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USAF BALLISTIC MISSILE PROGRAMS

1969 - 1970

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USAF BALLISTIC MISSILE PROGRAMS

1969-1970

by

Jacob Neufeld

Office of Air Force History

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I. THE OPERATIONAL FLEET

(U) [redacted] Credibility of America's land-based ICBM* force as an effective deterrent to nuclear war underwent nervous scrutiny in fiscal years 1969 and 1970. The cause was the Soviet Union's continuing drive to expand and improve its strategic offensive and defensive forces. (By the end of December 1969, it had deployed 1,109 land-based ICBM's, surpassing the U.S. total.) On 18 February 1970 President Richard M. Nixon described the Soviet drive as including work on "a new, more accurate warhead" for their Minuteman-size SS-11 missile, "continued testing of the multiple warhead for the SS-9, and research and development on improved components for their ABM+ system, together with improved coverage by their ABM radars." Despite these facts, the President decided that the United States for the time being should neither increase nor cut back its missile forces but pursue discussions with Moscow about limiting strategic weapons and thus avoid "another round of the arms race."[1]

(U) [redacted] It was against this background that the Air Force, during fiscal years 1969 and 1970, concentrated on modernizing and improving the existing Minuteman fleet of 1,000 ICBM's. To assure Minuteman's prelaunch survival of a nuclear attack, it studied ways

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*Intercontinental ballistic missile.

+Antiballistic missile.

[redacted]

[redacted]

to harden and defend its missile silos and continued research and development (R&D) projects on reentry systems that could penetrate the Soviet Union's ABM defenses.

(U) [redacted] Administration reductions of the defense budget, however, slowed Air Force Systems Command (AFSC) efforts to improve survivability of the missile force. A plan to relocate Minuteman in superhard rock silos was deferred, and certain missile modifications were repeatedly postponed. Lack of R&D funds also delayed other Air Force high priority projects, e.g., a proposed advanced ICBM designed to be the 1975-1985 nuclear deterrent. In another area, defense officials withheld authority from the Air Force to incorporate promising penetration aids on Minuteman, pending confirmation by U.S. intelligence of a Soviet low-altitude defense system. Likewise, the Strategic Arms Limitation Talks (SALT)--which the United States initiated with the Soviets at Helsinki, Finland, on 17 November 1969--forced delays or slowdowns of several Air Force missile improvement projects.

(U) [redacted] The Air Force participated with the Army and Navy in certain missile programs. Beneath this calm surface of cooperation, however, ran undercurrents of competition for available funds. In 1969 the Army had reoriented its Safeguard antimissile system to defend Minuteman silos. The Air Force, dissatisfied with

[redacted]

Safeguard's effectiveness, proposed alternate antimissile defenses. Too, the complexities in coordinating offensive and defensive missiles promised an Air Force-Army contest over command and control. Furthermore, a Navy proposal to develop an underwater long-range missile system threatened to make land-based ICBM's extinct. Although the Office of the Secretary of Defense (OSD) publicly reiterated its confidence in the "triad" of deterrence--ICBM's, bombers, and sea-launched missiles--Dr. John S. Foster, Director of Defense Research and Engineering (DDR&E) remarked on 24 May 1970: "We can no longer have confidence in the survivability of silo based missiles for more than a short period of time."

Updating Minuteman

(U) [redacted] Throughout fiscal years 1969 and 1970, Strategic Air Command's (SAC's) 1,000 Minuteman ICBM's were deployed in 20 strategic missile squadrons, each possessing 50 missiles. Three squadrons were assigned to each of five wings--the I, II, III, IV, and VI--supported from Malmstrom AFB, Mont.; Ellsworth AFB, S. Dak.; Minot AFB, N. Dak.; Whiteman AFB, Mo.; and Grand Forks AFB, N. Dak., respectively. Four squadrons belonged to Wing V at Warren AFB, Wyo., and one squadron--the 20th--operated independently at Malmstrom AFB.*2

*The designation Strategic Missile Wing (SMW) was applied as follows: 341st SMW (Wing I), 44th SMW (Wing II), 91st SMW (Wing III), 351st SMW (Wing IV), 90th SMW (Wing V), and 321st SMW (Wing VI). Squadron 20 (564th Strategic Missile Squadron) was incorporated into the 341st SMW upon completion of the latter's weapon system modernization.

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(U) [redacted] Between December 1967 and May 1969, Wing I exchanged its Minuteman I (LGM-30A) missiles--the oldest model in the force--for Minuteman II's (LGM-30F). A similar effort had been completed at Wing IV in October 1967. Because both conversion programs required modernization of launch facilities, the emerging weapon system (WS-133A-M) was dubbed Modernized Minuteman. The Improved Minuteman (WS-133B) system, which also employed Minuteman II missiles, was operational at Wing VI and at Squadron 20. However, their launch facilities differed from the Modernized Minuteman, having been originally designed to accommodate the Minuteman II. Wings II, III and V were equipped with the Minuteman I (LGM-30B model). Hence, in May 1969, the force contained 500 Minuteman I and 500 Minuteman II missiles.[3]

[redacted] The Minuteman II missile exceeded its predecessors in accuracy, range, yield, target selectivity, and protection against nuclear effects:[4]

	Minuteman I		Minuteman II
	LGM-30A	LGM-30B	LGM-30F
Reentry vehicles	Mk-5	Mk-11/11A	Mk-11B/C plus penetration aids
Target selection capability	1	2	8
Circular error probable (CEP) requirement (nautical miles (NM))	[redacted]		
Yield (megatons (mt))	[redacted]		
Maximum range (in nautical miles)	5,000	5,500	6,800

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[redacted]

(U) [redacted] To foil enemy radars Minuteman II carried a penetration aids system, the Mk-1 chaff dispenser. It was to be replaced by the Mk-1A system which substituted foil dispensers for chaff bags to extend radar frequency and improve masking capability.* Too, Minuteman II's reentry vehicles--the Mk-11B and Mk-11C--gave more protection against nuclear effects than the earlier models, the Mk-11/11A's.+5

[redacted] Replacement of Minuteman I and Minuteman II missiles by Minuteman III marked the next phase of force modernization. The new ICBM had an expected maximum range of 7,500 nautical miles with an accuracy CEP of 0.25 NM. Its first and second stages were the same as those of Minuteman II. It featured, however, an improved third stage plus a liquid-fueled post boost propulsion system (PBPS) which was actually a fourth stage. The PBPS permitted deployment of the multiple independently targetable reentry vehicle (MIRV).

DOE b(3)

[redacted] These might be directed to separate and widely dispersed targets or massed against a single one. A set of three target options was available to each reentry

*Mk-1A became operational during July 1969; the Air Force purchased 346 of them in March 1970.

+To improve inflight survivability, the Air Force secured approval in March 1970 to convert all Mk-11B models to Mk-11C's.

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vehicle. In addition, up to 16 chaff clouds were included to mask the warheads from area defense radars. As many as 10 Mk-12 decoys could be carried to nullify terminal area antimissile defenses.

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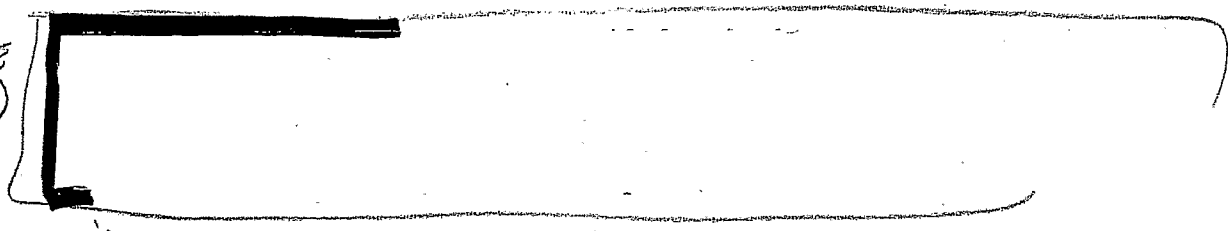
b (3)



(U) [redacted] An initial operational capability (IOC) target date of July 1969 had originally been set for Minuteman III modernization. The first 10 Minuteman III's were scheduled for Wing III; the entire Minuteman I fleet was to have phased out by September 1973. However, because of technical difficulties, funding limitations, and intelligence reports revealing a reduced buildup of Soviet missiles, the IOC was slipped first to December 1969 then to June 1970.[7]

(U) [redacted] In its fiscal year 1970 budget, submitted in the fall of 1968, the Air Force requested $690.5 million with which to buy 208 Minuteman III missiles. The outgoing Johnson administration cut this amount by $138.1 million, thereby dropping missile procurement to 162. In March 1969 the revised (Nixon) budget pared funds further, limiting Minuteman III purchases to 116. Increased costs reduced this number to 100 in September 1969. Despite these extensive cutbacks, the Minuteman III IOC target date of June 1970 remained intact. The deployment rate, however, dipped from 150 to 100 missiles a year. Completion of Wing III modernization, scheduled for June 1971, was

[redacted] [redacted]

extended into early fiscal year 1972;* and Minuteman I phaseout slipped from September 1973 to February 1974.[8]

(U) [redacted] The fiscal year 1971 budget picture was no brighter. USAF officials had hoped to purchase 165 missiles, but the number was cut to 131 in December 1969 and to 120 in March 1970. As a result, completion of Wing III modernization had to be rescheduled to January 1972, and the overall Minuteman I phaseout moved from February 1974 to November 1974. Air Force estimates of force composition by 30 June 1975 were 450 Minuteman II and 550 Minuteman III missiles.[9]

(U) [redacted] Minuteman III's Mk-12 decoy system also fell victim to fund shortages. In October 1968 OSD had tentatively approved purchase of 200 decoys. Nevertheless, the continuing absence of evidence of a Soviet low-altitude defense capability reduced the funding priority. Pending proof of such capability, OSD withheld procurement approval of the decoys but permitted completion of the Mk-12 decoy systems development. Furthermore, lack of money caused abandonment of a promising roll-control technique that would improve Mk-12 reentry vehicle accuracy.[10]

(U) [redacted] In May 1969 the Minuteman III IOC was threatened when an extensive fire destroyed an Atomic Energy Commission (AEC) facility at Rocky Flats, Colo. The plant produced plutonium parts for Minuteman III and Poseidon missile warheads for the Navy. Use of

*By accepting fewer spare missiles than were required, the Air Force hoped to maintain Wing III's deployment schedule of 110 Minuteman III missiles by the end of fiscal year 1971.

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"work around" procedures and partial restoration of the plant helped avert a delay. Minuteman III became operational on 19 June 1970 with 10 missiles postured at Wing III, Minot AFB, N. Dak.[11]

SALT: The Political Factor

(U) [redacted] During the summer of 1969, Dr. Henry Kissinger, Assistant to the President for National Security Affairs, convened a special panel in preparation for U.S. and Soviet Strategic Arms Limitation Talks. The White House panel's major objective was a U. S. position on controlling the spread of MIRV systems. The Arms Control and Disarmament Agency (ACDA) member--anticipating a Soviet Union rejection of onsite inspections--recommended a ban on flight testing. The ban would effectively prevent MIRV's deployment by eliminating a critical phase of its development. Air Staff panel members countered by showing that elements of the MIRV could be covertly flight tested. They argued that onsite inspections were essential to enforce the proposed ban. Furthermore, without engineering examination, it would be impossible to tell whether or not a MIRV system had been deployed. The panel subsequently accepted the Air Force position.[12]

[redacted] In April 1970 the Senate adopted Resolution 211 which suggested a U.S.-Soviet ban on MIRV deployment. Because the resolution failed to distinguish between MIRV and the Minuteman III missile, Air Force officials feared it might jeopardize the Minuteman

[redacted] [redacted]

[redacted]

modernization program.* Minuteman III--a replacement for the aging Minuteman I--had been designed primarily to penetrate enemy defenses.

DOE b(3)

[redacted] The Air Staff urged OSD to support the modernization plan. Should MIRV systems be banned, the Air Force would propose three options to divorce Minuteman III from MIRV: (1) load each missile with a single Mk-12 warhead, chaff, decoys and ballast; (2) replace Mk-12 with Minuteman II's Mk-11C reentry vehicle (this would require redesign of the Minuteman III); or (3) develop and deploy a new single reentry vehicle.[13]

Titan II's New Lease

(u) [redacted] Throughout fiscal years 1969 and 1970, the Titan II (LGM-25C) fleet consisted of 54 ICBM's. These were in three wings of two 9-missile squadrons each.+ The wings were located at Davis-Monthan AFB, Ariz.; Little Rock AFB, Ark.; and McConnell AFB, Kans. In addition, three Titan II test silos were situated at Vandenberg AFB, Calif. Two of these--which had been kept on alert status--were phased out on 31 December 1969 due to budgetary pressures.[14]

(u) [redacted] Failing to gain approval for developing an advanced ICBM, the Air Force argued for retention of the Titan II force, citing

*By the end of fiscal year 1970 S Res 211 had not been adopted.

+The 390th, 308th, and 381st SMW's, respectively.

[redacted]

the missile's long range, great weight-lifting capacity, and high yield. OSD agreed to set aside the original plan to start phasing out Titan II in fiscal year 1971. A new retirement schedule was agreed upon, calling for successive retirement of one squadron each in fiscal years 1974, 1976, and 1978.[15]

(U) [redacted] To fund the extended phaseout of Titan II, OSD deferred for a year the procurement of four and five Titan II systems, respectively, for fiscal years 1969 and 1970. OSD also canceled the Titan II follow-on operational test (FOT) program after fiscal year 1969. On 21 May 1969 the program ended with the launch of Glory Trip-39T, the third FOT sortie of the fiscal year. SAC decided not to launch the fourth FOT missile and use the money saved to maintain a full alert posture at Vandenberg AFB.[16]

(U) [redacted] OSD believed it unlikely that ending the 4-launches-per-year FOT series would affect Titan II's well-established accuracy and reliability factors. This belief hinged on using a ground bench-testing program in lieu of FOT to analyze subsystem performance. However, Air Force headquarters, supported by SAC, cited previous flight test failures that bench testing had failed to predict. The Air Force pointed out FOT could continue for only $200,000 more a year. Notwithstanding these arguments, Secretary of Defense Melvin R. Laird reaffirmed in April 1969 the OSD decision to cancel the program.

[redacted] [redacted]

He indicated, however, that Titan II flights would be needed in the Safeguard system target program.* In October 1969 a requirement was levied for three launches in fiscal year 1971 and two per year thereafter. Secretary Laird thought it "desirable that these firings also contribute to the purpose of FOT insofar as is possible."[17]

*See p 52.

[redacted]

II. MISSILE TESTING

(U) [redacted] The Air Force used flight tests to gather realistic performance data for evaluating its missile systems. Missiles launched down the Eastern Test Range (ETR) or Western Test Range (WTR) carried special equipment that supplied performance data to waiting ground stations. The flight test cycle began with research and development exercises. Demonstration and shakedown operations followed. Normally consisting of five new ICBM's, these tests refined the system and procedures for its use. Next came operational test launches to establish reliability and accuracy factors for the single integrated operational plan (SIOP). The cycle ended with follow-on operational tests that preserved SIOP reliability and accuracy factors during the life of the missile system.[1]

(U) [redacted] In fiscal years 1969 and 1970 all Minuteman missile configurations participated in at least one phase of the flight test cycle. Minuteman I (LGM-30B) resumed follow-on operational testing in January 1969 after a one-year suspension; it completed its Pacer Kite* special test series in November 1969. Demonstration and shakedown operations for Minuteman II missiles, begun in August 1966, finally ended in March 1969; operational testing commenced the following

*Pacer Kite (also Olympic Trials B) involved a series of specially instrumented test launches initiated under the direction of the Ogden Air Materiel Aerea (OOAMA), Air Force Logistics Command.

[redacted]

month. On 16 August 1968 a Minuteman III missile, carrying the MIRV, was successfully launched, marking the start of the system's research and development flight phase. After three follow-on operational tests of the Titan II in fiscal year 1969, the program was canceled.*

Minuteman I

(U) [redacted] The Minuteman I system had undergone follow-on operational tests for nearly two years when SAC suspended the program in January 1968. The suspension stemmed from the large accuracy error--1.6 NM CEP--that developed when the missile carried the heavyweight Mk-11A reentry vehicle. Since more than 130 missiles in the operational fleet were fitted with the Mk-11A, the Air Force moved swiftly to identify and resolve the problem. In February 1968 OOAMA conducted a series of special launches known as Pacer Kite; eight were completed by 30 June 1969 and the series ended in November 1969. While the tests detected no single cause for the large accuracy error, they did uncover many small but cumulative errors. Changes were therefore made in Minuteman I's computer program, and a two-thirds improvement in Mk-11A accuracy was expected.[2]

(U) [redacted] In December 1968--with Pacer Kite testing yet incomplete--SAC ordered a resumption of follow-on operational tests. This action was taken because of SAC's urgent need for up-to-date reliability and accuracy factors on that part of the Minuteman I force equipped with Mk-11 reentry vehicles. Actual testing resumed at the end of

*See pp 10-11.

January 1969. By the end of fiscal year 1970, 22 launches had been made with only one launch and three flight failures.[3]

Minuteman II

(U) [redacted] There were two distinct--but related demonstration and shakedown operations programs for Minuteman II missiles. The first involved the Improved Minuteman weapon system (WS-133B) postured at Wing VI, Grand Forks AFB, N. Dak. The operations, begun in August 1966, were suspended in 1967 after three flights because reentry vehicles consistently fell short of the desired impact point. To find out why, SAC instituted a 9-missile diagnostic test series called Olympic Trials. While the test series was in progress, SAC resumed Wing VI demonstration and shakedown launch operations in April 1968. The exercise, dubbed Giant Blade I, failed and the launchings were again suspended.[4]

(U) [redacted] The second program entailed the Modernized Minuteman weapon system (WS-133A-M), sited at Wing IV, Whiteman AFB, Mo. This system utilized the same LGM-30F missile as did the Improved Minuteman, but had a different launch system. Because the Giant Blade I failure was confined to Improved Minuteman's operational ground equipment, SAC permitted Modernized Minuteman to begin demonstration and shakedown operations. Designated Giant Fist, the program commenced on 8 July 1968 with a successful launch. Three days later the second test missile in the series aborted. Investigation of the incident,

combined with modification of Vandenberg AFB launch facilities, delayed the program considerably. It resumed in October 1968 with a successful exercise. Meanwhile, Olympic Trials had confirmed the theory that a clerical error in transcribing gravity data at Vandenberg AFB caused Improved Minuteman's accuracy problem. Confident that missile reliability was likewise under control, SAC scheduled two flight tests for November 1968--a Giant Fist and a Giant Blade. Both failed. SAC suspended Minuteman II demonstration and shakedown operations once more.[5]

(U) [redacted] An analysis by the Space and Missile Systems Organization (SAMSO)* revealed that recently procured third-stage motors contained irregular lots of solid propellant. These defects caused, 10 seconds after third-stage ignition, extreme acoustic vibrations and subsequent loss of steering control. A survey of the Minuteman II operational fleet disclosed some 300 missiles with the defective propellant. Of these, 83 were assigned top priority for immediate correction. The rest were continued in the flight test program and scheduled for modification "in-line" with other programmed changes.[6]

(U) [redacted] By January 1969, SAMSO had engineered and ground tested a modified nozzle control unit to reduce the severity of third-stage vibrations. To verify the effectiveness of this design change, special flight tests were scheduled. After the first SAMSO missile was successfully flown in late January 1969, SAC renewed the

*A unit of Air Force Systems Command (AFSC).

[redacted]

Minuteman II test program with a flight on 2 February 1969. The following month SAMSO launched another special flight test, while SAC successfully completed the Giant Fist exercise. Overall, the Minuteman II record had barely met minimum demonstration and shake-down operations requirements. Nonetheless, since defective conditions were identified and being corrected, SAC initiated Minuteman II operational testing.[7]

(U) [redacted] Both Minuteman II missiles--Improved and Modernized--were to undergo 25 operational tests each. SAC used strict criteria in selecting missiles for the tests. It decided not to launch any of the limited supply of missiles with hardened guidance and control units and reentry vehicles. And it excluded missiles lacking all required reliability modifications. The missile picked for the first operational test was a Modernized Minuteman, Glory Trip 19M,* which carried an unmodified, "low-priority" third-stage motor. Launched on 16 April 1969, the missile failed to perform due to acoustic vibrations. The effect of this alarming failure was to expand the list of Minuteman missiles disqualified from operational testing. Only the Improved Minuteman at Wing VI, with a 25 missile sample size, remained eligible to continue in the program.[8]

(U) [redacted] Operational testing continued on 25 April 1969. Improved Minuteman missiles were used in all but three of the remaining

*In the Minuteman II operation test series, Modernized Minuteman missiles were designated Glory Trip-XXM; Improved Minuteman, Glory Trip-XXF.

21 tests conducted through 30 June 1970. (One Modernized Minuteman missile was launched in March 1970 and two more in June.) Despite some minor problems, the Minuteman II operational test program posted a respectable record--19 successful launches out of 22 attempted. Moreover, launch and in-flight reliability goals were attained and accuracy better than the 0.5 NM objective was achieved. Minuteman II missiles also participated in a series of six special flights between December 1968 and July 1969. Their purpose was to verify the effectiveness of the new Mk-1A penetration aids system.[9]

Minuteman III

(U) [redacted] The Minuteman III research and development flight test program called for 28 launches. The main goal of the 15 launches from Cape Kennedy, Fla., was evaluation of systems accuracy; that of the 13 launches from Vandenberg AFB, Calif., penetrability analysis. On 16 August 1968 the program opened with a Cape Kennedy successful launch. The post-boost propulsion and control systems of the MIRV worked perfectly as each of the three unarmed reentry vehicles struck its intended target. The second flight over the ETR, in October 1968, ended in failure. Ground-testing identified the culprit as the thrust-termination system on the third-stage motor. Before the next launch in the series, design modification and extensive proof-testing became necessary.[10]

(U) [redacted] The program finally resumed in March 1969. The flight was only partly* successful due to a computer malfunction. Other problems hampered 1969 testing. For example, a faulty non-operational connector caused a flight failure in June; redesign and testing corrected this defect. In another instance, an inoperative chaff dispenser required an engineering change. However, most failures were related to the guidance and control system. Poor-quality workmanship by the manufacturer--Autonetics Division of North American Rockwell--was suspected. Meantime, after seeking a second source for guidance and control units, the Air Force awarded a development contract to Honeywell Corporation in July 1969.[11]

(U) [redacted] The research and development test program ended with a final launch in July 1970. Twenty-five missiles had been fired, 15 of which were successful; four partially successful; and six, failures. Minuteman III's launch reliability goal was achieved as was its 0.25 NM CEP accuracy objective.[12]

(U) [redacted] Three of the original launches were rescheduled as part of a series of 11 "post IOC" R&D flights, which involved special test missiles (STM's). Scheduled from September 1970 to April 1972, the STM's would: (1) test configurations not tested during the regular R&D phase (i.e., early thrust termination, high and low angle reentry, second source guidance); (2) obtain additional data in such areas as the

*Percentage of primary objectives achieved determined assignment of adjectival ratings: Successful=more than 80%; Partly Successful=20%-79%; Failure=19% or less.

[redacted]

Mk-12 high altitude fuze, second source third stage, reentry vehicle drag model; and (3) test production versions of design changes made since termination of the R&D program.[13]

(U) [redacted] Even while the research and development program was under way, Air Staff planners wrestled with the problem of inadequate range support for operational flight tests. The planners knew that a fully configured Minuteman III, with necessary range safety equipment, lacked power to reach Western Test Range terminals at Eniwetok and Kwajalein atolls. A new location was a must. An AFSC study recommended Canton Island as the most suitable site. One of the Phoenix Islands, Canton lay some 3,600 nautical miles southwest of Vandenberg AFB. Its shorter range and fixed position, in combination with other monitoring stations, would allow variable azimuth missile test launches. Too, there already were adequate housing facilities on the island. The single alternative to Canton Island was instrumented range ships, which would cost $10 million more and afford a less accurate scoring capability. The Air Force opted for Canton.[14]

(U) [redacted] One large obstacle stood in the way. Inasmuch as Canton Island was under joint U.S.-British administration, an agreement on its use for missile testing had to be negotiated. While awaiting diplomatic progress on the negotiations, the Air Force secured OSD endorsement to (1) release some $2 million in fiscal year 1969 research and development funds for WTR improvements, (2) develop new

monitoring equipment for missile flight tests, and (3) phase down the Eniwetok complex and transfer its activities to the Kwajalein range by 1 July 1969.[15]

(U) [redacted] Throughout 1969 negotiations for use of Canton Island dragged on. The American-Russian Strategic Arms Limitation Talks became the sticking point. The British insisted on including a provision that Minuteman III flights would be stopped if MIRV testing were a "subject of discussion" in the SALT. U. S. negotiators were anxious to reach an agreement on Canton Island but not at the expense of investing the British with a veto over Minuteman flight tests. As of 30 June 1970, no agreement had been reached. Meanwhile, the June elections in Britain switched government control from the Labourites to the Conservatives, implying an improved chance of arriving at an understanding.[16]

Launches from Operational Silos

(U) [redacted] In March 1965--at Wing II, Ellsworth AFB, S. Dak.--a Minuteman I (LGM-30B) missile had been electronically disconnected from squadron control and supplied with enough fuel for a 7-second flight. The missile was launched from the silo, climbed until its fuel was gone, then plummeted to earth. This successful exercise started Long Life, a series of limited launches from operational bases. The Air Force tried to repeat the success at Wing VI, Grand Forks AFB, N. Dak. However, successive attempts there in September and October

1966 to launch Minuteman II (LGM-30F) missiles ended in failure. During August 1968 the program, now named Giant Boost, resumed at Wing VI. When the launch aborted, the Air Force rushed a 7-second missile to Vandenberg AFB, where it was successfully flown on 1 September 1968.[17]

(U) [redacted] Secretary of the Air Force Harold Brown believed the successful exercise at Vandenberg AFB had redeemed public confidence in the Minuteman. Nevertheless, he urged OSD to expand the 7-second program and to include full-range launches from operational silos. The Air Force had advocated such flights since early 1963, but political and safety considerations had blocked them. A September 1968 report of the Nuclear Panel, USAF Scientific Advisory Board (SAB), reaffirmed the pressing need for long-range operational base launches (OBL) to establish weapon system effectiveness. Because tracking and range safety systems used on operational tests from Vandenberg AFB altered the missile's configuration, the Nuclear Panel recommended development of a self-destruct and instrumentation package to be carried inside the reentry vehicle (RV). Such a system promised greater realism by maintaining weight, length, and dynamics characteristics of operational missiles.[18]

(U) [redacted] After gaining OSD support in November 1968, the Air Force prepared to conduct multiple 7-second tests and to plan for OBL flights. Soon the Air Force detected weaknesses in the short-range program. It would cost from $10 to $15 million but would yield only

[redacted]

partial returns. More sobering, another 7-second missile failure--no matter how trivial the malfunction--would further erode public confidence. SAMSO proposed an attractive alternative--use of modified operational missiles (MOMS). In these missiles an inert component replaced the ignitor, thereby permitting countdown through first-stage ignition test procedures. The MOMS plan still required isolation of individual silos but cost much less and could be applied fleet-wide.[19]

(U) [redacted] In April 1969 Dr. Robert C. Seamans, Jr., the new Secretary of the Air Force, reviewed the short- and long-range OBL programs. In a subsequent report to Secretary Laird he stressed the urgent need for valid missile accuracy and reliability data, and favored the MOMS concept over the 7-second missile. He noted the latter was of little value and its benefits "not commensurate with the costs and risks of embarrassment." As for long-range flights, the Air Force Secretary discussed several options. The least expensive, quickest to implement, and most operationally realistic configuration was the uninstrumented launch. However, it entailed "unacceptable" risk and was apt to stir up intense political opposition. The self-contained safety system, proposed by the SAB, offered the next best option, but it would take 19 months to develop. Dr. Seamans therefore proposed using the Vandenberg range safety system in an initial exercise from Wing I, Malmstrom AFB, Wyo., during the winter of 1969-1970.[20]

[redacted]

(u) [redacted] Secretary Laird accepted the MOMS approach, but required retention of a launch capability for 7-second missiles. Further, to gain the President's approval of long-range flights, he asked the Air Force for more detail and hazard analysis. Scarce funds later overtook the operational base launch program and emphasis shifted to use of the modified operational missiles. The Air Force planned a countdown and simulated launch of 10 MOMS sorties at Wing VI in August 1970.[21]

(u) [redacted] By early 1970 the Air Force had established its position on full-range flights. From the various OBL options, the 19-month program for developing an RV-contained range safety package emerged as the preferred course. Even if OBL were not approved, the system could be used for Vandenberg AFB launches. In April 1970 Gen. John D. Ryan, Air Force Chief of Staff, directed AFSC to "get going" on the range safety package. He foresaw an initial flight from Malmstrom AFB in October 1971. Deputy Secretary of Defense David Packard approved these preparations, provided they were not carried out on a "crash basis" and had long-term application to operational testing.[22]

III. OPERATIONAL FLEET IMPROVEMENTS

(U) [redacted] At least since 1963 the Air Force had worked to protect its missile launch complexes against blast and shock effects of nuclear explosions. SAMSO's Plan I vulnerability hardness program, integrated with other modifications to improve weapon system effectiveness, had begun in late 1965. When completed in May 1969, it had also incorporated additional safeguards against such nuclear by-products as radiation and electromagnetic pulse phenomena. A series of simulation tests had proved that most Minuteman silos could withstand overpressures of more than 300 pounds per square inch (psi). However, the significance of even this degree of hardness diminished as the Soviets simultaneously increased the size of their offensive missile arsenal, increased payload megatonnage, and improved accuracy. Intelligence estimates were that by the mid-1970's a Soviet attack could destroy up to 85 percent of the Minuteman force. Inescapably, United States ICBM's had to be made ever more survivable.

Prelaunch Survival

(S) [redacted] The Air Force explored several sets of options to protect its missiles. One set pitted continued improvement of present silos against relocating the ICBM's to hard rock areas. A second set of choices would combine Minuteman with mobile launchers to intensify the enemy's targeting problems. The use of railroad cars

had been considered before but discarded. Nonetheless, various newer schemes envisioned Minuteman atop wheeled, tracked, and air-cushioned vehicles. Meantime, in the background loomed the extreme course of multiplying the number of missiles or, conversely, replacing the Minuteman force completely with a sea-based ICBM system. Whichever option was finally selected--hardening, active defense, mobility--the underlying assumption remained unchanged: U. S. missiles must "ride out" any attack.

(U) [redacted] During fiscal years 1969 and 1970, the Air Force's preferred basing concept for Minuteman was the Hard Rock Silo (HRS) program. Secretary of Defense Robert S. McNamara approved the program in November 1967. It would develop new launch facilities able to withstand 3,000 psi overpressures and launch control facilities capable of surviving 6,000 psi blasts. Drilled in hard rock formations and initially fitted with Minuteman III missiles, these silos could also hold the larger missiles of a future ICBM system. U.S.-wide site surveys found several geologically suitable areas with the Laramie Range, near Francis E. Warren AFB, Wyo., considered the best choice. The survey found enough terrain to put 1,000 Minuteman missiles into hard rock silos. Near-term planning, however, did not go beyond 150 to 450 silos.[1]

(U) [redacted] On 21 November 1968 and 26 March 1969 the Air Force--in cooperation with the Defense Atomic Support Agency (DASA)--conducted Rocktest I and Rocktest II, respectively. These high

[redacted]

[redacted]

explosive tests simulated the air blast and direct-induced, ground-shock characteristics of nuclear explosions. By demonstrating that scale model and full sized silo closures could survive, the tests built confidence in the feasibility of designing 3,000 psi-hard facilities.[2]

(U) [redacted] In August 1968 Dr. Foster permitted the Air Force to begin HRS engineering development. He stipulated, however, that in selecting contractors competitive proposals be used in lieu of the contract definition process. This approach was dictated by the need for a prototype test demonstration to provide data for facility design. Earlier, in May 1968, TRW Systems, Inc., was awarded a contract to provide system engineering and technical direction. In August 1968 the Boeing Company was engaged for program planning and engineering support. On 18 December 1968 the Air Force opened an industry competition to select a facility associate and an installation and test associate. In April 1969 it awarded the installation and testing contract to the Boeing Company; in May, the Bechtel Company won the facilities competition. For a time the Air Force, believing there were advantages in pursuing a "dual technology" approach, planned to employ an alternate facilities associate. This approach was later abandoned due to sharp fund cuts. Selection of a command and control associate was twice deferred then eventually allowed to lapse.[3]

(U) [redacted] In fiscal year 1968 the Air Force requested $4 million for HRS research and development as part of the Minuteman program;

[redacted]

[redacted]

OSD reduced the amount to $1.2 million. In fiscal year 1969, with HRS established as a separate program element, the budget request was $38 million; only $25 million was approved. Likewise, the $88 million requested in fiscal year 1970 was trimmed to $50 million. These fund cuts caused many changes in the HRS program. More upsetting, however, was the disagreement between the Air Force and Dr. Foster over the long-range value of the program and its immediate objectives.[4]

(U) [redacted] A case in point was the wide time gap between the latter's HRS deployment decision and the earliest possible prototype test demonstration. To meet an initial operational capability date of mid-fiscal year 1974 for the HRS, it was necessary for Dr. Foster to make a deployment decision before 31 December 1969. However, an important factor in his decision--the prototype test--had slipped from September 1971 to May 1972 due to budget cuts. In addition, he was concerned over the many new designs being introduced into the program, including a new command and control system, an advanced power system, and silo and suspension gear. Fearing these innovations would spiral development costs and produce an undesirable mix of concurrent development and deployment, Dr. Foster complained to the Air Force that: "We seem to be backing into design of the next ICBM system while resolving Hard Rock Silo interface problems." To overcome these financial and technical problems, he suggested Air Force officials

either (1) define the next ICBM system, or (2) reduce the scope of the Hard Rock Silo program to an investigation devoted to "typical silo, closure and suspension system technology."[5]

(U) Grant L. Hansen, Assistant Secretary of the Air Force for Research and Development, disagreed with Dr. Foster's suggestions. Citing the urgent need to develop Hard Rock Silo for use with Minuteman III, he proposed, instead, a third Rocktest-type experiment as one way to restructure the HRS program. He also pointed out to Dr. Foster that the shortage of money and slow MICCS* development had thwarted efforts to speed up the prototype test schedule.[6]

(U) Meanwhile, a new issue arose involving Minuteman survivability. On 14 March 1969 President Nixon announced he had modified the previous administration's Sentinel ABM system, which he renamed Safeguard. He stated that, if the Congress approved, he would initially deploy the Army's ABM to protect "our land-based retaliatory forces against a direct attack by the Soviet Union," specifically "selected Minuteman missile sites."[7]

(U) Mr. Nixon's announcement was made at a time when there was a great public outcry against defense expenditures and for "a reordering of the nation's priorities." Many members of Congress, supported by outside scientists and former defense officials, announced their intention to vote against the ABM system. In June

*Minuteman Integrated Command and Control System. See p 38.

and July the issue was joined in the Senate, where a "great debate" got under way. It was against this background that Dr. Seamans on 2 July wrote to Secretary Laird about the Minuteman survivability question. He said that--for the same degree of survival--the 10-year costs for the Safeguard antiballistic missile (ABM) system ($11.5 billion) were more than double the cost of deploying into Hard Rock Silos ($5.4 billion). Hence Hard Rock Silo was not only more cost effective but offered greater potential.*

(U) [redacted] The Air Force plan was to initially deploy 10 missiles in HRS during December 1973, then build to 450 silos by fiscal year 1977. Dr. Seamans favored development, in hard rock terrain, of a close-in hard point defense having missile site radars. He also urged design of a transporter/erector vehicle to furnish deception for Minuteman as needed.[8] Deputy Secretary Packard subsequently supported the Hard Rock Silo program with the proviso that it be "complemented by hard point defense." He believed the program's increased survivability plus Moscow's ability to verify the number of fixed U. S. ICBM's would stabilize the arms control environment.[9]

(U) [redacted] On 26 August 1969 Dr. Foster, who had completed his technical review of the Hard Rock Silo program, advised the Air Force that "a deployment decision can be made now with insignificant risk over making it at the conclusion of the planned

*The ABM issue became academic when the Senate, on 6 August 1969, approved the President's plan by a margin of one vote--51 to 50.

[redacted]

prototype demonstration." Hence, he directed the prototype test be canceled and Rocktest III substituted for it. He further advised the Air Force to expect a fiscal year 1971 decision approving no more than 300 silos.[10]

(U) [redacted] Air Force optimism over approval of the Hard Rock Silo program proved premature. A series of subsequent budget cuts reduced HRS funds to a final figure of $25 million in fiscal year 1970 and $40 million in fiscal year 1971. With its initial operational capability slipping far into the future, HRS's attractiveness diminished. Finally, on 11 December 1969 OSD canceled the HRS budget element and adopted in its place a Minuteman Rebasing program.* Funds projected for the Hard Rock Silo, MICCS, and Advanced ICBM Technology programs were to be rechanneled into a $77 million fiscal year 1971 budget for rebasing.[11]

(U) [redacted] During December 1969 and January 1970, the Air Force reevaluated its position and prepared alternate plans for prelaunch survival. The most attractive alternate to Hard Rock Silo--in Air Force eyes--was a program to improve hardness of existing silos. Dubbed Upgrade Silo, the program was relatively inexpensive yet promised to increase the hardness level of facilities from their current 300 psi rating to about 1,000 psi. When complemented by a hard point defense system, the Upgrade Silo program was expected to win OSD support.[12]

*The program included such options as hardening existing silos, and working toward a mobile ICBM concept. In addition, options were left open for a proposed new Air Force-operated hard point defense system.

(U) [redacted] In February 1970 the Air Force unveiled the proposed distribution of Minuteman Rebasing funds:

Command Data Buffer integration (formerly MICCS)	$15.0 million
Hardening existing silos (Upgrade Silo)	$25.6 million
Hard Rock Silo (HRS)	$ 6.0 million
Hard point defense	$10.0 million
Mobility	$20.4 million

The $6 million allotted to Hard Rock Silo was for completion of preliminary designs and retention of the HRS option for possible resurrection later.[13]

(U) [redacted] On 28 April 1970 Secretary Seamans set forth the Air Force position on Minuteman Rebasing. In a memorandum to Dr. Foster, he stressed the importance of preserving the huge investment in Minuteman and the possibilities of capitalizing on it. Beyond the hardening of existing silos, he advocated development of a hard point defense system.[14]

(U) [redacted] Dr. Foster replied on 24 May that upgraded silos and Hard Rock were both "unwise expenditures of funds." With Soviet accuracy improvements shrouded in uncertainty, "we can no longer have confidence in the survivability of silo based missiles for more than a short period of time." Dr. Foster doubted if either Hard Rock or upgraded silos would add much to hard point defense. Consequently, he concluded that the remaining options--shelter basing*

*This scheme envisioned the construction of several moderately hardened and widely dispersed missile shelters. Upon warning of attack, mobile launchers would assemble at one or more of these shelters. Since the enemy could not know which shelters were occupied, his targeting problem would be compounded.

[redacted]

[redacted]

and hard point defense--should be pursued in fiscal year 1971. Confident that shelter basing was workable, he recommended the Air Force increase its funding to $40 million for such basing, and raise to $18 million the investment for developing a hard point defense system. On the other hand, Dr. Foster deemed adequate the $15 million budgeted for a remote retargeting capability, and believed $4 million enough to terminate Hard Rock Silo contracts. This memorandum left no doubt of his explicit preference for shelter basing.[15]

(U) [redacted] The Air Force did not oppose shelter basing solely on grounds it meant abandoning the Minuteman investment. There were also the reasons of profound political implications and unpredictable costs. But even more serious were shelter basing's expected operational problems involving "security, warning time, command and control, force timing, range/payload, accuracy and manning." In short, the Air Force doubted that shelter basing would be either effective or practical.[16]

(U) [redacted] As fiscal year 1970 drew to a close, the Air Force-DDR&E debate did not cease. On 30 June the Air Force Council recommended that: (1) the hard point defense approach be changed to a relatively low cost program, (2) the attributes of Minuteman be emphasized, (3) elements of the silo upgrading program be arranged for approval in increments, and (4) efforts to gain OSD support continue.

[redacted]

Inflight Survival

(U) [redacted] Besides protecting underground launch complexes against attack, the Air Force concentrated on survival of its missiles during powered flight. It viewed the enemy's use of the "pindown" tactic a most serious threat. Pindown employed exoatmospheric nuclear explosions to spread a lethal screen of electromagnetic pulse and radiation across the path of U.S. missiles. Hence, the Air Force would either have to withhold launching the retaliatory force or risk its destruction.

(U) [redacted] One answer to pindown was to harden the missiles against nuclear effects. During 1966 and 1967, SAMSO investigated improved materials designed to add protection to sensitive missile electronics components and subsystems. Extensive nuclear simulation tests later verified the effectiveness of proposed modifications. In December 1968, the OSD approved an Air Force program to harden 240 Minuteman II (LGM-30F) missiles. Since this modification would take almost a year to complete, a decision to modify the remaining 260 Minuteman II's was deferred. Meanwhile, time could be profitably spent in conducting further tests and identifying possible funding sources. Minuteman III missiles would have the hardness modifications applied during production.[17]

(U) [redacted] The Minuteman II hardness modification schedule was soon upset by problems in the Minuteman II's third-stage motors.*

*See p 15.

Trouble in the missile's interstage connectors injected more delays in fiscal year 1969. As concern over the pindown threat mounted, SAC asked for a speedup in the modification program and approval to harden the remaining 260 Minuteman II's. General Ryan and Secretary Seamans concurred. They proposed that OSD authorize them to proceed immediately to modify the rest of the Minuteman II fleet, using $32.6 million from budget exercise 703 reallocations to cover the 1970 cost. Deputy Secretary Packard, however, saw no new compelling reasons for the modification. He turned down the Air Force proposal.[18]

(U) [redacted] In December 1969 Secretary Seamans reopened the issue. First, he called OSD's attention to the complexities in coordinating offensive and defensive missile forces. So long as Minuteman missiles remained vulnerable to nuclear effects, he cautioned, strategic plans could not be effectively executed. Moreover, a delay in approving funds threatened to further widen the gap between completion dates of the two phases of the hardness modification program--thereby raising costs unnecessarily. Dr. Foster supported this Air Force proposal and it was later approved.[19]

(U) [redacted] USAF officials thought it possible Soviet missiles, too, might be vulnerable to pindown tactics and supported development of a high-altitude fuze for triggering exoatmospheric explosions. More time was needed, however, to verify the suspected Soviet vulnerability.

Consequently, the Air Force canceled plans to incorporate the fuze into Minuteman II's Mk-11C reentry vehicle and planned to add the unit to the Minuteman III reentry vehicle, the Mk-12.[20]

(U) [redacted] The Air Force pursued other projects to complement its missile hardness modifications. One, a high altitude radiation detection system (HARDS), sensed and reported a nuclear-charged environment. In January 1968 HARDS had been installed in five airborne launch control center aircraft and at one launch control facility in each Minuteman wing. By the end of 1968 all post attack command control system (PACCS) aircraft carried HARDS. Furthermore, in October 1968 OSD expanded the ground-based network--the electromagnetic pulse sensor system (EMPSS)--to 20 Minuteman and six Titan II launch control centers; installation was completed in early 1970. OSD also approved incorporation of cancel launch in process (CLIP) devices in all Minuteman II and Modernized Minuteman control centers.* CLIP would first be installed at two missile wings, then throughout the fleet during the Minuteman III modernization program.[21]

(U) [redacted] Improvements beyond the HARDS were expected to evolve from the AFSC study--Project Havebird. The Havebird proposal envisioned an advanced detection system which could not only sense pindown, but could locate and measure nuclear explosions and identify corridors through which U.S. missiles could safely pass. Planned for deployment

*CLIP enabled launch crews to override a valid firing order once pindown was detected.

[redacted]

[redacted]

aboard PACCS aircraft, the system would afford a high degree of survivability. In July 1969 the Air Force proposed development of the system in fiscal year 1970 at a cost of $300,000 and $5 million in fiscal year 1971. OSD rejected the proposal but expressed interest in a revised USAF plan for beginning development in fiscal year 1973. Lastly, among other systems under study by the Air Force was one for detecting nuclear dust generated by surface bursts.[22]

Refining Command and Control

(U) [redacted] In July 1968 the Air Force approved development of the launch facility processor/status authentication system (LFP/SAS). This R&D project was specifically intended to enlarge the storage capability of Minuteman II and III computers whose memory banks neared saturation. However, Mr. John B. Walsh, Deputy to the Assistant Secretary of the Air Force (R&D), saw the program in much broader terms. At his suggestion the LFP/SAS was expanded to embrace missile guidance improvements, growth potential as a command and control system of the future, and "Defense Integration" (the linking of offensive and defensive missile forces). The estimated cost of this restructured program was $25 million in fiscal year 1969 and $40 million in fiscal year 1970.[23]

(U) [redacted] Renamed Minuteman Integrated Command and Control System in December 1968, the project was set up as a separate element in the fiscal year 1970 budget. Funded at $12.5 million in

[redacted]

fiscal year 1969 and $36 million in fiscal year 1970, MICCS was slated for initial operational capability in October 1972. OSD, nonetheless, insisted on more detailed justification and alternate plans before it would approve MICCS deployment.[24]

(U) [redacted] The separation of MICCS from the Minuteman Squadrons program* provoked a sharp reaction from Lt. Gen. Charles H. Terhune, AFSC vice commander. Convinced the separation would splinter management of the overall Minuteman program, General Terhune warned it could "only result in higher costs with no technical improvement to the weapon system." Actually, DDR&E established MICCS as a separate program element to offset criticism by the Bureau of the Budget (BOB). The Bureau had complained that the Minuteman program was vague while the Navy's Polaris and Poseidon missile programs were distinct. As it turned out, MICCS was in fact managed by the Minuteman System Program Office (SPO); only costs were kept separate.[25]

(U) [redacted] SAC protested the plan to include the enable command timer (ECT)--a positive control device for Minuteman--in the MICCS. SAC argued that putting more curbs on the Minuteman weapon system ran counter to Joint Chiefs of Staff and OSD guidance. In February 1969 Assistant Secretary Hansen reviewed SAC's protest and deferred the ECT.[26]

*The correct but little used designation for the basic Minuteman program.

(U) [redacted] Gen. Bruce K. Holloway, Commander in Chief, Strategic Air Command (CINCSAC), disagreed with the high priority given Defense Integration in the MICCS program. He believed MICCS's most urgent features were retargeting and memory augmentation. Without these, General Holloway claimed, "SAC will be unable to accomplish increased SIOP missile target and timing changes generated by MIRV in a timely manner." He urged the MICCS program be quickened to coincide more closely with Minuteman III deployment. General Ryan assured General Holloway of Air Staff backing on his priorities. He explained that emphasis on Defense Integration stemmed from OSD and BOB attention. Nevertheless, the requirements for offensive-defensive coordination were as yet undefined, so he felt it would be premature to eliminate Defense Integration from the MICCS.[27]

(U) [redacted] Successive fund reductions, however, dashed any hope for MICCS development. Fiscal year 1969 MICCS funds were reduced in stages to $5 million. During April 1969--in line with the slowdown in Minuteman III posturing--the MICCS fiscal year 1970 budget was sliced from $36 million to $20 million. In the fall of 1969, the fiscal year 1971 budget proposal for MICCS was pared from $62 million to $40 million. This steady scaling down of funds postponed MICCS's initial operational capability to July 1973.*[28]

*This refers to the IOC of Minuteman III's "soft" ground system; the Minuteman III/HRS IOC, planned for June 1974, was not affected.

(U) [redacted] Meanwhile, in January 1969 DDR&E announced MICCS would serve as the "building block" for a HRS command control and communications system. The Air Force construed this directive as expanding MICCS's role, while DDR&E saw it as restricting MICCS development to the HRS program. These differing interpretations later evolved into a major issue. The Air Force opposed any effort to absorb MICCS within HRS--and later within Minuteman Rebasing. It reasoned that tying MICCS to rebasing would jeopardize the program should rebasing be discontinued. Moreover, the $77 million budgeted for Minuteman Rebasing was not likely to yield the $40 million proposed for MICCS in fiscal year 1971.[29]

(U) [redacted] On 10 September 1969 Air Staff and DDR&E representatives met to resolve the MICCS issue. The outcome of the meeting was the cancellation of MICCS and establishment of a new line item for fiscal year 1971--the command data buffer (CDB) program. An initial $10 million was allotted CDB to develop a weapon system computer. Another $15 million for CDB system integration costs was distributed under various rebasing headings; $2.7 million came from the Minuteman Squadrons budget; and $3.8 million would be available from the deferred MICCS fiscal year 1970 account. In light of these funding actions, the Air Staff reoriented CDB to provide only remote retargeting and secure status authentication capabilities. In June 1970, CDB deployment was approved for 550 Minuteman III sites.[30]

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IV. R&D AND THE FUTURE

(U) [redacted] To meet the strategic needs of the 1975-1985 decade, the Air Force for several years had urged defense officials to approve development of an advanced ICBM (WS-120A). It visualized the new weapon as being larger, more powerful, and possessing greater accuracy than Minuteman. Air Force requests for authority to begin contract definition, however, were successively disapproved for fiscal years 1968, 1969, and 1970. In October 1968 Deputy Secretary of Defense Paul H. Nitze had summed up OSD's opposition to the advanced ICBM. He described it as a big inviting target which would become increasingly vulnerable with each improvement in Soviet missile accuracy. While deployment in Hard Rock silos and missile defense might "mitigate" concern over survivability, OSD felt the entire matter required more investigation. In addition, since it was less costly to improve Minuteman, "some unique capability dependent on increased missile size would have to be demonstrated to justify proceeding with the Advanced ICBM."[1]

(U) [redacted] Despite repeated failure to gain OSD support for the project, the Air Force continued its work on long-lead items in an Advanced ICBM Technology program. Funded at $10 million in fiscal year 1969, the project was to include studies of a variety of promising inertial guidance concepts. The system the Air Force had in mind would be nuclear hardened, have an all-azimuth targeting capability,

[redacted]

be adaptable to mobile launchers, and attain a guidance CEP of 400 feet at 5,500 nautical miles. Additionally, the Air Force undertook investigations into advanced propulsion systems. It put special stress on the dual mission--offensive and defensive--aspects of the liquid post-boost propulsion system. And it probed the "eject launch" technique, designed to make missiles more reliable and increase payload weight.[2]

(U) Insufficient funds, however, dogged the advanced ICBM project. In fiscal year 1970 the Air Force requested $20 million for the Advanced ICBM Technology program and $27 million for contract definition of the advanced ICBM. When OSD turned down the latter, the Air Force asked that a combined $47 million allocation be made to permit initiation of a competitive design phase. This proposal, too, was rejected by OSD. Subsequently, the $20 million in the Advanced ICBM Technology program budget was reduced to $15 million with the transfer of $2 million to an ABM defense research program and $3 million to mobile missile studies. Later, the Air Force's 1971 budget of $13 million for Advanced ICBM Technology was slashed to $6 million--$7 million being diverted to the Minuteman Rebasing* program for work on mobile systems.[3]

(U) As Air Force headquarters promoted the Advanced ICBM Technology program, AFSC was studying other alternatives,

*See pp 30-31.

[redacted]

including four proposed new ICBM's. They were designated Nemesis, Vulcan, Ranger, and Janus. Nemesis, a proposed small low-cost missile, would achieve its high survivability through proliferation. Between 2,000 and 10,000 Nemesis missiles could be deployed to guarantee assured destruction.* Vulcan, a larger missile, would resemble the advanced ICBM. To survive it would have to be placed in Hard Rock or given some other type defense. AFSC visualized Vulcan as performing all offensive missions--assured destruction, damage limitation,+ and defense suppression.‡ The proposed Ranger missile--whose chief asset would be its survivability--was to be carried on wheeled or air-cushioned vehicle launchers. It could be used for either assured destruction or defense suppression. Janus

*Assured Destruction--The capability to destroy an aggressor as a viable society, even after a well planned and executed surprise attack on our forces.

+Damage Limitation--The capability to limit the effects of nuclear destruction of population and industry by using offensive and defensive measures to reduce the weight of enemy attacks. Offensive measures included attacking enemy weapons prior to launch, while defensive damage limitation meant the destruction of enemy weapons after launch.

‡Defense suppression missiles were designed for attack against defensive installations, preliminary to follow-up penetrations.

[redacted]

was conceived as an offensive and defensive damage limiting* missile. General Holloway, CINCSAC, favored the Vulcan proposal because of its greater flexibility. However, if a choice had to be made between expanding the technological base and pursuing near-term improvements for Minuteman, SAC would opt for the latter.[4]

ABRES

(U) [redacted] The advanced ballistic reentry system (ABRES) program was a joint services effort managed by the Air Force. It developed and tested promising reentry vehicles and penetration aid devices for use on present and future ballistic missile systems. Besides, the program researched new applications in warhead arming and fuzing, environmental protection and hardening, and terminal guidance. The flight test portion of ABRES was widely dispersed. From Vandenberg AFB, full-scale Atlas ICBM's launched heavy payloads over the Western Test Range. Scale model Athena boosters and sounding rockets soared aloft from Green River, Utah, to plunge to earth on the White Sands Missile Range, N. Mex. In addition, ABRES-sponsored experiments were flown in conjunction with the Nike Targets+ program.[5]

(U) [redacted] During fiscal years 1969 and 1970, the project comprised more than 100 efforts being pursued by the aerospace industry

*See explanatory footnote, Damage Limitation, p 42.

+See pp 51-52.

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[redacted]

and government. An assortment of reentry techniques were under investigation. One technique would use small multiple reentry vehicles to overcome enemy defenses by "exhaustion," i.e., force of numbers. Another would employ low-angle reentry vehicles--in a 3 to 6 degree reentry angle--to underfly the radar horizon of broad area defense facilities. Also considered were maneuverable reentry systems for countering "low performance" terminal interceptors. Further, studies were pursued of early reentry decoys that resembled warheads down to 150,000 feet, electronic countermeasures to achieve more effective jamming, and optical countermeasures to mask reentry vehicles more effectively.[6]

(U) [redacted] Two Atlas flights in fiscal year 1969 gathered valuable reentry vehicle performance data and demonstrated new heatshield and nosetip materials for small multiple reentry vehicles. These new materials--three-dimensional quartz phenolics--would provide increased hardness levels. The Mk-3A, a modified Navy reentry vehicle (Mk-3), flew successfully under ICBM reentry conditions and emerged as a possible small multiple reentry vehicle for the Minuteman III. The Athena launch program, suspended in July 1968 after three consecutive flight failures, resumed in November 1968. By 30 June 1969, 13 successful Athena launches had carried a variety of payloads: Mk-3 intermediate range ballistic missiles, endoatmospheric and Mk-12 decoys, and arming and fuzing experiments. Small multiple

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reentry vehicle technology grew with the development of a miniaturized, hardened, S-band radar fuze. Also tested was a promising roll control technique that used centrifugally operated fins.[7]

[redacted] A planned low-angle reentry vehicle was in its preliminary design stages when ABRES officials prepared for a demonstration flight of a Mk-11 reentry vehicle at a 6° trajectory. The Mk-11 needed no heatshield changes and its arming and fuzing system was only slightly modified. Launched by an Atlas booster in September 1969, the flight proved successful and provided a near-term option for the low-angle reentry technique. Meanwhile, an advanced, low-angle reentry vehicle prototype was under development.

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The vehicle's flat 3 to 4° trajectory would require use of an arming and fuzing system independent of altitude. To achieve the requisite accuracy, the Air Force had contracted for a new inertial-type fuze. Two flight tests of the advanced low-angle reentry system were scheduled for fiscal year 1971.[8]

(4) [redacted] In July and October 1967 the Air Force in two flight tests successfully launched maneuvering/terminal fix reentry vehicles. The flights demonstrated the reentry vehicle could survive high acceleration forces (70 G's) and perform both crossrange and downrange maneuvers in excess of 20 nautical miles. Moreover, the vehicle's improved accuracy could be applied against hardened targets.

[redacted] [redacted]

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Responding to an ODDR&E request for an advanced development concept the Air Force proposed the reentry vehicle be a separate program element of $10 million in the fiscal year 1970 budget. When this recommendation was later turned down, the Air Force transferred development of the reentry vehicle to the ABRES program. Two MARCAS* flights, sponsored by the Advanced Research Project Agency (ARPA), were conducted during fiscal year 1969. Utilizing the jet interaction control principle, the reentry vehicles altered their ballistic paths upon command. The ABRES program also flight-tested self-cooling (transpiration) nosetips. And it probed maneuvering reentry vehicle subsystems: flap control, miniaturized inertial guidance, and terrain contour matching techniques. The objective was to combine these subsystems into one maneuvering reentry vehicle of the Mk-12 class. Two "preprototypes" were planned for flight testing in fiscal year 1971.[9]

(U) [redacted] Between fiscal year 1966 and 1969 ABRES program funding dropped from $147.7 million to $105 million. This dollar decline forced the Air Force to delay or cancel Atlas flights for testing new materials and reentry systems, and to postpone development of the improved Athena H booster. The fund cuts also produced a more subtle effect: Without the means to explore alternate technical approaches, ABRES planners were often forced to make

*Maneuvering reentry control and ablation study.

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premature judgments and commitments.

(4) [redacted] The ABRES program budget for fiscal year 1970 was approved at $107 million. Inflation, however, sapped any significance from this modest increase as development of advanced reentry systems and new materials slipped from six months to a year. The $105 million estimated for the fiscal year 1971 budget mirrored the continued deemphasis. Likewise, funding for fiscal years 1972 through 1975 was tentatively set at only $100 million a year. This restricted budget alarmed some members of the Air Staff. They envisioned about 25 percent of ABRES future budgets being devoted to developing an advanced maneuvering reentry vehicle. Test range operations--deeply cut in fiscal year 1970--also would have to be slashed even more than before. The Air Force's most serious concern, however, was how to keep a responsive and timely technological base in the face of dwindling ABRES expenditures.[11]

Hard Target Kill Candidates

[redacted] The Air Force analyzed at length several small multiple reentry vehicles for both assured destruction and damage limitation missions.

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D(3)

Given this mix of accuracy and payload--seven Mk-18's

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could be carried aboard the Minuteman III--the Air Force felt sure it could satisfy future requirements. OSD, however, deemed the present missile force adequate against projected enemy defenses. It questioned the need for a new reentry vehicle inasmuch as the Mk-3A could be readily made available. So in October 1968 OSD canceled funds for the proposed system. It later agreed to apply $8 million to Mk-18-type development under the ABRES and Advanced ICBM Technology programs.[12]

(U) [redacted] In January 1969 the Air Staff asked AFSC and SAC to suggest ways for perfecting Minuteman's near-term damage-limiting capability. One alternative considered would improve Minuteman's accuracy by (1) making guidance program changes in its computer to permit all-season targeting, and (2) modifying hardware to reduce reentry vehicle dispersion. Also considered were penetration tactics for suppressing enemy radars: flying lofted trajectories, low-angle reentry, and high-altitude detonations. In fiscal year 1970 some $4 million was approved for research on guidance software improvements as well as lofting techniques.[13]

[redacted] During the damage-limiting study, SAC took the opportunity to reopen the Mk-18 issue.

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Moreover, if Mk-19's accuracy could be improved

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to a 0.2 nautical mile (1,200 feet) CEP, its higher yield should make it a better hard target killer.

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[redacted] In April 1969 General Holloway, CINCSAC, gained support for the Mk-19 after informally briefing Deputy Secretary Packard, Dr. Seamans, and Gen. John P. McConnell, Air Force Chief of Staff.

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DOE b(3)

AFSC, nonetheless, proved this proposal too costly and its claimed yield overly optimistic. By July 1969 the Air Force position on a hard target killer still centered on the Mk-19.[15]

[redacted] The changing Soviet military posture underlined the need for a Mk-19 capability. Intelligence reports had predicted a massive buildup of Moscow's ABM systems. Now these reports were revised to show the Soviets engaged in an extensive program to harden offensive and defensive facilities. At the same time, the ability of the United States to destroy hardened installations was declining as lower yield weapons* entered the inventory.[16]

DOE b(3)

[redacted]

[redacted] Fiscal year 1971 funding proposals for the Mk-19 ranged from $3 million to $68 million. But should the Air Force ask for $3 million, the OSD would doubt its serious intent in pursuing the program. On the other hand, the Air Staff felt that a $68 million figure had little chance of approval. The decision was made to request $25 million and plan for an initial operational capability for the Mk-19 of mid fiscal year 1974. On 19 December 1969--just a few days before the Air Force was to submit the Mk-19 proposal to OSD--Deputy Secretary Packard directed the Air Force to postpone the program. He said higher yield multiple reentry vehicles would give the impression the United States wanted a first strike capability. Secretary Packard felt such an impression would undermine the ongoing and delicate Strategic Arms Limitation Talks.* The Air Force halted development on the Mk-19 but continued reentry vehicle technology in the ABRES program.

DOE b(3) [redacted]

Inter-Service R&D Programs

(U) [redacted] The Cold/Heat Soak program furnished valuable missile data to the Air Force and Army. The program consisted of six flights: the first in June 1967, four during fiscal year 1968, and the last on 10 December 1968. After exposure to extreme temperature changes, the solid-fueled Minuteman I missiles were launched from Vandenberg AFB.

*See pp 8-9.

[redacted]

The Air Force's interest centered on the missile's launch and powered flight reliability. Army radars at Kwajalein Island monitored the terminal phase of the flights to obtain tracking and discrimination data for its antiballistic missile systems. The test launches dispelled fears that temperature extremes would impede Minuteman I performance. The Air Force, nevertheless, intended continuing the tests for Minuteman II and III boosters.[18]

(U) [redacted] In addition to the above activity, the Air Force designed, developed, and launched specially configured reentry vehicles in support of the Army's Advanced Ballistic Missile Defense Agency (ABMDA). Two related but distinct projects were funded under the Nike Targets program at $7 million in fiscal year 1969 and $8 million in fiscal year 1970. The first project--reentry measurements program (phase B)--used surplus Atlas boosters, fitted with the sequential payload delivery system,* to dispense a variety of experimental packages to help the Army refine its discrimination techniques. A typical flight carried: (1) a large teflon-coated reentry vehicle instrumented to obtain wake physics data, (2) a 15" beryllium sphere, (3) a tethered radar reflector sponsored by the ABRES program, (4) two calibration balloons, and (5) a special sensor for obtaining long wave infrared signature data on the target complex. In January 1969, after 11 of 17 scheduled missions were flown, the program was suspended due to repeated telemetry failures. The trouble was traced to

*A maneuvering third stage.

[redacted]

the power supply system and corrected. The launchings were resumed in September 1969 and completed before the end of fiscal year 1970.[19]

(U) [redacted] The second project in support of ABMDA was the Safeguard (formerly Sentinel) system target test program. This test series of 37 Minuteman I and 11 Titan II* missiles aimed to develop antimissile discrimination techniques and evaluate Safeguard and Sprint interceptor components. The Air Force agreed to fund initial development and launch support; the Army, necessary reentry vehicle and missile booster modifications. A January 1969 revision of the program stemmed from a lack of software equipment vital to evaluating missile site radars at Kwajalein Island. As a result, the program's first missile launch was deferred from January to May 1970. A more annoying problem was the debris in the missile's reentry corridor generated during normal thrust termination and retrorocket operation of Minuteman I. The Arnold Engineering Development Center (AEDC) tackled this problem and, after extensive ground testing, made modifications that would reduce the contaminants. The Army, however, turned down some of the modifications as not meeting its exacting requirements while others were considered too expensive. So again the program was delayed with the initial launch not expected before July 1970.[20]

*See pp 10-11.

[redacted]

NOTES

Chapter I

1. The President's Report to Congress, 18 Feb 70, on United States Foreign Policy for the 1970's: A New Strategy for Peace, in Weekly Compilation of Presidential Documents, 23 Feb 70, vol. 6, no. 8, pp 229, 231. The figure on the Soviet Union's ICBM deployment by the end of calendar year 1969 is contained in the President's 1971 report to Congress on U.S. foreign policy, dated 25 Feb 71. See Weekly Compilation of Presidential Documents, 1 Mar 71, vol. 7, no. 9, p 357.

2. USAF Mgt Summary (S), Operational Status, 18 Jul 68, 17 Jan 69; USAF Programs and Reference (S), DCS/Plans & Ops, 18 Jul 69; USAF Mgt Summary (S), DCS/Plans & Ops, 20 Jan 70; hist (S), DCS/Plans & Ops, 1 Jan-30 Jun 70, pp 334-35.

3. See note above; Bernard C. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS) (Ofc/AF Hist, Sep 1969), pp 2-3; hist (TS), Dir/Ops, 1 Jan-30 Jun 69, p 387.

4. Fact Sheet (S), Minuteman Facts, Mar 69.

5. Fact Sheet (S), Penetration Systems Mk-1 and Mk-1A, Jul 69; hist (S), Dir/Dev & Acq, 1 Jan-30 Jun 70, pp 238-240; SMD 0-357-133B (30) (S), Minuteman, 17 Mar 70.

6. Fact Sheet (S), Mk-12 Reentry System, 30 Sep 69.

7. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS), p 55.

8. SMD 9-271-133B (25) (S), Minuteman, 30 Dec 68; Program Change Decision (S), SECDEF AF F-8-136, 26 Dec 68; Program Change Decision (S), SECDEF AF F-9-706, 15 Apr 69; SMD 9-123-133B (27) (S), Minuteman, 11 Apr 69; SMD 0-329-133B (28) (S), Minuteman, 6 Sep 69.

9. SMD 0-329-133B (29) (S), Minuteman, 24 Dec 69; SMD 0-327-133B (30) (S), Minuteman, 17 Mar 70.

10. SMD 9-238-133B (23) (S), Minuteman, 24 Jul 68; Program Change Decision (S), SECDEF AF F-8-110, 18 Oct 68; rprt (S), Air Staff Board Meeting 68-34 (19 Jun 68), 24 Jun 68; Fact Sheet (S), Mk-12 Reentry System, 30 Sep 69.

11. Monthly Report to SAF (R&D) (S), 31 May 69, 30 Jun 69; hist (S), Dir/Dev & Acq, 1 Jan-30 Jun 70, pp 238-240.

12. Hist (S), Dir/Dev, 1 Jan-30 Jun 69, p 146, 1 Jul-31 Dec 69, p 149; ltr (S), Msl Sys Div, Dir/Dev, to Maj Gen Henry B. Kucheman, Jr, DCS/R&D, subj: MIRV Working Group, 22 Jun 69; intvw (S), author with Lt Col Richard P. Rozhon, Msl Sys Div, Dir/Dev, 13 Apr 70; Recommendation for Decoration (U), Msl Sys Div, Dir/Dev, subj: Major Joseph H. Eibling, 4 Mar 70.

13. S Res 211, 91st Cong, 2d sess (1970); msg (S), Lt Gen Otto J. Glasser, DCS/R&D, Hq USAF, to Gens Ferguson, Holloway, and Phillips, subj: Minuteman III Alternatives, 1 May 70 [no DTG]; draft memo (S), SAF to SECDEF, subj: Possible Impact of SR 211 on MM III and MIRV, 1 atch, [ca May 70]; ltr (S), Aerosp Plans & Plcy Br, Dep Dir/Plans & Plcy, to DCS/Plans & Ops, subj: MM III Alternatives, 13 Dec 69.

14. USAF Mgt Summary (S), Operational Status, 18 Jul 68, 17 Jun 69; USAF Mgt Summary (S), DCS/Plans & Ops, 18 Jun 70; hist (TS), Dir/Ops, 1 Jul-31 Dec 69, pp 336-37; Program Change Decision (S), SECDEF AF F-9-307, 24 Oct 69.

15. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS), pp 5-6; Program Change Decision (S), SECDEF AF Z-9-107, 8 Sep 69.

16. Program Change Decision (S), SECDEF AF F-8-087/098, 17 Oct 68; hist (TS), SAC, FY 1969, II, pp 250, 253.

17. Program Change Decision (S), SECDEF AF F-8-087/098, 17 Oct 68; memo (S), J. W. Doolittle, Actg SAF to Asst SECDEF (Comptroller), subj: Titan II PCD F-8-098 (17 Oct 68), 3 atch, 14 Nov 68; memo (S), SECDEF to SAF, subj: Titan II Follow-on Operational Test Program, 11 Apr 69; memo (S), SECDEF to SAF, subj: Use of Titan II as Test Targets, 20 Oct 69.

Chapter II

1. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS), p 21.

2. Ibid, pp 23-25; hist (TS), Dir/Ops, 1 Jan-30Jun 69, p 389; 1 Jul-31 Dec 69, pp 328-29; hist (S), 1st STRAD, 1 Jan-30 Jun 68, I, chap II.

3. Hist (TS), SAC, FY 1969, II, 255-57; rprt (S), Ball Msl Eval, SAC Evaluation of Weapon System Capabilities, Minuteman "B," 1 Oct 70; hist (TS), Dir/Ops, 1 Jan-30 Jun 70, pp 334-35; Sup to the Staff Digest (S), Hq USAF, 4 Dec 69.

4. Memo (S), John B. Walsh, Asst SAF (R&D), to SAF, subj: Minuteman II DASO, 19 Dec 68.

5. Hist (TS), SAC, FY 1969, II, 260-61, 264; msg (S) CINCSAC to CSAF and AFSC, 301413Z Nov 68.

6. Hist (TS), SAC, FY 1969, II, 264-65; ltr (S), Msl Sys Div, Dir/Dev, to SAF, et al, subj: Test Report on Launch of Minuteman II, 29 Jan 69.

7. Hist (S), 1st STRAD, 1 Jul 68-30 Jun 69, I, chap II; hist (TS), Dir/Ops, 1 Jan-30 Jun 69, p 389.

8. Hist (TS), SAC, FY 1969, II, 267-270.

9. Rprt (S), Ball Msl Eval, SAC, Evaluation of Weapon System Capabilities, Minuteman "F," 1 Oct 70; hist (TS), Dir/Ops, 1 Jan-30 Jun 69, p 389, 1 Jul-31 Dec 69, p 329, 1 Jan-30 Jun 70, p 334.

10. Hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 125-26; Fact Sheet (S), Minuteman III Flight Testing, 4 Jun 69.

11. Hist (S), Dir/Dev, 1 Jan-30 Jun 69, pp 143-45; talking paper (S), subj: Autonetics Involvement in Minuteman, ca Apr 70; ltr (S), Gen John C. Meyer, VCSAF, to SAF, subj: Minuteman III Flight Test Results, 1 atch, 15 Jan 70; Monthly Report to SAF (R&D), (S), 31 Jul 69.

12. Ltr (S), AFSC to SAF (R&D), subj: Minuteman III Flight Test Reporting, 1 atch, 5 Aug 70; memo (S), Msl Sys Div, Dir/Dev, to DCS/R&D, ca Apr 69; hist (S), Dir/Dev, 1 Jul-31 Dec 69, p 149.

13. Ltr (S), Msl Sys Div, Dir/Dev, to DCS/R&D, subj: Minuteman FY 1971 RDT&E Presentation to OSD Comptroller and BOB, 17 Oct 69; rprt (S), DSMG 70-9, 31 Mar 70.

14. Hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 125-26; rprt (S), Air Staff Board Meeting 69-63 (4 Dec 68), 1 atch, 6 Dec 68; hist (S), 1st STRAD, 1 Jul 68-30 Jun 69, I, chap II.

15. Memo (S), Alexander H. Flax, Asst SAF (R&D), to DDR&E, subj: AFWTR Support for MM III Operational Testing, 19 Dec 68; memo (S), John S. Foster, Jr, DDR&E, to SAF (R&D), subj: AFWTR Support for MM III Operational Testing, 20 Dec 68.

16. Memo (S), Dr. Robert C. Seamans, Jr, SAF, to SECDEF, 25 Mar 70; ltr (S), David Packard, Dep SECDEF, to William P. Rogers, Secy of State, 30 Jun 70.

17. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS), pp 28-30; Fact Sheet (S), Launches From Operational Sites, 5 Mar 70.

18. Memo (S), SAF to SECDEF, subj: Minuteman Test Launch Program, 19 Sep 68; first draft rprt (S), Minuteman Launches from Operational Sites, USAF SAB Nuclear Panel, 26 Sep 68.

19. Memo (S), Paul H. Nitze, Dep SECDEF to SAF, subj: Minuteman Test Launch Program, 9 Nov 68; memo (S), Dr. Harold Brown, SAF, to CSAF, subj: Minuteman Operational Launches, 19 Nov 68; talking paper (S), Msl Sys Div, Dir/Dev, subj: Minuteman Operational Base Launches, 30 Jan 69.

20. Ltr (S), Dr. H. G. Stever, Chmn USAF SAB, to SAF, subj: OBL, 1 atch, 10 Apr 69; memo (S), Seamans to SECDEF, subj: Minuteman Operational Base Launch (OBL) Program, 25 Apr 69.

21. Memo (S), Melvin Laird, SECDEF, to SAF, subj: Minuteman Operational Base Launch (OBL) Program, 6 Jun 69; memo (S), Seamans to SECDEF, subj: Minuteman Operational Base Launch (OBL) Program, 2 Jul 69; memo (S), OSAF, to CSAF, subj: Minuteman Operational Base Launch (OBL) Program, 14 Aug 69; ltr (S), Msl Sys Div, Dir/Dev, to Sp Actys Div, Dir/Prod & Prog, subj: Minuteman Launches from Operational Sites, 26 Sep 69; Air Staff Summary Sheet (S), DCS/Plans & Ops, subj: Minuteman OBL Program, 23 Dec 69; hist (TS), Dir/Ops 1 Jul-31 Dec 69, pp 334-35, 1 Jan-30 Jun 70, p 334; rprt (S), Air Staff Board Meeting 70-24 (24 Jun 70), 1 atch, 26 Jun 70.

22. Memo (S), Seamans to Dep SECDEF, subj: Minuteman OBL Program, 26 Jan 70; MR (S), John B. Walsh, Asst SAF (R&D), subj: Resume of Recent Events on Minuteman Operational Base Launch (OBL) Program, 13 Feb 70; memo (S), Seamans to SECDEF, subj: Minuteman Operational Base Launch (OBL) Program, 26 Mar 70; msg (S), Gen John Ryan, CSAF, to AFSC Comdr, et al, subj: OBL, 142345Z Apr 70; memo (S), Seamans to CSAF, subj: OBL Program, 22 Apr 70.

Chapter III

1. Hist (S), Dir/Dev. 1 Jul-31 Dec 68, pp 122-24; hist (S), DCS/Plans & Ops, 1 Jul-31 Dec 68, pp 293-97; hist (S), Dir/Dev, 1 Jan-30 Jun 69, pp 140-42; background paper (S), Msl Sys Div, Dir/Dev. [Hard Rock Silo], 25 Jun 69; memo (C), Lt Col Ellsworth E. Tulberg, Hard Rock Silo PEM, to Lt Gen Glasser, DCS/R&D, subj: Hard Rock Silo Siting, 14 May 70.

2. Hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 122-24, 1 Jan-30 Jun 69, pp 140-42, 1 Jan-30 Jun 70, pp 242-43; background paper (S), Msl Sys Div, Dir/Dev, [Hard Rock Silo], 25 Jun 69.

3. Hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 122-24, 1 Jan-30 Jun 69, pp 140-42; hist (S), DCS/Plans & Ops, 1 Jan-30 Jun 69, p 416; Fact Sheet (S), Hard Rock Silo, 30 Jun 69; memo (U), Foster to Asst SAF (R&D), subj: Hard Rock Silo Development, 5 Aug 68; SMD 9-240-125B(2) (S), Hard Rock Silo, 31 Jul 68; ltr (S), DCS/R&D to VCSAF, subj: Source Selection Authority HRSD, 18 Apr 69; ltr (S), Msl Sys Div, Dir/Dev, to Dir/Dev, subj: Hard Rock Silo Contract, 2 Jun 69; background paper (S), Msl Sys Div, Dir/Dev, [Hard Rock Silo], 25 Jun 69; msg (S), AFSC to CSAF, 172005Z Sep 69; memo (S), Asst SAF (R&D), to DDR&E, subj: HRSD, 20 Sep 69; memo (U), Grant L. Hansen, Asst SAF (R&D), to DDR&E, subj: Hard Rock Silo Development (HRSD), 6 Oct 69.

4. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS), pp 60-61; hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 122-24; hist (S), DCS/Plans & Ops, 1 Jul-31 Dec 68, pp 293-97; hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, pp 104-105; hist (TS), Dir/Ops, 1 Jul-31 Dec 69, pp 332-33; background paper (S), Msl Sys Div, Dir/Dev, [Hard Rock Silo], 26 Jun 69; talking paper (S), Msl Sys Div, Dir/Dev, 10 Jun 69; memo (S), Spencer J. Schedler, Asst SAF (Fin Mgt), to Asst SECDEF (Comptroller), subj: Hard Rock Silo Development Program Plan, 25 Jul 69; ltr (S), Msl Sys Div, Dir/Dev, to Engr Mgt Gp, Dir/Dev, subj: HRS FY 70 Funding, 1 Aug 69.

5. Memo (S), Foster to Asst SAF (R&D), subj: Hard Rock Silo (HRS) Program, 1 Mar 69.

6. Memo (S), Hansen to DDR&E, subj: Hard Rock Silo (HRS) Program, 9 Apr 69; memo (S), Hansen to DDR&E, subj: HRSD Plan, 2 May 69.

7. Public Papers of the Presidents of the United States. Richard Nixon, 1969 (Washington: Government Printing Office, 1971), pp 216-219.

8. Memo (TS), Seamans to SECDEF, subj: Future Deployments of Minuteman Force, 2 Jul 69; Air Staff Summary Sheet (TS), Maj Gen Glenn A. Kent, Asst CSAF (SA), subj: Future Deployments of the Minuteman Force, 10 Jun 69.

9. Memo (S), Packard to SAF, subj: Future Deployments of the Minuteman Force, 26 Aug 69.

10. Memo (TS), Foster to Asst SAF (R&D), subj: HRS, 26 Aug 69; ltr (S), Msl Sys Div, Dir/Dev, to Dir/Dev, subj: ODDR&E HRS Memo for SAFRD (26 Aug 69), 16 Sep 69.

11. Air Staff Summary Sheet (S), Msl Sys Div, Dir/Dev, subj: Major Budget Issues, FY 1971 HRS Deployment, ca Oct 69; Program Budget Decision (S), No 293, 11 Dec 69.

12. Hist (S), Dir/Dev, 1 Jul-31 Dec 69, pp 147-48; hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 69, pp 104-105; msg (S), AFSC to CSAF, 041951Z Feb 70; brief (S), Lt Col Tulberg, HRS PEM, Hard Rock Silo Sizing, 13 Mar 70; rprt (S), Air Staff Board Meeting 70-14 (13 Mar 70), 17 Mar 70; memo (S), Lt Col Tulberg, HRS PEM, to Brig Gen C.H. Bolender, Dep Dir/Dev, subj: HRS Program, 17 Mar 70; SMD 0-373-125B(4) (S), Hard Rock Silo, 25 Mar 70; memo (S), SAF to Dep SECDEF, subj: Minuteman Survivability, 4 Feb 70.

13. Memo (S), Lt Col Tulberg, HRS PEM, to Lt Gen Bolender, Dep Dir/Dev, subj: HRS Program, 17 Mar 70.

14. Memo (S), Seamans to DDR&E, subj: Minuteman Rebasing, 28 Apr 70.

15. Memo (S), Foster to SAF, subj: Minuteman Rebasing, 21 May 70.

16. Air Staff Summary Sheet (S), Dep Dir/Strat & Def Forces, subj: Minuteman Rebasing, 21 May 70; memo (S), Hansen to SAF, subj: Minuteman Rebasing, 2 Jun 70.

17. Hist (TS), SAC, FY 1969, II, 301-303; memo (TS), John B. Walsh, Asst SAF (R&D), to Ben T. Plymale, Dep DDR&E, subj: Minuteman Inflight Hardness, 17 Oct 68; memo (TS), Plymale to Walsh, subj: Inflight Hardness Requirements, 22 Oct 68; Monthly Report to SAF (R&D) (S), 31 Jan 69, 31 Mar 69, 30 Apr 69, 31 May 69, 30 Jun 69, 31 Jul 69, and 30 Sep 69; Program Change Decision (S), SECDEF AF F-8-136, 26 Dec 68; rprt (S), Air Staff Board Meeting 69-46 (12 Aug 69), 13 Aug 69.

18. Hist (TS), SAC, FY 1969, II, 302; Air Staff Summary Sheet (TS), DCS/Plans & Ops, subj: Minuteman II Hardening, 1 atch, 28 Aug 69; memo (TS), Seamans to David Packard, subj: Minuteman II Hardening, 29 Aug 69; memo (TS), Packard to Seamans, subj: Minuteman II Hardening, 25 Oct 69.

19. Memo (TS), Seamans to Packard, subj: Minuteman II Hardening, 1 Dec 69; SMD 0-329-133B(29), Minuteman, 24 Dec 69.

20. Hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, pp 104-105; SMD 9-238-133B(23) (S), Minuteman, 24 Jul 68; ltr (S), Msl Sys Div, Dir/Dev, to Lt Gen McNickle, DCS/R&D, subj: High Altitude Fuze, 11 Mar 69.

21. Hist (TS), SAC, FY 1969, II, 304-306; hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, p 221; Program Change Decision (S), SECDEF AF F-8-087/098, 17 Oct 68; Program Change Decision, SECDEF AF F-8-110, 18 Oct 68; Program Change Decision (S), SECDEF AF F-8-136, 26 Dec 68.

22. Rprt (S), Program Review Committee Meeting 70-18 (3 Feb 70), 1 atch, 3 Feb 70; brief (S), Dir/Ops Req & Dev Plans, subj: Exoatmospheric Radiation Detection System (Havebird), Jan 70; hist (S), Dir/Ops Req & Dev Plans, 1 Jan-30 Jun 69, p 90, 1 Jul-31 Dec 69, p 99, 1 Jan-30 Jun 70, p 320.

23. SMD 9-238-133B(23) (S), Minuteman, 24 Jul 68; memo (C), Walsh to DCS/R&D, subj: Minuteman LFP, 15 Aug 68; hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 127-28; msg (S), CSAF to SAMSO, et al, subj: Revision of Launch Facility Processor/Status Authentication System Program, 252112Z Oct 68; msg (S), SAMSO to CSAF, et al, subj: Revision of Launch Facility Processor/Status Authentication System Program (AFIN 27229), 152333Z Nov 68.

24. Program Change Decision (S), SECDEF AF F-8-136, 26 Dec 68; Fact Sheet (S), MICCS, Dec 68.

25. Ltr (U), Lt Gen Charles H. Terhune, VComdr AFSC, to Gen J. P. McConnell, CSAF, subj: Establishment of Minuteman Integrated Command and Control Subsystem (MICCS) as a Separate Program Element, 15 Jan 69; ltr (U), Gen McConnell to Lt Gen Terhune, subj: Establishment of MICCS as a Separate Program Element, 10 Feb 69; Air Staff Summary Sheet (U), subj: MICCS, 24 Jan 69; memo (S), Strat Div, Dep Dir/Strat & Def Forces, to VCSAF, subj: Minuteman Integrated Command and Control System (MICCS), 11 Dec 69.

26. Msg (S), SAC to CSAF, subj: Enable Command Timer Control (ECTC), 131716Z Jan 69; msg (S), CSAF to SAC, subj: Enable Command Timer (ECT), 172224Z Jan 69; memo (S), Alexander H. Flax, Asst SAF (R&D), to CSAF, subj: Enable Command Timer, 17 Feb 69.

27. Msg (S), Gen Bruce K. Holloway, CINCSAC, to Gen John Ryan, VCSAF, subj: Minuteman Program Requirements (AFIN 7982), 221846Z Feb 69; msg (S), Gen Ryan to Gen Holloway, subj: Minuteman Program Requirements, 052109Z Mar 69.

28. SMD 9-123-133B(27) (S), Minuteman, 11 Apr 69; Air Staff Summary Sheet (S), Major Budget Issues, FY 1971 MICCS, ca Oct 69; Monthly Report for Asst SAF (R&D) (S), 30 Jun 69.

29. SMD 9-279-125B(3) (S), Hard Rock Silo, 24 Jan 69; ltr (S), Msl Br, Strat Div, Dep Dir/Strat & Def Forces, to VCSAF, subj: Minuteman Integrated Command and Control System (MICCS), 11 Dec 69.

30. See note above; msg (S), DCS/R&D, Hq USAF, to AFSC et al, 182022Z Dec 69; msg (S), VCINCSAC, to DCS/R&D, Hq USAF (AFIN 31322), 241821Z Jan 70; MR (S), Msl Sys Div, Dir/Dev, subj: MICCS/CDB, ca Jan 70; Program Budget Decision (S), SECDEF No 293, 11 Dec 69; SMD 0-362-133F(1) (S), MICCS, 3 Mar 70; msg (U), Dir/Dev, Hq USAF, to AFSC, 272043Z Mar 70; SMD 0-380-133F(2) (S), MICCS, 1 Jun 70; rprt (S), Air Staff Board Meeting 70-20 (13 May 70), 15 May 70; intvw (S), author with Lt Col Robert Borland, MICCS PEM, 12 Nov 70.

Chapter IV

1. Nalty, USAF Ballistic Missile Programs, 1967-1968 (TS), pp 56-59; hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, pp 203-205; memo (TS), Nitze to SAF, subj: WS-120A, 31 Oct 68.

2. Hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, pp 293-97.

3. Hist (S), Dir/Ops Req & Dev Plans, 1 Jan-30 Jun 69, pp 73-75, 1 Jul-31 Dec 69, pp 100-101; memo (S), DDR&E to SAF, subj: Approval of USAF FY 1969 Advanced ICBM Technology Program, 20 Dec 68.

4. Hist (S), Dir/Ops Req & Dev Plans, 1 Jan-30 Jun 69, pp 76-78, 1 Jul-31 Dec 69, pp 97-98; rprt (S), Force Structure Committee Meeting 69-21 (12 Aug 69), 1 atch, 12 Aug 69.

5. Brief (S), Dir Reentry Systems, SAMSO, subj: ABRES, Feb 70.

6. Fact Sheet (S), ABRES, 30 Sep 69; rprt (S), Air Staff Board Meeting 69-46 (12 Aug 69), 1 atch, 13 Aug 69.

7. Hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 128-131; 1 Jan-30 Jun 69, pp 146-48, 1 Jul-31 Dec 69, pp 149-150, 1 Jan-30 Jun 70, p 240; hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, pp 228-230.

8. See note above.

9. Fact Sheet (S), Maneuvering Reentry Vehicle, Oct 69; talking paper (S), Msl Sys Div, Dir/Dev, subj: Advanced Reentry Vehicle, Jan 70; hist (S), Dir/Dev, 1 Jan-30 Jun 69, pp 146-47.

10. Hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 128-29, Jan-Jun 70, p 240; Fact Sheet (S), ABRES, 30 Sep 69; SMD 9-314-627A(9), ABRES, 25 Jun 69; MR (S), Col William R. Manlove, Ch Msl Sys Div, Dir/Dev, [ABRES FY 70 Funding], 10 Sep 69; Monthly Report for Asst SAF (R&D) (S), 31 Jul 69.

11. Rprt (S), Program Review Committee 69-78 (5 Nov 69), 1 atch, 5 Nov 69; MR (S), Lt Col Gladstone S. Lewis, ABRES PEM, [ABRES Out-Year Funding], 13 Mar 70; SMD 0-346-627A(10) (S), ABRES, 6 Jan 70.

12. Hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, pp 217-220; ltr (S), H. Guyford Stever, Chmn USAF SAB to CSAF, 1 atch, 19 Sep 68; Program Change Decision (S), SECDEF AF F-8-110, 18 Oct 68, AF F-8-136, 26 Dec 68.

13. Hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 68, p 227; RAD 9-129 (1) (S), Damage Limiting Capability, 23 Jan 69; SMD 0-329-133B(28) (S), Minuteman, 6 Sep 69.

14. Hist (TS), SAC, FY 1969, II, 325-26; hist (S), Dir/Ops Req & Dev Plans, 1 Jan-30 Jun 69, pp 85-89; Ltr (S), Msl Sys Div, Dir/Dev, to Strat Div, Dep Dir/Strat & Def Forces, subj: Near Term Damage Limited RAD 9-129 (1), 20 Mar 69; rprt (S), Air Staff Board Meeting 69-60 (20 Nov 68), 22 Nov 68.

15. Hist (TS), SAC, FY 1969, II, 325-26; hist (S), Dir/Ops Req & Dev Plans, 1 Jan-30 Jun 69, pp 85-89, 1 Jul-31 Dec 69, pp 112-15.

16. Rprt (S), Air Staff Board Meeting 69-59 (10 Dec 69), 1 atch, 19 Dec 69.

17. Ibid.; hist (S), Dir/Ops Req & Dev Plans, 1 Jul-31 Dec 69, pp 110-15, memo (TS) Packard to SAF, subj: Hard Target Policy, 19 Dec 69.

18. Hist (S), 1st STRAD, 1 Jun 68-31 Jul 69, I, chap II.

19. Talking paper (S), Msl Sys Div, Dir/Dev, subj: Nike Targets Program, ca Jan 70; hist (S), Dir/Dev, 1 Jan-30 Jun 69, pp 148-150; 1 Jul-31 Dec 69, pp 150-53, 1 Jan-30 Jun 70, p 242; ltr (S), Dir/Dev to SAF, subj: Report on Launch of Nike Targets Mission KX-117, 2 Jun 70.

20. Fact Sheet (S), Nike Targets Program, 30 Sep 69; hist (S), Dir/Dev, 1 Jul-31 Dec 68, pp 120-22, 1 Jan-30 Jun 69, pp 148-150, 1 Jul-31 Dec 69, pp 151-53, 1 Jan-30 Jun 70, p 242.

GLOSSARY OF TERMS AND ABBREVIATIONS

ABM	antiballistic missile
ABMDA	Advanced Ballistic Missile Defense Agency
ABRES	advanced ballistic reentry system
ACDA	Arms Control and Disarmament Agency
actg	acting
Actg SAF	Acting Secretary of the Air Force
AEC	Atomic Energy Commission
AEDC	Arnold Engineering Development Center
aerosp	aerospace
Aerosp Plans & Plcy Br	Aerospace Plans and Policy Branch
AF	Air Force
AFB	air force base
AFLC	Air Force Logistics Command
AFSC	Air Force Systems Command
AFWTR	Air Force Western Test Range
Apr	April
Ariz.	Arizona
Ark.	Arkansas
ARPA	Advanced Research Project Agency
asst	assistant
Asst SAF (R&D)	Assistant Secretary of the Air Force (Research and Development)
Asst SECDEF	Assistant Secretary of Defense
atch	attachment
Aug	August
ball	ballistic
BOB	Bureau of the Budget
Brig Gen	Brigadier General
(C)	Confidential
ca	about
Calif.	California
CDB	command data buffer
CEP	circular error probable
ch	chief
chap	chapter
chmn	chairman

Chmn USAF SAB	Chairman, United States Air Force Scientific Advisory Board
CINCSAC	Commander in Chief, Strategic Air Command
CLIP	cancel launch in process
Col	Colonel
Colo.	Colorado
comdr	commander
Cong	Congress
CSAF	Chief of Staff, United States Air Force
DASA	Defense Atomic Support Agency
DASO	demonstration and shakedown operations
DCS	Deputy Chief of Staff
DCS/Plans & Ops	Deputy Chief of Staff, Plans and Operations
DCS/R&D	Deputy Chief of Staff, Research and Development
DDR&E	Director of Defense Research and Engineering
Dec	December
dep	deputy
Dep DDR&E	Deputy Director of Defense Research and Engineering
Dep Dir/Plans & Plcy	Deputy Director, Plans and Policy
Dep Dir/Strat & Def Forces	Deputy Director, Strategic and Defense Forces
Dep SECDEF	Deputy Secretary of Defense
dev	development
dir	director
Dir/Dev	Director of Development
Dir/Dev & Acq	Director of Development and Acquisition
Dir/Ops	Director of Operations
Dir/Ops Req & Dev Plans	Director of Operational Requirements and Development Plans
div	division
DSMG	Designated Systems Management Group
DTG	date-time group
ECT	enable command timer
ECTC	enable command timer control
EMP	electromagnetic pulse
EMPSS	electromagnetic pulse sensor system
Engr Mgt Gp, Dir/Dev	Engineering Management Group, Directorate of Development

et al.	and others
ETR	Eastern Test Range
eval	evaluation
Feb	February
fin	financial
FOT	follow-on operational test
FY	fiscal year
Gen	General
gp	group
HARDS	high altitude radiation detection system
hist	history
HPD	hard point defense
hq	headquarters
HRS	Hard Rock Silo
HRSD	Hard Rock Silo development
HTK	hard target kill
ibid.	in the same place
ICBM	intercontinental ballistic missile
intvw	interview
IOC	initial operational capability
Jan	January
JCS	Joint Chiefs of Staff
Jr	Junior
Jul	July
Jun	June
Kans.	Kansas
kt	kiloton
LCFP	launch control facility processor
LFP	launch facility processor
LGM	silo launched, surface attack, guided missile
Lt	Lieutenant

Lt Col	Lieutenant Colonel
Lt Gen	Lieutenant General
ltr	letter
Maj	Major
Maj Gen	Major General
Mar	March
MARCAS	manèuvering reentry control and ablation study
memo	memorandum
mgt	management
MICCS	Minuteman Integrated Command and Control System
MIRV	multiple independently targetable reentry vehicle
Mk	Mark
MM	Minuteman
Mo.	Missouri
MOMS	modified operational missiles
Mont.	Montana
MR	memorandum for record
MRV	multiple reentry vehicle
msg	message
Msl Br, Strat Div	Missile Branch, Strategic Division
Msl Sys Div	Missile System Division
mt	megaton
mtg	meeting
n. d.	no date
N. Dak.	North Dakota
NM	nautical mile
N. Mex.	New Mexico
NOFORN	not releasable to foreign nationals
Nov	November
OBL	operational base launch
Oct	October
ODDR&E	Office, Director of Defense Research and Engineering
ofc	office
OOAMA	Ogden Air Materiel Area
ops	operations

OSAF	Office of the Secretary of the Air Force
OSD	Office of the Secretary of Defense
OT	operational test
p	page
PACCS	post attack command control system
PBPS	post boost propulsion system
PCD	program change decision
PEM	program element monitor
pen	penetration
pp	pages
psi	pounds per square inch
RAD	requirements action directive
R&D	research and development
RD	Restricted Data
RDT&E	research, development, test, and evaluation
req	requirement
rprt	report
RV	reentry vehicle
(S)	Secret
SAB	Scientific Advisory Board
SAC	Strategic Air Command
SAF	Secretary of the Air Force
SAFRD	Assistant Secretary of the Air Force (Research and Development)
SALT	Strategic Arms Limitation Talks
SAMSO	Space and Missile Systems Organization
SAS	status authentication system
S. Dak.	South Dakota
SECDEF	Secretary of Defense
secy	secretary
sess	session
SIOP	single integrated operational plan
SMD	systems management directive
SMS	strategic missile squadron
SMW	strategic missile wing
Sp Actys Div, Dir/Prod & Prog	Special Activities Division, Director of Production and Programming
SPO	systems program office
SR	Senate Resolution

S Res	Senate Resolution
STM	special test missile
STRAD	Strategic Aerospace Division
Strat Div	Strategic Division
subj	subject
sup	supplement
sys	system
(TS)	Top Secret
(U)	Unclassified
U. S.	United States
USAF	United States Air Force
VCINSAC	Vice Commander in Chief, Strategic Air Command
VComdr	vice commander
VCSAF	Vice Chief of Staff, United States Air Force
WS	weapon system
WTR	Western Test Range
Wyo.	Wyoming

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