weapon programme were reported for the first time in a series of articles about Deng Jiaxian, the nuclear physicist responsible for designing, building and testing China's nuclear weapons.[148] His identity as the director of the nuclear weapon effort was kept secret for nearly

30 years. Three new details are noteworthy. According to several articles, the Soviet Union explicitly promised in a 1957 agreement to supply China with a 'teaching model' of a nuclear weapon but failed to keep its pledge.[149] This appears to be the first specific public explanation of the broken promise. Another point of interest is a reference about how China was able to design a fusion warhead only 32 months after its first test of a fission weapon, less than half the time it took the USA, the USSR or France. According to the report, while Deng and his colleagues were having difficulty with the calculations for a theoretical design of a thermonuclear warhead, a group of nuclear scientists in Shanghai discovered some form of design 'shortcut' which allowed the project to proceed quickly. It no doubt helped China to know that four other nations had already exploded hydrogen bombs. The third new detail was the statement that China has conducted 32 nuclear tests since 1964, 3 more than available data indicate. It is believed that this figure is quoted from foreign sources; it is not an official figure.[150]

On 21 March 1986 Premier Zhao Ziyang announced China's decision to renounce atmospheric testing of nuclear weapons. Since 1975, when France ceased its above-ground tests, China had been the only nuclear weapon state to conduct tests in the atmosphere. Although not a signatory to the 1963 Partial Test Ban Treaty, China has decided to implement its main provision. China conducted its last atmospheric nuclear test in 1980.

Notes and references

[1] Smith, B. A., 'Air force installs first MX missiles in Minuteman silos', *Aviation Week & Space Technology*, 11 Aug. 1986, p. 25; Rhodes, J. P., 'The first Peacekeeper', *Air Force Magazine*, June 1986, pp. 82–4.

[2] Congressional Budget Office, *The MX Missile Test Program and Alternatives*, Staff Working Paper, Feb. 1986.

[3] The four leading concepts were Superhard Silos, Superhard Silos with Concealment, Carry Hard and Shallow Tunnel. The other four were Hardened Minuteman Silos, Rail Mobile, Ground Mobile and Deep Basing; see General Accounting Office (GAO), *ICBM Modernization: Status, Survivable Basing Issues, and Need to Reestablish a National Consensus*, GAO/NSIAD-86-200, Sep. 1986, p. 34; and US Congress, House Appropriations Committee (HAC), *Hearings on Department of Defense Appropriations for 1987*, Part 6, p. 380 (hereafter cited as HAC, *FY 1987 DOD*). The other three regular congressional hearing series are abbreviated similarly—HASC: House Armed Services Committee; SAC: Senate Appropriations Committee; and SASC; Senate Armed Services Committee.

[4] Halloran, R., 'Air force commander seeks to place MX missiles on trains', *New York Times*, 27 Oct. 1986, p. A18; Lynch, D. J. 'Air force favors MX on trains', *Defense Week*, 17 Nov. 1986, p. 1; Lynch, D. J., 'Reagan decision on Midgetman and MX expected', *Defense Week*, 15 Dec. 1986, p. 1.

[5] Smith, R. J., 'Midgetman missile plans generate political debate', *Science*, 6 June 1986, pp. 1186–8; Smith, R. J., 'Mobile missile design generates controversy', *Science*, 27 June 1986, pp. 1590–3; Smith, R. J., 'Proposal to ban mobile missiles favors targeting over arms control', *Science*, 22 Aug. 1986, pp. 831–3; Morrison, D. C., 'Missile gridlock', *National Journal*, 7 June 1986, pp. 1366–70; Walker, P. F. and Wentworth, J. A., 'Midgetman: missile in search of a mission', *Bulletin of the Atomic Scientists*, Nov. 1986, pp. 20–6; GAO, *DOD Acquisition, Case Study of the Air Force Small Intercontinental Ballistic Missile*, GAO/NSIAD-86-45S-16, 31 July 1986; GAO, *ICBM Modernization: Status, Survivable Basing Issues, and Need to Reestablish a National Consensus*, GAO/NSIAD-86-200, Sep. 1986.

[6] *Department of Defense Appropriation Bill, 1987*, Senate Report 99-446, pp. 312–15; *National Defense Authorization Act for Fiscal Year 1987*, Senate Report 99-331, pp. 168–70.

[7] DOD, Undersecretary of Defense for Research and Engineering (USDRE), *Report of the*

Defense Science Board Task Force on Small Intercontinental Ballistic Missile Modernization, Mar. 1986, p. v.

[8] Les Aspin, Chairman of the HASC, argued that of the $840 billion in costs for developing and operating strategic weapons over a more than 20-year basis, the Midgetman would be 5.3 per cent of the total. HASC, *Midgetman: Sliding Shut the Window of Vulnerability*, 10 Feb. 1986.

[9] DOD, Office of the Assistant Secretary of Defense for Public Affairs (OASD-PA), News Release No. 75–86, 28 Feb. 1986; USAF, *Legislative Environmental Impact Statement: Small Intercontinental Ballistic Missile Program*, Nov. 1986.

[10] Pincus, W., 'Nuclear test brings criticism by Soviets', *Washington Post*, 23 Mar. 1986, p. A1.

[11] Smith, R. J., 'Proposal to ban mobile missiles favors targeting over arms control', *Science*, 22 Aug. 1986, pp. 831–3; Lynch, D. J., 'Soviet targets slipping from view as US planners try to keep pace', *Defense Week*, 30 June 1986, p. 1.

[12] Gordon, M. R., 'Reagan orders a study to decide if US should build new missile', *New York Times*, 25 Apr. 1986, p. A1.

[13] Gordon, M. R. 'Reagan reported to favor keeping 1979 limit on arms', *New York Times*, 22 Apr. 1986, p. A1; Pincus, W. and Oberdorfer, D., '2 subs to be dismantled', *Washington Post*, 22 Apr. 1986, p. A20.

[14] Sloan, S. R., *The NATO Allies and the Issue of Continued US Observance of SALT II Limits*, Study Prepared for Senate Democratic Leader Robert C. Byrd by the Congressional Research Service (CRS), 4 Apr. 1986.

[15] *Congressional Record*, 10 Apr. 1986, p. S4026.

[16] Two other US submarine accidents were reported during the year. The *Atlanta* (SSN 712) ran aground in the Strait of Gibraltar on 29 April. Sometime around 20 October, somewhere in the Atlantic the *Augusta* (SSN 710) 'struck something underwater', possibly colliding with a Soviet submarine, and sustaining $1.5 million in damage.

[17] See House Foreign Affairs Committee, Report 99–643, 17 June 1986.

[18] Sussman, B., 'Public would preserve SALT II treaty, not help Nicaraguan contras', *Washington Post*, 25 June 1986, p. A16.

[19] Kenny, Maj. M., USAF, 'Pilot report: B-1B', *Air Force Magazine*, June 1986, pp. 58–62; Coyne, J. P., 'Bringing on the B-1B', *Air Force Magazine*, June 1986, pp. 63–9.

[20] 'B-1B readies for service', *Aviation Week & Space Technology*, 2 June 1986, pp. 46–62.

[21] North, D. M., 'Development problems delay full B-1B operational capability', *Aviation Week & Space Technology*, 3 Nov. 1986, pp. 34–5; Stewart, J., 'Flaws slow new fleet of planes', *Atlanta Journal and Constitution*, 9 Nov. 1986, p. 1.

[22] According to the HASC, black programmes have grown eight-fold in the past five years. See *Aviation Week & Space Technology*, 19 May 1986, p. 15; and Morrison, D. C., 'Pentagon's top secret "black" budget has skyrocketed during Reagan years', *National Journal*, 1 Mar. 1986, pp. 492–8.

[23] *Aviation Week & Space Technology*, 9 June 1986, p. 25.

[24] HAC, *FY 1986 DOD*, Part 2, p. 490.

[25] White House, Office of the Press Secretary, Presidential Statement on Interim Restraint, 27 May 1986; White House, Fact Sheet, US Interim Restraint Policy: Responding to Soviet Arms Control Violations, 27 May 1986; Gordon, M. R., 'Air force delay said to keep US to '79 arms limit', *New York Times*, 29 Aug. 1986, p. A1.

[26] Gordon, M. R., 'US might hasten breach of treaty', *New York Times*, 6 Oct. 1986, p. A12.

[27] Smith, R. J., '131st cruise B52 rolled out; treaty implications disputed', *Washington Post*, 18 Nov. 1986, p. A3; Smith, R. J., 'US poised to exceed SALT limit', *Washington Post*, 9 Nov. 1986, p. A1; Wilson G. C. and Smith, R. J., 'US to break SALT II limits Friday', *Washington Post*, 27 Nov. 1986, p. A9; Gordon, M. R., 'US exceeds limit set in 1979 accord on strategic arms', *New York Times*, 29 Nov. 1986, p. 1.

[28] Taubman, P., 'Soviet to abide by arms treaty "for time being"', *New York Times*, 6 Dec. 1986, p. 1.

[29] Fuerbringer, J., 'House Democrats press arms limits', *New York Times*, 11 Dec. 1986, p. A15; Gordon, M. R., '57 Senators ask Reagan in a letter to observe '79 arms pact', *New York Times*, 16 Dec. 1986, p. A12.

[30] *Aviation Week & Space Technology*, 9 Sep. 1985, p. 29; 'SRAM II Phase 2 Study', *Energy and Technology Review*, June–July 1986, pp. 2–3.

[31] *National Defense Authorization Act for Fiscal Year 1987*, Conference Report, House Report 99–1001, p. 442; Lynch, D. J., 'SRAM II still favored by AF', *Defense Week*, 10 Nov. 1986, p. 6.

[32] US DOD, *Annual Report of the Secretary of Defense to the Congress, FY 1988* (hereafter cited as *DOD, FY 1988*).

[33] Arkin, W. M., 'Fewer warheads in Europe', *Bulletin of the Atomic Scientists*, Aug./Sep. 1986, pp. 4–5.

[34] SAC, *Energy and Water Development Appropriations for 1987*, Part 2, p. 1258 (hereafter cited as SAC, *FY 1987 EWDA*).

[35] Fouquet, D., 'No plans for neutron bomb, says NATO', *Jane's Defence Weekly*, 16 Aug. 1986, p. 231.

[36] Manners, G., 'SACEUR's plans for nuclear stockpile', *Jane's Defence Weekly*, 25 Oct. 1986, p. 948.

[37] SAC, *FY 1987 EWDA*, Part 2, p. 1261.

[38] See, e. g., Morrison, D. C., 'The Navy's vanishing nuclear arsenal', *National Journal*, 13 Sep. 1986; Polmar, N., 'Tactical nuclear weapons', *US Naval Institute Proceedings*, July 1983.

[39] HAC, *FY 1987 DOD*, Part 4, p. 156.

[40] HAC, *FY 1987 DOD*, Part 4, p. 132.

[41] HAC, *FY 1987 DOD*, Part 4, p. 156.

[42] HAC, *FY 1987 DOD*, Part 4, p. 156.

[43] HAC, *FY 1987 DOD*, Part 4, pp. 132, 156.

[44] HAC, *FY 1987 DOD*, Part 4, pp. 132, 156.

[45] HAC, *FY 1987 DOD*, Part 4, p. 164.

[46] HAC, *FY 1987 DOD*, Part 4, p. 155.

[47] HAC, *FY 1987 DOD*, Part 5, pp. 513–14.

[48] HAC, *FY 1987 DOD*, Part 5, pp. 479, 558.

[49] HAC, *FY 1987 DOD*, Part 5, p. 560.

[50] SAC, *FY 1987 EWDA*, Part 2, p. 1270.

[51] HAC, *FY 1987 DOD*, Part 5, p. 555.

[52] HAC, *FY 1987 DOD*, Part 5, p. 555.

[53] HAC, *FY 1987 EWDA*, Part 4, p. 79; HAC, *FY 1987 EWDA*, Part 6, p. 1505–6. See also Hiatt, F. and Atkinson, R., 'Lab creating a new generation of nuclear arms', *Washington Post*, 9 June 1986, p. A1; Taylor, T. B. 'Endless generations of nuclear weapons', *Bulletin of the Atomic Scientists*, Nov. 1986, pp. 12–15; and Taylor, T. B., 'Nuclear testing is a Pandora's Box', *Federation of American Scientists Public Interest Report*, Dec. 1986.

[54] Smith, R. J., 'X-ray laser budget grows as public information declines', *Science*, 11 Apr. 1986, pp. 152–3.

[55] *TechTrends International*, 11 Aug. 1986, p. 6.

[56] The policy was first made public in a speech to the Foreign Policy Association by Deputy Secretary of State Kenneth W. Dam on 14 January 1985. (Department of State, *Current Policy No. 647.*) Subsequent speeches on 20 February 1985 and 28 March 1985 by Ambassador Nitze repeated the essential points (Department of State, *Current Policy No. 657* and *677*). See also Jackson, R. L., *The New Strategic Policy: Issues for Congressional Consideration*, CRS Report no. 85-134F, Congressional Research Service, 18 Apr. 1985; and Arkin, W. M., 'The new mix of defense and deterrence', *Bulletin of the Atomic Scientists*, June/July 1986, pp. 4–5.

[57] This designation and other information were released by the USSR to bolster its argument that the missile is a modification of the SS-13. (Foreign Ministry Press Conference with Chief of Staff Akhromeyev and Deputy Foreign Minister Bessmertnykh, cited by Melor Sturua in *Izvestiya*, FBIS-SU, 6 June 1986.) For a discussion of the SS-13/SS-25 issue, see Mendelsohn, J. 'Proportionate response: sense or nonsense?', *Arms Control Today*, Jan./Feb. 1986, p. 8.

[58] DOD, *Soviet Military Power* 1986 (hereafter cited as *SMP, 1986*), p. 26; US Arms Control and Disarmament Agency (ACDA), *Fiscal Year 1987 Arms Control Impact Statements* (hereafter cited as *ACIS, FY 1987*), p. 26. The transporter-erecter-launcher for the SS-25 had been previously described as off-road capable; see *SMP, 1984*, p. 24.

[59] Background briefing by senior Administration official, 24 Mar. 1986; *SMP, 1986*, pp. 26–7. The ICBM RV figure given in *SMP, 1986*, p. 25, includes 10 SS-X-24 missiles by the end of 1986.

[60] Background briefing by senior Administration official, 24 Mar. 1986.

[61] Gordon, M. R., 'Second Soviet missile mishap is reported by US officials', *New York Times*, 18 Sep. 1986, pp. A1, A18; Pincus, W., 'Officials debate threat of new Soviet missile', *Washington Post*, 12 Aug. 1986, p. A14.

[62] An interview with DOD officials in May 1984 indicated that the number of single-warhead SS-17 and SS-19 missiles deployed at that time was 'too few to matter'. The Joint Chiefs of Staff refer to 'the most accurate versions of the SS-18 and SS-19 missiles'; see *United States Military Posture for FY 1987* (hereafter cited as *JCS, FY 1987*), p. 21. *SMP, 1986*, preface, indicates that, as of the end of 1985, the Mod. 4 SS-18 modernization programme was 'reaching completion'.

[63] *DOD, FY 1988*.

[64] *SMP, 1985*, p. 31; *SMP, 1986*, p. 28; SASC/SAC, *Soviet Strategic Force Developments, Joint Hearings*, S. Hrg. 99-335, 26 June 1985, p. 9 (hereafter cited as SASC/SAC, *S. Hrg. 99/335*).

[65] The silos are reportedly larger than those used by the SS-18; see Gertz, B., 'Soviet test of SS-18 may violate SALT II', *Washington Times*, 13 Apr. 1986, p. 13.

[66] Gordon, M. R., 'US reports failure in recent Soviet test of big new missile', *New York Times*, 15 Apr. 1986, pp. A1, A8; Gordon, M. R., 'Second Soviet missile mishap is reported by US officials', *New York Times*, 18 Sep. 1986, pp. A1, A18; 'Soviet acknowledges explosion of a missile', *New York Times*, 19 Sep. 1986, p. A7.

[67] Gertz, B., 'Soviet successfully test missile that will be largest in arsenal', *Washington Times*, 7 Jan. 1987, p. 3.

[68] See, for example, *SMP, 1985*, p. 31; *SMP, 1986*, p. 28; *DOD, FY 1987*, p. 59; *ACIS, FY 1987*, p. 26; SASC/SAC, *S. Hearing 99-335*, pp. 6–9.

[69] Lucas, H., 'Soviet MARV to begin flight tests', *Jane's Defence Weekly*, 19 Jan. 1985, p. 96.

[70] *SMP, 1986*, p. 29.

[71] *SMP, 1986*, p. 121.

[72] *Jane's Defence Weekly*, 15 Feb. 1986, p. 223.

[73] Jordan, J., 'Leviathan of the deep', *Jane's Defence Weekly*, 1 Mar. 1986, p. 381. See also SIPRI, *World Armaments and Disarmament: SIPRI Yearbook 1986* (Oxford University Press: Oxford, 1986), p. 55.

[74] Details of the new submarine base, based on US Landsat photographs, were reported in August by the Oslo-based Norwegian Foreign Policy Research Institute; see 'Kola unveiled', *Jane's Defence Weekly*, 13 Sep. 1986, pp. 538–40; and 'Soviets building bases in Arctic, Norway says', *Washington Post*, 23 Aug. 1986, p. A18.

[75] A depiction of the base at Polyarnyy, with piers and two tunnels for Delta and Yankee Class submarines and other cruise missile and attack submarines, appears in *SMP, 1986*, pp. 20–1. Two tunnels are reported under construction at the base near Vladivostok; see *Sankei*, 31 Mar. 1986, cited in *Arms Control Reporter*, p. 611.B.304.

[76] *SMP, 1986*, p. 30.

[77] *SMP, 1986*, pp. 30–1. The missiles that are expected to be flight-tested before the end of the decade have also been described as replacements or follow-ons; see SASC/SAC, *S. Hrg. 99–335*, pp. 7, 11.

[78] Among the numerous articles on the incident see: Gwertzman, B., 'Moscow reports fire on atomic sub in North Atlantic', *New York Times*, 5 Oct. 1986, p. 1; Bohlen, C., 'Soviet A-sub blaze off Bermuda kills 3', *Washington Post*, 5 Oct. 1986, p. A1; Rosenthal, A., 'Soviet nuclear sub catches fire; 3 die', *Boston Globe*, 5 Oct. 1986, p. 1; Gwertzman, B., 'Soviet submarine, crippled by fire, on its way home', *New York Times*, 6 Oct. 1986, p. A1; Rensberger, B., 'Soviet sub fire seems to be out', *Washington Post*, 6 Oct. 1986, p. A1; 'Soviet sub under tow after blaze is put out', *Boston Globe*, 6 Oct. 1986, p. 1; Gwertzman, B., 'Soviet atomic sub sinks in Atlantic 3 days after fire', *New York Times*, 7 Oct. 1986, p. A1; Wilson, G. C. and Smith, R. J., 'Crippled Soviet sub sinks in Atlantic, no nuclear contamination expected', *Washington Post*, 7 Oct. 1986, p. A1; 'Moscow's new policy reflected in sub report', *New York Times*, 5 Oct. 1986, p. 14; Preston, A., 'Political consequences of the Soviet "Yankee" SSBN sinking', *Jane's Defence Weekly*, 18 Oct. 1986, pp. 876–7.

[79] Cannon, L. 'Missile test by Soviets goes astray', *Washington Post*, 16 Sep. 1986, p. 5; Berke, R. L., 'Unarmed Soviet test missile is reported to land in China', *New York Times*, 17 Sep. 1986, p. A4; 'Soviet SS-N-8 goes astray during test', *Jane's Defence Weekly*, 27 Sep. 1986, p. 658.

[80] *SMP, 1986* is not clear on the number of Bear H bombers. The document notes that there are 150 Bear bombers (pp. 8, 23), thus implying that about 50 Bear Hs are deployed, given the number of older Bear airframes, but also specifies that there are about 40 Bear Hs now in the inventory (p. 32).

[81] 'On the trail of the Soviet Bear-H', *Jane's Defence Weekly*, 11 Oct. 1986, p. 796. According to the Joint Chiefs of Staff, routine intercontinental training flights are conducted to points off both the North American coasts; see *JCS, FY 1987*, p. 31.

[82] *SMP, 1986*, p. 32; *SMP, 1985*, p. 33; *SMP, 1984*, p. 28.

[83] Background briefing by a senior defence official, 24 Mar. 1986. See also *SMP, 1986*, pp. 4, 33; SAC-SASC, *S. Hrg, 99–335*, p. 12. The expected introduction date for the Blackjack has been pushed back from 1986–87 in *SMP, 1983* (p. 26), to 1987 in *SMP, 1984* (p. 29) and to 1988 in *SMP, 1985* (p. 34).

[84] SASC/SAC, *S. Hrg. 99–335*, p. 12; *SMP, 1983*, p. 26; *SMP, 1984*, p. 29; *SMP, 1985*, p. 34; *SMP, 1986*, p. 33.

[85] *SMP, 1986*, p. 33.

[86] 'Kola unveiled', *Jane's Defence Weekly*, 13 Sep. 1986, pp. 538–40; 'Soviets building bases in Arctic, Norway says', *Washington Post*, 24 Aug. 1986, p. A18.

[87] *FBIS Daily Report*, USSR, FBIS-SU-86-164, vol. 3, no. 164 (25 Aug. 1986), p. V3, a translation of Army General V. Shabanov, USSR Deputy Defence Minister, under rubric 'Combat potential: technical equipment: the material basis of defense might', *Red Star*, 15 Aug. 1986, 2nd edn. pp. 2–3.

[88] *SMP, 1986*, pp. 41–4.

[89] Admiral Crowe testified that the Soviet Union has 'The world's only operational ABM system featuring interceptor missiles with both conventional and nuclear warheads'; see Statement of Admiral William J. Crowe, Jr, USN, Chairman of the JCS on Nuclear Testing before the Senate Foreign Relations Committee, 8 May 1986, p. 2. It is not clear whether he was referring to the Galosh or modified Galosh missile or the new Gazelle missile. The older ABM-1B Galosh was believed to be dual-capable. See *JCS, FY 1978*, p. 28; Collins, J. M. and Cronin, P. M., *U.S./Soviet Military Balance*, Congressional Research Service, Report No. 85–83F, 15 Apr. 1985, p. 22.

[90] 'White House assesses reports of Soviet Asat laser facilities', *Aviation Week & Space Technology*, 15 Sep. 1986, p. 21.

[91] Pincus, W., 'Soviet believed building radar sites', *Washington Post*, 16 Aug. 1986, p. A19; Gordon, M. R. 'U.S. is debating role of 3 new Soviet radars', *New York Times*, 19 Dec. 1986, p. A11; Morrison, D. C., 'Radar diplomacy', *National Journal*, 3 Jan. 1987, pp. 17–21. The sites are in Skrunda, in western Latvia; Mukachevo, in the Ukraine, near the Czechoslovakian border; and Baranovichi, 160 km south-west of Minsk.

[92] Gordon, M. R., 'Soviet finishing large radar center in Siberia', *New York Times*, 23 Nov. 1986, p. 8.

[93] Manners, G., 'SACEUR's plans for nuclear stockpile', *Jane's Defence Weekly*, 25 Oct. 1986, p. 948.

[94] *JCS, FY 1987*, p. 32; *SMP, 1986*, p. 33.

[95] 'Syria has SS-23 long-range missile site', *Jane's Defence Weekly*, 26 July 1986, p. 92; 'Soviet SS-23s in Europe', *Jane's Defence Weekly*, 25 Oct. 1986, p. 927.

[96] *SMP, 1986*, p. 39.

[97] Correspondence between US Navy SSPO and authors, Apr. 1986.

[98] Correspondence between US Navy SSPO and authors, Apr. 1986.

[99] The JWGs are: 1. Joint Systems Performance and Analysis; 2. Polaris Joint Reentry System Working Group; 3. Trident Joint Reentry System Working Group; 4. Joint Motor Life Study Coordination Group; 5. Joint Steering Task Group; 6. Strategic Weapon System Test Group; 7. UK Test Documentation Group; 8. Strategic Weapon Test Group; and 9. Joint US/UK Polaris Program Financial Management Working Group.

[100] 'Polaris remotoring near completion', *Jane's Defence Weekly*, 12 July 1986, p. 8.

[101] 'NWC Polaris Test Schedule', documents received in 1986 under the US Freedom of Information Act.

[102] Periodic static testing at NWC China Lake will further deplete the 80 sets of motors available, as will DASO flight-tests and A-3TK follow-on testing at ESMC. Eight sets of motors are expected to be expended in flight-tests during 1986–87.

[103] Hutchinson, R., 'Guidance system fault causes Polaris test failure', *Jane's Defence Weekly*, 16 Aug. 1986, p. 228.

[104] US Navy, SSPO, 'Polaris/Poseidon/Trident Flight Test History and Forecast-U', (secret, partially declassified), 17 Apr. 1986; and Freedman, L., *Britain and Nuclear Weapons* (Macmillan: London, 1980), p. 147.

[105] 'Full house at Brüggen', *RAF News*, 17–30 Oct. 1986, p. 1.

[106] *Hansard*, 107 (21), 9 Dec. 1986, col. 147.

[107] Urban, M., 'RAF seeks new missile to beat Soviet air defences', *The Independent*, 10 Nov. 1986.

[108] *Hansard*, 107 (21), 9 Dec. 1986, col. 146.

[109] Roberts, J., 'Kinnock would take 3 years to eliminate nuclear forces', *Defense Week*, 8 Dec. 1986, p. 3.

[110] 'Speech of M. Jacques Chirac, Prime Minister, at the Institute of Higher National Defence Studies (IHEDN)', 12 Sep. 1986, translated in *Speeches and Statements*, Sp.St/LON/126/86, by the French Embassy in London.

[111] See note 110.

[112] 'Une plus-value pour les FAS: Le Mirage IVP, Le missile air-sol moyenne portée (ASMP)', *Air Actualite*, no. 390 (May 1986), pp. 29–32.

[113] However, one source credits the Mirage IVA as being able to accommodate tactical nuclear gravity bombs; thus this aircraft could still have a reserve tactical nuclear role even after the

withdrawal of the strategic AN-22. See 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, 17 Aug. 1984 and 2, 9 Aug. 1985 (secret, partially declassified). In either case these aircraft will be phased out, as the first of 75 Mirage 2000Ns armed with the ASMP take on the nuclear role in 1988.

[114] See note 112.

[115] Commissariat à l'Energie Atomique (CEA), *Informations non classifiées sur l'armement nucléaire français*, 26 June 1986.

[116] Langereux, P., 'La France met en service le missile air-sol nucléaire ASMP', *Air et cosmos*, no. 1087 (15 Mar. 1986), p. 45.

[117] See note 116, p. 44.

[118] CEA, *Rapport Annuel 1985*, pp. 77–9.

[119] CEA, *Informations non classifiées sur l'armament nucléaire français*, 26 June 1986; and, CEA, 'Regard sur l'avenir du CEA', *Notes d'Information*, Jan.–Feb. 1986, p. 7.

[120] '136 missiles one été tirés par le "Gymnote"', *Air et cosmos*, no. 1090 (5 Apr. 1986), p. 26.

[121] Interviews with officials of the French Embassy, Washington, DC.

[122] 'Visite Ministerielle à bord du Terrible', *Air et cosmos*, no. 1087 (15 Mar. 1986), p. 28.

[123] 'French signals', *Aviation Week & Space Technology*, 3 Nov. 1986, p. 31.

[124] 'Speech of M. Jacques Chirac, Prime Minister, at the Institute of Higher National Defence Studies (IHEDN) (12 Sep. 1986)', translated in *Speeches and Statements*, Sp.St/LON/126/86, by the French Embassy in London.

[125] *France* magazine, French Embassy, Washington, DC.

[126] 'French in discussions with SDIO on ATBMs', *Defense Electronics*, Jun. 1986, p. 24.

[127] 'Excerpts from the Speech of M. Jacques Chirac, Prime Minister, Before the National Assembly', 9 Apr. 1986, *Speeches and Statements*, Sp.St/LON/44/86, French Embassy, London.

[128] 'Strategic and space systems', *Revue Aerospatiale*, no. 34 (Nov. 1986), pp. 32–4.

[129] *Air et cosmos*, 15 Mar. 1986, said it would be ordered by the end of the year. As of 6 November it had not yet been ordered.

[130] Assemblée Nationale, *Rapport no. 393, sur le projet de loi de finances pour 1987*, au nom de la commission des finances, de l'économie général et du plan, Annexe no. 39; Défense, Titres V et VI, 12 Nov. 1986, p. 38.

[131] *News from France*, 24 Nov. 1986, p. 2. *Jane's Defence Weekly*, 15 Nov. 1986, p. 1143, gives a figure of nine warheads; 'Missiles', *Air et cosmos*, 15 Nov. 1986, p. 9, gives 8–12 warheads.

[132] Ferrari, A., 'Regard sur l'avenir du CEA,' *Notes d'Information* (CEA: Paris, Jan.–Feb. 1986), p. 8.

[133] 'Défense 1987: un projet de budget lié à la Loi de programmation', *Air et cosmos*, 4 Oct. 1986, p. 27.

[134] 'Le future P.A.N. "Richelieu" de la Marine nationale,' *Air et cosmos*, no. 1083 (15 Feb. 1986), p. 53.

[135] 'L'Armee de Terre aura son "Leclerc" et la Marine son "Richelieu" et l'Armee de l'Air?', *Air et cosmos*, no. 1082 (8 Feb. 1986), p. 31.

[136] 'French five-year budget proposal includes funding for new missiles, ships, reconnaissance satellites', *Aviation Week & Space Technology*, 17 Nov. 1986, p. 25. Another source credits the S4 with only a single warhead; see 'Military program bill for 1987–1991 adopted', *News from France* from the French Embassy Press and Information Service, Washington, DC vol. 86.22 (24 Nov. 1986), p. 2.

[137] de Galard, J., 'L'Assemblée nationale a adopté le budget 1987 de la Défense', *Air et cosmos*, 22 Nov. 1986, p. 7; and 'Military program bill for 1987–1991 adopted', *News from France*, French Embassy Press and Information Service, Washington, DC, vol. 86.22 (24 Nov. 1986), p. 2.

[138] 'Military program bill for 1987–1991 adopted' (note 137).

[139] Speech to the French National Assembly by Defence Minister Giraud on 12 November, reprinted in *Journal Officiel*, 12 Nov. 1986.

[140] See 'Chinese flight test new missile version', *Aviation Week & Space Technology*, 30 June 1986, p. 16; 'Missile range increases', *Jane's Defence Weekly*, 15 Feb. 1986, p. 233; and *Asian Security 1986* (Research Institute for Peace and Security: Tokyo, 1986). p. 84.

[141] See *China Daily*, 28 Jan. 1986, translated in Institute for Defense and Strategic Analysis (IDSA) *News Review on China, Mongolia, the Koreas*, Feb. 1986, p. 77; 'Chinese flight test new missile version', *Aviation Week & Space Technology*, 30 June 1986, p. 16.

[142] Quotation from *People's Daily*, 25 Jan. 1986, reported in British Broadcasting Corporation (BBC), *Summary of World Broadcasts*, Part 3, 28 Jan. 1986, cited in Institute for Defense and Strategic Analysis (IDSA), *News Review on China, Mongolia, the Koreas*, Feb. 1986, p. 77.

[143] The photograph appeared in the Chinese and the English versions of *Xinhua* on 31 December.

[144] For background on China's SSBN programme, see Fieldhouse, R. W., 'Chinese nuclear weapons: an overview', in SIPRI, *World Armaments and Disarmament: SIPRI Yearbook 1986* (Oxford University Press: Oxford, 1986), pp. 97–113.

[145] See, for example, Ebata, K., 'Chinese SSNs "now in operation" ', *Jane's Defence Weekly*, 13 Oct. 1984, p. 603.

[146] Li Yuezhu and Xiong Zhengyan, 'Antichemical warfare corps embody modernization', *Xinhua*, 1 Aug. 1986, translated in US Department of Defense, *Current News*, Foreign Media Edition, 12 Sep. 1986, p. 53.

[147] Li Yeuzhu and Xiong Zhengyan (note 146).

[148] See Ku Mainan, 'Deng Jiaxian: China's father of A-bomb', *Beijing Review*, vol. 29, no. 32 (11 Aug. 1986), pp. 20–2; *Outlook Weekly*, 26 June 1986 (in Chinese).

[149] Ku Mainan (note 148), p. 21; Davies, H., 'Russia "broke A-bomb promise to Chinese" ', *Daily Telegraph*, 23 June 1986.

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