2

U.S. Military Space Programs

THROUGHOUT THE NEARLY five-decade history of U.S. military interest in space, there have been numerous space weapons defense programs the U.S. Government and military have embarked upon to increase U.S. capabilities in these areas. These programs were chosen because they were believed to be in accordance with existing or emerging national security needs and because they had the requisite political support and perceived scientific and technological prerequisites for success.

Each of these programs chronicled in this chapter achieved varying degrees of success with varying setbacks and have multifaceted organizational histories. These programs are not a comprehensive listing of relevant U.S. military space programs; rather, they have been chosen because they comprise a representative sampling of U.S. military space programs over the past five decades.

Project Corona

Project Corona served as the United States' first photoreconnaissance satellite system, operating from August 1960–May 1972 collecting both intelligence and mapping imagery (U.S. National Reconnaissance Office, n.d., 1). This program's provenance dates back to the Cold War and even to the Pearl Harbor attack. Because of the combination of the Pearl Harbor attack, the Soviet Union's development of atomic and hydrogen bombs, and the surprising 1950 North Korean invasion of South Korea, the U.S. realized it needed to gain the ability to conduct strategic reconnaissance of the Soviet Union and the territory of other potential U.S. adversaries (Day, Logsdon, and Latell 1998, 2–3).

Corona's programmatic origins stemmed from studies about the possible military uses of space done at the Rand Corporation think tank during the 1950s that became part of an Air Force reconnaissance satellite initiative known as Weapons System WS-117L in 1956. Following the aftermath of the 1957 Sputnik launch, the Eisenhower administration seized on Rand's idea of a photoreconnaissance satellite that would return exposed film to Earth in a reentry capsule instead of electronically; this idea was incorporated into WS-117L in 1957. President Eisenhower approved this plan in February 1958 giving the CIA the leading role in this program but managing it jointly with the Air Force in an arrangement comparable to that for the U-2 aerial reconnaissance plane (Day, Logsdon, and Latell 1998, 5–6; Greer 1973, 1–37).

President Eisenhower inspecting the capsule from Discoverer XIII in 1960–the first object ever ejected from an orbiting satellite and subsequently recovered. *(Dwight D. Eisenhower Presidential Library)*

The following passage from a September 14, 1960 CIA memorandum provides further explanation of Corona's military and intelligence value:

> New equipment bearing upon the art of photographic interpretation has clearly expanded the quantity and quality of information derived from that photography. We have seen the extensive uses to which the material and the information derived there from can be put for strategic intelligence purposes, emergency war planning, intelligence purposes related to the responsibility of theater commanders, research and development requirements of the Department of Defense, and operational purposes of the military as well as intelligence operations. . . Its vast geographic coverage clearly enhances our ability to search for guided missile sites of all sorts, and will permit the identification of installations with which we have all become familiar. . . In addition to the uses for positive information on the USSR, it will materially assist in refining the targets for other collection programs and improving their potential (Ruffner 1995, 85–86).

Corona was a classified program whose funding was derived from off-budget resources possessed by the DCI, and noncompetitive bidding contracts for this project were negotiated with Lockheed by the CIA. The entire program and its key applications were classified top secret (Cloud 2001(a), 205). On August 26, 1960, Eisenhower decreed that all photography from Corona and future successor programs be covered by the highly restricted TALENT-KEYHOLE security protocols covering air and space reconnaissance systems in a directive to the secretary of State, secretary of Defense, attorney general, Atomic Energy Commission chair, and DCI (Ruffner 1995, 75).

The secretive NRO was created in 1961 to manage all U.S. aerial and space reconnaissance. NRO's existence was not publicly acknowledged until 1992 (Cloud 2001(a), 205; Cloud 2001(b), 237).

The first attempted Corona test launch was February 28, 1959, the first successful recovery of a Corona spacecraft from space was on August 12, 1960, and the first Corona image taken from space was on August 18, 1960, with many unsuccessful launch and recovery attempts complicating efforts during the program's early attempts to achieve viability (U.S. National Reconnaissance Office, n.d.; Greer 1973, 19–22). These satellites were launched from Cooke (later Vandenberg) Air Force Base (AFB) in California into near polar orbits. Using high-resolution strategic photography with panoramic cameras was Corona's key objective. The Keyhole (KH)-1 camera system, Corona's earliest, used one vertical panoramic camera, and the KH-2 and KH-3 cameras achieved incremental improvement. In the KH-4 camera system the satellite deployed pairs of tilted, longer-range, and higher resolution cameras rotated in synchronization. Later Corona cameras such as the KH-5 and KH-6 achieved greater spatial coverage and higher image calibration results as the program developed and evolved during the 1960s (Cloud 2001(b), 238–39; Greer 1973, 11).

Imagery derived from Corona photography produced numerous enhancements to U.S. knowledge of foreign military and intelligence trends and developments. An August 26, 1964 CIA National Intelligence Estimate (NIE) on China's Lop Nor nuclear test site in western China stressed that it thought this site could be ready for use in about two months, but believed that the Chinese did not have sufficient fissionable material to make a nuclear test within the next several months. The NIE concluded that China was unlikely to be able to conduct a nuclear test until after 1964, although the Chinese succeeded in conducting their first nuclear weapons explosion on October 16, 1964 (Ruffner 1995, 237–244; Nuclear Threat Initiative 2003, 1).

During the June 1967 Middle East War, Corona photographs were able to verify the damage Israeli air attacks had inflicted on Egyptian, Syrian, and Jordanian aircraft and prove that such claims were not exaggerated. Additional Corona accomplishments in the Middle East were providing proof during 1970 of Israeli–Egyptian cease-fire agreement compliance or violations following the 1967 war (Greer 1973, 37–38).

Corona conducted its 145th and final launch on May 25, 1972, and the final recovery of Corona imagery occurred on May 31, 1972 before the program was concluded due to emerging technological enhancements in satellite surveillance such as the Defense Support Program (DSP) satellites (Greer 1973, 38).

Quantitative measures of Corona's success include that it was the world's first photoreconnaissance satellite, achieved the first mid-air recovery of a vehicle returning from space, conducted the first mapping of Earth from space, provided the first stereo-optical data from space, and was the first reconnaissance program to fly 100 missions. Additional numerical accomplishments include improving imaging resolution from eight meters to six meters, individual images covering areas nearly 10-by-120 miles, taking over 800,000 images from space, and a collection consisting of 2.1 million feet of film (National Reconnaissance Office n.d., 2).

Corona's qualitative accomplishments are even more impressive. It provided U.S. policymakers with information on international security crises, trends, and developments such as the Russian and Chinese nuclear weapons programs, the 1967 Middle East War, Berlin Wall construction, the 1969 Soviet/Chinese border conflict, and the 1971 India/Pakistan War. Corona provided technical information about Soviet nuclear facilities and capabilities that made it possible for the U.S. to enter into arms control negotiations with the Soviets and to plan effective and cheaper weapons systems to use against U.S. adversaries. Most importantly, it gave U.S. policymakers sufficiently accurate information to enable the U.S. to get through the international crises of this period, while avoiding making erroneous calculations about enemy capabilities that could have produced serious consequences such as global military confrontation (Day, Logsdon, and Latell 1998, 226–229).

On February 22, 1995, President Bill Clinton issued Executive Order 12951 authorizing the public release and declassification of historical Corona imagery to the National Archives and Records Administration within 18 months (President of the United States 1995, 10789–10790). A section of the NRO website (www.nro.gov/corona/facts.html) includes examples of Corona imagery, Web casts, and other information on this vitally important program including biographies of key Corona personnel in the industrial, intelligence, and military communities.

The Soviet Union's response to Corona was the Zenit satellite reconnaissance program, which had its genesis in a January 30, 1956 governmental decree authorizing the development of an artificial satellite called Object D. After several years of trial and error the Soviets finally achieved successful space imagery photos from the Zenit 2-Kosmos 7 mission between July 28–August 8, 1962 (Gorin 1998, 158, 164; Siddiqi 2003, 250, 354). On March 10, 1964 the Soviet Ministry of Defense declared Zenit 2's space reconnaissance capability operational, although this capability was not limited to the satellite itself. Zenit satellites were initially launched from Tyuratam or Baikonaur in what is now Kazakhstan, but beginning in 1966 the rockets carrying these satellites were launched from Plesetsk in northern Russia (Gorin 1998, 166).

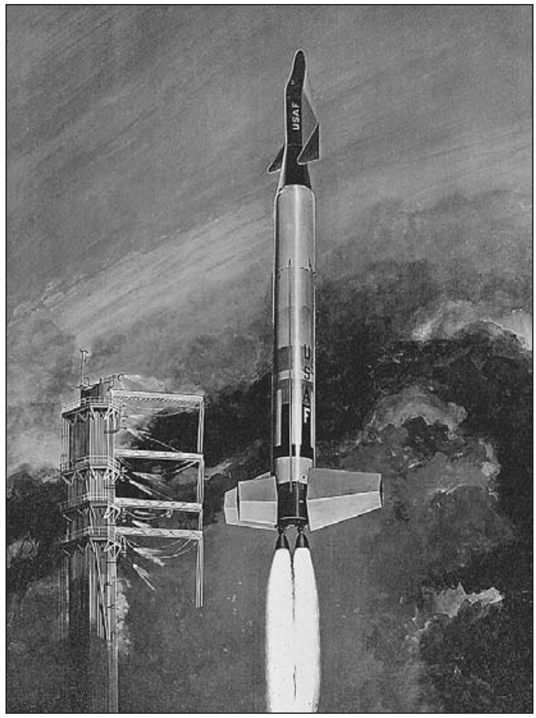
These satellites initially remained in orbit for 8–12 days, although their orbital lifetimes would gradually increase. Consequently, the Soviets needed to launch many more of these satellites than the United States did, and they averaged 30 to 35 launches per year during the early 1970s, while the U.S. was averaging 6 to 10 launches annually. A key reason for the short lifespan of the Zenit satellites was their inability to eject individual film rolls to aircraft anywhere on Earth, in contrast with Corona. Zenit satellites and imagery had to be brought down within Soviet territory (Lindgren 2000, 125–126).

Zenit's data was used by numerous organizations within the Soviet military including its military intelligence service, the GRU, whose Satellite Intelligence Directorate interpreted and analyzed space photos. Additional Soviet photoreconnaissance users during this period included the Topographical Directorate of the Armed Forces General Staff and the Strategic Rocket Forces Commanding Staff. Topographical Directorate responsibilities included military mapping, and Intelligence Department responsibilities included using Zenit information for precision ICBM targeting. The Soviets also sought to disguise their military space missions by mixing military and civilian satellites and failed probes as part of the Kosmos program, which constituted approximately 95% of Soviet space missions at this time (Gorin 1998, 167).

The Zenit program did not have a clear end in the early 1970s like Corona but has probably evolved into current Russian military space satellite programs such as the Kobalt, Yenisey, Strela–3, and GLONASS systems described in Chapter 4 (Gorin 1998, 169; Center for Nonproliferation Studies 2005(?), 1–3).

Dyna-Soar

Project Dyna-Soar, which was an abbreviation of dynamic soaring, was an Air Force program with the collaboration of the National Advisory Committee on Aeronautics (NACA) (NASA's predecessor agency) in the later 1950s and early 1960s, which sought to give the Air Force a manned presence in space and serve as a military counterweight to NASA's emerging manned space program. The program's genesis began during the summer of 1952 when NACA directed its organizational laboratories to study issues and problems concerning high altitude supersonic flight (U.S. Congress, House Committee on Science and Technology 1985, 207). In the aftermath of the 1957 Sputnik launch, Air Force leaders became concerned with developing a reusable shuttle vehicle to perform orbital reconnaissance or serve as a strategic deterrent by conducting nuclear bombing missions. By December 1957 Dyna-Soar became possible through the consolidation of three previously existing Air Force research and development programs: Hywards, which covered a boost-glide vehicle; the high altitude reconnaissance system Brass Bell; and the Rocket Bomber rocket missile whose collective activities included testing piloted vehicles to obtain aerodynamic, structural, and human factor data and speeds and altitudes beyond the reach of the then cutting edge X-15 fighter plane. Dyna-Soar was intended to operate at an altitude of 350,000 feet and at a speed of 10,800 miles per hour as opposed to the X-15's altitude and speed ceilings of 250,000 feet and 4,000 miles per hour (Houchin 1999, 4–5; Spires 1998, 74; Spires 2004, 2:760–761).



A Dyna-Soar (Dynamic Soaring) vehicle clears the launch tower atop an Air Force Titan II launch vehicle in this 1961 artist's concept illustration. Originally conceived by the U.S. Air Force in 1957 as a manned, rocket-propelled glider in a delta-winged configuration, the Dyna-Soar was considered by Marshall Space Flight Center planners as an upper stage for the Saturn C-2 launch vehicle. *(NASA)*

A 1958 Air Force document provides a detailed description of Dyna-Soar's anticipated military potential stressing that the rocket engine would allow it to reach an altitude of 170,000 feet at a speed of nearly 18,000 feet per second. Additional Dyna-Soar attributes described by this document included the crew being able to monitor automatic system operation and make corrections as necessary, operate reconnaissance equipment and observe activities in areas it overflies, the ability to provide high-quality photographic, radar, and intelligence data, and perform extremely accurate strategic bombing at speeds and altitudes capable of providing significant protection against hostile fire (Spires 2004, 2:751–752).

A recent Air Force historical analysis of Dyna-Soar's technical and operational capabilities made the following assessment. This appraisal noted that Dyna-Soar could be pictured as an isosceles triangle, which would have a cylindrical fuselage for the pilot in front and a rear payload bay. Triangles attached perpendicularly to the main wing structure would provide aerodynamic surfaces for control and stability. Dyna-Soar would be launched by a modified ICBM or first-generation Saturn rocket and separate from that rocket upon reaching orbital velocity. The craft would conduct its mission on an orbital glide path around the earth then reenter the atmosphere by using retro-rockets to reduce its speed and have some flexibility to choose at which bases to land. This latter attribute gave it a heightened flexibility that craft in NASA's Mercury, Gemini, and Apollo programs did not have (Erickson 2005, 162–163).

Dyna-Soar's long-term viability would be seriously limited by the Eisenhower administration's belief that satellites should not be employed as offensive nuclear weapons systems or orbital bombs (Erickson 2005, 165). This belief would receive concrete policy reinforcement on January 26, 1960 in National Security Council Directive 5918 *US Policy on Outer Space,* which sought to emphasize civilian scientific space exploration and development activity while restricting military space activities to defense support and limiting offensive space weapons to study projects (Spires 1998, 80–81). This desire for predominantly peaceful uses of outer space by the Eisenhower administration was opposed by some members of Congress, the public, and Air Force officials who believed the Soviets would attempt to eliminate U.S. reconnaissance satellites through military means (Houchin 1988, 276).

An additional factor casting doubt on Dyna-Soar's future was Eisenhower's November 2, 1959 decision transferring control of the Saturn rocket system from the Air Force to the new National Aeronautics and Space Administration (NASA) over objections from the JCS. The Air Force's ability to develop the military super-booster rockets necessary for Dyna-Soar would also be diminished by the December 30, 1959 directive from Secretary of Defense Neil McElroy (1904–1972) transferring DOD space activities from ARPA to DOD's DDR&E, which required military space projects to compete with other military funding requests (Spires 1998, 79).

During the Kennedy administration, the increasing Dyna-Soar costs incurred the intense scrutiny of Secretary of Defense Robert McNamara (1916–), whose emphasis on systems management of DOD programs has been the subject of sustained historical and public policy analysis (Murdock 1974; Roherty 1970; Enthoven and Smith 2005). During January 1963, McNamara told the House Armed Services Committee that Dyna-Soar faced considerable technical problems with particular emphasis on its reentry capabilities. That same month, McNamara also directed DDR&E director Harold Brown (1927–), who later became secretary of Defense from 1977–1981, to examine Dyna-Soar's advantages and disadvantages in relationship to anticipated benefits from NASA's two-man Gemini program.

McNamara consulted with NASA administrator James Webb (1906–1992) in March 1963 on potential alternatives to spending $600 million on Dyna-Soar, which McNamara felt had vague military requirements. In October 1963, McNamara and Brown visited the Martin-Marietta factory in Denver to review progress on the X-20 aircraft and Titan III missile, and McNamara remained concerned with what he saw as the Air Force's apparent inability to answer what it wanted to do in space and its reasons for being in space (Stares 1998, 124). Both McNamara and Brown finished this Denver visit unconvinced that Dyna-Soar could perform either bombing or satellite inspection missions, and they remained convinced that existing unmanned systems such as Corona were more cost-effective for reconnaissance missions. The October 1963 U.S.–Soviet agreement renouncing weapons of mass destruction in outer space and growing international acceptance of reconnaissance satellites also facilitated Dyna-Soar's demise. All of these factors lead to Dyna-Soar's cancellation on December 10, 1963 (Spires 1998, 124; Houchin 1999, 13–14; Houchin 1988, 279).

Despite being cancelled, Dyna-Soar left an important legacy to influence future Air Force aerospace research and development. Air Force Secretary Eugene Zuckert (1911–2000) approved continuing 36 Dyna-Soar research programs in areas including advanced technology, hardware, and technical data, and specifically high-temperature material and fabrication processing enhancements that facilitated the development of spacecraft and large rocket boosters. Research from 2,000-plus hours of wind tunnel testing increased knowledge of aerodynamic stability and control and structural design problems.

Dyna-Soar also represented the first officially authorized military space-faring system and the only system that included an offensive mission capability. It led to the development of the Titan III space booster and its aerodynamic space operations emphasis would also influence design of the Space Shuttle in the 1970s.

Manned Orbiting Laboratory (MOL)

A 1961 Air Force proposal involving putting a continuous military force in space with piloted craft, manned surveillance, and space stations can be viewed as the provenance of the MOL (Posey 1998, 75). MOL received more formal DOD support in 1963 in the aftermath of Dyna-Soar's cancellation. It was envisioned as a way of determining human military usefulness in space. Both the Air Force and Navy participated in MOL, whose objectives included enhancing understanding of what individuals could do in space and how this capability could be used for defense purposes, developing technology and equipment to improve manned and unmanned space flight, and experimenting with this technology and equipment. The laboratory was designed to support two men in orbit for 30 days. DOD selected 17 astronauts for the program whose membership consisted of test pilots and graduates of the Aerospace Research Pilot School at Edwards AFB, California (U.S. Congress, House Committee on Science and Technology 1985, 208).

MOL's genesis dates from a December 10, 1963 announcement assigning responsibility for this program to the Air Force if the military could define and justify a military space mission NASA could not perform (Posey 1998, 75). The news release announcing MOL contained information on its projected mission and its relationship with NASA. This release mentioned that MOL would be connected to a modified Gemini capsule and launched into orbit by a Titan III booster. Astronauts would move to the laboratory upon reaching orbit and return to their capsule and the earth once their orbital assignments were completed. MOL was designed to permit space rendezvous with orbiting Gemini capsules delivering replacement crews if lengthy space laboratory operations were needed. MOL would use existing NASA tracking and control facilities for NASA and DOD space flight programs, and the laboratory would conduct military experiments involving manned equipment and instrumentation, if NASA desired, for scientific and civilian missions (Spires 2004, 2:848).

Between 1963–1965, MOL technical specifications were established. The station would consist of a modified Gemini capsule connected to a cylindrical module 10 feet in diameter and 42 feet in length. Approximately half of this structure would be a pressurized working area for the crew, and another unpressurized section would have life support equipment and a restartable rocket engine for orbital adjustments.

MOL would be launched by a Titan III to a 150-mile high orbit, and the astronauts would leave Gemini to move to their workplace. The astronauts would stay in orbit for a week or two with 30 days being the maximum time for such missions before returning to Gemini and heading back to Earth. While in orbit, MOL astronauts would watch and photograph activity in the Soviet bloc and inspect hostile satellites and destroy them if necessary. Proposed MOL experiments included using large optics in space, tracking Earth and space targets, electromagnetic intelligence surveys, multispectral photography, and post-strike target assessment using equipment such as the KH-10 camera (Posey 1998, 76).

MOL's launch site was initially set up at Cape Kennedy, Florida but was shifted to Vandenberg AFB, California to get better quality coverage of the Soviet Union. President Lyndon Johnson (1908–1973) announced approval of MOL on August 25, 1965 with an initial program budget of $150 million. Primary MOL contractors were Douglas, which was responsible for the laboratory canister; McDonnell for the Gemini capsule; and General Electric for space experiments. The Air Force hoped to launch the first unmanned MOL in 1968 with manned crews to follow soon after (Spires 1998, 129–130).

The Air Force placed high hopes on the MOL as its means of beginning and maintaining a manned military space presence as reflected in a 1965 program justification statement. This document contended that man was the key to the future in space, that MOL was a bridge from research and development experiments to being able to conduct traditional military operations in space, that new regions and technologies have been historically exploited for military advantage, and that MOL is needed to prevent hostile exploitation of space against the United States (Erickson 2005, 418).

This optimistic Air Force position on MOL stands in partial contrast to a 1964 statement by DDR&E Albert G. Hall (1914–1992). Hall argued that there was not a decisive case for manned space supremacy as a key component of military supremacy. He believed the United States should purchase insurance against the possibility of a manned operational system being required by the middle 1970s in the form of a flight test system to determine human effectiveness in performing desired military activities in space. Hall believed MOL should be directed to examining human ability to perform military operations in space while acknowledging that there was no clear consensus on the military significance of manned space technology (Erickson 2005, 420–421).

The Air Force was convinced there was a valid raison d'etre for manned military activity in space and that MOL was the mechanism for such activity. An excerpt from a 1964 document explicitly described MOL astronaut responsibilities:

> The 2-man crew will discriminate, detect, point, track, evaluate, reprogram and command as appropriate in missions of reconnaissance, fly-by inspection, co-orbital inspection. . . and perform support tasks such as navigation, re-entry, etc. The reconnaissance mission tasks seem to be well conceived. . . They [the crew]

> examine the area photographs and look for targets and then program themselves on a suitable orbit to take high resolution photographs of targets of interest. High resolution photos are then taken of these targets (Erickson 2005, 465).

Over the next few years MOL would proceed to carry out several experiments as part of its prospective program development. A March 1965 Air Force operational document describes 12 of 14 declassified MOL experiments covering a daunting array of intelligence, military, and space science activities. Examples of these included measuring human ability to acquire and track predetermined ground targets under multiple conditions; measuring their ability to acquire and track satellite targets under multiple conditions; measuring the ability to detect surface targets and make cursory intelligence assessment; measuring the ability to make decisions and adjustments from electromagnetically emitted information; measuring crew members' ability to perform in-space maintenance; determining what human functions and tools are required to work outside of spacecraft; determining crew members' ability to use a remote control maneuvering unit; measuring human ability to navigate in space and geodetically survey uncooperative targets; determining crew members' ability to use radiometric and related equipment to perform military and scientific activities; measuring crew members' daily performance capabilities; measuring the physiological and biomedical factors of crew members under long-term orbital conditions such as weightlessness; and evaluating human capabilities to control, coordinate, and use sensors to detect, track, classify, and catalog sea targets (Erickson 2005, 467–468).

MOL achieved some substantive progress during its existence. In November 1966, the Air Force conducted a number of successful tests, including nine on-board experiments, using a Gemini capsule launched by a Titan IIIC rocket. By 1967 MOL planners completed design work on a basic Gemini–Titan MOL arrangement and a new West Coast launch facility and selected for training 12 astronauts from the Air Force, Navy, and Marine Corps (Spires 1998, 131).

Despite these positive developments, storm clouds emerged and lingered over MOL. There was concern in Congress that MOL duplicated NASA's Apollo Applications Program (APP) involving lunar exploration. This concern was reflected in a March 21, 1966 House Government Operations Committee report on these programs. This document asserted that NASA participation in MOL would achieve significant cost savings, that NASA's existing APP's fiscal year 1967 budget request of $100 million was almost as much as MOL's budget request, and that since both of these programs were research and development programs with unclear operational missions, that combining them would achieve significant savings (U.S. Congress, House Committee on Government Operations 1966, 46).

Besides concern over program duplication, other factors coincided to produce MOL's decline and termination. The Vietnam War's ongoing costs and the burgeoning financial drain of Great Society social programs reduced political support for the space program, and DOD and Apollo space programs experienced budget cuts. Space represented 20% of DOD's research and development budget, and astronautic programs constituted one-third of the Air Force's budget, and half of this expenditure involved MOL with what was the most expensive of Air Force research and budget development programs not directly related to the Vietnam War (Spires 1998, 133).

These factors and DOD's belief that national security space missions could be better accomplished with cheaper unmanned spacecraft resulted in MOL's cancellation on June 10, 1969, although the DOD acknowledged that MOL had been managed well and that excellent results had been achieved by program participants (Spires 1998, 133; Spires 2004, 2:860–862).

Sentinel and Safeguard Antiballistic Missiles

Both the Sentinel and Safeguard ABM programs represented governmental attempts to build ABM systems to counter a growing Soviet nuclear threat. Sentinel emerged in the 1960s from military efforts to develop an ABM system after abortive U.S.–Soviet attempts to limit ABMs in their overall arms control discussions. These efforts saw the Air Force evaluate the potential of using lasers to burn missile warheads in flight but determined they could not produce sufficient energy to damage a warhead. Army ballistic missile defense research emphasized developing radars encased in hardened structures along with a faster missile system named Sprint. The new radars and Sprint would be combined into a system called Nike-X and in 1966 military leaders recommended Nike be deployed to defend the entire United States against a Soviet ICBM attack (U.S. Centennial of Flight Commission 2003, 1).

Secretary of Defense Robert McNamara instead favored developing independently targetable reentry vehicles that would allow a single ABM to attack multiple targets. During 1967, McNamara agreed to begin working on a modified and scaled back version of Nike-X called Sentinel, which he felt should focus on Chinese rather than the Soviet ICBMs, since arms control negotiations with the Soviets were not progressing on this issue.

McNamara responded to Soviet intransigence on September 18, 1967 by announcing that the United States would begin deploying the small-scale Sentinel system to counter Chinese ballistic missiles (Haas 1988, 235; Bowen 2005, 44; U.S. Centennial of Flight Commission 2003, 1).

Sentinel's initial deployment plans called for 6 Perimeter Acquisition Radars, 17 Missile Site Radars, 480 Spartan missiles, 192 Sprint missiles with an additional missile site radar, and 28 Sprints planned for Hawaii. If fully deployed, Sentinel would have been capable of defending most of the continental United States, Hawaii, and parts of Alaska (Bowen 2005, 44).

The early months of the Nixon administration in 1969 were not a propitious time to advocate new defense weapons systems because of increasing public opposition to the Vietnam War and the fact that the Sentinel's interceptor missiles were nuclear armed. There was significant opposition to Sentinel for environmental and anti-Vietnam war reasons in some areas of the country. New England notably was a center of this activity, and Senator

The last of six production version Spartan missiles rises from Meck Island at Kwajalein Missile Range in the Marshall Islands on April 3, 1975. The 55-foot long Spartan was the long range interceptor of the Army's Safeguard Ballistic Missile Defense System. It had a range of several hundred miles and was designed to carry a nuclear warhead in the megaton range. *(Bettmann/Corbis)*

Edward Kennedy (Democrat from Massachusetts) (1932–) was a prominent figure in this opposition (Bowen 2005, 44).

This vociferous opposition caused the Nixon administration to further scale back the Sentinel program and rename it Safeguard. This new program would no longer be an area ABM system that would try to protect civilian and military assets but would serve as a point defense system intended to protect ICBM sites. The Nixon administration also wanted to retain an ABM system to use as a bargaining chip in arms control negotiations with the Soviet Union (U.S. Centennial of Flight Commission 2003, 2; Bowen 2005, 44).

Intensive debate and negotiation occurred between the Nixon administration and Congress over Safeguard's fate during the first few months of 1969 (Gross 1975). Critics of deploying Safeguard such as Senator Stuart Symington (Democrat from Missouri) (1901–

1988) stressed concerns about Safeguard's technical reliability, questioned whether the Soviet missile threat warranted deployment of such a weapons system, and felt that more emphasis should be placed on domestic social spending (U.S. Congress 1969, 22478–22479).

Proponents of deploying Safeguard such as Senator Henry Jackson (Democrat from Washington) (1912–1983), emphasized the need to counter the steady growth in Soviet nuclear missile development and deployment and potential instability in the Soviet leadership, which did not promote strategic stability between the two sides (U.S. Congress 1969, 22483).

In August 1969, Congress passed legislation funding 2 of 12 Safeguard sites with the Senate passage of this bill occurring by a margin of two votes (U.S. Congress 1969, 22498). President Richard Nixon (1913–1994) decided to deploy Safeguard, which would defend Minuteman ICBM sites at Grand Forks AFB, North Dakota and Malmstrom AFB, Montana, and these two sites were under construction in 1972 as ABM treaty negotiations were occurring with the Soviet Union (Bowen 2005, 44–45).

The Nixon administration was also interested in the possibility of using Safeguard to defend the National Command Authority in Washington, D.C. A January 24, 1970 NSC memorandum prepared for National Security advisor Henry Kissinger (1923–) stated that advantages of using Safeguard as a Washington ABM site would decrease the temptation for a third country or a crazed military commander trying to provoke a U.S.–Soviet nuclear exchange by knocking off the "head" of the United States and causing its other military limbs to lash out at its perceived assailant. This memorandum also argued that such a system would be the equivalent of the Galosh ABM system the Soviets were deploying around Moscow, that such deployment would be consistent with the administration's rationale for providing a missile defense system to protect civilian and military command and control authorities, and that work on a Washington ABM site could proceed without the Nixon administration having to take a definitive stand on the kind of area defense system it wanted to build.

This appraisal went on to acknowledge that there could be political problems with appearing to protect only the president and Congress while delaying population defense measures, that a Washington ABM would have limited regional coverage and might not include cities like Baltimore or Philadelphia, and that this system could not defend Washington against bomber attack (U.S. National Security Council 1970, 1–4).

These modest U.S. efforts to develop a limited ABM system stood in sharp contrast to extensive Soviet ABM programs. An August 1970 CIA assessment of Soviet ABM activities mentioned that eight launch sites in Moscow ABM defenses were operational in early 1970 and that eight Hen House radars were either operational or under construction and deployed in five locations on the Soviet Union's periphery to provide early warning of missile attack, with one of these radars being at Olenegorsk near Murmansk and the other at Skrunda in Latvia. This assessment went on to contend that these ABM sites and other radars provided warning of ICBM attacks from the northwest, China, submarine launch areas in the north, the western Pacific, and eastern Mediterranean. The CIA stressed that this coverage could not currently monitor submarine-launched missiles from the western Mediterranean, but that Soviet deployment of three to five additional radars could close this and other existing coverage gaps (U.S. Central Intelligence Agency 1970, 20; Schneider 1971, 26).

Original plans called for Safeguard deployment, beyond the North Dakota and Montana sites mentioned earlier, to the upper Midwest; central and southern California; Warren AFB, Wyoming; Whiteman AFB, Missouri; the Michigan–Ohio area; southern New England; Washington, D.C.; Dallas, Texas; and the Florida–Georgia area (Bowen 2005, 47).

The May 26, 1972 ABM Treaty between the United States and Soviet Union, coming after lengthy negotiations, would be the beginning of the end for Safeguard. This agreement limited both sides to construction of one limited ABM system to protect its national capital area and another to protect an ICBM launch area. Both of these sites had to be at least 1,300 kilometers apart to prevent creation of effective regional defense zones or the beginning of a nationwide ABM system. The Treaty also limited each side to no more than 100 interceptor missiles and 100 launchers at each ABM site while also imposing restrictions on both sides to limit qualitative improvements in their ABM technology such as not developing, testing, or deploying ABM launchers capable of launching multiple interceptor missiles simultaneously and prohibiting systems for rapidly reloading launchers (U.S. Department of State n.d., 1; Burr 2001; Baucom 1992, 91–113; Bulkeley and Brauch 1988).

The United States maintained one ABM site under the treaty at the Grand Forks, North Dakota locale mentioned earlier. The Army realized that this site would be overwhelmed in a large-scale missile attack but wanted to retain the Grand Forks site for a year to gain operational experience for potential future ballistic missile defense systems. Congress, however, remained opposed to potential ballistic missile defense systems, and on October 2, 1975, the House of Representatives voted to deactivate Safeguard; subsequently the JCS ordered program termination on February 10, 1976. Following material disposition, the site's nontechnical infrastructure was declared excess property and turned over to the Department of the Interior. In 1984, the Army reacquired this infrastructure to provide support for the new SDIO. The facility has never been demolished and remains under Army control, although there are no apparent plans to include it in ongoing U.S. ballistic missile defense programs during the George W. Bush administration (Bowen 2005, 50).

Defense Support Program (DSP) Satellites

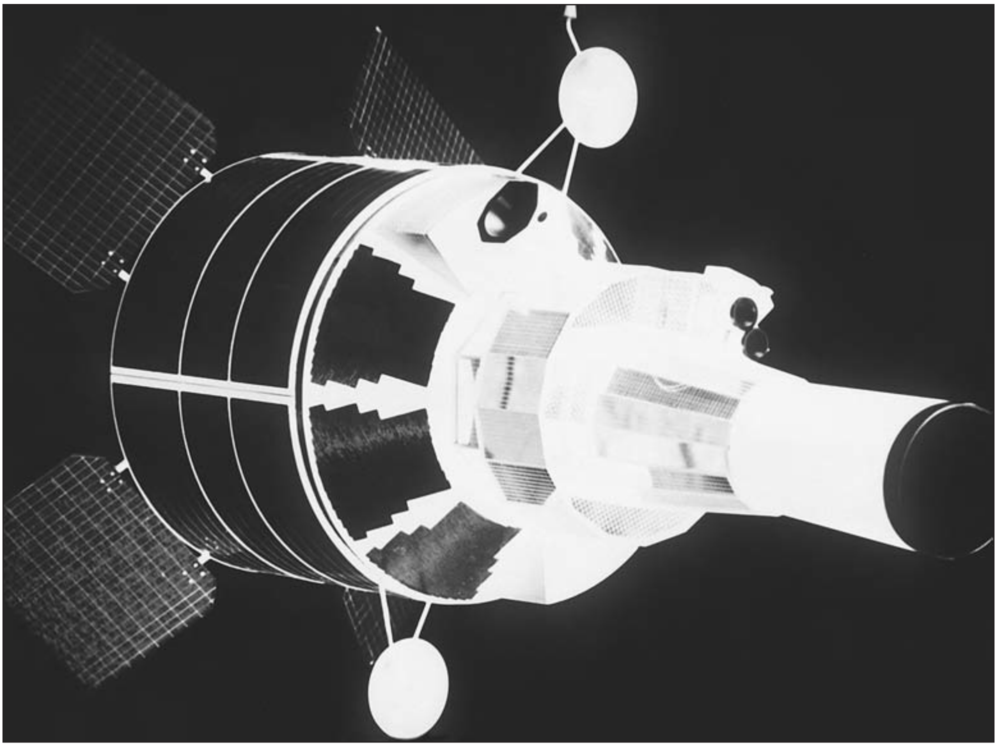
Cancellation of Dyna-Soar and MOL and the ongoing success of Corona demonstrated the preeminence of reconnaissance satellites in U.S. military space policy as the 1970s began. The need to develop a satellite system with more technologically sophisticated capabilities to detect Soviet or other hostile military activities was apparent to U.S. policymakers at this time and would lead to the development of the DSP satellite program during this period.

What became known as DSP had its genesis during the 1960s when U.S. military policymakers realized the Missile Defense Alarm System (MIDAS) military radar missile-warning program was proving inadequate to provide timely warning of hostile ballistic missile launches against the United States. Such inadequacy resulted in MIDAS's January 1966 cancellation (Spires 2004, 2:975, 1084). In August 1966, DOD's DDR&E approved development of Program 949 to replace MIDAS. Program 949 was intended to serve as a means of providing the United States with early simultaneous warnings of threats to U.S. military assets from ICBMs and the Soviet's Fractional Orbital Bombardment Systems and Submarine Launched Ballistic Missiles (SLBM). During 1969, a security breach caused the Air Force to change the program designation to Program 647, which then became known as DSP (Spires 2004, 2:1095).

A formal DOD awarding of this program and military satellite warning programs to the Air Force occurred on September 8, 1970 when Deputy Secretary of Defense David Packard (1912–1996) issued DOD Directive 5160.32 "Development of Space Systems," whose partial contents included assigning functional responsibilities within the Office of the Secretary of Defense and armed services for developing and acquiring space systems, giving the Air Force responsibility for developing, producing, and deploying space systems for warning and surveillance of enemy nuclear delivery and launch vehicle capabilities, and DOD's Director of Defense Research and Engineering being responsible for monitoring space technology to limit technical risk and cost as well as preventing unwarranted program duplication (U.S. Congress, Senate Committee on Armed Services 1971, 2670).

The first DSP satellite was launched from Cape Canaveral, Florida on November 6, 1970 on a Titan III rocket. The satellite's payload was reportedly secret but information about its launch was covered in the *New York Times* and on a sign at a Cocoa, Florida bank (Richelson 1999, 64). A detailed description of DSP capabilities and early weaknesses is described in a recent Air Force analysis of military space programs. This appraisal mentioned that DSP satellites weighed 2,000 pounds and measured 23 feet in length and 10 feet in width. DSP satellites rotated six revolutions per minute so their telescopes were able to scan the earth. This assessment also noted that Air Force planners were concerned about the ability of DSP software to receive and process large amounts of data before transmitting that data almost instantaneously worldwide. Satellite managers also were concerned about coverage gaps due to unfavorable sensor angles over the pole, and they lobbied DOD officials for additional satellites to achieve enhanced coverage but were turned down in the 1970s due to budget constraints (Spires 2004, 2:1095).

Data and imagery acquired by DSP satellites were sent to a global network of ground stations whose locations included Buckley AFB, Colorado; Vandenberg AFB, California; Guam; Hawaii; and Nurrungar, South Australia, Australia. The Nurrungar facility assumed command and control responsibilities for DSP on May 19, 1971. While Nurrungar had no problem communicating with the DSP, it had problems communicating reliably with the



Artist's concept of the Defense Support Program satellite in space. *(U.S. Department of Defense)*

United States, but these were eventually resolved. Another problem Nurrungar and other Australian satellite intelligence facilities had to contend with during this period was opposition to their presence from some elements of the opposition Australian Labor Party (Richelson 1999, 67–68; Ball 1987; Ball and Richelson 1985, 178–181, 190).

Additional DSP technological enhancements occurred during the 1970s and beyond. During the mid-1970s, the longer than anticipated lifespan of the four orbiting DSP satellites allowed military engineers to equip unlaunched DSP satellites with enhanced infrared sensors providing more accurate missile launch count and launch point determination capability. During March 1980, Secretary of Defense Harold Brown approved a document authorizing the Air Force to continue with ongoing DSP improvements and work with the Defense Advanced Research Projects Agency (DARPA) on exploring future DSP enhancements. This development allowed for improvements to existing satellites as well as new DSP enhancements planned for the mid- to late 1980s.

Examples of these upgrades included a more sensitive MOSAIC optical sensor system to counteract scanning limitations from continually "staring" at the earth's surface and a Sensor Evolutionary Development program, which involved developing mercury-cadmium-telluride sensor cells to provide more infrared detectors with enhanced sensitivity. Additional DSP modifications during the early 1980s included improved ground station computers and software (Spires 2004, 2:1095–1096).

The first improved DSP satellite, Flight 12, was launched into orbit on December 22, 1984 by a Titan 34D Transtage rocket. Enhancements in this satellite included a modified star sensor, new power supplies for command encryption units, and an upgraded nuclear detection package. Plans at this time also called for future DSP launches to be performed by the Space Shuttle. These plans were delayed by the January 1986 shuttle Challenger tragedy and the failure of Titan 34D launches in August 1985 and April 1986. Consequently, DSP Flight 13 would not reach orbit until November 1987.

During June 1989, AFSPACOM launched the beginning of a new series of satellites to replace two older DSP satellites. Flight 14—measuring 33 feet in length, weighing over 5,200 pounds, and capable of deploying more powerful solar arrays—was the first enhanced DSP craft. November 1990 saw another satellite join its DSP cohorts in orbit, which included three operational satellites and two spares. One DSP satellite was located over the Indian Ocean at 70° E longitude and was responsible for monitoring Asian ICBM launches. The other two satellites concentrated on SLBM launches from a position of 70° W longitude over the South Atlantic and over the eastern Pacific at 135° E longitude (Spires 2004, 2:1096).

The August 1990 Iraqi invasion and conquest of Kuwait and the ensuing crises of Operations Desert Shield and Desert Storm gave DSP satellites an excellent opportunity to demonstrate their strategic warning value. During Operation Desert Shield, DSP satellites detected an accident at an Iraqi arms depot at As Shuaybah, which the Iraqis were using to supply their troops in southern Kuwait. U.S. analysts estimated that this explosion destroyed nine storage bunkers and eight storage buildings capable of supplying six Iraqi heavy divisions for three days of medium- to high-intensity combat. On January 28, 1991 coalition strikes on an additional Iraqi ammunition depot produced an explosion so large that it was acquired by DSP sensors, and both Israel and the Soviet Union asked the United States whether it had used tactical nuclear weapons in carrying out this airstrike (Richelson 1999, 173).

During military operations in Operation Desert Storm, DSP satellites were able to keep track of Iraqi Scud missile launches and send this information to Strategic Air Command's global communications network. This near instantaneous capability made it possible to provide U.S. forces in Saudi Arabia with rapid warning of these launches, which made it possible for them to get Patriot missiles armed and to suit up in chemical defense gear in case these Scuds carried chemical weapons (Kutnya 1998, 103).

The rapid success of U.S. and allied forces in Operation Desert Storm occurred because of many factors, with space intelligence playing a particularly important role. This was the first military conflict to make comprehensive use of space systems support, with DSP and other satellite assets assisting coalition ground, naval, and air forces for multifaceted purposes such as communications, navigation, targeting, and search and rescue.

Soldier with gas mask in Saudi Arabia, 1990. Such protective equipment was used out of fears that Iraqi leader Saddam Hussein might order his forces to use chemical or biological weapons against coalition forces. *(Derek Hudson/Sygma/Corbis)*

The official DOD report on this war used this language to describe the crucial support role played by DSP satellites:

> DSP was the primary Scud launch detection system during Operation Desert Storm. The DSP constellation and associated ground station processing provided crucial warning data of Scud launches. This data was disseminated by a variety of means. The national military command center used DSP data to provide military and civilian warning to Israel and the Gulf states (U.S. Department of Defense 1992, 176–177).

Positive appraisals of DSP's performance during Desert Storm were not limited to the United States. On November 5, 1991, Australian defense minister Robert Ray (1947–) told his country's Parliament how coalition forces used space systems during Desert Storm to provide weather data, navigational assistance, information on military forces geographic locations, and other intelligence information. Ray went on to mention how Australia's Nurrungar facility served as an important part of the DSP system and referred to DSP's role in detecting the launch of Iraqi Scud missiles and providing warning of this to civilian populations in Israel and Saudi Arabia. The minister concluded his remarks with the following prescient observation about Nurrungar's importance in ensuring national security and international stability:

> I trust that the important role played by the joint defence facility, Nurrungar, in the Gulf War will further enhance public appreciation of its significance in efforts to promote measures for maintaining peace and stability, both globally and regionally. If anything, facilities such as Nurrungar are likely to be more important in the post Cold War period. They not only provide intelligence and early warning at a time when the prospect of proliferation is increasing, but also their arms control and verification function will be of greater significance to the cause of world peace (Australia. Parliament, 1991, 2374).

Despite these positive accomplishments, concern arose over DSP in the early 1990s from DOD and Congress over the system's age, ability to meet emerging security threats, and program management. A 1993 private sector contractor report prepared for the Air Force's Space and Missile Systems Center in Los Angeles stressed its belief that DSP had been in a holding pattern for several years because the Air Force was interested in pursuing a replacement early warning system. This document also expressed concern that insufficient investment in DSP replacement programs or technologies was causing unnecessarily high production costs to maintain the existing DSP infrastructure. It also expressed its belief that upgrades to DSP capabilities must occur within the then existing political environment of reduced defense budgets, the then prevalent international strategic environment placing greater emphasis on regional conflicts and limited nuclear war potential instead of the protracted nuclear Cold War confrontation with the former Soviet Union, and an evolving security environment marked by proliferating tactical ballistic missiles to third world countries capable of threatening U.S. and allied forces (U.S. Congress, House Committee on Government Operations 1994, 284, 299).

Additional concern over DSP's ability to meet these emerging security threats at this time was also expressed by DOD personnel during testimony before the U.S. House Appropriations Committee during annual budget request hearings. This concern noted that DSP had significant weaknesses in its Tactical Warning and Attack Assessment (TW/AA) mission including its design for 1970's ICBM technology, that its data processing architecture prevented it from quickly transmitting warning messages to users, and being unable to track all potential targets because of limited system technological sensitivity (U.S. Congress, House Committee on Appropriations 1993, 391–392).

This DOD appraisal of DSP deficiencies went on to make the following analysis of system capabilities and weaknesses, emphasizing that it provided insufficient warning time about attacks from shorter and intermediate range missiles, that DSP sensors had limited sensitivity against many contemporary targets since it was designed to operate primarily in the short-wave infrared frequency band, and that DSP was vulnerable to solar outages because of seasonal variations in the sun's position relative to satellites. These cumulative shortfalls made DSP inadequate for meeting current and emerging threats to U.S. security from proliferated, dimly lit, and short-burning missiles (U.S. Congress, House Committee on Appropriations 1993, 392).

DSP program management concerns also were brought to the attention of DOD policymakers and congressional oversight committees. A May 1993 General Accounting Office (GAO) report to the Acting Secretary of the Air Force Michael B. Donley said it was premature to upgrade DSP ground stations because the Air Force had not completed validation of operational requirements as required by various DOD and Air Force regulations. GAO also found the global processing capabilities in the planned DSP ground station upgrades might not be cost-effective. This global processing capability would theoretically permit the Air Force to process the data generated by all DSP satellites at a single ground station. The Air Force, however, announced it had no plans to reduce the number of DSP ground stations. This response, along with the incomplete technical requirements process for DSP global processing capabilities, led GAO to question the Air Force's plans to spend $95 million for upgrading these stations (U.S. General Accounting Office 1993(b), 1).

DSP's contractor was TRW, now Northrop Grumman Space Technology. Twenty-two DSP program satellites were launched as of November 25, 2005 with the most recent being in February 2004. A final DSP was delivered to the Air Force in May 2005. Each satellite can operate for up to 10 years (Smith 2005, 1). Despite its age and concerns over its ability to meet emerging ballistic missile threats, DSP has remained the United States' principal early warning satellite system, withstanding attempts to replace it with other programs such as the Advanced Warning System in the early 1980s; the Boost Surveillance and Tracking System in the later 1980s; the Follow-on Early Warning System in the early 1990s; and the Alert, Locate, and Report Missile System in the mid-1990s. These programs failed because of technology problems, high costs, and other affordability problems (U.S. General Accounting Office 2001, 5).

The Space-Based Infrared System (SBIRS) is the military's latest effort to develop a successor satellite reconnaissance and early warning program to replace DSP. Its troubled development and evolution are chronicled later in this chapter.

Strategic Defense Initiative (SDI)

The signing of international arms control treaties such as the 1972 ABM treaty and the SALT treaty that same year by the United States and the Soviet Union appeared to limit attempts to develop defenses against ballistic missile defense systems. These treaties also appeared to codify the doctrine of mutually assured destruction (MAD), which posited that the nuclear weapons arsenals of both sides would destroy U.S. and Soviet military assets and civilian populations, into the nuclear deterrence theory and policies of both of these countries and even into international law (Sokolski 2004, 137–174).

Although MAD had adherents in both the U.S. Government and military, it also had numerous critics. These critics gained particular ascendancy with the advent of the Reagan administration in 1981, which sought to reassert American strength in the international security environment in the aftermath of losing the Vietnam War and the failures of detente with the Soviet Union (Schweizer 2002; Winik 1996; Wirls 1992).

A team of advisors headed by former undersecretary of the Army Karl R. Bendetsen (1907–1989) briefed Reagan on their missile defense concerns in January 1982 and recommended that he initiate a national program to develop missile defenses for the United States (Council on Foreign Relations 2002, 3; Baucom 1992, 153–155).

This dissatisfaction with MAD as a moral and practical mechanism for dealing with what Reagan administration policymakers saw as a growing security threat from the Soviet Union's nuclear and conventional military forces was given additional impetus during the early 1980s. National defense controversies during the early years of the Reagan administration involved the proposal to develop the MX missile system as a means of upgrading the United States' then existing land-based ICBM arsenal while also exploring possible airborne or sea-based deployments of the MX. Dissatisfaction with the political bickering over this and other subjects during late 1982 and early 1983 resulted in Reagan administration policymakers researching the possibility of deploying defensive systems that could protect the continental United States and its allies from Soviet nuclear missiles (Weinberger 1990, 302–303; Baucom 1992, 171–196).

A crucial factor in this U.S. decision to explore ways of developing and deploying a defense system against nuclear missiles came from President Ronald Reagan (1911–2004). Reagan had grown particularly disillusioned with the MAD doctrine for both moral and military strategic reasons (Shultz 1993, 261–264). The following passage from Reagan's autobiography expresses his thoughts on this subject and how he proposed putting this evolving thinking into practical action:

> I came into office with a decided prejudice against our tacit agreement with the Soviet Union regarding nuclear missiles. I'm talking about the MAD policy—'mutual assured destruction'—the idea of deterrence providing safety so long as each of us had the power to destroy the other with nuclear missiles if one of us launched a first strike. Somehow this didn't seem to me to be something that would send you to bed feeling safe. It was like having two westerners standing in a saloon aiming their guns at each other's head—permanently. There had to be a better way. Early in my first term, I called a meeting of the Joint Chiefs of Staff—our military leaders—and said to them: Every offensive weapon ever invented by man has resulted in the creation of a defense against it; isn't it possible in this age of technology that we could invent a defensive weapon that could intercept nuclear weapons and destroy them as they emerged from their silos? They looked at each other, then asked if they could huddle for a few moments. Very shortly, they came out of their huddle and said, "Yes, it's an idea worth exploring." My answer was, "Let's do it" (Reagan 1990, 547).

During February 1983, the JCS unanimously recommended a national security strategy placing heightened emphasis on strategic defenses (U.S. Army Space and Missile Defense

During his national security speech on March 23, 1983, President Ronald Reagan speaks to the nation regarding the Strategic Defense Initiative, proposing intensive research on a space-based antiballistic missile defense system that would destroy Soviet missiles before they reached their target. *(Ronald Reagan Presidential Library)*

Command n.d., 2). Following extensive consultations with his advisors and other administration policymakers, Reagan introduced his ideas to the public in a nationally televised address on March 23, 1983. This speech reviewed the status of U.S. relations with the Soviet Union and current and historical international security and arms control developments. Near the conclusion of this speech Reagan presented his revolutionary vision for altering the military strategic landscape with the following declaration:

> Let me share with you a vision of the future which offers hope. It is that we embark on a program to counter the awesome Soviet missile threat with measures that are defensive. Let us turn to the very strengths in technology that spawned our great industrial base and that have given us the quality of life that we enjoy today. What if free people could live secure in the knowledge that their security did not rest upon the threat of instant U.S. retaliation to deter a Soviet attack, that we could intercept and destroy strategic ballistic missiles before they reached our own soil or that of our allies?
>
> I believe this is a formidable, technical task, one that may not be accomplished before the end of this century. Yet, current technology has attained a level of so-

phistication where it's responsible for us to begin this effort. It will take many years, probably decades of effort on many fronts. There will be failures and setbacks, just as there will be successes and breakthroughs. And as we proceed, we must remain constant in preserving the nuclear deterrent and maintaining a solid capability for flexible response. But isn't it worth every investment necessary to free the world from the threat of nuclear war? We know it is (*Public Papers of the Presidents of the United States,* 1984, 442–443).

The first tangible policy step in implementing this lofty and controversial vision was directing National Security Advisor William P. Clark, Jr. (1931–) to formulate detailed instructions for implementing this program throughout relevant civilian and military departments in NSDD 85 on March 25, 1983 (Feycock 2006, 205). Reagan's ideas would become known as the Strategic Defense Initiative (SDI) because of the proposal's drastic impact on the U.S. and global strategic environment. The program's audacity and some overselling of its assets by proponents created a firestorm of domestic and international controversy causing many critics to call it "Star Wars." These critics, such as Senator Edward Kennedy, along with opponents in Congress and some elements in U.S. and international diplomatic and security circles, attempted to claim that SDI would militarize space, create a new arms race, violate the ABM Treaty, and demonstrate that the United States was no longer willing to defend its allies against nuclear missile attack. Such controversies plagued SDI and future U.S. ballistic missile defense programs in the years to come (Shultz 1993, 258–261; Weinberger 1990, 309; National Review 1988, 18; Lambeth and Lewis 1988, 755–770).

DOD moved quickly after Reagan's actions described in NSDD 85 by commissioning two studies on SDI's policy implications and technical feasibility. The policy study was headed by Undersecretary of Defense for Policy Fred Ikle (1924–) who delegated the authority to Paul Hoffman of Pan Heuristics, a Los Angeles policy research group, and the technology study was lead by former and future NASA administrator James Fletcher (1919–1991) (Weinberger 1990, 310). The Fletcher report was completed in February 1984 and recommended SDI research proceed in areas such as surveillance, acquisitions, and tracking; directed energy weapons; battle management, command and control, and communications; survivability, lethality, and threat vulnerability; and selected support systems (U.S. Army Space and Missile Defense Command n.d., 2; U.S. Congress, House Committee on Armed Services 1985).

Important elements of the March 1984 policy study included recognizing that advanced ballistic missile defense had the potential to reduce the military value of ballistic missiles and their importance in the strategic balance, while related technologies could give the Soviet Union an incentive for nuclear arms reductions; the Soviets continuing ongoing efforts to discredit ballistic missile defense systems; that the Soviets might change their behavior if they were convinced the United States was serious in its missile defense programs; the need to revise the ABM Treaty if a widespread missile defense system were to be deployed over the United States; and the Soviets increasing their dependence on defensive military systems. Additional findings of this study include ballistic missile defenses enhancing the possibility of deterring intentional nuclear attacks, providing greater safety against accidental nuclear weapons use or unintended nuclear escalation, and presenting new arms control opportunities if uncertainties about technical feasibility, costs, and Soviet response are resolved (U.S. Congress, Senate Committee on Foreign Affairs 1984, 103–105; Fought 1987).

SDI's formal beginnings date from NSDD 119 signed by President Reagan on January 6, 1984 and placed the program under DOD's leadership. Key elements of this document reflecting SDI's raison d'etre include DOD managing the program and the SDI program manager reporting directly to the secretary of Defense, SDI placing primary emphasis on technologies involving nonnuclear components, and research continuing on nuclear-based strategic defense concepts as a hedge against a Soviet ABM breakout (Feycock 2006, 216).

On March 27, 1984, Secretary of Defense Casper Weinberger (1917–2006) appointed Air Force lieutenant general James Abrahamson (1933–) as the first director of the Strategic Defense Initiative Organization (SDIO), which was given responsibility for developing SDI. Weinberger signed the SDIO charter on April 24, 1984, giving Abrahamson extensive freedom in managing the program (Federation of American Scientists n.d., 5).

A May 7, 1984 memorandum from Deputy Secretary of Defense William H. Taft IV (1945–) to the secretary of the Air Force provided additional direction and guidance on the mission and program management of SDI's boost and space surveillance tracking systems. SDI attributes mandated in this document included the ability to provide ballistic missile TW/AA; satellite attack warning/verification (SAW/V); satellite targeting for U.S. ASAT operations; and SDI surveillance, acquisition, tracking and kill assessment SATKA. Additional program mandates included program plans showing specific requirements, critical milestones, and costs along with alternative means of achieving these objectives (Spires 2004, 2:1130–1131).

SDIO was organized into five program areas covering SATKA, Directed Energy Weapons (DEW) Technology, Kinetic Energy Weapons (KEW) Technology, Systems Concept/Battle Management (SC/BM), and Survivability, Lethality, and Key Technologies (SLKT). SATKA program objectives included investigating sensing technologies capable of providing information to activate defense systems, conduct battle management, and assess force status before and during military engagements. A key SATKA challenge was developing the ability to discriminate among hostile warheads, decoys, and chaff during midcourse and early terminal phases of their trajectories (DiMaggio et al. 1986, 6–7).

The DEW program sought to examine the potential for using laser and/or particle beams for ballistic missile defense. DEW can deliver destructive energy to targets near or at light speed and are particularly attractive for using against missiles as they rise through the atmosphere. Successfully engaging missiles during these flight stages can allow missiles to be destroyed before they release multiple independently targeted warheads. Relevant weapon concepts studied under DEW included space-based lasers, ground-beam lasers using orbiting relay mirrors, space-based neutral particle beams, and endoatmospheric charged particle beams guided by low-power lasers (DiMaggio et al. 1986, 7–8).

KEW program applications involved studying ways of accurately directing fairly light objects at high speed to intercept missiles or warheads during any flight phase. Technologies being investigated by this program include space-based chemically launched projectiles with homing devises and space-based electromagnetic rail guns (DiMaggio et al. 1986, 8).

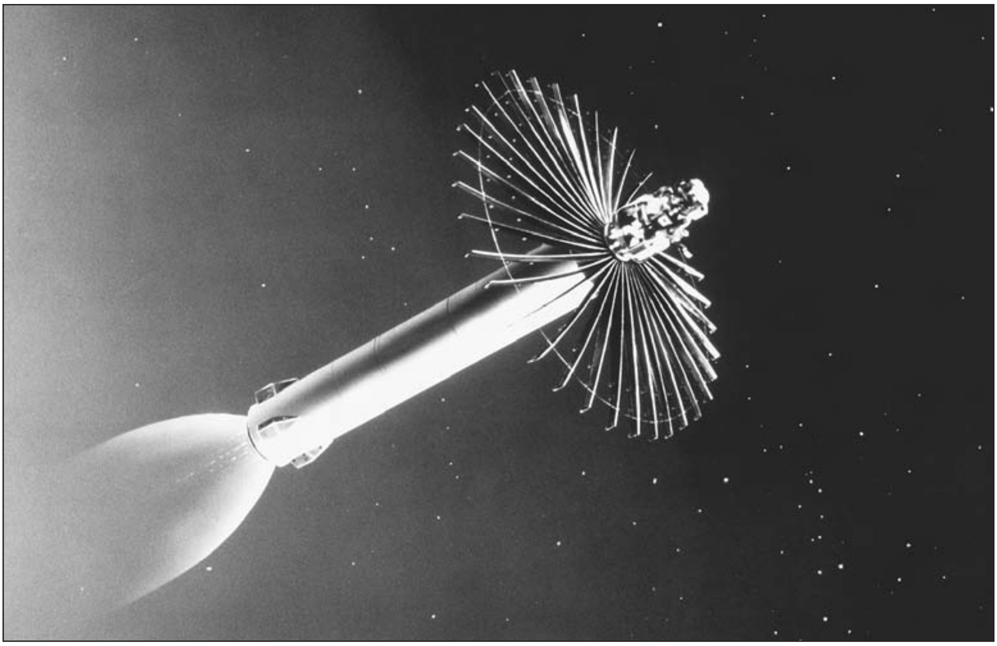
Research pertinent to SC/BM programs explores defensive architecture options allowing for deployment of extremely responsive, reliable, survivable, and cost-effective battle management and command, control, and communications systems. Factors examined in such programs must include mission objectives, offensive threat analyses, technical capabilities, risk, and cost (DiMaggio et al. 1986, 8–9).

SLKT program components seek to support research and technology development for improving system effectiveness and satisfying system logistical needs. Such survivability and lethality study efforts seek to produce information about expected enemy threats and the ability of SDI systems to survive efforts to destroy or defeat it. Relevant SLKT supporting technology research areas include space transportation and power, orbital maintenance, and energy storage and conversion. Pertinent SDI logistical research, under program auspices, is crucial for evaluating and reducing deployment and operational costs (DiMaggio et al. 1986, 10).

SDI achieved significant program and technical accomplishments over the next decade. A June 1984 Homing Overlay Experiment achieved the first kinetic kill intercept of an ICBM reentry vehicle, SDIO established an Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS) Project Office in July 1984, and a High Endoatmospheric Defense Interceptor (HEDI) Project Office in October 1984. March 1985 saw Weinberger invite allied participation in U.S. ballistic missile defense programs, and in October 1985 National Security Advisor Robert McFarlane (1937–) introduced a controversial "broad interpretation" of the ABM Treaty, which asserted that certain space-based and mobile ABM systems and components such as lasers and particle beams could be developed and tested but not deployed (U.S. Army Space and Missile Defense Command, n.d. 2–3; U.S. Congress, Senate Committee on Armed Services, Subcommittee on Theater and Strategic Nuclear Forces 1986, 136–144).

During August 1986 the Army's vice chief of staff approved the U.S. Army Strategic Defense Command theater missile defense research program, and the following month this official also directed the establishment of a Joint Theater Missile Defense Program Office in Huntsville, Alabama to coordinate Army theater missile defense requirements. May 1987 saw the successful kinetic energy intercept by the Flexible Lightweight Agile Guided Experiment of a Lance missile, which was a high-velocity, low-altitude target. In July 1988 Hughes Aircraft delivered the Airborne Surveillance Testbed Sensor to the military, which was the most complex long-wavelength infrared sensor built at that time.

February 1989 saw President George H.W. Bush (1924–) announce that his administration would continue SDI developments; a June 1989 national defense strategy review



An artist's concept of the Army Homing Overlay Experiment (HOE) homing and kill vehicle preparing to intercept a mock nuclear warhead more than 100 miles above the mid-Pacific Ocean. The HOE sensor in the nose locks onto the target and the third stage axial propulsion motor maneuvers the vehicle onto a collision course. The 15-foot radial "net" opens to destroy the incoming warhead by impact at more than 15,000 feet per second. *(U.S. Department of Defense)*

concluded that SDI program goals were sound; SDIO approved an Endoatmospheric/Exoatmospheric Interceptor program during summer 1990 to succeed HEDI; the first successful ERIS intercept took place during January 1991; and in June 1991 there were successful tests of the lightweight exoatmospheric projectile integrated vehicle strap down and free flight hover (U.S. Army Space and Missile Defense Command n.d., 3–4; U.S. Department of Defense 1989, 1–31).

SDI was able to achieve significant accomplishments during the 1980s and early 1990s as the list above demonstrates. The program remained controversial during its first decade before SDIO was renamed the Ballistic Missile Defense Organization (BMDO) by the Clinton administration on June 14, 1994 (U.S. Department of Defense 1994, 1).

Program expenditures remained a source of controversy for some congressional appropriators. SDIO's budget, according to a 1989 DOD report, was $3.8 billion for fiscal year 1989 representing 0.33% of the $282.4 defense budget for that year (U.S. Department of Defense 1989, 27). A 1992 congressional review of SDIO expenditures quantified that the organization had received $25 billion since 1984 for ballistic missile defense system research and development and that the Bush administration's proposed fiscal year 1992 budget estimated system acquisition costs to be $46 billion (U.S. General Accounting Office 1992(a), 10).

Changing SDI program objectives complicated SDIO's work and operational efficiency. SDI was originally intended to provide a massive system for defending the United States against Soviet ballistic missile attacks. During 1987 program objectives shifted from defending against massive missile strikes to deterring such strikes. The 1990 introduction of the Brilliant Pebbles space-based interceptor (see next entry) caused SDIO to change organizational direction again. A number of organizational realignments were implemented during September 1988 such as adding a chief of staff to oversee SDIO activities; adding a chief engineer to ensure multiple engineering tasks and analysis received top-level attention; and the creation of a Resource Management Directorate, which merged Comptroller and Support Services Directorates in an effort to enhance management efficiency (U.S. General Accounting Office 1992(a), 2; Federation of American Scientists n.d., 8).

Operation Desert Storm also heralded important changes in SDIO program activities. The use of Patriot missile batteries against Iraqi Scud missiles during this 1991 conflict achieved some success but with significant attending controversy over how successful the Patriot system had actually performed (U.S. Congress, House Committee on Government Operations, Subcommittee on Legislation and National Security 1993; Snodgrass 1993).

During his January 29, 1991 State of the Union address to Congress as this conflict raged, President Bush announced another SDI shift to the concept called Global Protection Against Limited Strikes (GPALS) as reflected in the following statement ". . . I have directed that the Strategic Defense Initiative program be refocused on providing protection from limited ballistic missile strikes, whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas and to our friends and allies" (*Public Papers of the Presidents of the United States 1991,* 78).

This shift to GPALS came about as a result of a perceived decline in the Soviet missile threat and the emergence of tactical ballistic missile threats from Iraq and other third world countries. GPALS would have two ground-based and one space-based segment. One of the ground-based components would consist of sensors and interceptors to protect U.S. and allied missile forces overseas from missile attack. An additional ground-based segment would protect the United States from accidental or limited attacks of up to 200 warheads. GPALS spaced-based component would help detect and intercept missiles and warheads launched from anywhere in the world. SDIO sought to integrate these three segments to provide mutual coordinated support and required that each of these entities be designed to work together using automated data processing and communication networks (U.S. General Accounting Office 1992(a), 2–3).

This governmental emphasis on localized theater, as opposed to global strategic missile defense, was also reflected in the fiscal year 1991 congressional conference committee report on the defense budget issued October 24, 1990. This legislation called for the secretary of Defense to establish a centrally managed theater missile defense program funded at $218,249,000, required DOD to accelerate research and development on theater and tactical ballistic missile defense systems, and called for the inclusion of Air Force and Navy requirements in such a plan and the participation of these services (U.S. Congress, House Committee on Appropriations 1990, 117–118).

SDI and the concept of ballistic missile defense continued generating controversy throughout its first decade. Although SDIO was able to achieve relatively viable funding and enough operational successes to retain sufficient political support within DOD and in Congress to persevere as an organization, its organizational mission focus never remained constant. Contentiousness over whether there was even a need for SDI or ballistic missile defense was reflected in the following 1991 statements before House Government Operations Committee oversight hearings on SDI.

Opponents of SDI such as Federation of American Scientist's Space Policy Project director John Pike claimed that ballistic missile threats to the United States were examples of hyperbolic rhetoric, that SDI was too expensive, had numerous technical problems, and that its deployment could jeopardize international arms control. Pike described SDI as being a "Chicken Little" approach to existing threats, which would cost more than $100 billion instead of current projections of $40 billion. He also contended that SDI had significant computing and software problems, that its deployment would end the ABM Treaty and imperil arms control progress, and there was no compelling reason to deploy SDI based on the existing strategic environment (U.S. Congress, House Committee on Governmental Operations, Legislation and National Security Subcommittee 1992, 194).

Proponents of SDI such as Keith Payne of the National Institute for Public Policy emphasized how the Iraqi use of Scud missiles during Operation Desert Storm had drastically changed Cold War strategic assumptions about how ballistic missiles might be used in future military conflicts. These proponents stressed the threat to civilians from missiles that could carry chemical warheads, how normal life ended in cities threatened by Iraqi Scud attacks, how Iraqi conventionally armed missile attacks during the Iran–Iraq War caused nearly 2,000 deaths, forced the evacuation of urban areas like Tehran with ruinous economic consequences, and warned that such events could happen to U.S. and allied metropolitan areas due to ballistic missile proliferation (U.S. Congress, House Committee on Government Operations, Subcommittee on Legislation and National Security 1992, 284).

SDI supporters further stressed how the presence of ballistic missiles equipped with weapons of mass destruction in the hands of third world countries such as Iraq could drastically reduce the flexibility of U.S. leaders in responding to such threats. Examples of this reduced flexibility would involve U.S. leaders having to assess the possibility of third party ballistic missile strikes against U.S. forces, allies, or U.S. population centers, sufficient to limit the president's freedom of action to respond; emerging ballistic missile threats could have a debilitating effect on the U.S. capability to establish allied coalitions and respond to aggression as it did in Operation Desert Storm; and activities such as escorting threatened commercial shipping through hostile waters during the Iran–Iraq War or militarily evacuating U.S. citizens from foreign hot spots could become increasingly dangerous. Payne and other missile defense supporters stress that such defenses enable the United

States to maintain the credibility of its overseas security commitments and encourage the belief that the United States will not be deterred from defending its national interests and allies (U.S. Congress, House Committee on Government Operations, Subcommittee on Legislation and National Security 1992, 284–285).

SDIO continued its activities as the Clinton administration began in 1993. Ballistic missile defense was not high on the national security priorities of this administration as it took office (Lindsay and O'Hanlon 2001, 87). SDIO's initial institutional incarnation came to an end with DOD Directive 5134.9 on June 14, 1994, which established the BMDO as the organizational focal point for U.S. ballistic missile defense efforts. The now preponderant emphasis on developing defenses against theater ballistic missile threats, while also adhering to the ABM Treaty, was reflected in BMDO's mission, whose characteristics included deploying an effective and rapidly mobile theater missile defense system to protect forward-deployed and expeditionary components of U.S. and allied armed forces; defending the U.S. homeland against limited ballistic missile attacks; demonstrating advanced technology options for enhanced missile defense systems including space-based defenses and associated sensors; making informed decisions on development, production, and deployment of such systems in consultation with U.S. allies; and adhering to existing international agreements and treaty obligations while using nonnuclear weapon technologies (U.S. Department of Defense 1994, 1–2).

SDI may have been conceived and initially presented with idealistic fervor, but its inception was driven by profound and substantive dissatisfaction with the military and moral predicament of the United States being unable to defend its population and military interests against hostile ballistic missile attacks. SDI and its successor programs have survived and evolved into contemporary national missile defense programs because of their ability to pragmatically adapt to prevailing political, economic, and military environments facing the United States and its national security interests (Clagett 1996).

Brilliant Pebbles

Brilliant Pebbles is a program that experienced a brief life and achieved some technological success before its termination. The program's theoretical intellectual origins may be said to have begun around 1960 when DARPA's Project Defender missile defense technology inventory stressed the high defense value of using space-based interceptors to attack and destroy ICBMs while they were in their boost phase. During the 1980s, Brilliant Pebbles became a space-based interceptor program designed to be capable of destroying Soviet ICBMs during their boost phase, and would be capable of eliminating multiple Soviet warheads and decoys before they could be dispersed to multiple targets (Baucom 2004, 143–145).

In late 1986, Reagan and Secretary of Defense Casper Weinberger began entering a missile defense system into the overall defense acquisition process. This decision would eventually result in the September 1987 approval of the Strategic Defense System (SDS)

Phase I Architecture. This architecture consisted of six major subsystems including a space-based interceptor (SBI), a ground-based interceptor, a ground-based sensor, two space-based sensors, and a battle management system. SDS was intended to have a structure capable of producing further refinement of missile defense components that could be integrated into and improve overall system architecture in an iterative process.

An important change in SDS was SBI's replacement by Brilliant Pebbles. SBI was intended to be a large satellite housing several individual hit-to-kill interceptors. Several hundred SBIs were to orbit the earth and launch their interceptors at individual Soviet missiles in case of an attack, destroying these missiles during their boost phase. SBI's weaknesses were its projected $18–$30 billion cost and its large size making it an easy target for Soviet ASAT weapons (Baucom 2004, 152; U.S. Missile Defense Agency Historians Office n.d., 3–4).

Brilliant Pebbles came to be seen as a solution to this problem. SDIO officials believed Brilliant Pebbles could utilize advances in miniaturized sensors and computers to develop interceptors capable of operating without the sensors and communications infrastructure SBI required. These officials hypothesized that, because of Brilliant Pebbles, Soviet ASATs would have to contend with several thousand small and hard to find interceptors orbiting in constellations over strategically significant global regions instead of being able to confront several hundred large targets (U.S. Missile Defense Agency Historians Office n.d., 4).

Brilliant Pebbles was formally integrated into the SDS system in 1989 after Lt. General George L. Monohan, Jr. (1933–1993) became SDIO's second director. This decision made it possible to eliminate one constellation of space-based sensors achieving additional SDS cost reductions. The planned Brilliant Pebbles deployment would see the system consist of several large lightweight, low-cost, single hit-to-kill kinetic kill vehicles providing integrated sensors, guidance, control, and battle management. Individual Brilliant Pebbles interceptors would have their own sensors, computers, and thrusters to detect, track, and intercept hostile missiles. These interceptors weighed about 100 pounds and meant that SDIO no longer had to place 100,000-pound laser battle stations in orbit and could be launched by lighter medium-lift rockets (Missile Defense Agency Historians Office n.d., 4; U.S. National Aeronautics and Space Administration 1999, 5).

Additional Brilliant Pebbles attributes that were developed at the Energy Department's Lawrence Livermore National Laboratory (LLNL) include a wide-field-of-view telescope with a high-resolution multispectral sensor capable of viewing a land area the size of Virginia and individual buildings from 1,000 kilometers height, a multipurpose antenna capable of communicating with other space-based or ground platforms, two sets of thrusters and propellant tanks, and the ability to fly sideways or accelerate straight ahead (Foley 1988, 32–33).

Brilliant Pebbles' prospects, ironically, began declining just after the 1989 decision to integrate it into SDI program objectives. In June 1989, President George H.W. Bush issued National Security Directive (NSD) 14 on the SDI program. This document determined that SDI remained programmatically sound and directed Secretary of Defense Dick Cheney (1941–) to commission an independent review of SDI to see NSD 14 objectives carried out. This review was conducted by Ambassador Henry Cooper (1936–), who served as the chief U.S. negotiator at the defense and space arms control negotiations in Geneva. Cooper's report was submitted to the president on March 15, 1990 and contained a strong endorsement of Brilliant Pebbles, which its author believed was essential to SDI's success (Baucom 2004, 154–155; Missile Defense Agency Historians Office n.d., 4; U.S. General Accounting Office 1993(a), 29).

Cooper's report also emphasized that the most critical threats to U.S. security, in light of the Cold War's decline, would come from unauthorized or terrorist attacks with ballistic missiles and that U.S. forces would encounter increasing threats from shorter range theater ballistic missiles as ballistic missile technology and weapons of mass destruction proliferated. Cooper recommended that the SDI program shift its emphasis from preparing for a mass attack by thousands of Soviet warheads to developing defenses against limited ballistic missile attacks. He became SDIO's third director in July 1990 and began working to implement his report recommendations with Bush's January 1991 GPALS program announcement of this formal shift in U.S. missile defense policy (Missile Defense Agency Historians Office n.d., 4–5; U.S. Congress, Senate Committee on Armed Services 1992, 271–378).

Brilliant Pebbles received a mixed reception from congressional defense specialists during its existence, which was reflective of the often passionate congressional debate on SDI. Speaking before the Senate on August 4, 1990, Senator Malcolm Wallop (Republican from Wyoming) (1933–) praised what he saw as Brilliant Pebbles' very promising near-term interceptor technology and criticized an attempt by Senators Jeff Bingaman (Democrat from New Mexico) (1943–) and Richard Shelby (Democrat from Alabama) (1934–) to cut $200 million in Brilliant Pebbles program funding and transferring such funding to other SDI programs in New Mexico and Alabama, charging that this action turned SDI into a "technological welfare program" (U.S. Congress 1992, S12354–12355).

Some Democrats like then House Armed Services Committee chair representative Les Aspin (Democrat from Wisconsin) (1938–1995) and then Senate Armed Services Committee chair senator Sam Nunn (Democrat from Georgia) (1938–) were concerned that Brilliant Pebbles could have a negative effect on the ABM Treaty. Aspin and Nunn were also concerned about Brilliant Pebbles' effectiveness against low flying tactical missiles; that SDI's emphasis on this program was reducing spending for ground-based weapons, which they felt could be deployed faster to protect U.S. territory from ballistic missile attacks; and that the Soviets would see Brilliant Pebbles as part of U.S. plans to neutralize their nuclear forces, which, Aspin believed, would terminate possible Soviet interest in the then ongoing Strategic Arms Reduction Treaty (START), intended to reduce Soviet and U.S. strategic forces by 30% (Trowell 1991, 1836–1844).

Concerns over Brilliant Pebbles were expressed in a number of GAO reports during the early 1990s. A March 1991 assessment criticized SDIO for paying Brilliant Pebbles contractors to improve a design concept before LLNL had demonstrated that it would work. GAO further doubted LLNL's ability to complete a projected test program by the summer of 1993 because of the program's compression providing minimal time to account for near inevitable future problems. Lastly, the GAO emphasized that the program's flight test failed to achieve all of its objectives (U.S. General Accounting Office 1991, 6).

Another GAO report, issued a year after this initial assessment, was particularly critical of the computer simulations used by SDIO to design and implement Brilliant Pebbles' ability to defend against ballistic missiles as the following excerpt demonstrates:

> SDIO's estimates of effectiveness are based on computer simulations of various numbers of interceptors deployed against certain hypothetical ballistic missile attacks. SDIO has identified over 40 hypothetical attack scenarios, or threats, against the United States and its allies, which includes short-, intermediate-, and long-range ballistic missile attacks originating from all over the world and submarine launched attacks against the United States. SDIO has investigated many potential deployment schemes to identify a constellation that provides the optimum global protection against all threats. As of December 1991, SDIO had not evaluated through simulations the performance of Brilliant Pebbles against all identified threats (U.S. General Accounting Office 1992(b), 3).

This report also determined that these computer simulations included deployment decision assumptions that improved system performance with the increased deployment of Brilliant Pebbles. In addition, these SDIO simulations determined that Brilliant Pebbles constellations orbiting close to the equator would be most effective against missiles launched from the Middle East or Europe, while constellations orbiting over the North and South Poles would be most effective against attacks from Russia (U.S. General Accounting Office 1992(b), 4).

A September 1992 GAO report for the House Government Operations Committee analyzed seven flight tests of Brilliant Pebbles interceptors. This analysis mentioned that SDIO asserted that five of these tests were successful and two unsuccessful but GAO determined that SDIO inaccurately described the results in four of the seven tests (U.S. General Accounting Office 1992(c), 2).

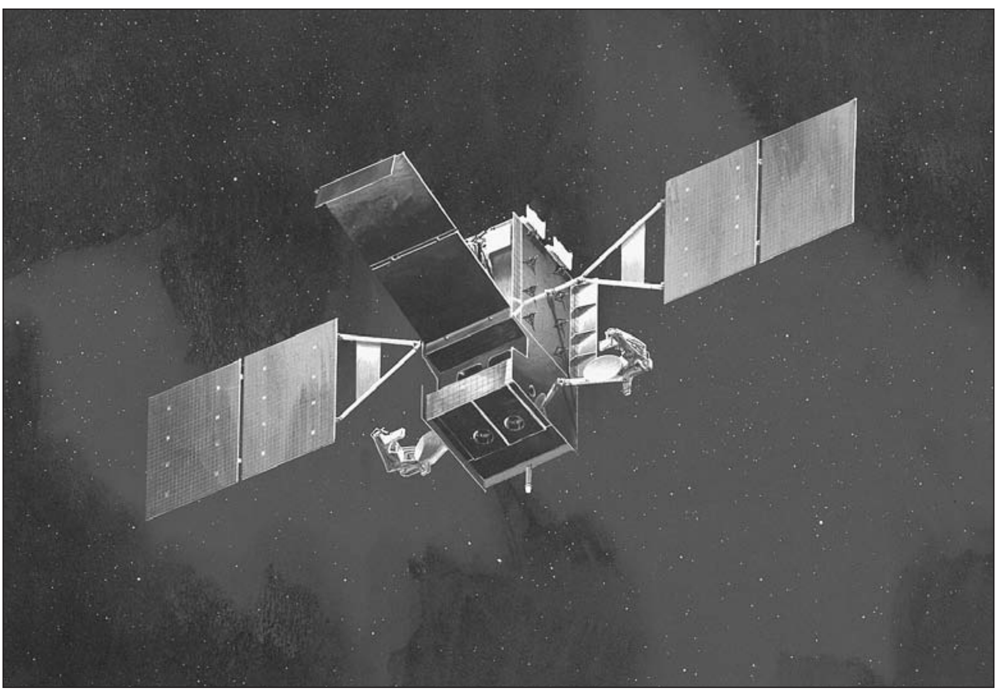
These negative performance management reports and an evolving U.S. emphasis on developing more limited forms of ballistic missile defense during the early 1990s took its toll on Brilliant Pebbles. This was accelerated with the conclusion of the first Bush administration and the emergence of the Clinton administration in 1993. In November 1992, SDIO announced that Brilliant Pebbles would be removed from DOD's acquisition process. SDIO also transferred the program to the Air Force effective December 18, 1992, and new contracts in January 1993 converted Brilliant Pebbles into an "advanced technology demonstration" program. February 2, 1993 saw Aspin, now President Bill Clinton's (1946–) secretary of Defense, issue SDI program budget guidance by reducing Brilliant Pebbles to an anemically funded technology base program. Later DOD budget guidance for Brilliant Pebbles saw its budget reduced 25%, and it became the Advanced Interceptor Technology (AIT) program in March 1993.

Brilliant Pebbles' demise became official on December 1, 1993 when BMDO acting deputy director James D. Carlson issued an order ending the program due to budgetary constraints, although he thought the program had made progress given historical investments in it (Baucom 2004, 183–185).

Space-Based Infrared System (SBIRS)

The Space-Based Infrared System (SBIRS) is intended to replace DSP and serve as the United States' critical missile defense and early warning capability during the 21st century. Its program areas, including the existing DSP, SBIRS High, and the Space Tracking and Surveillance System (STSS), are described in greater detail in Chapter 3. The SBIRS High program component is expected to detect a missile launch, determine its course, and warn appropriate ground forces in 10–20 seconds as opposed to the 40–50 seconds required by DSP (U.S. Air Force Space Command n.d., 1; Smith 2006, 3–4).

This program's troubled history originated in 1994 when DOD consolidated its existing infrared space programs and selected SBIRS as its preferred "system of systems" approach



Space-Based Infrared System satellite acts as missile defense and as an early warning system. *(Lockheed Martin)* to dealing with space reconnaissance and surveillance (Smith 2005, 2; U.S. General Accounting Office 2003(b), 7). Lockheed Martin and Northrop Grumman were awarded a $2.16-million contract to build SBIRS High in 1996. DOD increased the contract to $4.18 billion in September 2002, which does not include the cost of three of the five projected satellites (Smith 2005, 3).

SBIRS's initial purpose was serving as an acquisition program for supporting national and theater missile defense by tracking missiles throughout their flight and being able to discriminate warheads from decoys in supporting a missile defense mission. During 1998, the SBIRS program office had to be restructured based on an Air Force directive to delay satellite launches by two years to fund other DOD priorities. According to GAO, this contributed to program instability since the contractor was required to stop and restart activities and devise interim solutions that would not normally have occurred (U.S. General Accounting Office 2003(a), 6). Negative cost and schedule trends, along with performance estimates, caused DOD to take the program off an acquisition track and return it to a long-term technology development track. These concerns caused Congress to transfer SBIRS program management from the Air Force to the Ballistic Missile Defense Organization (now Missile Defense Agency) in October 2000 (U.S. General Accounting Office 2003(b), 7).

Congressional concerns about SBIRS program costs and technical problems were reflected in committee budget authorization reports, as shown in this 2001 House Appropriations Committee report denying the Air Force's $93,752,000 program request and replacing it with $30 million. The committee report noted:

> The Committee notes that the SBIRs High development program is facing serious hardware and software design problems. These programs are driving significant program shortfalls in all years, totaling more than $500 million. A recent GAO report notes that sensor jitter and inadequate infrared sensitivity as well as an issue of stray sunlight have plagued the program and are driving cost increases and schedule delays. Program officials have indicated that there are currently unbudgeted payload redesign activities and that schedule variances experienced to date portend serious schedule impacts ahead. The program office also reports "inconceivable software code growth" with an "overwhelming" number of discrepancy reports in ground mission software. The program is achieving "at best 1/2 of the estimated software development productivity" required to meet its schedule. Given these issues, the Committee believes it is prudent to defer satellite hardware procurement to provide additional time for development (U.S. Congress, House Committee on Appropriations 2001, 140).

Although SBIRS has continued in ensuing years, its viability and programmatic efficiency remain the subject of concern with DOD as well as in Congress. A May 2003 report by the Defense Science Board and Air Force Scientific Advisory Board, which also focused on space acquisition programs, maintained that cost had replaced mission success as the key factor in managing space development programs such as SBIRS; that unrealistic estimates produced unrealistic budgets and undeliverable programs; that undisciplined program definition and uncontrolled system growth requirements increased costs and schedule delays; that government capabilities to lead and manage the space acquisition progress have seriously eroded because of excessively surrendering such authority to industry during the 1990s; and that industry has failed to implement best management practices in programs such as SBIRS (U.S. Defense Science Board 2003, 2–4).

An October 2003 GAO report on SBIRS asserted that the program remained at substantial risk of cost and schedule increases despite recent restructuring (U.S. General Accounting Office 2003(a), 2). Delivery of a SBIRS High sensor for launch on one satellite was delayed until August 2004 due to electromagnetic interference between the sensor and other spacecraft equipment. Launch of the first SBIRS satellite for geosynchronous orbit has slipped repeatedly and is now expected in 2008 (Smith 2005, 4).

A September 30, 2005 DOD report observed that SBIRS's high costs had increased from $9,613,300 to $10,638,100 (a 10.7% increase) during the preceding year (U.S. Department of Defense, Acquisition Resources and Analysis 2005, 3). DOD requested $756 million for SBIRS for fiscal year 2006 (October 1, 2005–September 30, 2006). The House Appropriations Committee report on this legislation described the program as "extremely troubled" and complained that program costs had increased from $4 billion–$10 billion, while the Senate Appropriations Committee report cut SBIRS funding by $100 million given its protracted accounting and management problems (Smith 2005, 4; U.S. Congress, House Committee on Appropriations 2005, 181; U.S. Congress, Senate Committee on Appropriations 2005, 219).

SBIRS retains sufficient support with DOD and Congress to linger on, but its historic and ongoing cost control, management, and technical problems make predicting its future problematic.

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