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Preface

On Friday, November 18, 1995, a group of present and former industry and Air Force officials gathered for a black-tie event at the Los Angeles Airport Marriott Hotel. The event was a twenty-fifth anniversary gala in celebration of the Defense Support Program (DSP).

The DSP satellites that had been launched into orbit for the previous twenty-five years could detect the infrared emissions of missile plumes from their stations 22,300 miles above the earth. They would have provided the first warning of a possible Soviet missile attack (as well as a means of confirming the accuracy of subsequent radar reports that missiles were headed toward the United States). By eliminating U.S. reliance on a single means of warning and extending the warning time that U.S. leaders would have in the event of a Soviet attack, they represented one of several technological achievements that had helped stabilize the precarious U.S.–Soviet nuclear standoff during the 1970s and 1980s.

The evening began at 6:00 P.M. with cocktails, followed by dinner. The attendees had been scheduled to hear a 9:00 P.M. address by General Thomas S. Moorman Jr., the Air Force vice chief of staff. Moorman had served in a variety of intelligence and reconnaissance assignments since joining the Air Force in 1962, including a stint as the staff director of the supersecret National Reconnaissance Office. More recently, in 1990, he had become commander of the Air Force Space Command, whose responsibilities included operating the DSP satellites.

Moorman was to be there to praise the DSP program. However, many of those who had been involved in that program were not happy about either his prospective presence or the event's focus. Some felt the anniversary event slighted the contributions of those involved in the Missile Defense Alarm System (MIDAS) and 461 programs, DSP's forerunners. Others were displeased at Moorman's presence, for they felt he had been among key Air Force officials who were denigrating the capabilities and accomplishments of DSP, in order to push for a new, costly infrared satellite program.

Because of events in Washington, Moorman never made it to the dinner. But the schisms that revolved around the event, including Moorman's planned address, represent part of the history of MIDAS and DSP—one of intense debates, disagreements over technical feasibility and proposed programs, and, at times, hard feelings.

America's Space Sentinels: DSP Satellites and National Security tells that story. But it also tells several other, far more important, stories. One of these concerns the creation and evolution of the MIDAS/DSP programs, which has involved design of the original satellites and sensors, the establishment of the original ground stations and subsequent fixed and mobile terminals, improvements in the sensors carried on the satellites, and upgrades of the ability to process and disseminate the data collected.

The consequences of these improvements and upgrades have included more accurate estimates of missile launches and impact areas, the reduction in coverage gaps (some of which resulted from changes in foreign missile capabilities), as well as the ability to employ DSP in support of theater conflicts such as Operation Desert Storm. In the near future the DSP system will be replaced by the Space-Based Infrared System (SBIRS), whose satellites will have different infrared sensors and a greatly reduced dependence on overseas ground stations.

As will become clear, much of the evolution of the U.S. satellite early warning system has occurred in response to changes in the international political and military environment, as well as changes in U.S. strategic policy. Thus, the development of improved sensors and mobile ground terminals was the direct result of a shift in U.S. strategic nuclear policy initiated by the Carter administration and vigorously pursued by the Reagan administration. More recent changes, such as the Air Force Attack and Launch Early Reporting to Theater (ALERT) and Army-Navy Joint Tactical Ground Station (JTaGS) programs, are the product of a world in which intermediate-range ballistic missiles (IRBMs) fired by Iraq, Iran, or North Korea, with their short flight times and theater targets, are considered a more pressing threat than intercontinental ballistic missiles (ICBMs) sitting in Russian or Chinese silos.

The history of the DSP program also serves as a case study of a system that performs well beyond expectations. It is not simply that DSP satellites exhibited far greater lifetimes than had been expected as well as greater accuracy in identifying the location of missile launches, even prior to sensor upgrades. DSP satellites also proved to be valuable in a variety of missions beyond their primary mission of detecting Soviet or Chinese intercontinental or submarine-launched ballistic missiles and their secondary mission of monitoring nuclear detonations in the atmosphere.

DSP satellites, even the earliest generation, would prove useful in detecting and monitoring the launch of IRBMs (such as Scuds), detecting aircraft flying on afterburner, monitoring the movements of other spacecraft, and providing data on events such as explosions at weapons depots, airplane crashes, the detonation of meteorites in the atmosphere, and raging forest fires. Some DSP capabilities are only now beginning to be fully exploited.

When a system proves to be so versatile and able to satisfy the data requirements of a much wider range of consumers than anticipated, complications can arise; this, in fact, did occur with DSP. More customers can produce fear on the part of the system "owner" (in DSP's case, the Air Force) that the system will be diverted to other missions and compromise the original, primary mission. As a result, the owner may prove reluctant to see the system's capabilities fully exploited. Thus, the Air Force was uninterested when one of the DSP contractors suggested employing DSP data to detect the movements of Soviet Backfire bombers that might threaten the U.S. fleet. Years later, the Air Force was also concerned that Army and Navy involvement in the DSP program might dilute DSP's primary mission of warning of Soviet missile launches.

The DSP's history also illustrates how such a program, because of the need to locate ground stations on foreign territory and the value of the data produced to other governments, can play a role not only in U.S. foreign relations but even in the domestic politics of a number of governments. A ground station may become a target for protesters and a national political issue, which the host government may seek to manage through a policy of secrecy. Issues concerning the host government's role in ground station operations may become a point of contention between the host and guest. At the same time, the strategic relationship with the host government may grow stronger—both because the need for a ground station allows the host government to successfully negotiate for a greater role in the program and because it becomes dependent on the data. Eventually, the guest government may seek to avoid the vagaries of depending on a foreign host.

A program such as DSP may also play a role in relations with nations that have no formal role in the program. The data produced by DSP may be offered by the United States as an inducement to other nations to pursue programs such as theater missile defense, or demanded by allies (such as Israel) who see it as an important means of reducing their vulnerability to missile attack. Thus, the history of the DSP can broaden a reader's understanding of subjects such as the impact of policy decisions and a changing international environment on weapons and space systems development, the impact of competing bureaucratic interests and priorities on the chances of fully exploiting a warning/intelligence system such as DSP, and the significant role a relatively unknown program such as DSP can have in relations with a number of nations.

But aside from its implications for such issues, the history of DSP is important because DSP was an important space program during the Cold War and remains one in the post–Cold War era. As noted, it added stability to the U.S.–Soviet strategic relationship by improving U.S. warning capability. In addition, it has enhanced U.S. intelligence capability with respect to foreign missile and nuclear programs, played a significant role in Operation Desert Storm, and is, to an increasing extent, being enlisted in the causes of disaster relief and prevention as well as scientific exploration.

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Since 1999, the history and evolution of the DSP and SBIRS programs have added to the lessons that could be drawn from the programs' earlier years and have also provided additional lessons.

DSP's employment for a multitude of functions beyond the detection of strategic missile launches and atmospheric nuclear detonations became an accepted and valued part of its capability. As a result, those capabilities—including detection of theater missile launches, the detection of military and nonmilitary infrared events on the surface of the earth (such as aircraft flying on afterburner, forest fires, and detonations), and the monitoring of orbiting space systems—have become standard elements of the SBIRS mission.

The last few years of the DSP program, whose launch history concluded with DSP Flight 23 in 2007, also demonstrated the fragility of space systems, and how failure in orbit can quickly turn an extraordinarily sophisticated piece of hardware into little more than a piece of space junk. Such failures, coming at the end of a program, and after a decision to close down the production line, put additional pressure on the successor program to deliver its first spacecraft on time.

Unfortunately, SBIRS provided one of the primary examples of some of the problems plaguing several of America's national security space programs at the end of the twentieth century and the beginning of the twenty-first. Those problems included the expansion of requirements to satisfy potential customers seeking SBIRS data and an undisciplined requirements process that caused the continual addition of requirements long after the spacecraft entered the development phase.

Such problems helped kill another key national security space program, the electro-optical component of the National Reconnaissance Office's Future Imagery Architecture. SBIRS was almost another casualty, but it survived; as of early 2012, it has produced two highly elliptically orbiting payloads and one geosynchronous satellite. But it will still be several years before SBIRS has completed the takeover from DSP and before it will be possible to judge the extent of the program's success.

Acknowledgments

This book grew out of a project I headed for the National Security Archive on the Military Uses of Space. In the course of that project I began, via the Freedom of Information Act (FOIA), to accumulate a significant number of documents concerning the infrared launch detection satellites that the United States began work on in the late 1950s.

But those documents would represent only the tip of the iceberg of what I would acquire over the next several years, including yearly histories of all the government organizations involved in the research and development and operation of the spacecraft as well as a large number of memos from the files of the Aerospace Defense Command, the United States and Air Force Space Commands, the Air Force Space and Missile Systems Center (formerly known as the Space Systems Division, Space Division, and the Space and Missile Systems Organization [SAMSO]).

In addition, a number of valuable documents were released pursuant to FOIA requests to the Office of the Secretary of Defense, the Air Force, the Navy, the Central Intelligence Agency, the Defense Intelligence Agency, and other organizations. Therefore, I owe an enormous debt to the Freedom of Information offices at these organizations as well as to those at a number of other organizations.

My knowledge and understanding of MIDAS and DSP, as well as the search for a successor, are also the product of a number of interviews and conversations held with individuals presently or formerly involved with the programs. In particular I would like to thank Marvin Boatright, Harold Brown, Patrick Carroll, Jim Chambers, Dave Cohn, Sidney Drell, Daniel Fink, Alexander Flax, William G. King Jr., Ellis Lapin, Ed Mickalaus, Wolfgang Panofsky, Bob Richards, Jack Ruina, Bernard Schriever, and Ed Taylor. Others who cannot be acknowledged know who they are and that they have my thanks.

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In addition, despite the extent to which this book relies on declassified documents and interviews, it also relies on the reporting that has appeared in a number of key aviation and space publications—particularly *Aviation Week & Space Technology*, *Aerospace Daily*, and *Space News*. I greatly appreciate the work these publications have done in reporting the DSP story.

Finally, the National Security Archive provided support in a variety of ways, and the Center for Defense Information's library proved to be a valuable resource.

Abbreviations

3GIRS	Third-Generation Infrared Surveillance Satellite
ABM	Antiballistic missile
ACDA	Arms Control and Disarmament Agency
ADC	Air Defense Command
ADCOM	Aerospace Defense Command
AEC	Atomic Energy Commission
AFBMD	Air Force Ballistic Missile Division
AFL-CIO	American Federation of Labor–Congress of Industrial Organizations
AFSATCOM	Air Force Satellite Communications System
AFSC	Air Force Systems Command
AFSCF	Air Force Satellite Control Facility
AFSPACECOM	Air Force Space Command
AFSPC	Air Force Space Command
AFTAC	Air Force Technical Applications Center
AIRSS	Alternative Infrared Satellite System
ALARM	Alert, Locate, and Report Missiles
ALERT	Attack and Launch Early Reporting to Theater
AMOS	Air Force Maui Optical Station
ANGB	Air National Guard Base
AR	Advanced RADEC
ARAM	Advanced RADEC Analysis Monitor
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
ASAT	Antisatellite
ASIO	Australian Security Intelligence Organization
ATF	Activation Task Force
ATRR	Advanced Technology Risk Reduction
AWS	Advanced Warning System
BMD	Ballistic Missile Defense
BMDO	Ballistic Missile Defense Organization
BMEWS	Ballistic Missile Early Warning System
BSTS	Boost Surveillance and Tracking System
CENTCOM	U.S. Central Command
CEP	Circular error probable
CGS	CONUS Ground Station

CHIRP	Commercially Hosted Infrared Payload
CIA	Central Intelligence Agency
CINCAD	Commander in Chief, Aerospace Defense Command
CINCEUR	Commander in Chief, European Command
CINCPAC	Commander in Chief, Pacific Command
CINCSPACE	Commander in Chief, U.S. Space Command
CMO	Central MASINT Office (DIA)
COMINT	Communications Intelligence
CONAD	Continental Air Defense Command
CONUS	Continental United States
CSS	Communications Subsystem
CSTC	Consolidated Satellite Test Center
CSV	Crew support vehicle
CTPE	Central Tactical Processing Element
DAB	Defense Acquistion Board
DARPA	Defense Advanced Research Projects Agency
DCI	Director of Central Intelligence
DDC	Data Distribution Center
DDR&E	Director of Defense Research and Engineering
DEFSMAC	Defense Special Missile and Astronautics Center
DEW	Distant Early Warning line
DIA	Defense Intelligence Agency
DICBM	Depressed trajectory ICBM
DNI	Director of Naval Intelligence
DOD	Department of Defense
DPSS	Data Processing Subsystem
DRB	Defense Resources Board
DRM	Discoverer Radiometric Mission
DSARC	Defense Systems Acquisition Review Council
DSCS	Defense Satellite Communications System
DSMG	Designated Systems Management Group
DSP	Defense Support Program
DSP-A	DSP Augmentation
DTS	Detection Test Series
ECS	Engagement Control Station
EGS	European Ground Station
ELINT	Electronic Intelligence
EMP	Electromagnetic pulse
EPAC	Eastern Pacific
FBW	Fly-by-wire
FEWS	Follow-On Early Warning System
FOBS	Fractional Orbital Bombardment System
FOIA	Freedom of Information Act

FT	Fuel tanker
FTD	Foreign Technology Division (AFSC)
GAO	General Accounting Office
GAO	Government Accountability Office
GCN	Ground Communications Network
GPS	Global Positioning System
GRID	Group for the Investigation of Jet Propulsion
GRU	Chief Intelligence Directorate, Soviet General Staff
HRMSI	High Resolution Multi-Spectral Instrument
IAC	Intelligence Advisory Committee
IBM	International Business Machines
ICBM	Intercontinental ballistic missile
IDA	Institute for Defense Analyses
IOT&E	Initial operational test and evaluation
IRBM	Intermediate-range ballistic missile
IRAS	Infrared Augmentation Satellite
IUS	Inertial upper stage
JCS	Joint Chiefs of Staff
JDEC	Joint Data Exchange Center
JDF-N	Joint Defense Facility–Nurrungar
JDSCS	Joint Defence Space Communications Station
JROC	Joint Requirements Oversight Council
JSTARS	Joint Surveillance Target Attack Radar System
JTaGS	Joint Tactical Ground Station
KGB	Committee for State Security (USSR)
KY	Kapustin Yar
LADS	Low-Altitude Demonstration Satellite
LASER	Light Amplification by the Simulated Emission of Radiation
LCS	Laser Crosslink System
LCV	Logistics crew vehicle
LOCE	Limited Operations–Intelligence Center, Europe
LPS	Large Processing Station
LRS	Limited Reserve Satellite
MASINT	Measurement and Signature Intelligence
MCS	Mission Control Station
MCT	Mobile Communications Terminal
MDA	Missile Defense Agency
MDM	Mission Data Message
MEL	Mobile erector launcher
MENS	Mission Element Need Statement
MGS	Mobile Ground System
MGSU	Mobile Ground Support Unit
MGT	Mobile Ground Terminal

MIDAS	Missile Defense Alarm System
MILSTAR	Military Strategic and Tactical Relay
MOS	Multi-Orbit Spacecraft
MPA	Magnetospheric Plasma Analyzer
MPT	Multipurpose tanker
MRBM	Medium-range ballistic missile
MSP	Mosaic Sensor Program
MSTI	Miniature Sensor Technology Integration
MSX	Midcourse Space Experiment
MTBF	Mean time between failure
MUFON	Mutual UFO Network
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVSPASUR	Naval Space Surveillance Center
NCA	National Command Authorities
NCMC	NORAD Cheyenne Mountain Complex
NDS	NUDET Detection System
NEACP	National Emergency Airborne Command Post
NIE	National Intelligence Estimate
NII	Scientific Research Institute (USSR)
NLT	No later than
NMD	National Missile Defense
NORAD	North American Aerospace Defense Command
NRO	National Reconnaissance Office
NSA	National Security Agency
NSC	National Security Council
NSD	National Security Directive
NSDD	National Security Decision Directive
NSDM	National Security Decision Memorandum
NSSD	National Security Study Directive
NTBJPO	National Test Bed Joint Program Office
NTPR	Nuclear Targeting Policy Review
NUDET	Nuclear Detonation
ONIR	Overhead Non-Imaging Infrared
OSI	Air Force Office of Special Investigations
PASS	Phased Array Subsystem
PATRIOT	Phased Array Tracking to Intercept of Target
PAVE PAWS	Perimeter Acquisition Vehicle Phased Array Warning System
PD	Presidential Directive
PIM	Performance Improvement Spacecraft
PMD	Program Management Directive
PRM	Presidential Review Memorandum
PSAC	President's Scientific Advisory Committee

PTSS	Precision Tracking Space System
RAMOS	Russian-American Observation Satellite
RADEC	Radiation detection
RGS	Relay Ground Station
RM	Radiometric mission
ROC	Required Operational Capability
RRG	Requirements Review Group
RTS	Research Test Series
SABRS	Space and Atmospheric Burst Reporting System
SAC	Strategic Air Command
SAIC	Science Applications International Corporation
SALT	Strategic Arms Limitation Talks
SAMSO	Space and Missile Systems Organization
SAVE	SABRS Validation Experiment
SBEWS	Space-Based Early Warning System
SBIR	Space-Based Infrared
SBIRS	Space-Based Infrared System
SBS	Space-Based Sensor
SCG	Security Classification Guide
SCS	Space Communications Squadron
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SDS	Satellite Data System
SED	Sensor Evolutionary Development
SGT	Survivable Ground Terminal
SIOP	Single Integrated Operational Plan
SLBM	Submarine-launched ballistic missile
SLRA	Soviet Long-Range Aviation
SLV	Security/logistics vehicle
SMTS	Space and Missile Tracking System
SNA	Soviet Naval Aviation
SNIE	Special National Intelligence Estimate
SOC	Satellite Operations Center
SOPA	Synchronous Orbit Particle Analyzer
SOR	Specific Operational Requirement
SPACC	Space Command Center
SPS	Simplified Processing Station
SPS/R	SPS Replacement
SRAM	Short-range attack missile
SRAM	Sandia Radiation Analysis Monitor
SRBM	Short-range ballistic missile
SSBN	Nuclear ballistic missile submarine
SSD	Space Systems Division, Air Force Systems Command

STSS	Space Tracking and Surveillance System
SWRS	SLOW WALKER Reporting System
SWS	Space Warning Squadron
TACDAR	National Systems Tactical Detection and Reporting
TaGS	Tactical Ground System
TBMDS	Theater Ballistic Missile Defense System
TCE	Three-Color Experiment
TEL	Transporter-erector-launcher
TERS	Tactical Event Reporting System
THAAD	Theater High Altitude Area Defense
TIBS	Theater Intelligence Broadcast System
TRAP	Tactical Related Applications
TRD	Tactical Requirements Doctrine
TRE	Tactical Receive Equipment
TRUMP	Target Radiation Measurement Program
TRW	Thomson-Ramo-Woolridge
TSD	Tactical Surveillance Demonstration
TSDE	Tactical Surveillance Demonstration Enhanced
TSS	Transportation Subsystem
TVM	Target-via-missile
UHF	Ultrahigh frequency
USSPACECOM	U.S. Space Command
VHF	Very-high frequency
VUE	Visible Ultraviolet Experiment
VSS	Visible Light Surveillance System

AMERICA'S SPACE SENTINELS

ONE

Bad News Travels Fast

From September 8, 1944, to March 27, 1945, over a thousand German V-2 (Vengeance Weapon Number Two) missiles landed on London, killing and injuring thousands. The V-2, which had been known as the A-4 until renamed by Joseph Goebbels's Propaganda Ministry, was only one of a number of German missiles that had reached various stages of design, testing, or production before the Nazi Reich crumbled in May 1945.[1]

Nazi Germany's ultimate failure in the war did not prevent either the United States or the Soviet Union, allies on their way to becoming adversaries, from appreciating the accomplishments of German scientists in the aviation and missile fields—or from seeking to acquire their future services as well as the results of their wartime endeavors.[2] The U.S. Army had to move quickly, for many of the key sites in the German missile program were located in what would be the Soviet zone of occupation. The U.S. Army Ordnance's Special Mission V-2 had managed to determine the location of the archive for Peenemunde, the German missile research and development center, located on the Baltic. On May 27 U.S. Army trucks hauled away fourteen tons of documents. The United States also acquired parts for 100 V-2s, as well as Wernher von Braun and other scientific talent.[3]

German missile facilities located in the Soviet occupation zone included, in addition to Peenemunde, the Zentralwerke V-2 assembly facility and the Mittelwerke Gmbtl production plant in Thuringia. In its march through Poland, the Red Army had captured a facility at Lehesten, where the Nazis had conducted missile flight tests and static test firings of V-2 rocket engines.[4] With the potential value of such facilities in mind, the Soviets sent scientific intelligence teams to investigate. A 1944 visit to Poland by Soviet missile experts was followed, beginning in 1945, by a more extensive effort. The Soviets sought to collect as much V-2 hardware and as many launch facilities, blueprints, engineers, and technicians as possible.[5]

In September 1945 Sergei Korolev arrived in Germany to join the effort. Korolev was a rocket scientist who had fallen victim to Stalin's reign of terror, having been sentenced to ten years' imprisonment in September 1938 for his alleged subversion of military projects. After about a year of forced labor in the bleak arctic gold mines at Kolyma, he had been transferred to a *sharaga*, a penal institution for engineers and scientists who worked on military projects while serving their sentences.[6]

Like many scientists in the Soviet Union and the United States who would pioneer the development of ballistic missiles and satellites, Korolev had become engrossed in the romance of space and rocketry as a youngster. He had been inspired by the work of Konstantin E. Tsiolkovskiy, who wrote of spaceships and interplanetary travel, and became one of the leaders of the rocket enthusiasts who formed the Moscow-based Group for the Investigation of Jet Propulsion (GRID).[7]

Korolev and his fellow Russians were disappointed by what they found at Peenemunde. The Germans had stripped the center of much of its equipment when they evacuated the facility in early 1945, while the forces defending it had blown up many of the buildings. In addition, the invading Soviet forces had already made off with some of what was salvageable.[8]

What Korolev and the Soviets could not get from the remains of the German facilities they hoped to get from the scientists who had worked there. In the spring of 1946 they selected Helmut Groettrup, who had served as the liaison between the guidance development unit of the Wehrmacht's rocket program and the staff of program head Walter Dornberger, as the director of the German contingent. By September 1946 the 5,000 personnel under Groettrup and Korolev's guidance had produced a V-2 variant, designated the R-1 by the Soviets. Its range was about 167 miles, only marginally greater than that of the V-2.[9]

In the early morning of October 22, 1946, only hours after a symposium to consider German suggestions for further missile development, the Soviets abruptly deported all of the important missile specialists to the Soviet Union, along with their families and some household goods. Thousands of other specialists from the eastern zone were also relocated. In addition, the Soviets brought along the Nazi missile plants, some V-2 rocket engines, and blueprints and engineering studies for other advanced long-range weapons.[10]

After arriving in Moscow on October 28, a small number of scientists, including Groettrup, were settled about thirteen miles north-northeast of central Moscow, near Kaliningrad, where Scientific Research Institute-88 (NII-88) had been established. About 175 of the German scientists were shipped off to the institute's Branch 1, on Gorodomyla Island in Lake Seliger, approximately 150 miles to the northwest of Moscow.[11]

The Germans would be employed to help the Soviet Union move far beyond the capabilities embodied in the V-2s. On March 14, 1947, Soviet Premier Georgi Malenkov told a meeting of aircraft and rocket designers that "we cannot rely on such a primitive weapon; our strategic needs are predetermined by the fact that our potential enemy is to be found thousands of miles away."[12]

The next day, at a Politburo–Council of Ministers meeting, Soviet dictator Josef Stalin observed: "Under Hitler, German scientists have developed many interesting ideas. . . . a rocket [with intercontinental range] could change the fate of the war. It could be an effective strait jacket for that noisy shopkeeper, Harry Truman. We must go ahead with it, comrades. The problem of the creation of transatlantic rockets is of extreme importance to us."[13]

A few months later, work at NII-88 came to a halt when several German experts were ordered, without warning, to board a train. A week later the train arrived near Kapustin Yar, a small village southeast of Moscow, on the banks of the Volga River, which became the first Soviet ballistic missile test range. Awaiting their arrival were several thousand engineers from the Red Army as well as Soviet military officers. The Germans were to assist in test launches of the first R-1s. The first successful R-1 launch, in October 1947, landed a substantial distance from the intended target. By that time the Soviets were also at work developing the R-2, which had a projected range of 365 miles.[14]

In July 1949 Korolev was summoned to a meeting in Stalin's office to discuss the future of the missile program. Stalin's focus was still on a missile with a far greater range than that of the R-1 or R-2; he told the rocket designer, "We want long, durable peace. But Churchill, well he's warmonger Number One. And Truman, he fears the Soviet land as the devil's own stench. They threaten us with atomic war. But we're not Japan. That's why . . . things must be speeded up!"[15]

As part of that process a new missile program was initiated in 1950, one that involved three distinct designs. One was the R-3, a seventy-five-ton missile with a range of 1,860 miles. Although it could not reach the United States, it was conceived of as the first Soviet strategic missile, with the ability to reach American bases in England, Japan, and elsewhere.[16]

Stalin's death in March 1953 was followed by a general reevaluation of strategic weapons programs. At a summer 1953 meeting, attended by Vyacheslav A. Malyshev, head of the nuclear weapons program, and Dmitriy Ustinov, director of the strategic missile and bomber program, Korolev suggested that the R-3 program be canceled because of the missile's limited range. What was really required, he argued, was a missile with a range of 4,200 to 5,000 miles, which thus would be capable of delivering a nuclear warhead to U.S. territory. By this time, studies concerning the feasibility of such missiles had been under way for several years.[17]

Despite initial opposition to Korolev's suggestion, a study of his proposal led to approval, in May 1954, of a program to begin development of the *Semyorka,* or R-7 intercontinental ballistic missile (ICBM), which would be designated the SS-6 SAPWOOD by the U.S. intelligence community. Along with the new missile program the Soviets decided to construct a new and more intricate test center, choosing a site they code-named Tashkent-50, near the Tyuratam railroad station in the Kazakhstan desert.[18]

The first static test firings of the R-7 engines began in February 1956. After several postponements the first launch was finally scheduled for March 1957. Liftoff would finally take place on the third attempt, on May 15, 1957. But at T+50 seconds, the missile exploded over the test range.[19]

On August 21, 1957, several weeks after a U.S. Atlas missile test had ended in failure, another in a long line of failures, an R-7 lifted off from its Tyuratam launchpad and made a successful journey to the Pacific Ocean. All systems worked properly, resulting in the first flight of an ICBM. The missile's dummy warhead splashed down in the Pacific, after a journey of about 4,000 miles. On August 26 TASS, the official Soviet news agency, announced the August 21 test and observed that "a super-long-range multi-stage intercontinental ballistic rocket" had been successfully tested, demonstrating that "it is now possible to send missiles to any part of the world." A second successful test followed on September 7.[20]

Even before the first successful tests, Soviet ICBMs were operational politically. Beginning in 1955, First Secretary Nikita Khrushchev denigrated the capabilities of bombers, in which the United States had a significant advantage, and praised the utility of missiles. In a December 29, 1955, speech, Premier Nikolai Bulganin boasted of Soviet successes in missile development. Less than two months later, foreign ministry official Anastas Mikoyan asserted that, using planes or missiles, the Soviet Union could deliver a nuclear weapon to any point on earth. During his April 1956 state visit to Britain, Khrushchev claimed that the Soviet Union would soon have "a guided missile with a hydrogen warhead that can fall anywhere in the world." Later that year, in response to the British-French-Israeli invasion of Egypt, Khrushchev "rattled his rockets."[21]

The Soviet military was also trumpeting the value of missiles and discussing the strategy for their use. In his speech on Soviet military accomplishments to the Twentieth Party Congress in 1956, Defense Minister Georgi K. Zhukov referred to long-range and "mighty" missiles. Between July 1955 and December 1956, the number of Soviet technical personnel assigned to research and development programs increased by almost 25 percent. A 1957 Soviet article cited three advantages that would accrue to the owner of

ICBMs: the missiles could be used with mobile launchers; they could operate under all weather conditions and cut through air defenses; and they would be capable of launching surprise attacks from concealed positions.[22]

While Soviet scientists had been developing and testing their missiles, and Soviet leaders talked of rocket warfare, the U.S. intelligence community had been investigating, wondering about, and attempting to project the course of the Soviet missile program. In the early 1950s very little concrete information was available. Colonel Georgi Tokaty-Tokaev, deputy chairman of the Soviet state commission on missile production, had defected in 1948 and was debriefed shortly afterward. There were also the German scientists who had been repatriated. In 1954 a U.S. listening post in Turkey began intercepting signals from Kapustin Yar. But that was about all.[23]

The October 1954 National Intelligence Estimate (NIE) entitled *Soviet Capabilities and Probable Programs in the Guided Missile Field* reflected the sparse sources of information. Its authors noted that "we have no firm current intelligence on what particular guided missiles the USSR is presently developing or may now have in operational use."[24] However, based on evidence concerning Soviet interest in missile development, including the exploitation of German experience in the area, Soviet capabilities in related fields, and several other factors, U.S. intelligence concluded:

> We believe that the USSR, looking forward to a period, possibly in the next few years, when long-range bombers may no longer be a feasible means of attacking heavily defended US targets, will make a concerted effort to produce an [ICBM]. In this event it probably could have ready for series production in about 1963 (or at the earliest possible date in 1960) an [ICBM] with a high yield nuclear warhead.[25]

Over the next few years, additional intelligence was obtained from new aerial and ground collection operations. A British Canberra photo reconnaissance aircraft had overflown Kapustin Yar by 1955. Further coverage was obtained after U-2 overflight missions began in 1956. An intercept station at Peshawar, Pakistan, began operations in 1957, with Tyuratam as one of its targets. That same year an overflight of Tyuratam produced a picture of an ICBM on its launchpad.[26]

On March 12, 1957, the Intelligence Advisory Committee (IAC) approved a new NIE on Soviet missiles, relying on these sources of information. The estimate predicted that the Soviets might have an ICBM ready for operational use by 1960 or 1961.[27]

The tests of August and September provided additional data for the U.S. intelligence community to study. As a result, the forecast for Soviet missile development, contained in NIE 11-4-57, published on November 12, 1957, advanced to 1959 ("or possibly even earlier, depending upon Soviet requirements for accuracy and reliability") the date at which the Soviets could attain a marginal missile capability with up to ten ICBMs in the field. The estimate assumed the missiles would have a maximum range of 5,500 nautical miles and a 50 percent chance of landing within 5 nautical miles of the target.[28]

But virtually before the ink on the new NIE had dried, the Soviet Union, on October 4, 1957, placed the earth's first artificial satellite, *Sputnik* ("Traveling Companion") into orbit. The satellite weighed only 184 pounds, but it was substantially heavier than the 3.5-pound *Vanguard,* America's first satellite-to-be, and had a traumatic effect on the American public. Even sophisticated scientists were moved to expressions of panic. John Rinehart of the Smithsonian Astrophysical Observatory announced, "No matter what we do now, the Russians will beat us to the moon. . . . I would not be surprised if the Russians reached the moon within a week." Edward Teller, a father of the H-bomb, declared on national television that the United States had lost "a battle more important and greater than Pearl Harbor."[29]

Some prominent senators, including Henry M. Jackson of Washington and Stuart Symington of Missouri, were also alarmed. To Jackson, *Sputnik* was "a devastating blow to the prestige of the United States." Symington urged President Dwight Eisenhower to call a special session of Congress. In a telegram to Richard Russell, chairman of the Senate Armed Services Committee, Symington called *Sputnik* "proof of growing Communist superiority in the all important missile field." Russell agreed, telling his Georgia constituents that the "Russians have the ultimate weapon—a long range missile capable of delivering atomic and hydrogen explosives across continents and oceans."[30]

Compounding the fear, *Sputnik II,* weighing 1,121 pounds, was orbited on November 3; it carried research instrumentation and a living dog. The Soviets also orbited the entire second stage of the booster, bringing the total package in orbit to 4,000 pounds. The launchings seemed to reinforce the warning of the 1957 report of the Security Resources Panel (a subcommittee of the Scientific Advisory Committee of the Office of Defense Mobilization) that the Soviet Union had "probably already surpassed" the United States in ICBM development and that the Strategic Air Command (SAC) bomber force was threatened by the prospect of an early Soviet ICBM capability.[31]

A Special National Intelligence Estimate (SNIE) was commissioned in the wake of *Sputnik,* completed in December 1957, and approved by the IAC on December 17. The SNIE concluded that the "USSR is concentrating on the development of an ICBM which, when operational, will probably be capable of carrying a high-yield nuclear warhead to a maximum range of about 5,500 nautical miles." The estimate also predicted that the Soviets would probably have an initial operational capability of up to ten prototype ICBMs between mid-1958 and mid-1959. Within a year after achieving that initial capability, it could have 100 operational ICBMs, and 500 about one or two years after that.[32]

In the early 1950s, before the missile threat really arrived, the United States began a series of projects to allow detection of attacking Soviet bombers. In 1952, work on the Pinetree Line of radars in Canada commenced. In February 1954 President Eisenhower approved the Distant Early Warning (DEW) Line project. Construction of the radars began in the spring of 1955 and ended early in 1957. These ground-based radar systems would provide the SAC with one or two hours' tactical warning of any approaching Soviet bombers.[33] But one or two hours of warning that Soviet missiles had been launched would not be available. Only thirty minutes after the missiles left their launchpads, their warheads would detonate on U.S. soil. Maximum warning required placing detection systems where they could provide the earliest possible warning.

On January 14, 1958, in reaction to the *Sputnik* launch, Secretary of Defense Neil H. McElroy approved construction of the Ballistic Missile Early Warning System (BMEWS). BMEWS would consist of large ground-based radars at Clear, Alaska; Thule, Greenland; and Fylingdales Moor in Yorkshire, along with a complicated system of rearward communication lines to bring the information to commanders in the United States.[34]

But even before the *Sputnik* launch, concern over obtaining adequate warning of a Soviet missile attack had led to the investigation of the possibility of detecting missile launches even earlier than radars could manage—via heat generated by the missile and the infrared emissions of missile plumes.[35] In 1948 J. A. Curcio and J. A. Sanderson of the Naval Research Laboratory produced a report that discussed the use of lead sulfide detectors to distinguish the infrared signal from the rocket motor plume. In 1955 two RAND Corporation scientists, Sidney Passman, an expert on infrared technology, and William Kellogg, an expert on high-altitude earth observation, commented:

> It appears to be a basic characteristic of an ICBM that aerodynamic heating causes it to get hot during takeoff and even hotter during re-entry into the atmosphere. Since hot metal is a good emitter of infrared radiation, it would be expected that the missile could be detected by infrared detectors during its flight through the atmosphere. The emission of infrared radiation by the rocket flame during the boost stage further increases this expectation, with the added possibility that there may be enough radiation to permit infrared detection during that part of the powered flight which occurs above the atmosphere.[36]

The RAND experts explored techniques for detecting ICBMs during and after their boost phase, including a fleet of "picket airplanes" that would patrol the Soviet periphery in search of missile launches.[37] There was, however, according to Kellogg and Passman, a serious problem with any plan to use aircraft for the infrared early warning mission. Because of the curvature of the earth, much of the boost phase would be unobservable. There would then be a serious risk of detection failure once the powered phase of the missile's flight had ended. Kellogg and Passman noted that

> during the early stages of the [ICBM] takeoff there is more than enough infrared emission, but the earth gets in the way. . . . After burnout there is not nearly enough infrared signal to give detection at any useful range. . . .
>
> The figures . . . lead one to speculate on the increased warning time and perhaps more accurate trajectory prediction that might be possible by getting around this geometrical limitation with a very-high-altitude search station—perhaps with a satellite-borne infrared search set.[38]

In June 1956 the Air Force selected Lockheed's Missile Systems Division to build a military photographic reconnaissance satellite. Lockheed also proposed a number of additional systems, such as electronic and weather reconnaissance satellites, largely following suggestions made by RAND experts since the late 1940s. Joseph Knopow, a young Lockheed engineer, proposed using a satellite equipped with an infrared radiometer and telescope to detect both the hot exhaust gases emitted by long-range jet bombers and large rockets as they climbed through the atmosphere.[39]

Such thinking was the motivation for Lockheed's proposal for a constellation of accurately positioned polar orbiting satellites, which would sweep over the vast Sino-Soviet land mass and instantly report any detection of missile launches to one of three strategically located ground stations. If the idea proved workable, satellites equipped with infrared "eyes" would signal the departure of large rockets as soon as they left their launchpads.[40]

Two individuals who played an important role in persuading military officials of the feasibility and value of such a system were Colonel William G. King Jr. and Lieutenant Colonel Quentin Riepe of Detachment 1 of the Air Research and Development Command (ARDC). They frequently traveled from their Wright Field, Ohio, headquarters to espouse the potential of satellites for reconnaissance and surveillance to often skeptical Air Force officers. In addition, the work of Kellogg and Passman "had captured the attention of various science advisory committees" and created support for an infrared warning satellite.[41]

As a result, before the end of 1957, Lockheed's proposal became Subsystem G of Weapons System 117L (WS-117L), the overall Defense Department space-based reconnaissance and surveillance program. WS-117L consisted of three programs: the SENTRY radio-return reconnaissance satellite project, the Discoverer experimental satellite (which served as a cover for the Central Intelligence Agency's (CIA's) CORONA film-return reconnaissance satellite project), and Subsystem G.

Although Lockheed would be the prime contractor for the spacecraft, it would not design the critical payload. Among the companies Lockheed turned to was Aerojet-General of Azusa, California, which had been formed in 1942 by California Institute of Technology scientist Theodore von Karman and four associates. Aerojet had been involved in the development of rockets and in studying the possible infrared detection of ballistic missiles for a number of years (and had provided some of the data that had been used by Curcio and Sanderson). By the end of 1956, a number of scientists and engineers who would be heavily involved in the infrared detection program in the years ahead had joined the staff.[42]

Subsequent to the October *Sputnik* launch, Aerojet received a follow-on contract. But Aerojet would not be alone in trying to design a suitable spaceborne detection system. Its competition came from Baird-Atomic of Cambridge, Massachusetts. Of course, at that time it had yet to be demonstrated that a reliable payload could be designed by anyone. It would be several more years before the issue would be settled.