Tracking the Unthinkable:

The Donnelly Flats MIDAS Ground Station and the Early Development of Space Warning Systems, 1959-1967

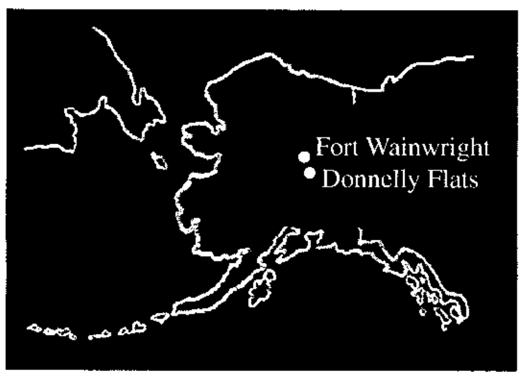
September 2006

CEMML TPS 06-19

TRACKING THE UNTHINKABLE:

THE DONNELLY FLATS MIDAS GROUND STATION AND THE EARLY DEVELOPMENT OF SPACE WARNING SYSTEMS, 1959-1967

Fort Wainwright Donnelly Training Area, Alaska



Prepared by:

Kathy Price

Edited by:

Glenda Lesondak

for the
Center for Environmental Management of Military Lands
Colorado State University

and

Conservation Branch
Directorate of Public Works
U.S. Army Garrison Alaska

September 2006

CEMML TPS 06-19

TABLE OF CONTENTS

LIST OF FIGURES

Cover photo: Donnelly Flats Receiver Building No. 2, ca 1970s. Courtesy Bob Siptrott.

LIST OF MAPS

LIST OF TABLES

CHAPTER 1.0 Introduction

On an October night in 1957, a small black sphere streaked through the heavens. The Soviet Union's Sputnik I, the world's first man-made satellite, had begun its orbit into history.

That night in the far north, scientists at the University of Alaska's Geophysical Institute were among the first to observe this surprising new object in the skies.[1] Like their colleagues around the world, the scientists in Fairbanks realized that they had just witnessed the birth of the Space Age. It was an age that would expand scientific frontiers and reward human curiosity, but it would also reflect the high-stakes drama of the Cold War between the United States and the Soviet Union. The cold reaches of space would become the backdrop for intense strategic and technical competition between the two superpowers.

Just two years later, about one hundred miles to the south, another scene in the space drama began to unfold as the U.S. Air Force began building an experimental satellite tracking station in Interior Alaska. For a few years, this modest facility near the small town of Delta Junction would play a role in the nascent Cold War space race for military security. The Donnelly Flats MIDAS station, though short-lived, was one of the early components of a space-based missile-warning project that evolved into today's defense support program satellite network.

MIDAS, or Missile Defense Alarm System, was the first satellite system designed to warn U.S. commanders of hostile missile launches. Because a satellite could use infrared technology to detect and track a missile's heat plume shortly after launch, it could provide the earliest possible warning of surprise attack. A successful satellite system could double the available warning time, pinpoint the origin of a hostile launch, and theoretically provide additional deterrence.[2]

The MIDAS concept called for a series of polar-orbiting, relatively low-orbit satellites. The satellites would monitor launch signatures and then transmit data to ground stations, which would be linked into the North American Air Defense Command (NORAD) network. The project began with initial proposals in 1955, with the first launch attempted five years later. The original series of satellite launches continued through 1963. A modified MIDAS program known as Program 461 continued to refine the technology in 1966-1967. After that, the second-generation Defense Satellite Program (DSP) took over the warning mission, using a geostationary orbital configuration.[3]

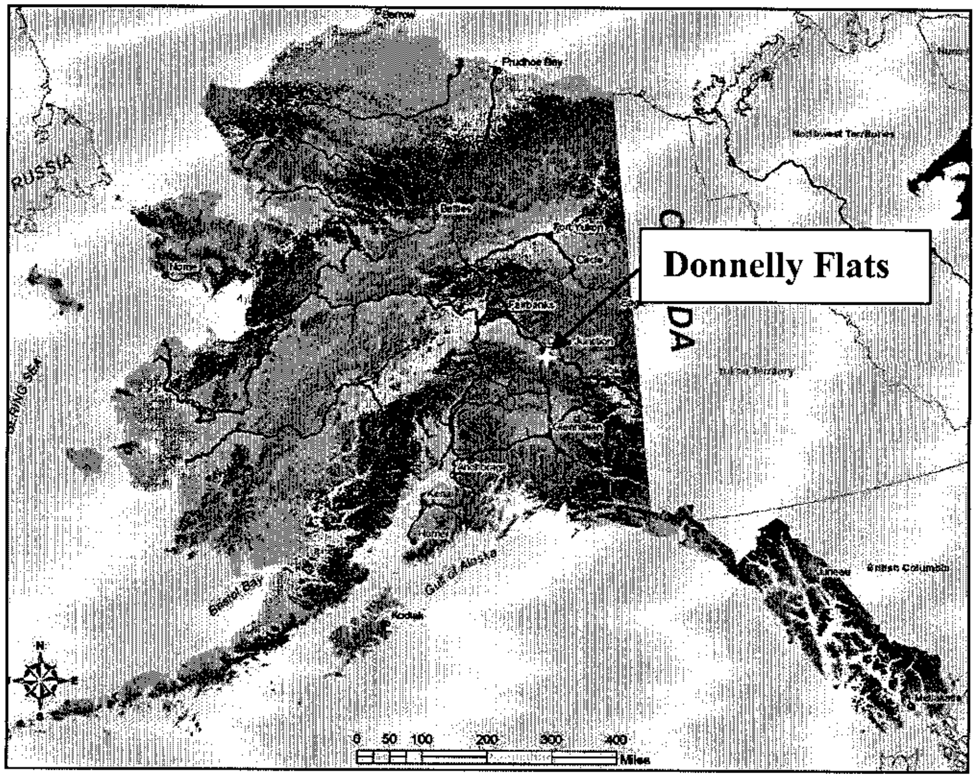
The MIDAS system, like any other satellite program, required control centers and widely dispersed ground stations to maintain communication and receive data

[1] More precisely, it was the orbiting rocket booster from Sputnik which observers initially tracked. The Sputnik satellite itself was quite small, only 22 inches in diameter, was painted black, and was traveling between 16,000 and 18,000 miles per hour. E. Nelson Hayes, *Trackers of the Skies*, (Washington, DC: Smithsonian Institution, 1967) 57. The Alaskan observation team was led by Dr. Gordon Little. They were among the first to report reliable observations to astronomers at the Smithsonian Astrophysical Observatory, the official U.S. clearinghouse for Sputnik reports. Hayes, 54.

[2] As an important side benefit, MIDAS could complement other programs like VELA Hotel, which searched for nuclear detonations in space. MIDAS could provide data on Soviet missile tests and help monitor compliance with weapons testing treaties.

[3] An interim system known as Program 949 operated between the closure of Program 461 and the beginning of the DSP, using infrared detectors and a "quasi-geostationary" orbit. Michael Binder, email to author, 30 May 2006.

from its satellites. The Donnelly Flats ground station, also known as North Pacific Station, was part of a worldwide network of tracking stations the Air Force created to support its satellite programs.



Map 1. Location of Donnelly Flats. Map courtesy USAG-AK GIS.

The Donnelly Flats tracking station was active at various times between 1961 and 1967, supporting MIDAS and Program 461. It was located on a flat valley floor on the southern portion of Fort Greely, with personnel housing and some support functions provided twelve miles north on Fort Greely's cantonment. Today, the remnants of this station are on training lands managed by the U.S. Army Garrison Alaska (USAG-AK). This report presents the untold story of the Donnelly Flats tracking station as part of an analysis of the property's eligibility for the National Register of Historic Places.[4] Since this study relied solely on unclassified information, the story is not complete. Even with this limitation, a picture emerges of the dramatic early years of the space program and the role a remote Alaska station played in the development of support networks.

The MIDAS system was a complex and ambitious undertaking, pushing the limits of contemporary state-of-the-art aerospace engineering. It was intended to be an operational warning system, but as events played out, it served as a research and development proof-of-concept system instead. The original MIDAS designers faced tremendous technical challenges. This was the first decade of the space age, when rocket boosters could still explode spectacularly on their launch pads. Communications and attitude control systems on satellites would regularly fail, making payloads useless. When orbits *were* successfully established, hardware

[4] Fort Greely was realigned and closed in 2001. The surrounding training lands were transferred to Fort Wainwright under the name Donnelly Training Area (DTA). The Army now considers the DTA to be a part of Fort Wainwright. Fort Greely's support facilities on the cantonment were reopened, and are now managed by the Space and Missile Defense Command, along with some acreage dedicated to SMDC operations.

components could still malfunction in unanticipated space conditions. The MIDAS system was a first-generation attempt to overcome these and other challenges. The lessons learned in the MIDAS years – including lessons of what not to do – led to the success of subsequent space warning systems, including the one currently in use. Even now, as a defunct site, Donnelly Flats is a reminder of the enormous effort it took to develop today's capabilities.

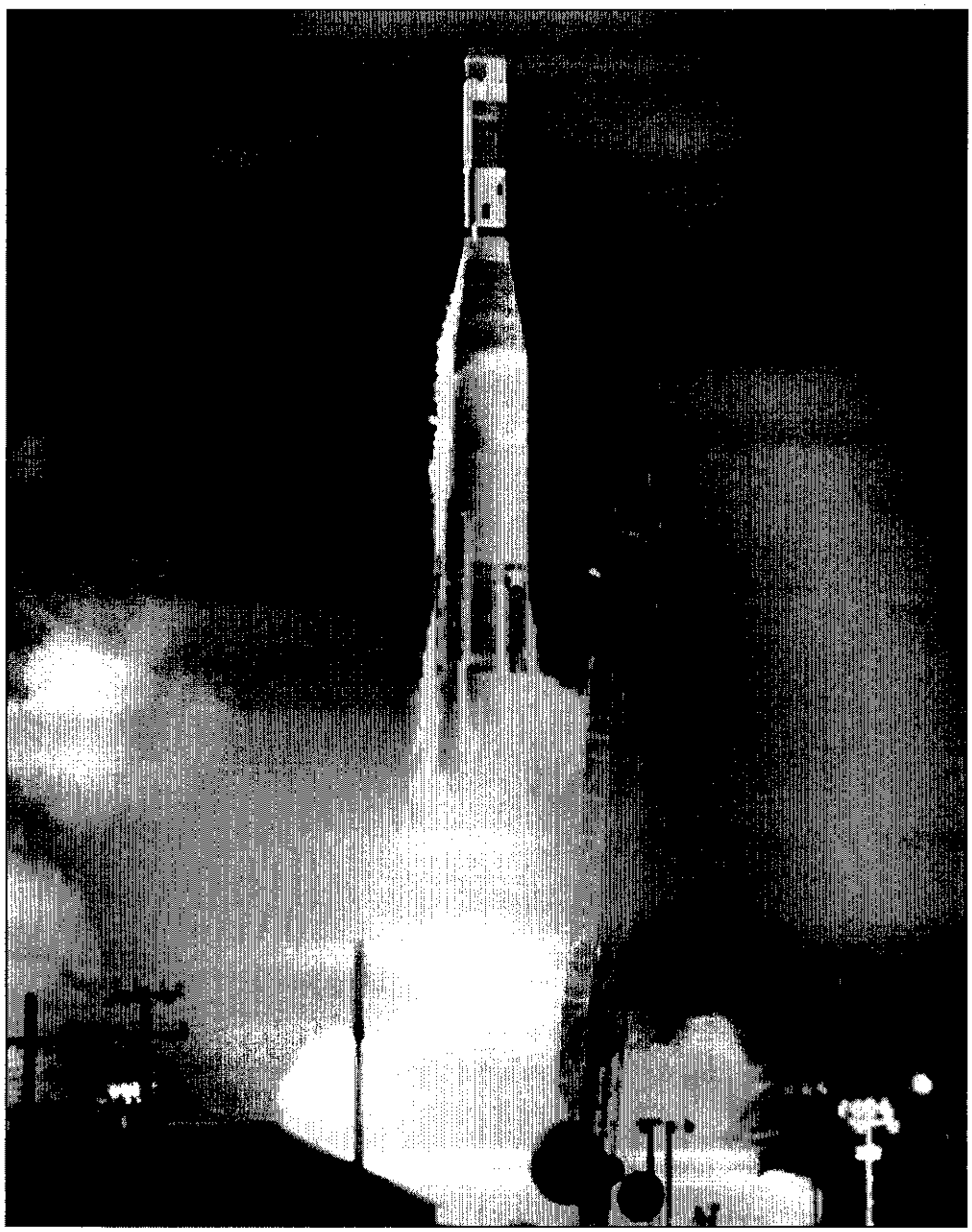


Figure 1. Launch of MIDAS IV on Atlas/Agena B, 21 October 1961. U.S. Air Force photo, courtesy NASM Smithsonian Institution (SI 2005-7940).

CHAPTER 2.0 Cold War Competition on the Space Front

The Cold War was a multidimensional conflict between the U.S. and the U.S.S.R., lasting from approximately 1946 to 1991. It was a confrontation between competing social and political systems: capitalism and communism, democracy and totalitarianism. Throughout the era, the two superpowers faced off politically, economically, and technologically. While proxy wars occurred in Korea, Vietnam, and Afghanistan, no direct hot war ever broke out between the superpowers, although that possibility created a constant sense of underlying threat.[5] By 1991, the Soviet Union had dissolved, and the long standoff had come to an end.

2.1 The Space Rivalry Blasts Off

The Cold War played out on many levels, but technological competition was one of the most intense and high-stakes arenas. Some would argue that technological competition was the central strategic aspect of the Cold War. Within that realm, space technology was such a critical element that one commentator has simply called the conflict The Great 50-Year Space War.[6]

The story of United States-Soviet space competition reaches back to the end of WWII. In the waning months of the war, Allied forces began to close in on the German facilities which held the secrets of the Nazi V-2 rocket. As the Allied armies advanced, top German rocket scientists under Dr. Werner von Braun decided it would be preferable to surrender to the Americans rather than the Soviets. This prevented the best German research personnel and their designs from falling into Soviet hands.

However, it took some time before the U.S. initiated a significant space effort. In the late 1940s, no organized civilian space program existed. Private firms and a few government-sponsored research labs had started to develop some capabilities but this resource remained untapped for several years.[7] Some military specialists were interested in the potential advantages of space technology, but other priorities occupied the armed forces after the war. A rapid demobilization was underway, and defense funding had dropped precipitously from wartime levels. Although Dr. von Braun and some of his team arrived in the U.S. to continue their work for the U.S. Army, funding and attention remained at low levels.

But by the middle of the 1950s, circumstances had changed. The U.S.S.R. possessed atomic weapons, hydrogen bombs, and a long-range bomber fleet that could attack North American targets. Although the U.S. possessed a similar arsenal, fears of Soviet aggression and surprise attack ran deep. U.S. defensive strategies centered on early warning, methods for destroying attacking bomber formations, and counteroffensives. Radar nets, in combination with forward-deployed fighter

[5] Intense moments of international tension occurred on several occasions, particularly between 1958 and 1962. This was the era when reconnaissance and warning satellites were being developed in earnest. The successful deployment of these systems may well have stabilized the Cold War's hair-trigger standoff.

[6] Brig. Gen. Simon P. Worden and Maj. John E. Shaw, *Whither Space Power? Forging a Strategy for the New Century*, (Maxwell AFB, AL: Air University Press, 2002) 13, citing John Shaw, "The Influence of Space Power Upon History," *Air Power History*, Winter 1999.

[7] Walter A. McDougall, *The Heavens and the Earth: A Political History of the Space Age*, (New York: Basic Books, 1985) 77-78. For a detailed discussion of the development of U.S. space programs and policy, see McDougall.

wings and NIKE anti-aircraft systems, formed the basis of defense, with Strategic Air Command bombers poised to undertake counterstrikes.

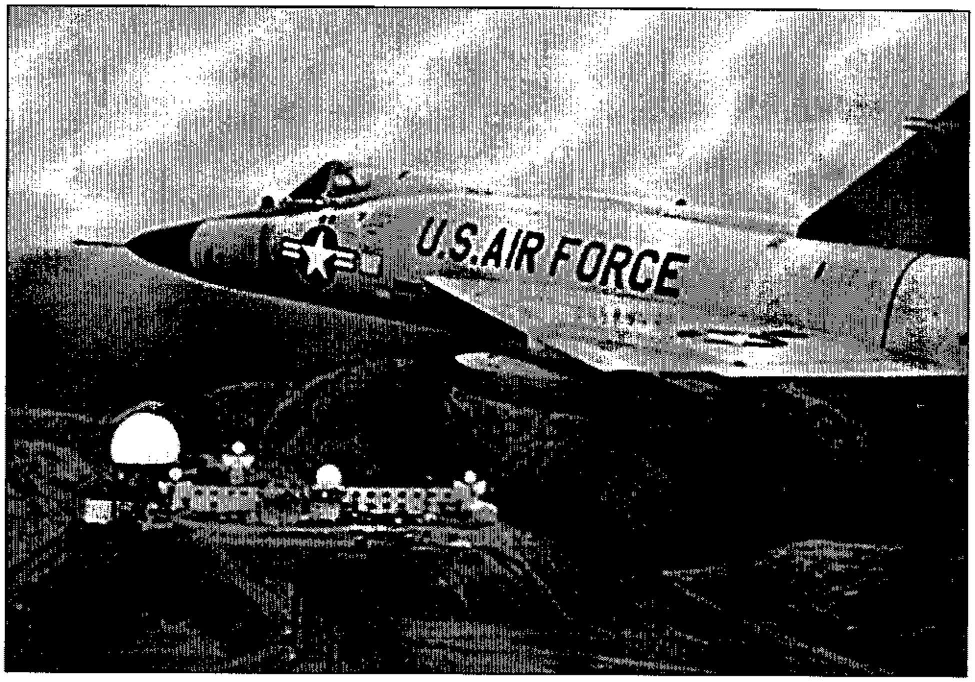


Figure 2. Air Force F-102 flying over Nike Site Summit, Anchorage, ca. 1968. U.S. Air Force photo.

In 1957, the Soviets successfully tested an intercontinental ballistic missile (ICBM). The introduction of ICBMs radically restructured strategic options. Unlike bomber formations, missiles were not recallable after they lifted off. They could be launched with no warning, from protected bases deep in Soviet territory. They traveled to their targets with great speed, needing only about thirty minutes to reach their destinations. Elaborate air defense systems designed to thwart bomber formations would be rendered essentially obsolete, virtually overnight.

Although the Soviets had successfully tested ICBM technology, it would take time for them to deploy operational systems. At first, U.S. strategists did not know how advanced the Soviet deployments were and feared a "missile gap." As it turned out, the gap was overestimated, and the U.S. had time to finish developing its own ICBM technologies and to "catch up" in space. But it was critically important to determine what the Soviet capabilities were and to employ early warning systems so that a Soviet first strike would not be able to cripple a U.S. response and, with it, any deterrence against such an attack in the first place.

Initially, the U.S. relied on high-flying U-2 aircraft to capture imagery of the Soviet Union. However, overflights of Soviet territory were politically delicate, to say the least. In 1960, the Soviets shot down a U-2 piloted by Gary Powers, triggering an international incident and causing the U.S. government considerable embarrassment. It became clear that aircraft alone could not accomplish the reconnaissance mission.

In this environment, military satellites became a high priority. Surveillance satellites could provide strategic information regarding the other side's capabilities which was difficult or impossible to obtain by other means. In the event of a surprise attack, warning satellites could signal an alert fifteen minutes sooner than ground-based radars could. Consequently, space became a critically important monitoring location and was soon a central element in Cold War strategy. In the view of some strategists, space technology would provide the key to security.[8]

2.2 Sputnik Raises the Stakes

Just as the military began to focus on space programs in earnest, the Eisenhower administration, concerned about international perceptions, adopted a policy of promoting the peaceful uses of space. For a few years in the mid 1950s, this meant that military space programs, while acknowledged, proceeded with little fanfare. "In those days," recalled one Air Force participant, "you could say the effort involved reconnaissance, but you could not say it was a satellite."[9]

WHERE WERE THEY WHEN....?

The announcement of Sputnik's launch interrupted business as usual in hundreds of ways. In Cambridge, Mass., a group of scientists from the Smithsonian Astrophysical Observatory were spending their evening at an orchestra practice when word was whispered to some of the players. In an eerie parody of musical chairs, the astronomers silently departed one by one to analyze the reports and start tracking the object.

In Washington, the Soviet embassy was hosting a party for international space scientists in honor of the IGY. The attendees chatted with their Soviet hosts about the prospects for satellites, unaware that Sputnik was already up until the news was announced later in the evening.

In a final irony, Von Braun's team at Redstone Arsenal was welcoming the new Secretary of Defense that evening and preparing to brief him on the progress of Project Orbiter (Jupiter/Explorer I), a system that could have launched a military satellite months ahead of Sputnik, had there been a directive to do so.

—Hayes 52, McDougall 61-62, 131

One of the most delicate issues was the question of "freedom of space." International law allowed each nation to claim the airspace above it as part of its sovereign area. In 1957, it was not clear whether this sovereign airspace continued out past the earth's atmosphere into outer space. This question was not academic. In fact, it was crucial to the future of reconnaissance satellites. Would sending a satellite into orbit over a rival nation's land mass technically constitute an act of war?

One of the ways the U.S. hoped to establish the precedent of freedom of space was by launching an experimental scientific satellite as part of the International Geophysical Year of 1957 (IGY). If this peaceful satellite was not challenged, it would establish a precedent, and future satellite missions would be secure.

The IGY provided a forum for international scientific cooperation, and both the U.S. and the U.S.S.R. began planning satellite experiments several years in advance. The U.S. went to work on the Vanguard satellite, a scientific project coordinated by the Navy. For public relations reasons, in keeping with the peaceful prototype idea, designers were directed to avoid using any systems originally developed as part of weapons production, such as Atlas ICBM boosters.[10]

In the meantime, while Vanguard was being designed, military satellite development continued quietly on the sidelines. But on the night of October 4, 1957, the Soviets shattered the status quo. A rocket lifted off from a test range in Kazakhstan, and the U.S.S.R. announced to the world that the first Sputnik satellite was orbiting the earth.

[8] Donald R. Baucom, "The Formative Years: Technology and America's Cold War Strategy," in R. Cargill Hall and Jacob Neufeld, eds, *The U.S. Air Force in Space, 1945 to the Twenty-first Century: Proceedings of the Air Force Historical Foundation Symposium Andrews AFB, MD, September 21-22, 1995,* (Washington, DC: USAF History and Museums Program, 1998), 57.

[9] Just a few years later, the rule would reverse, and "you could say it was a satellite, but you could not say that it involved reconnaissance." Maj. Gen. David D. Bradburn, "Evolution of Military Space Systems," Hall and Neufeld, 61.

[10] R. Cargill Hall, "Civil-Military Relations in America's Early Space Program," in Hall and Neufeld, 25.

The successful launch of Sputnik took the American public and many in the government and scientific establishment by surprise. Coming as it did less than six weeks after a successful Soviet ICBM test, Sputnik shifted the momentum of the space race emphatically toward the U.S.S.R. In the political and diplomatic spheres, it was a tremendous coup.

Sputnik's launch had far-reaching effects in social, political, and military arenas. It raised the possibility that the Soviets could achieve technological superiority in space. This was a disturbing thought for U.S. allies and the domestic public alike. Later, Senator John F. Kennedy described the essence of the problem. "If the Soviets control space they can control the Earth, as in past centuries the nation that controlled the seas dominated the continents," he proclaimed. "We cannot run second in this vital race. To ensure peace and freedom, we must be first."[11]

However, the Soviets had also done the U.S. one tremendous favor. Because the U.S.S.R. had been the first country to launch a satellite that orbited without regard for national airspace boundaries, it could not object to another country doing so, even if the satellite were used to gather intelligence. In the long run, this was "an American strategic victory of the highest order...."[12] In the short run, America needed to catch up in space, and fast.

The shock of Sputnik and the impending menace of ICBMs immediately propelled U.S. space efforts into overdrive. Before Sputnik's launch, military satellite programs had been relatively low profile and were modestly funded. Then, as one Air Force officer recalled, "Sputnik went into orbit and suddenly there was money all around."[13] Another participant remembered that with Sputnik's launch, "everyone became a space cadet and it wasn't necessary to plead our case any longer. Now the Washington crowd came to us and said: 'Where is your satellite? Why aren't you ready to launch?'"[14]

It was a new hurry-up, high-stakes game for both sides. Satellite programs had to respond to the new imperative, ready or not.[15]

---

[11] Worden, 5. Quoting Sen. John F. Kennedy campaign speech, 1960.

[12] Stephen B. Johnson, "The U.S. in Space: Cooperation and Coercion," *Policy Options*, April 2002, 59.

[13] Bradburn 61.

[14] Hall, "Civil-Military Relations", 26.

[15] In response to Sputnik, the U.S. created new space agencies, including the civilian National Aeronautics and Space Agency (NASA). Within the Department of Defense, the Advanced Research Projects Agency (ARPA) centralized all military space research. ARPA's control was short-lived, and its effectiveness was a point of contention. However, its existence signified the new focus and high profile of space programs in the Defense Department. To further streamline efforts among the service branches, the Secretary of Defense assigned the development of communication and weather satellites to the Army and navigation satellites to the Navy. The Air Force would have control of military rocket boosters and would be responsible for launching payloads for the other services. The Air Force would also be in charge of surveillance and warning satellites. Future space systems development would be assigned to the Air Force as well. Space and Missile Systems Center, "Mission and Organization," http://www.losangeles.af.mil/SMC/HO/INDEX.HTM, 1. Although the Air Force would develop, deploy and operate the reconnaissance systems, the ultimate customer would be the newly established National Reconnaissance Office (NRO). The top-secret NRO was created in 1961 to direct the operations of these satellites. It assigned the missions, and coordinated with the Air Force to receive data from the operational reconnaissance satellites. The existence of the NRO was declassified in 1992. Worden, 19.

CHAPTER 3.0 The MIDAS Program

The new sense of urgency affected the satellite programs which were already underway. One of these was WS-117L, the Advanced Reconnaissance System.

3.1 Genesis

> *The ballistic missile is, above all, a weapon of surprise. Conversely, the most important defensive measure associated with it is protection from surprise.*
>
> – Gen. Bernard A. Schriever, USAF[16]

In 1954 the Air Force had established the Western Development Division of the Air Research and Development Command, and had begun to plan a series of reconnaissance satellites jointly known as Weapon System 117L (WS-117L), or the Advanced Reconnaissance System. WS-117L was intended to carry out a variety of reconnaissance and warning missions.

WS-117L went out for bid in 1955, and in 1956 the Air Force selected Lockheed as the prime contractor. At first, the program was funded at only a fraction of what its managers proposed. Some modest progress was made, but the project was hardly rocketing forward. Sputnik, however, "substantially improved the funding situation for space activities," and early in 1958, the Advanced Reconnaissance System received new resources and high priority ranking from the National Security Council.[17]

By 1958, the different subsystems of WS117L had crystallized into three separate efforts: CORONA (known publicly as Discoverer), SAMOS (Sentry), and MIDAS. Although Lockheed was the prime contractor for 117L's subsystems, these three programs were eventually funded and engineered independently of one another.

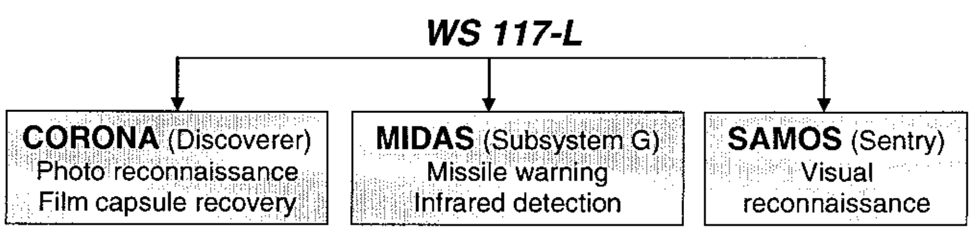


Figure 3. Component programs.

[16] Lt. Gen. Bernard A. Schriever, "The Operational Urgency of R & D," *Air University Quarterly Review* 12, (Winter/Spring 1960-61), 232.

[17] N.W. Watkins, "The MIDAS Project: Part I, Strategic and Technical Origins and Political Evolution 1955-1963," *Journal of The British Interplanetary Society* 50, (1997), 217.

CORONA and SAMOS were the two other primary programs. SAMOS was an early attempt to transmit visual reconnaissance images to earth, while CORONA captured film imagery and returned it to earth in a capsule. With its analog technology, SAMOS could not transmit its data to the ground quickly enough before passing out of range, and it was ultimately unsuccessful.[18] CORONA, on the other hand, was the most successful of the three WS-117L programs.

At first, the CORONA program operated under an elaborate cover story. Publicly, it was known as Discoverer, and its launches were widely publicized as a series of scientific missions intended to gather information about space conditions. Meanwhile, the real CORONA took surveillance pictures and returned them to earth in a capsule over the Pacific Ocean. Air Force planes retrieved the package in mid-air, still under cover of the alleged scientific program. CORONA became more covert after the Discoverer story was discontinued in 1962. The program operated until 1972, with 121 successful missions.[19]

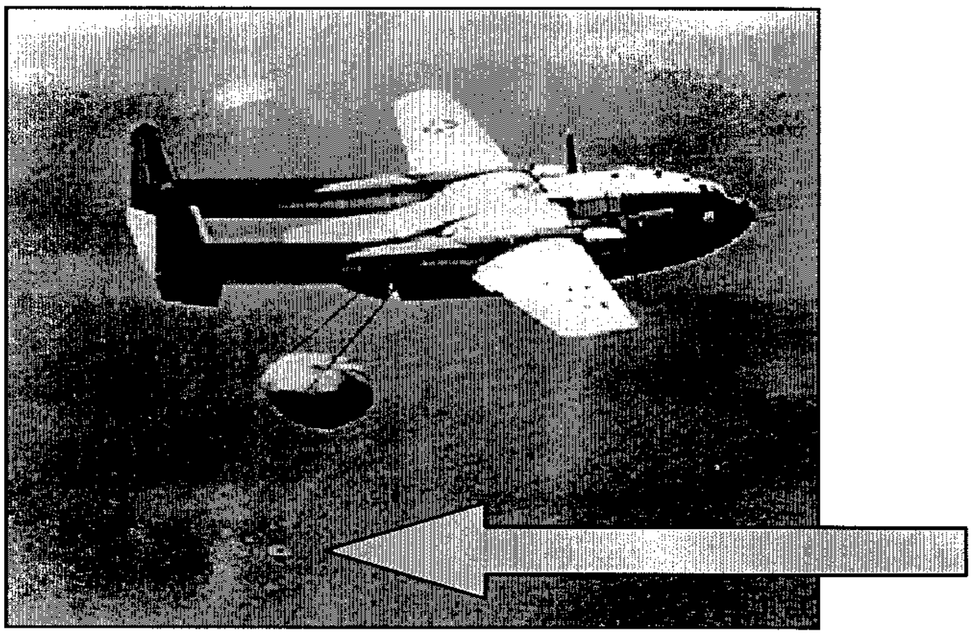


Figure 4. A C-119 recovers the Discoverer (CORONA) 14 capsule. U.S. Air Force, *http://www.wpafb.af.milmuseumspace_flightsf6a-3.jpg.*

[18] Watkins, 222.

[19] The true purpose of CORONA was known to very few people until years later. Even ground controllers, who sent commands to the satellite, were not cleared to know the meaning of what they were sending. David C. Arnold, *Supporting New Horizons: The Evolution of the Military Satellite Command and Control System, 1944-1969,* Ph. D. Diss., Auburn University, May 2002, 198, 245. Even Lockheed, the prime contractor, was kept in the dark. Only four people on its staff were briefed. "KH-1 CORONA," *http://www.globalsecurity.org/space/systems/kh-1.htm.*

ALASKA'S ROLE IN CORONA

CORONA used polar-orbiting satellites to take pictures of "denied" areas behind the Iron Curtain. Consequently, successful film recovery was the key to the CORONA program.

When it was time to bring the capsule containing the film back to earth, ground controllers would send a signal to the satellite which would cause it to fire retrorockets to position the capsule for reentry. After the capsule reentered the atmosphere, a special parachute deployed to control its descent toward the Pacific Ocean. Then, specially modified C-119 aircraft based in Hawaii were dispatched to the target area, known as "the ballpark." In well-rehearsed flight patterns, the pilot would approach the descending capsule, snag the parachute lines in mid-air, and the crew would reel the capsule onto the plane. In the event the aircraft missed, frogmen were stationed on nearby vessels and could be helicoptered to the splashdown site to make a water retrieval.

Given the satellite's orbital speed and trajectory, Alaska was the best place to send the re-entry commands so that the capsule would come down in the ballpark. The Air Force constructed a tracking station at Chiniak, on Kodiak Island, primarily for CORONA support. The Chiniak station, call letters KODI, supported CORONA missions from 1959 to 1972, when the program ended. The station continued in service for a few more years, until 1975.

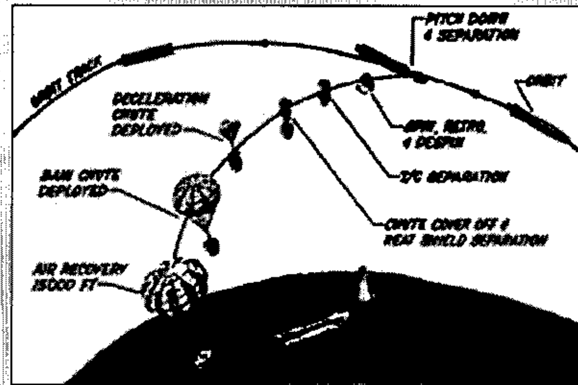


Figure 5. CORONA recovery process. Courtesy Bob Siptrott, http://209.165.152.119/af_track/bob_recovery.html.

MIDAS, or Missile Defense Alarm System, called for a constellation of polar-orbiting satellites which could use infrared technology to detect and track a missile's heat plume. MIDAS satellites would identify potentially hostile launches and then transmit data to ground stations, which would be linked into the North American Air Defense Command (NORAD) network. This would offer up to fifteen minutes' additional warning beyond what ground radars could provide.[20]

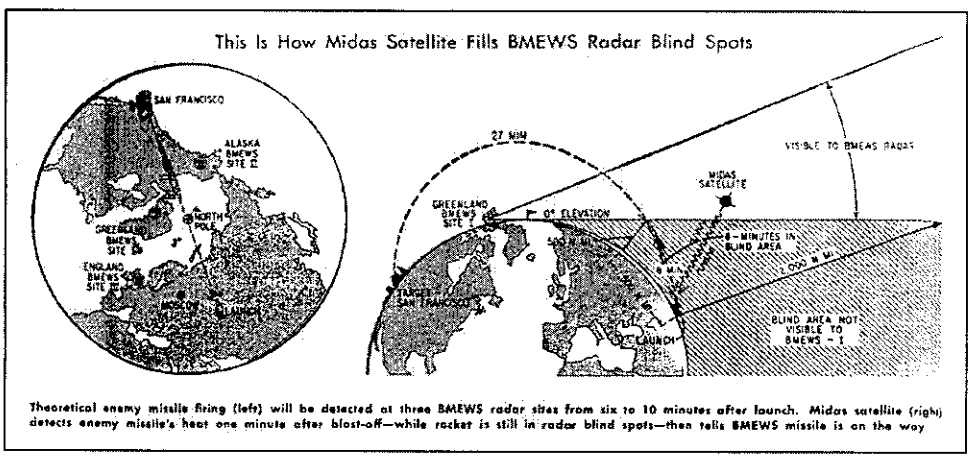


Figure 6. Diagram from contemporary magazine. "How Satellites Work With Radar," *Electronics*, 1 April 1960, 42.

[20] The infrared detectors tracked signatures from a missile's rocket motor during the initial portion of the ascent when the motor was operating. MIDAS could only provide the additional 15 minute warning window for land-based ICBMs. Sea-launched ballistic missiles (SLBMs) had shorter trajectories, which MIDAS was not designed to track. Email, Michael Binder, 30 May 2006.

When MIDAS began, virtually all the technology was untested, from the infrared sensors to the space vehicle to the ground support. Yet everything had to be reliable, or the system would be pointless, or worse. As one historian explained, "The eventual operational requirements for MIDAS would have to be much more demanding than those for the contemporary Discoverer/CORONA program. It would need greater reliability if it was to be the basis for a nuclear counterattack, and its technology...was less advanced."[21]

The MIDAS program was spurred on by the Sputnik effect and the exigency of the times. The need for missile warning was so great that tremendous pressure was placed on the designers and engineers to produce an operational system, even before the preliminary space research had been done. As it turned out, in spite of the investment in equipment, facilities, and research, MIDAS never was placed on active alert to warn NORAD and the Strategic Air Command of impending attack.

3.2 Technical Difficulties

The system's usefulness depended on its ability to do several things: detect launches almost instantaneously, avoid false alarms, and flash the warning to a command center. The infrared technology in particular required substantial research and development to make sure the sensors would screen out background thermal radiation and identify missile signatures correctly.[22]

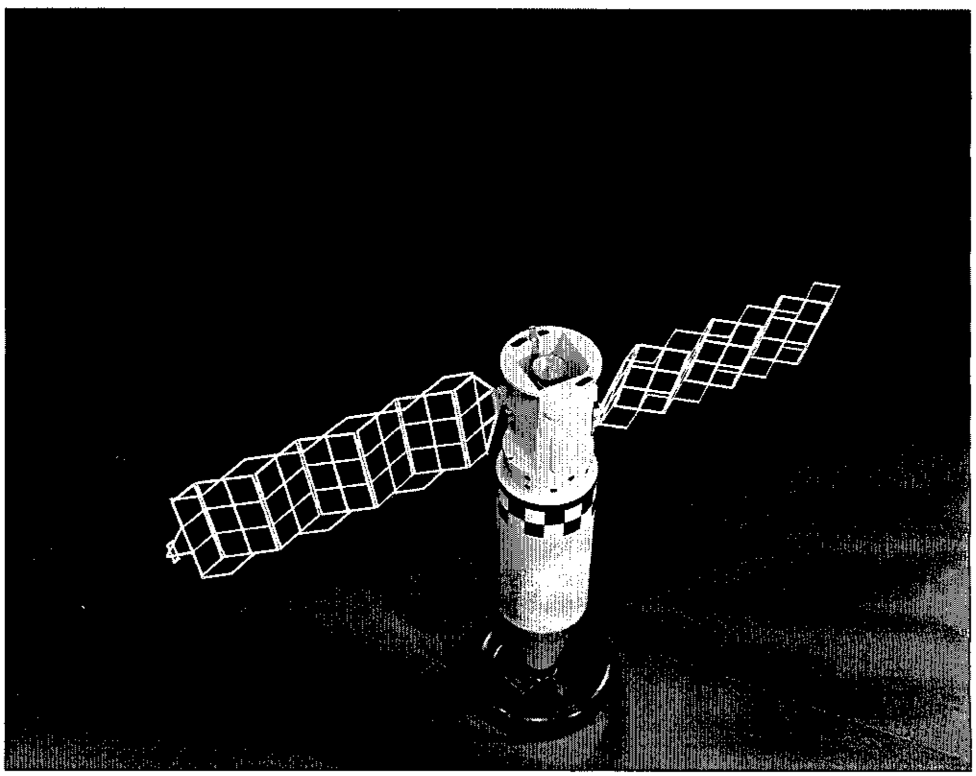


Figure 7. Model of MIDAS satellite with its solar array extended. U.S. Air Force photo 180715, courtesy National Air and Space Museum, Smithsonian Institution (SI 2005-7939).

[21] Harry Waldron, "The MIDAS Program," Space and Missile Systems Center History Office, December 1998, 2.

[22] "It was not enough to detect the presence of a missile launch reliably, it was also essential both to minimize spurious signals and to find a way of recognizing them as spurious if they were generated – in other words, the goal was both to detect missile launches and to *not report* other infrared events as missile launches." Watkins, 217.

The challenges of infrared detection from space were complex. Wavelengths of various chemical substances in the booster exhaust would create a "signature" that the satellite sensors could measure and identify. However, the detector would have to account for the background radiation in the atmosphere in order to discriminate a rocket signature. A contemporary science writer pointed out that "[t]he problem...is complicated by the fact that the principal combustion projects from a hot rocket exhaust are carbon dioxide and water vapor. But these are also the principal constituents of the atmosphere." The sensors would also have to exclude readings from natural infrared anomalies such as volcanoes, forest fires, and the reflection of sunlight on clouds. Sensors would be seeking a signature that was partially absorbed by the atmosphere before the wave emissions even reached the satellite, so the absorption factor had to be calculated as well. At the time MIDAS was first proposed, there had been some high altitude flights to collect atmospheric infrared data but no space-based measurements to use as a baseline.[23]

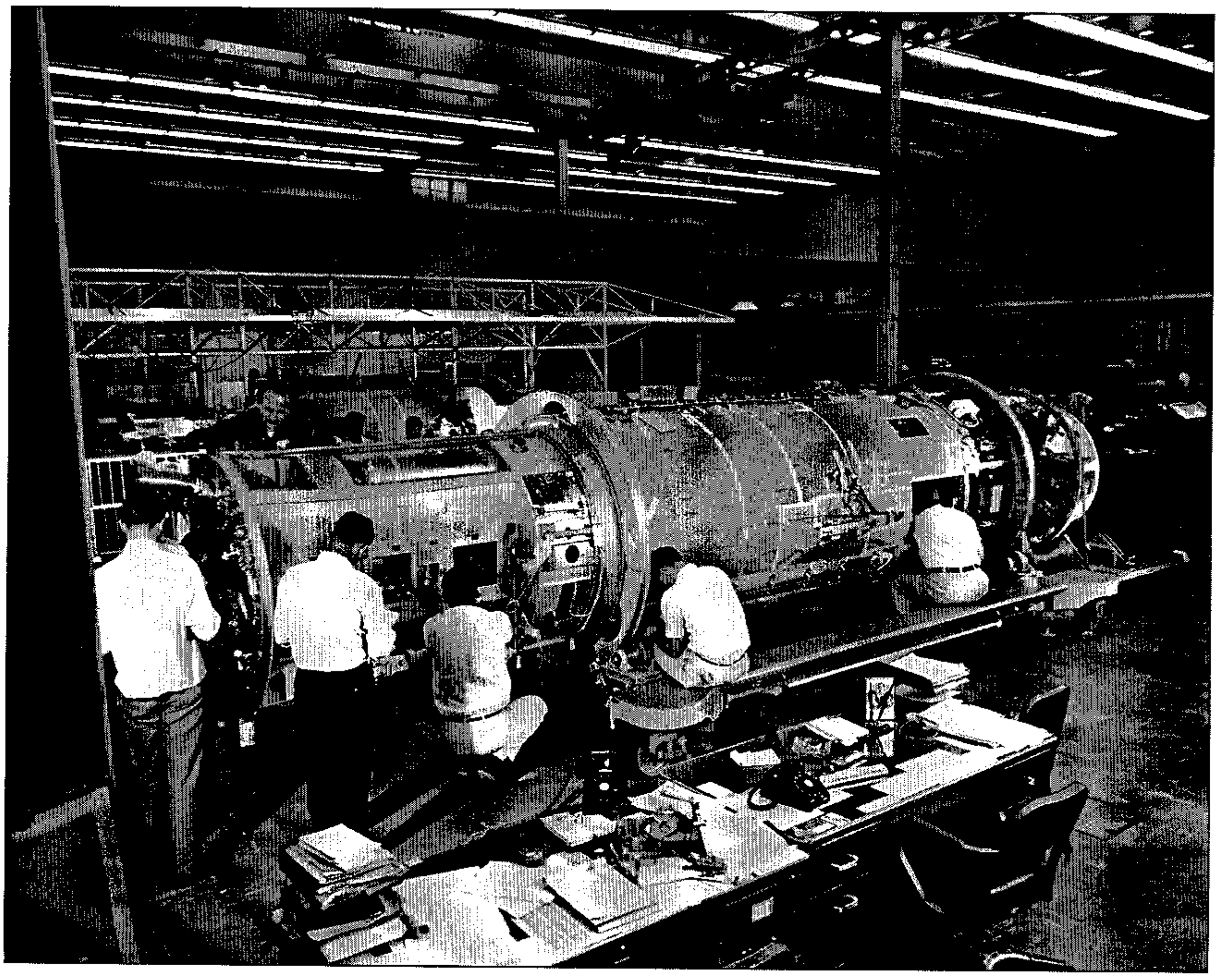


Figure 8. Technicians assembling hardware for MIDAS IV Agena booster. U.S. Air Force photo 180716, courtesy National Air and Space Museum, Smithsonian Institution (SI 2005-7938)

[23] Quote, Philip J. Klass, "Lack of Infrared Data Hampers MIDAS," *Aviation Week and Space Technology*, 24 September 1962, 54-55, 57. Discussion of atmospheric effects and background information compiled from Klass, 55 and R. Cargill Hall, "Missile Defense Alarm: The Genesis of Space-Based Infrared Early Warning," *Quest: The History of Spaceflight Quarterly*, Spring 1999, 6. Many of the program histories cited elsewhere in this report also discuss the debate over the lack of background data.

THE MANNED ORBITING LAB

MIDAS satellites were unmanned vehicles, relying on infrared sensors to detect missile launches. For a while, the Air Force also investigated the possibility of having human military observers in space to complement this capability.

The Manned Orbiting Lab (MOL) program began in 1963 with plans to test a two-astronaut cylindrical station connected to a Gemini spacecraft. According to a participant, MOL was intended to provide information on the use of military personnel in space, but "was essentially a manned reconnaissance vehicle with cameras." [24]

The Air Force trained three groups of astronauts for the mission and developed an MOL prototype, but it was never launched. The program was cancelled in 1969.

Engineering a reliable infrared detector was only one aspect of the system. To ensure that warnings would flash from the MIDAS sensor 2,000 miles up in space to the proper decision makers on the ground, there had to be an infrastructure that went far beyond the satellite hardware. MIDAS required research and engineering facilities to develop the hardware, launch complexes to send the vehicle into space, and tracking stations around the world to monitor its journey into orbit and control its flight. Once the satellites were up and circling regularly over the polar regions, they would transmit signals to dedicated ground stations. In the event of a surprise attack, these stations could compress and relay the data directly to commanders at NORAD. On a more everyday level, these stations would monitor the satellites and record the transmitted data for future use.

3.3 A Program in Flux

The Air Force launched nine MIDAS missions between 1960 and 1963. Early launches were plagued with technical failures, which was not unusual for the time. In fact, the celebrated "Discoverer" program (CORONA) experienced twelve consecutive failures before registering a success, far more initial failures than MIDAS had.[25] Yet MIDAS provoked more controversy within Congress and the Defense Department because of its considerable expense and its technical challenges, and this controversy ultimately re-shaped the program.

Midas Infrared Measurements Cut Short by Telemetry Failure

Figure 9. Headline, *Aviation Week*, 6 June 1960, 31.

Debates swirled at high levels, including Congress, regarding the cost and the technical difficulties the program faced. As a result, in 1962 the Secretary of Defense McNamara directed the Air Force to reconfigure MIDAS as a research and development program. Instead of following its planned progression from an experimental to an active warning system, MIDAS would test concepts and system improvements but would not become operational. Scheduled MIDAS launches in 1963 would go forward, but after that, the program would shift focus. A series of

[24] John L. McLucas, "The U.S. Space Program Since 1961: A Personal Assessment," in Hall and Neufeld, 88.

[25] The first U.S. CORONA capsule recovery did not occur until the program's thirteenth mission, and the first film recovery on the fourteenth.

research test satellites known as RTS-1 would continue to refine detection capabilities. Meanwhile, the Air Force would pursue plans for a follow-on system.

Ironically, by 1963 the existing MIDAS program began to report preliminary success. MIDAS 7 and MIDAS 9 performed favorably. But by then, the program had already been re-cast as a research effort. In 1966, the modified MIDAS program known as Program 461 made a final series of polar-orbit test launches with the RTS-1 satellites. Although these tests proved successful and finally vindicated the system's designers, the MIDAS program had run its course.[26] In 1966 the Air Force opened bids for a second-generation system that abandoned low-level polar orbits in favor of a geostationary orbital configuration. The winner was Lockheed's competitor TRW. That system eventually became known as the Defense Support Program (DSP).

Table 1. MIDAS and 461 Launches.

Date	Payload	Launch Vehicle/ Spacecraft	Orbital Info	Results
2/26/60	MIDAS 1	Atlas 29D/ Agena A	Equatorial	Launch failure
5/24/60	MIDAS 2	Atlas 45D/ Agena A	Equatorial	Attitude control failure in orbit
7/12/61	MIDAS 3	Atlas 97D/ Agena B	Polar	Power failure in orbit
10/21/61	MIDAS 4	Atlas 105D/ Agena B	Polar	Incorrect orbit
4/9/62	MIDAS 5	Atlas 110D/ Agena B	Polar	Power failure in orbit
12/17/62	MIDAS 6	Atlas 131D/ Agena B	Polar	Launch failure
5/9/63	MIDAS 7	Atlas 119D/ Agena B	Polar	SUCCESS 47 days in orbit
6/12/63	MIDAS 8	Atlas 139D/ Agena B	Polar	Launch failure
7/18/63	MIDAS 9	Atlas 75D/ Agena B	Polar	SUCCESS 11 days in orbit
6/9/66	Prog 461 RTS-1 F1	Atlas 7201/ Agena D	Polar	Launch failure
8/19/66	Prog 461 RTS-1 F2	Atlas 7202/ Agena D	Polar	SUCCESS 325 days in orbit
10/5/66	Prog 461 RTS-1 F3	Atlas 7203/ Agena D	Polar	SUCCESS 372 days in orbit

Adapted from Hall, "Missile Defense Alarm," 15, and Richelson, 250.

It is worth remembering that in the Cold War space race, the line between operations and research was not always clearcut. In 1960, Air Force General Bernard Schriever pointed out that, "...in a technological war of the kind we are now waging the laboratory, the assembly line, and the test range comprise the combat theater. Research and development has become almost an operational function, inseparable

[26] Two out of three of the RTS-1 missions were successful. Hall, *Missile Defense Alarm*, 15.

from the strategic performance of the systems which it produces."[27] MIDAS and its ground stations were on the front lines of this "combat." As a result, the follow-on system – the DSP – was able to take on the warning mission in the early 1970s. Today, MIDAS is considered to be a success – not as an operational system, but as a pioneering proof-of-concept program that laid the groundwork for the DSP.[28]

[27] Schriever, 234.

[28] Fred Simmons and Jim Creswell, "IR Eyes High in the Sky: The Defense Support Program" *Crosslink*, vol. 1, no 2, Summer 2003, 2.

CHAPTER 4.0 Satellite Support

> *[W]ithout the military satellite command and control system, there could have been no winning the Cold War.*
>
> – Arnold, 7

Rocket launches are packed with drama, as countdowns progress toward a fiery ignition and liftoff. Yet none of that drama would have a purpose if no one on the ground could monitor a vehicle once it was in space. Ground support is the hidden element in space history, often overlooked in discussions of programs and policies and systems development.

4.1 "Talking" to the Satellites: Command and Control

But what is satellite support? Basically, it consists of all the ground efforts to track and contact a satellite and collect its data. As one author put it, command and control "provides the essential link between the satellite in its lonely orbit and the people who need its data."[29] A centralized control facility coordinates the activities of remote tracking stations as they work together in relays to track satellites, maintain communication, and transfer data.

A satellite's orbital pattern affects how ground operations are conducted. Orbits can be geosynchronous or inclined. Inclined orbits are described by their angles of inclination from the equator and can range from equatorial to polar. A satellite in geosynchronous orbit moves at the same speed as the earth below it. From a ground observer's perspective, it appears to stand still. Once in orbit, a geosynchronous satellite can be served by a single ground station.

Other satellites with inclined orbits require a worldwide ground support network. The location of these stations is a function of the "ground track" of the satellite: the areas of the earth it is passing over. Because the earth is rotating while the satellite is orbiting, the ground track does not cross the same place on every orbit. This means the same ground station cannot capture every pass. However, the ground station does not have to be directly under the satellite to support it. It can capture any passes within a radius known as the station mask. The more often the ground track falls within the station mask, the more useful the ground station will be.

For a polar-orbiting satellite, there is more distance between successive ground tracks at the equator than near the poles. In the polar regions, the ground tracks are much closer together, allowing high latitude tracking stations to capture more passes.[30] The Arctic and Antarctic were desirable locations for ground communication with polar-orbiting satellites, because they were positioned strategically under

[29] Arnold, 2.

[30] "[A] satellite passed successively farther west of the launching point on each revolution because the earth rotates under the satellite's orbit....Therefore, the optimum location for tracking polar orbits is at or near the poles because the earth does not rotate as far away from a satellite's orbit." Arnold, 56. Polar orbits can also be eccentric, with considerable variation between apogee and perigee. This is a useful characteristic. "[A] small perigee over the target area enhances photo resolution...while a large apogee away from the target area facilitates communication with distant ground stations (higher altitude, longer commo times)." Email, Michael Binder, May 31, 2006.

the satellites' ground track. The Antarctic was off-limits for political reasons, so Arctic locations were of prime importance. Alaska in particular was useful because of its geographical position and because it was United States territory.

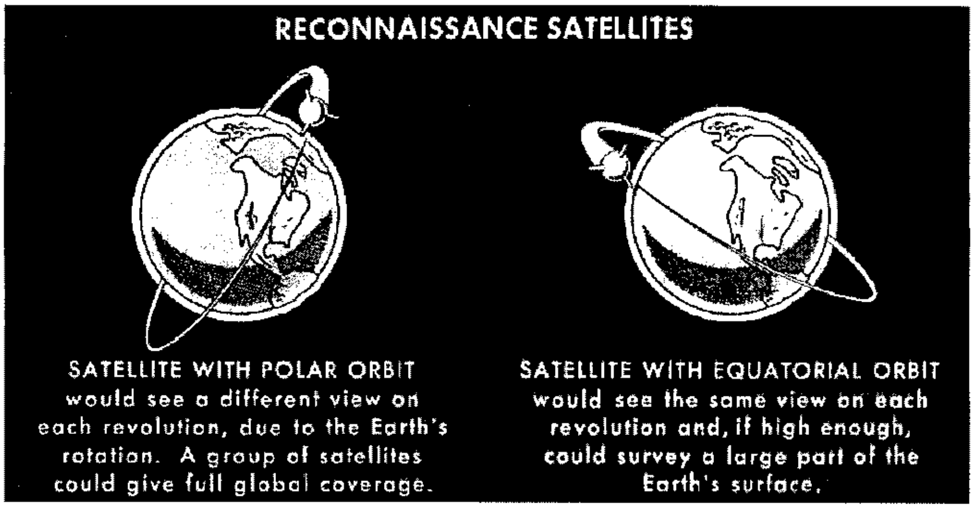


Figure 10. Example of equatorial and polar orbits. Marvin Hobbs, *Basics of Missile Guidance and Space Techniques, vol 2* (New York: John F. Rider Publishing, 1959), 2-77.

Ground operations are also affected by the height of the orbit. A satellite in geosynchronous orbit moves at the same relative speed as the earth below it. The laws of physics dictate that it will be about 22,000 miles out to sustain the proper velocity. Other satellites are much closer. A typical equatorial orbit is about 300 miles high while polar orbits are usually around 2,200 miles distant. These near-earth satellites make multiple passes in a day. From a ground observer's perspective, the closer a satellite is, the faster it is moving around the earth. Naturally, the faster the satellite passes by, the less time the ground station has to track it and communicate with it before it is out of range. These fast passes prompted early Air Force controllers with the CORONA program to create the so-called Six Second Rule: "Two seconds to identify the problem, two seconds to decide what to do, and two seconds to do it."[31]

As the satellite crosses the horizon, the tracking station has to locate, or "acquire" it.[32] Once the space vehicle is acquired, station technicians observe its orbital parameters, or "ephemerides" – position, speed, and trajectory – in order to calculate its future location. They can then "hand it off" to the next tracking station as it passes quickly out of range. Each tracking station only has the satellite in its sights for a short time during the satellite pass.

In addition to keeping track of where the satellite would be, ground controllers had to communicate with the satellite to monitor its operation and collect its data. Telemetry is the term used for the measurement and transmission of data across

[31] Arnold, 158, quoting Patrick O'Toole email.

[32] Satellites can be tracked using optical or radio wavelengths. Optical methods include satellite telescopes and special satellite tracking cameras. Radio tracking can be accomplished in several ways. A satellite can send signals directly to the ground from a pre-programmed on-board beacon or transponder, and its orbits can be calculated by interferometry, a method that measures incoming signal angles. Ground stations can also track satellites using radar echoes to measure the satellite's distance, and antenna angles to indicate bearing. Since returning signals weaken with distance, it is more common for ground-based radars to send a pulse to the satellite, activating its transponder, which would then return a signal back to earth, allowing for both tracking and communication.

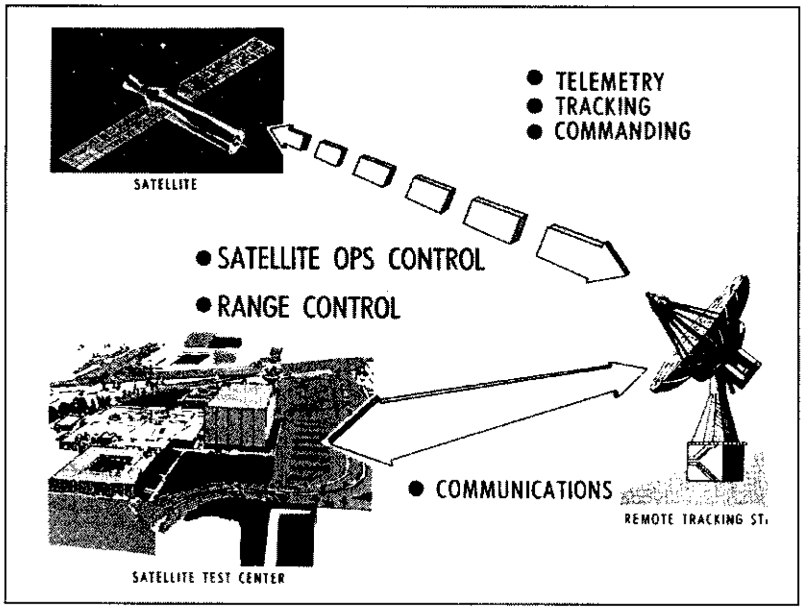


Figure 11. Command and control illustration, Air Force Satellite Control Network. Courtesy Bob Siptrott.

distances. In satellite operations, telemetry provides diagnostic information about the performance of the satellite and its on-board technology. Telemetry can also refer to the transfer of mission data, such as photographs, TV transmissions, or whatever the data product might be. In simplified terms, telemetry is accomplished by transferring the desired information onto radio signals and exchanging those signals between the satellite and its ground stations. This exchange of signals is the heart of the command and control function.[33]

4.2 Support During a Pass

Pass support is coordinated through a central control facility, which sends pre-pass orbital status to the remote tracking stations and determines any commands that needed to be processed. During the pass phase, the tracking station captures the satellite telemetry and transmits commands. Following a pass, telemetry would be forwarded to the command center and the station would prepare for the next pass.

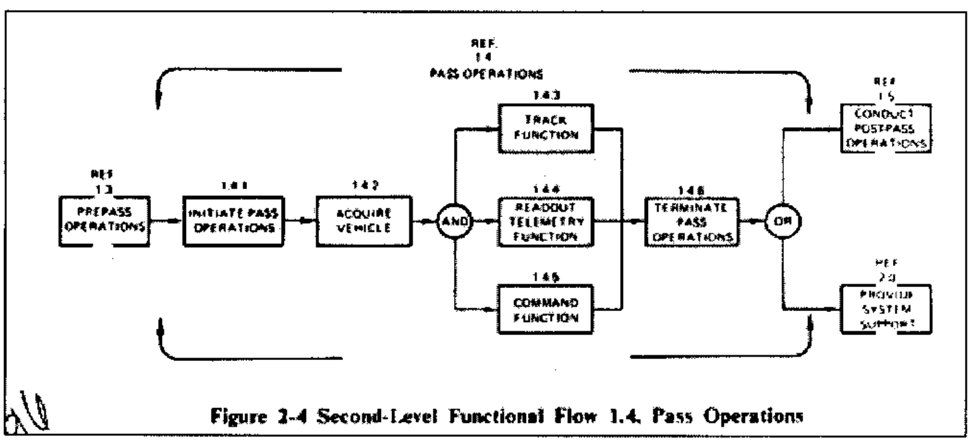


Figure 12. Pass Operation Diagram from AFSCN. Courtesy Bob Siptrott.

In addition to communicating with the satellite, remote ground stations must also communicate with the central command and control location. In the early 1960s, this meant using the standard land-based networks of the day: telephone lines, underwater cables, microwave towers, tropospheric scatter and high frequency radio. Although the control room at the Air Force's Satellite Test Center in Sunnyvale, CA, was "one of the world's most modern communications hubs" at the time, re-

[33] Arnold, 2.

mote site communication was not always equally advanced. The CORONA tracking station on Kodiak, for example, relied on one telephone line and one teletype machine to reach Sunnyvale.[34] However, because of its warning function, MIDAS would have been designed with state-of-the-art, real-time connections to the NORAD network for its mission data, as well as operational connections to satellite controllers at Sunnyvale.

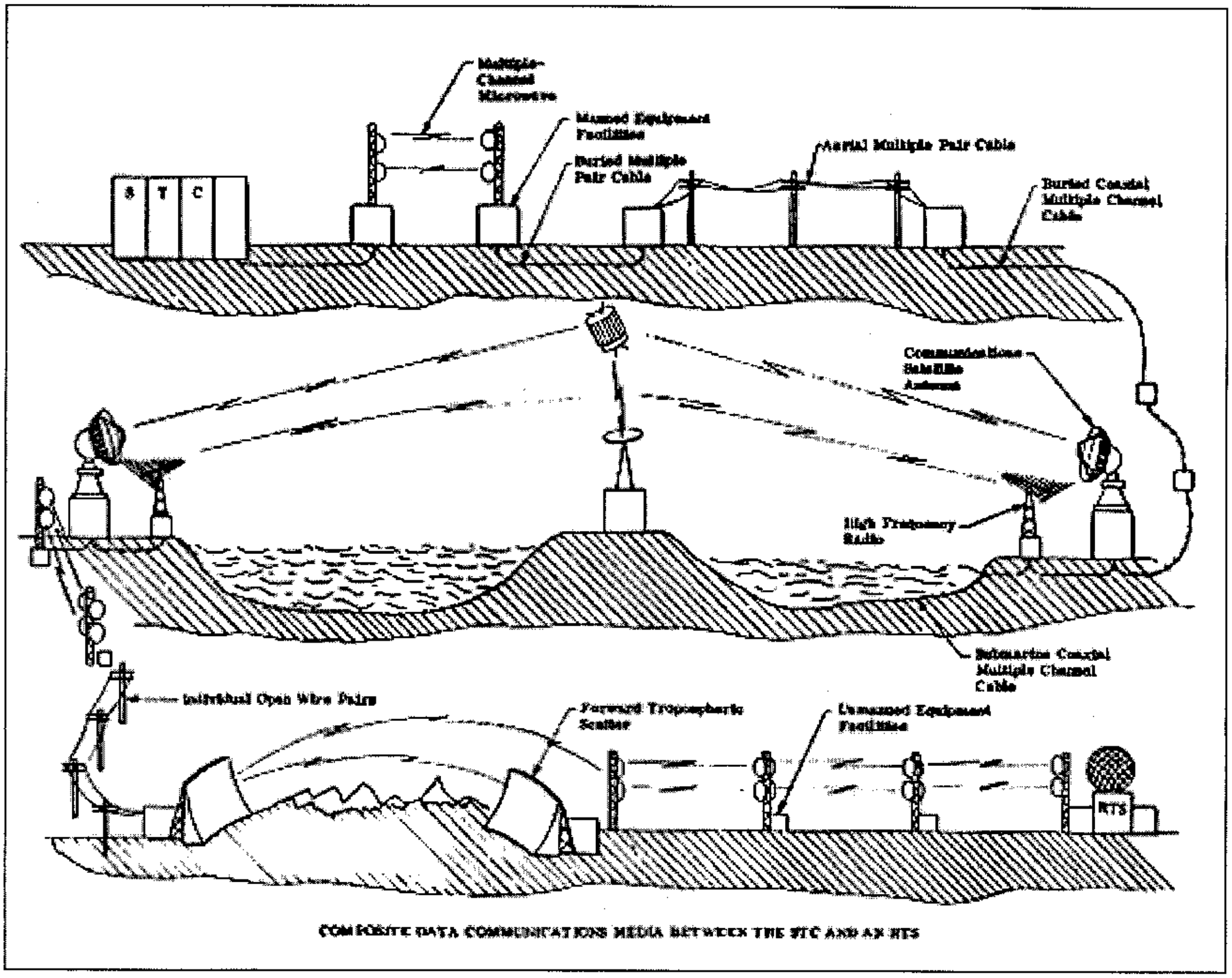


Figure 13. Example of communications between a remote tracking station (RTS) and the Air Force control center at Sunnyvale (STC). Courtesy Bob Siptrott.

[34] Arnold, 152. The tracking station on Kodiak Island relied on one telephone line and a single one hundred word-per-minute teletype to reach Sunnyvale. Technicians forwarded some telemetry readouts over the teletype and phone line, but much of the data was mailed in hard copy. Arnold, 96-97. Since CORONA returned its mission data to earth in a capsule and not thru telemetry, this delay was not significant.

4.3 The Early Challenges of Satellite Support

> *"The tracking and data-acquisition system... makes this miracle [of spaceflight] possible. It is probably even more complex than the space vehicle..."*
>
> – Dr. Werhner von Braun, ca 1963[35]

Locating and communicating with a small speeding object in space can be a daunting task, requiring precision tracking and timing. In the earliest years of the space age, when tracking technologies were in their infancy, it was especially challenging. As historian David Arnold put it, "[i]n those early days... everyone tried their best to make command and control work, inventing most everything as they went along."[36]

Satellites were difficult to track because variations in the earth's gravitational pull caused their orbits to shift slightly on every pass. Computers were essential to predict these changing orbits, but computer tracking programs were just being invented. Orbital calculations and data processing were run on state-of-the-art 32K memory machines, programmed with punch cards.[37] To complicate matters, sometimes satellites would end up in the wrong orbit because of technical malfunctions.

Radio beacons on payloads were weak and could be unreliable. To compensate, early receiving antennas were large and cumbersome. The distance between control centers and widely dispersed ground stations also created a considerable hurdle. It seems inconceivable today that a satellite ground station would have to rely on land-based communications to reach its control center, or submit telemetry readouts through the mail, but this was the case in places like Kodiak.

Under these circumstances, when a launch date approached, ground stations prepared intensively. In the early years, station staff might rehearse for a launch for three to four weeks.[38] Low-orbit satellites like these moved quickly, and each station would only have the satellite in its sights for a short time. At tracking stations around the world, the ground equipment and the people had to be standing by and ready, even if the launch was scrubbed or the satellite equipment failed.

Although we now take satellites for granted as part of the infrastructure of modern life, it was not that long ago that engineers and technicians created this technology. They overcame the challenges, even if they were "inventing...as they went along."

[35] Wernher von Braun, *Space Frontier* (New York: Holt, Rinehart and Winston, 1963), 69, quoted in Arnold, 263.
[36] Arnold, 17.
[37] Arnold, 151, 152. The earliest tracking computers themselves were analog rather than digital.
[38] Arnold 156.

CHAPTER 5.0 North Pacific Station: Ground Support for the MIDAS Program

The MIDAS program called for operational readout stations at three high-latitude locations in the United Kingdom, Greenland, and Alaska. The plan was for these stations to receive infrared data transmissions from the satellites, then compress and relay that information to a control center linked to NORAD.

One of these stations was the North Pacific Station, located at Donnelly Flats in Interior Alaska. The station was located on Army land within the Fort Greely military land withdrawal, 12 miles south of Delta Junction and about 110 miles south of Fairbanks. It consisted of two complexes: a transmitter site and a receiving site, which were linked to a neighboring White Alice communications facility.

"Donny," as the technicians called it, came online in 1961. When the MIDAS program was suspended in 1963, the station was reduced to a caretaker status with a skeleton crew. Later, the internal equipment was reconfigured for the MIDAS follow-on, Program 461, and the site went back on line successfully in 1966 and 1967. It was shut down permanently in November 1967 when the program ended, and its equipment was removed and transferred to other stations.

5.1 The Air Force Satellite Control Network

The MIDAS stations and their sister stations in other Air Force satellite programs were collectively known as the Air Force Satellite Control Network (AFSCN). The AFSCN was based in a command and control center at Sunnyvale, California.

The AFSCN was created to support the first-generation military reconnaissance satellites. Because Lockheed was the prime contractor on these systems, the AFSCN was originally operated by Lockheed and its subcontractors under U.S. Air Force direction. As time passed, the Air Force took control of the operation and assigned operations to the 6594th Test Wing, although it continued to operate the network with considerable contractor assistance. At a higher level, the Air Force itself took mission direction from the security agencies which were collecting the surveillance data.

From 1959, when the first stations came on line, until the late 1970s, twelve different ground stations handled AFSCN support at various times. These stations included three in Alaska: Annette Island, active from 1959-1963; Chiniak on Kodiak Island, active from 1959-1975; and Donnelly Flats, active (with gaps) from 1961 to 1967. Other stations included Ft. Dix, NJ; Thule, Greenland; Guam; Seychelles; Kaena Point, Hawaii; New Boston, New Hampshire; Vandenberg, California; and TCS Oakhanger in Great Britain. Several of these are still active today.

The network was developed to coordinate support for the three systems that spun off of WS-117L – MIDAS, CORONA and SAMOS. Each of these systems had been designed by a different aerospace team for different missions, so initially each had different technical specifications for its remote ground stations. As the tracking function matured and programs changed, some ground stations became obsolete while others were reconfigured to handle new multiple satellite support tasks.[39]

Although the AFSCN's ground support network grew out of the needs of WS-117L and supported all of its programs, MIDAS planners designed their system to eventually spin off from AFSCN. As a warning system, MIDAS' primary purpose was to feed information directly to NORAD.[40] Therefore, MIDAS designers planned a separate Tracking and Control Center, or TCC, in the central U.S. The TCC would coordinate with the three northern readout stations and would be linked to a MIDAS Operations Center (MOC) at NORAD's Cheyenne Mountain facility. However, the TCC and MOC were never built, and MIDAS ground support remained under AFSCN until the program was terminated.

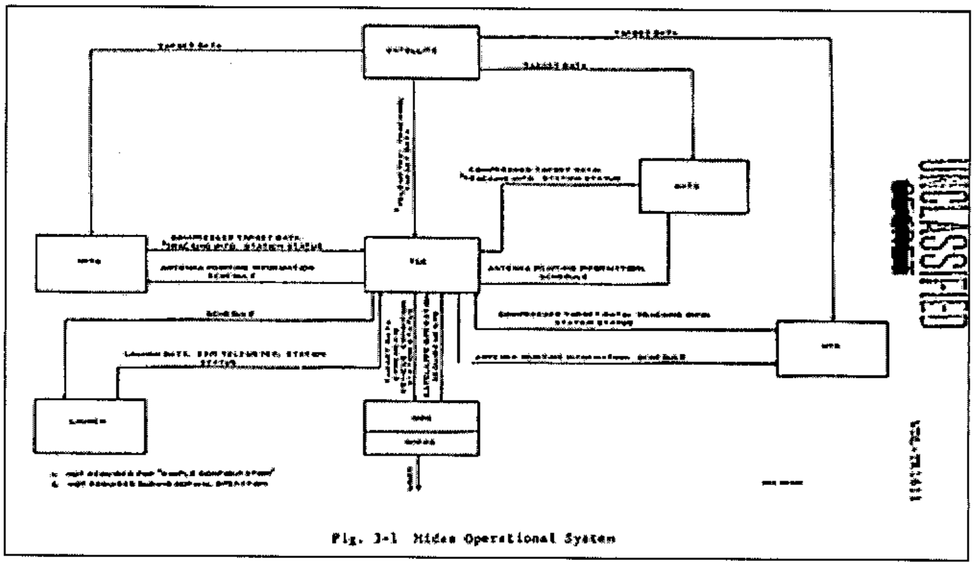


Figure 14. Proposed tracking and operation diagram. From Philco, *Operational MIDAS Ground Stations*, Sept 1961, 3-2.

5.2 The Changing Role of Donnelly Flats

Donnelly was intended to be the permanent North Pacific Station in an operational MIDAS system. It was funded and designed in early 1959 during the initial phase of the MIDAS concept, so the infrastructure reflected some of the earliest MIDAS plans. By the time it was equipped for use just two years later, the program had already changed. Technology had advanced and Donnelly's support mission had been scaled back. Consequently, some of the buildings were never used for their original purpose.[41] Donnelly was reconfigured for the 461/RTS launches, then disappeared like the rest of the MIDAS program when those experimental satellites went dark in 1967.

[39] It soon became evident that the Air Force would need a more coordinated network with ground stations capable of multiple satellite support. That, along with technological advances, prompted a system-wide upgrade starting in 1963. The upgrade was known by the name Multiple Satellite Augmentation and the acronym MSAP. At the same time, programs like MIDAS were being re-evaluated and re-designed.

[40] MIDAS had potential as an intelligence asset as well, being one of the prototypes for the various "National Technical Means" of arms control verification. For example, it would be able to observe and record data on Soviet missile test firings, as well as warn of actual missile attack. Whether it served this purpose during its experimental phase, and whether Donnelly may have been part of the development of these procedures is not known. If so, this could add one more layer of historical significance to the Donnelly site.

[41] These include the angle tracker building and two of the receiver buildings at the receiver site, and all the infrastructure at the transmitter site.

The MIDAS program experienced many modifications between its original conception and the conclusion of the 461/RTS series flights. By the time 461 was completed, resources and attention were already invested in the next-generation DSP.

Events and technologies had moved forward so quickly that it was easy to forget the scope of the early MIDAS plans. Originally, the MIDAS program was going to launch a series of prototype, experimental satellites and then move as quickly as possible into operational status. There were to be four test flights in Phase 1, six R&D flights in Phase 2, and then an operational system in Phase 3. By 1961, the schedule had been pushed back and the test flights reconceived as Series II and Series III, with prototypes in Series IV.[42] It was not until August 1962 that McNamara's directive finally cancelled all hopes for an operational MIDAS system.

A Lockheed report submitted in Dec 1961 offers a look into MIDAS facility plans before the McNamara break point. At that time, the company still expected MIDAS to become an operational system. The report classifies MIDAS facilities into four types: manufacturing, R & D facilities, operational facilities, and launch support.

In the Lockheed report, the R&D and operational aspects of MIDAS are linked together. As LMSC engineers understood it, during the R&D stage MIDAS would rely on existing facilities to provide program support while separate "single-purpose facilities specifically unique for the MIDAS requirements" were under construction. As these new operational facilities were completed, they would join the R&D program until the entire operational system was finished. Then the complete, integrated system would be able to go on line as a stand-alone entity.[43]

According to this report, the "R&D" facilities used for MIDAS support included the Point Arguello launch complex, Vandenberg Control Center and Tracking Station, the Satellite Test Center (AFSCN), and tracking stations in South Africa, Hawaii, Alaska, and New Hampshire. As noted above, these were not truly R&D facilities. They were existing resources created for other operational programs and utilized for the R&D phase of MIDAS.[44]

The planned operational facilities for MIDAS included the following:

- An independent launch facility with related storage and support buildings
- Launch tracking station
- Pacific downrange tracking and relay stations
- An orbit injection tracking station to monitor the final stage of transition from launch to orbital phase
- A dedicated Tracking and Control (TCC) facility to direct network operations (this would remove MIDAS from the AFSCN)

---

[42] Re test flight plans, Hall, *Missile Defense Alarm*, 7, 9. The Strategic Air Command was pushing to have access to the warning capabilities that MIDAS promised Some believed that this pressure contributed to MIDAS' technical problems by shortchanging the baseline research that was necessary to improve reliability. In any case, there was an ongoing tug-of-war over how much the early program should concentrate on research and how quickly it should become operational. After several years of controversy, this was settled in August 1962 when the Secretary of Defense directed MIDAS to be a research-only program.

[43] Lockheed Missiles and Space Company, *MIDAS Facilities Master Plan*, report submitted under contract AF04(647)-787, 15 December 1961, 2-103, 2-301.

[44] LMSC 2-202, 2-203. Re planned facilities, LMSC 2-302, 2-303.

- A Control and Display facility at NORAD's Cheyenne Mountain complex

- Three high-latitude tracking and readout stations, designated as North Pacific Station (Donnelly Flats), United Kingdom Station, and North Atlantic Station

When the Lockheed report was prepared, only two of these facilities existed. The "orbital injection" tracking station was part of an existing missile range. The only other complete facility was Donnelly Flats. The rest were essentially a wish list, in site selection or design phases, but not yet approved for construction.

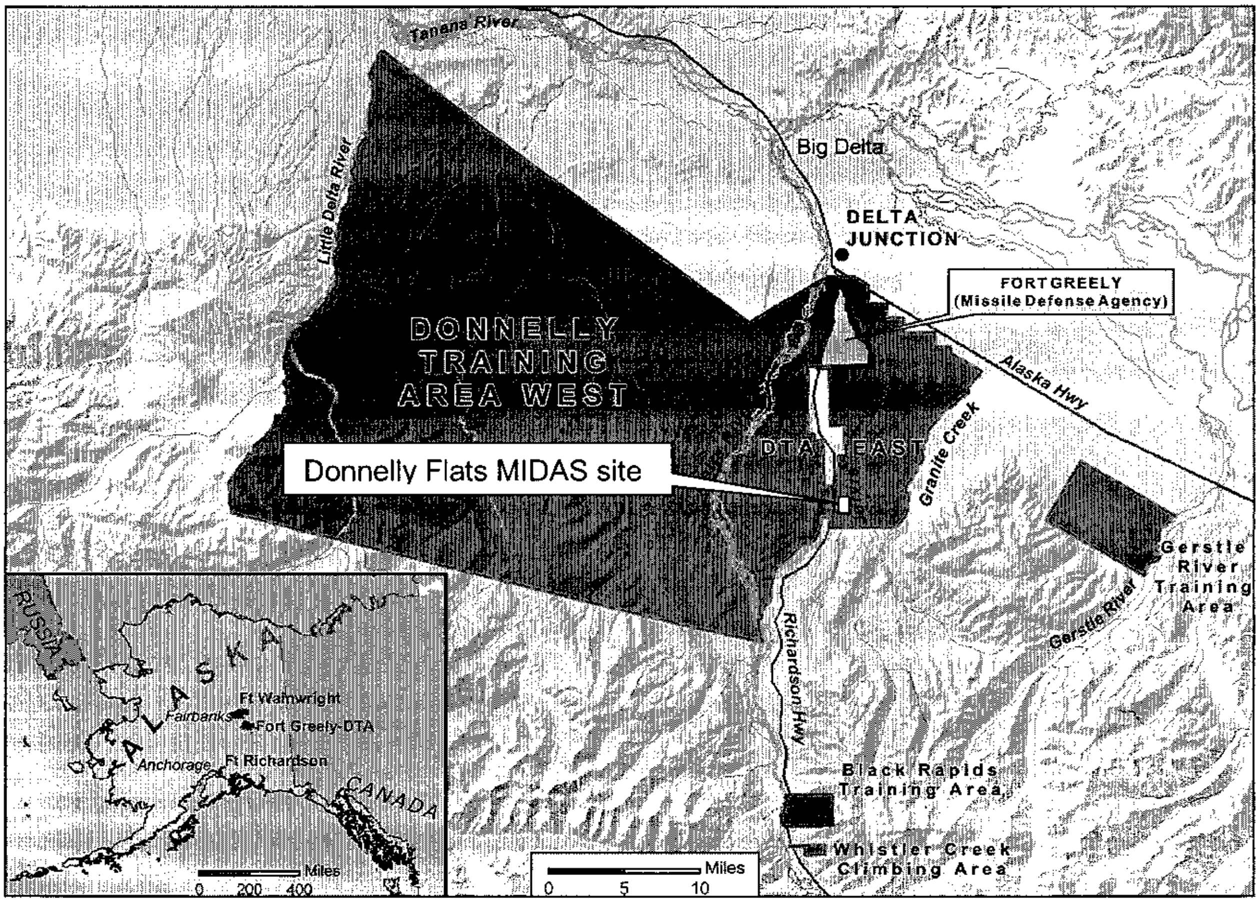
MIDAS planners had designed and built Donnelly to be part of this separate MIDAS ground system. It was only intended to be part of the AFSCN during the transitional R&D phase while the rest of the MIDAS facilities were being constructed. However, the McNamara directive altered Donnelly's fate. By the time MIDAS 6 was ready to launch in December 1962, it was clear that no separate tracking and control center would be needed, and none of the central operational facilities on the wish list would be built. This meant that Donnelly would remain under the AFSCN throughout the remaining R&D program. It would never be part of a stand-alone tracking system, although that had been the ultimate plan for the station. After the directive came out, Donnelly supported four more flights which had been scheduled under the original MIDAS program, and then went into caretaker status.

In 1965, the Air Force directed contractors to prepare for a series of RTS-1/Program 461 launches the following year. Technicians returned to Donnelly to prepare the station and upgrade its equipment for the new program. Donnelly supported those flights from the summer of 1966 until the fall of 1967, when the satellites went out of service.

After that, the station was closed permanently. As a result, it faded away into the footnotes of history. In fact, it became easy to summarize the entire effort at Donnelly this way: "...the station went into caretaker status within a very short time. Its purpose in life was never fulfilled, it having been determined in high places that the entire system was not utilitarian."[45] Yet in the early phases of the program, MIDAS planners had intended Donnelly Flats to be an important element of MIDAS and its anticipated role in national defense.

[45] Lyman Woodman, *The Army Corps of Engineers in Alaska*, Report, U.S. Army Engineer District, Alaska, Elmendorf Air Force Base, 1973.

These early efforts to develop MIDAS and its missile defense warning capability took place at a quiet site at the southern end of Fort Greely, only a few miles from today's Missile Defense activities.



Map 2. MIDAS site location on Donnelly Training Area.

The Donnelly Flats MIDAS site is located twelve miles south of the Fort Greely cantonment and about twenty-five miles south of Big Delta where the Tanana and Delta Rivers converge, along one of the primary natural routes connecting Interior Alaska with the coast. That route follows the Delta River drainage to the foothills of the Alaska Range and runs southward through the mountains at Isabel Pass.

The MIDAS site is located in an area of open, flat terrain, bounded by low hills in the north and the Granite Mountains to the southeast. A large, lone hill known as Donnelly Dome rises out of the valley on the west side of the Richardson Highway, and the Alaska Range dominates the view to the south. The surrounding terrain is lightly wooded and brushy, with vegetation consisting primarily of birch, aspen, willows, and spruce. The area experiences an Interior Alaska climate, with temperature extremes ranging from sixty below zero to ninety above, with frequent brisk winds.

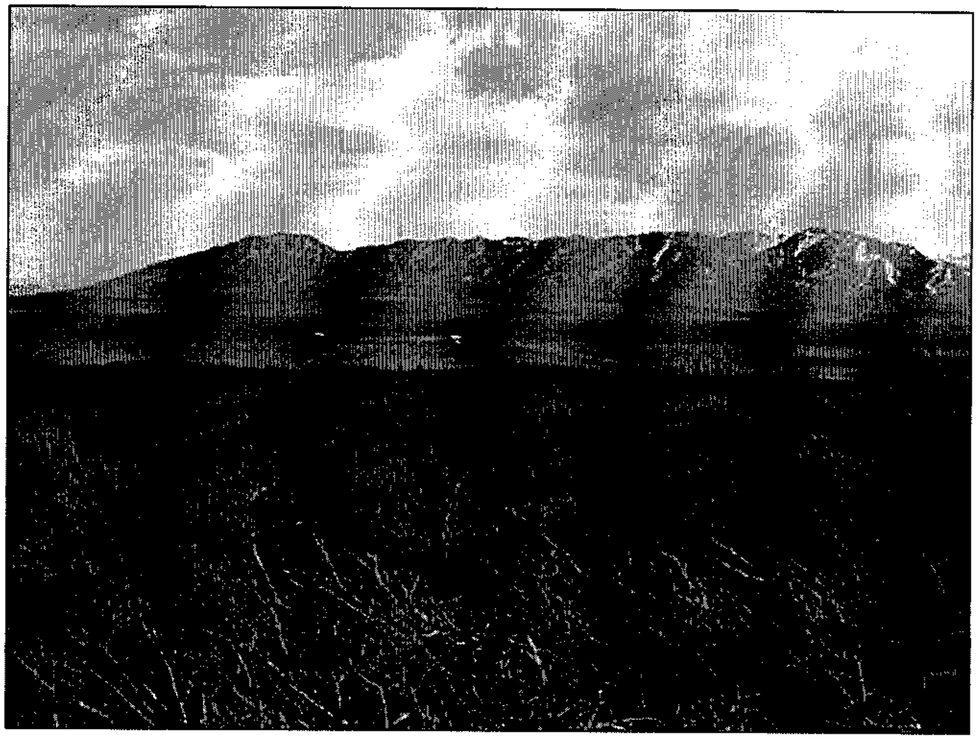


Figure 15. View of MIDAS receiving area from Donnelly Ridge, May 2005. Looking to the east, Granite Mountains in background.

6.1 Area History

Because of its geography, the Delta River area has long been a transportation and communications corridor. People were using and traversing this region as far back as 13,000 years ago, communicating, migrating, and trading. For at least the past 2,000 years, Native Athabascan groups inhabited the area and maintained traditional trade networks along the rivers and through the passes.

By the early 1900s, thousands of fortune-seekers had swarmed to northern gold rush boomtowns like Dawson City and Fairbanks, creating a need for new transportation and communications links with the coast. In response, the U.S. Army Signal Corps began building telegraph lines for the Washington Alaska Military Cable and Telegraph System (WAMCATS) in 1899. In addition to WAMCATS, the Army oversaw construction of the Richardson Trail, created to link the coastal port of Valdez to the Yukon River border town of Eagle and later on, Fairbanks. An early Signal Corps station was located near Donnelly Roadhouse, south of the present-day MIDAS site.

With the onset of World War II, military activities intensified. In 1942, the Air Transport Command began operating an airfield near Big Delta as part of the Northwest Staging Route. Pilots ferrying Lend-Lease aircraft along the Alaska-Siberia (ALSIB) route used it as an auxiliary field on their way north to Ladd Field. In the same year, engineer troops completed the Alaska Highway. The new road connected to the existing Richardson Highway near Big Delta, providing the first road link between Alaska and the continental U.S. Following the war, the community of Delta Junction developed around the terminus of the highway.

HEART AMONG THE GLACIERS

What is now Donnelly Dome is known in local Tanana Athabascan languages as *Luutadzeey* (ice heart) or *Luutah ch'edzeey'* (heart among the glaciers). The first name was shared by Abraham Luke, and the second by Andrew Isaac.

The present name dates to the early days of the Richardson Trail, when it took several days to travel from Valdez to Fairbanks. Roadhouses offering meals and lodging sprang up along the route approximately one day's travel apart.

One of the roadhouses on the trail near the Delta River was operated by Ed Donnelly and R.E. Shanklin. Although Donnelly only operated the roadhouse for about four years, his name remained on the roadhouse and the landscape. The Ice Heart became known as Donnelly Dome and the surrounding area, Donnelly Flats.

Citations: "Born With The River," Mischler 1984, AK Dept. of Natural Resources, Div. of Geological and Geophysical Surveys, Anchorage. "Tanacross Placenames List," Kari 1983, manuscript on file at the Alaska Native Language Center, University of Alaska-Fairbanks. Walter T. Phillips, "Roadhouses of the Richardson Highway," Alaska Historical Commission Studies in History No. 161, 1983.

In 1955, the Army established Fort Greely. The fort consisted of the existing airfield, a new cantonment, and thousands of acres of training lands to the south and west. To accommodate its cold weather training and testing missions, the Army developed testing and training ranges in areas east of the Delta River. In the late 1950s, the White Alice network and the BMEWS Rearward Communications system modernized military communications, and relay stations were constructed along the Richardson Highway corridor at Delta Junction, Donnelly, and Gerstle River.

When the MIDAS station was proposed in 1959, Donnelly Flats itself was part of the Fort Greely Air Drop and Testing Area, which probably consisted of natural vegetation and terrain, with some clearings for a drop zone. The closest developed areas were Fort Greely's main cantonment, twelve miles to the north, some recreational properties at Summit Lake, and a lodge at Paxson seventy miles to the south. With the exception of a handful of homestead claims along the highway, the area surrounding the MIDAS site consisted of undeveloped military or public domain lands.

6.2 Site Selection

Although the Air Force was in charge of the MIDAS program and the aerospace contracting that went with it, the U.S. Army Corps of Engineers was the agency designated to oversee the construction of the MIDAS ground facilities in Alaska. Consequently, both the Air Force and the Corps were involved in selecting a location for this MIDAS station. According to Corps records, the Air Force contacted them to initiate the project on April 10, 1959, and a siting team arrived in Alaska immediately to investigate possibilities. Just over two weeks later they had agreed on the Donnelly Flats site. Whether this reflects agreement on the qualities of the site or simply the rush nature of the project is not clear. Unfortunately, the available records do not describe why this particular Alaskan site was selected to support the MIDAS program.[46]

However, some of the reasoning can be inferred. Although the Air Force had constructed AFSCN facilities along the coast at Kodiak and Annette Island, MIDAS required a separate ground station.[47] Its technical requirements were different, and so was its mission. Both MIDAS and CORONA used polar-orbiting satellites and needed high-latitude ground stations to maximize contact time. The difference lay in data recovery. CORONA satellites captured film imagery, which was ejected

[46] Memo, *Design and Construction Schedules, Donnelly Flats Air Force Station, Alaska (MIDAS)*, Floyd Henk, AK District Corps of Engineers, to North Pacific Division Engineer, Portland, 17 Aug 1960. Washington National Records Center, Suitland, MD, RG 77. 077-64A-2125-23, folder 1. Lockheed did prepare siting studies, but these were not located for this project. They are referenced in LMSC MIDAS Facilities Master Plan as Lockheed Missiles and Space Division, "Preliminary Area Selection Report, Alaska Attack Alarm Station, LMSC 428154, March 1959 and "Final Site Selection Survey MIDAS Program North Pacific Defense System," April 1959.

[47] MIDAS was originally designed as a stand-alone system with its own ground stations and its own control network that would feed directly into NORAD/SAC. The control center was never built, and in its place the AFSCN operated the stations. See previous chapter.

in a capsule over the Pacific Ocean and retrieved in mid-air by USAF planes. The tracking station at Kodiak was geographically positioned to send the ejection commands. A MIDAS station, on the other hand, did not need to be near the coast to do its job. The MIDAS system, unlike the CORONA system, sent its mission data in transmissions directly to the ground stations.

MIDAS was intended as an early warning system that would complement the Ballistic Missile Early Warning System (BMEWS) radar. Sensibly enough, the Air Force planned to place MIDAS readout stations at the three BMEWS radar sites in Alaska, Greenland, and England. The Greenland site, for example, was co-located with the BMEWS site at Thule. Donnelly Flats is approximately one hundred air miles east of the Clear BMEWS station. Strictly speaking the facilities are not co-located, but this requirement would have narrowed down the prospective locations. An interior location for MIDAS was preferable for security reasons as well. It would have been more difficult for the Soviets to eavesdrop or try to jam transmissions at a site hundreds of miles inland.[48]

Once the Air Force had decided to place the MIDAS station in central Alaska, other factors came into play. The primary requirement for the new station was freedom from electrical signal interference.[49] At the time, Donnelly was remote enough to meet this requirement. Although the nearby highway was one of Alaska's primary roads, the traffic load was light enough that the Air Force was not concerned about interference from passing cars. The major concern over interference arose from nearby land claims along the highway. If any of those claimants decided to open a roadside business, for example, their neon signs would pose an interference problem. This prospect was considered serious enough that the Air Force asked the Bureau of Land Management to cancel those claims and remove the land from further entry.[50]

Figure 16. Aerial view, Fort Greely looking south, 1951. Jarvis Creek on left, Delta River on top right. Courtesy Cold Regions Research and Engineering Lab (CRREL) collection, Fort Richardson.

In addition to having a clear signal zone, an operational MIDAS station would also require access to a military communication network if it was to serve as an active warning system. Around the same time that the MIDAS station was under construction, a BMEWS Rearward Communications site was built on Donnelly Ridge, giving the station access to NORAD.

[48] During CORONA launch windows, for example, Soviet trawlers reportedly appeared in the waters off Kodiak. Former tech rep Marv Sumner recalled, "Sometimes we thought the Russians knew as much as we did about our schedule. Sometimes they left when a launch was scrubbed, before we were aware of the scrub." Marv Sumner and Bob Siptrott, "Kodiak Tracking Station's First Pass Supports," electronic document, *http://209.165.152.119/af_track/bob_chapter3a.html*, accessed Feb 14, 2005.

[49] Teletype, Space Systems Division to Alaska Air Command, 18 May 1961. USACE Realty audit files, Fort Greely, Vol V. Arnold also refers to a requirement that the stations be at least 600 nautical miles from the U.S.S.R., 93.

[50] BLM cancelled four Trade & Manufacturing claims held by James Alves, Pete Costa, Paul Decker, and James Phillips. Real Estate Directive 7569, 5 June 1963. "Real Estate Acquisition Planning Report, Donnelly Flats Air Force Station Protective Zone," U.S. Army Corps of Engineers, Alaska District, 15 February 1962.

Finally, although this site was away from populated areas, it was not too isolated. Remote facilities, such as the Distance Early Warning (DEW) Line, were extremely expensive to build and sustain. To minimize the cost of construction and logistical support, it made sense to locate the MIDAS station in an area that was accessible by road or rail, and close enough to military infrastructure to simplify support operations. Donnelly Flats was accessible by road and close to the Fort Greely cantonment, while still being remote enough to be clear of most signal interference. The land was already under military jurisdiction, which would also have speeded construction. It is likely that many of these considerations were taken into account for this program, which was already a very high-cost proposition.[51]

6.3 Construction History

In the mid 1950s, military construction in Alaska was booming. The federal government spent more than one billion dollars in the Cold War buildup of military bases, DEW Line facilities, and Aircraft Control and Warning (AC&W) radar sites. By the time MIDAS construction was proposed, the blitz had tapered off, but large projects were still underway, the primary one being the BMEWS facility at Clear.

In Alaska, construction challenges abounded. Essential materials had to be shipped in from distant suppliers. Short intense summers limited the window for site preparation and foundation work. Winter construction was possible, but this was usually done only if a structure had already been enclosed. In addition, during the 1950s there was a shortage of resident construction workers. Contractors, tradesmen, and laborers came north in a construction rush and had to be housed, sometimes at remote construction sites. Labor disputes occasionally disrupted construction projects, further complicating the scenario.

It was in this context that the Army Corps of Engineers set to work on the Donnelly MIDAS station in April 1959. To meet a target completion date of October 1960, a number of things had to happen simultaneously in the first ninety days: architectural design, surveys, preliminary site preparation contracts, material procurement, even permission from the Army to use the Fort Greely acreage.[52] Only then could the Corps award the prime contract and hope to stay on schedule.

Meeting the target date was not a simple task. Although Donnelly Flats was an expedited construction project, it faced real-world delays. Because of a nationwide steel manufacturing strike in 1959 which would have had "an extreme impact" on completion of the station, engineers took the unusual step of procuring structural steel in advance on a separate contract prior to the award of the MIDAS construction.[53] This in turn meant that the engineers could not wait for design work on the primary station building, the Admin. and Data Acquisition building. Instead, they contracted for the prefabricated steel using specifications from an existing design and had the architectural contractor work that into the overall site design after-

[51] According to Arnold, preferred sites would be close to "military airfields, railheads, and all-weather transportation facilities with water, telephone, power, and housing." Arnold, 92.

[52] The design firm was Ralph Parsons Co., Los Angeles.

[53] The initial timelines give some idea of how quickly this project moved. The Air Force contacted the Alaska District of the Corps of Engineers on April 10, 1959. Initial site selection was complete by April 29th. Facility design began on May 18, site surveys were done by June 1, and design review was complete by June 27. The project went out for bid on July 2, within ninety days of initiation. Memo, *Design and Construction Schedules, Donnelly Flats Air Force Station, Alaska (MIDAS)*, Floyd Henk, Alaska District Corps of Engineers, to North Pacific Division Engineer, Portland, 17 Aug 1960. Washington National Records Center, Suitland, MD, RG 77. 077-64A-2125-23, folder 1.

wards. The steel arrived in time for the 1960 construction season and delays were averted.[54]

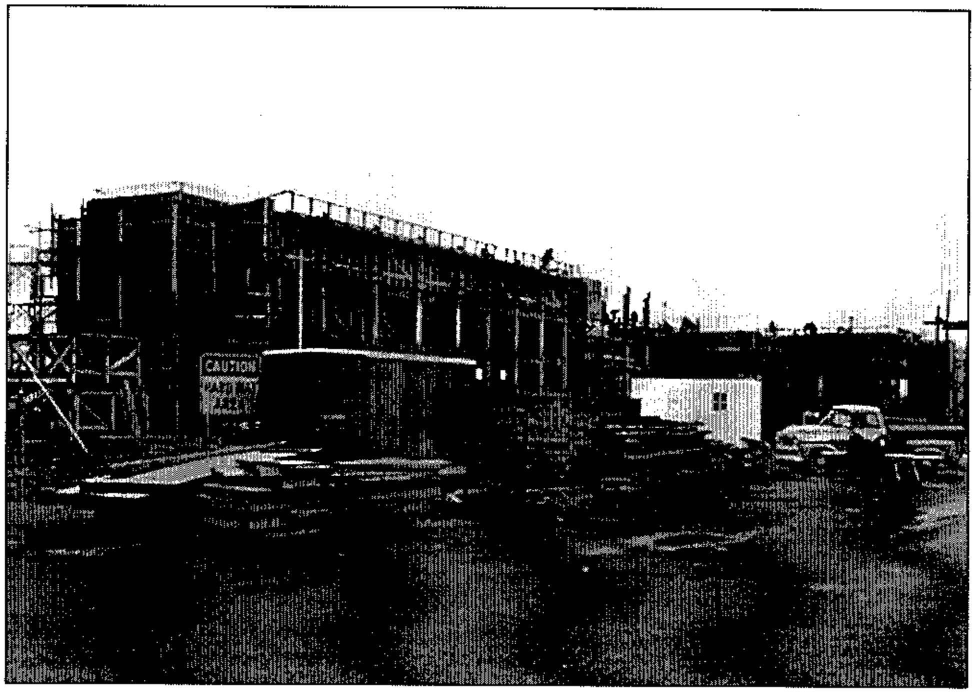


Figure 17. Construction scene, MIDAS barracks, Fort Greely cantonment, Aug 1960. Washington National Records Center, RG 77, 077-64A-2125-23 DA1354 neg 19.

Project planners also had to bear in mind the short construction seasons as well as the effect of strikes closer to home. To solve the first problem, planners awarded the contract for the contractors' camp and site preparation in June 1959, so that work could commence as soon as possible and foundations could be laid before the winter freeze-up. Peter Kiewit Sons of Seattle began that work in July, but an Alaska carpenter's strike loomed as a potential delay. To address this, the Corps declared this contract critical defense construction, which exempted it from the strike.

On July 23rd, the Corps opened bids for the Donnelly Flats technical facilities. The low bidder was Chris Berg, Inc., a contractor from Seattle. By the end of the first summer, the construction camp was in and the site was ready. Workers had begun foundations and some structural work was underway. Construction of the technical facilities resumed in the spring of 1960, and proceeded on schedule with buildings completed by October. Support facilities consisting of a 200-man barracks-style dormitory/mess hall and vehicle warm storage on the Fort Greely main post were constructed under separate contracts. The total value of these MIDAS structures was $5.487 million, excluding equipment.[55]

[54] The BMEWS project, on the other hand, did experience strike-induced delays. "Governor Optimistic on Settlement Possibility," *Fairbanks Daily News-Miner*, 20 July 1959, 1, 7.

[55] Re contracts and construction status, "Two Years of Brisk Activity Assured by U.S. Defense Construction Work," *Fairbanks Daily News-Miner*, 11 November 1959, 70. "Peter Kiewit Co. Bids Low on Job at Donnelly Dome," *Fairbanks Daily News-Miner*, 24 June 1959, 1. "Chris Berg Gets Contract," *Fairbanks Daily News-Miner*, 31 July 1959, 6. "Donnelly Dome Station Marks Fort Greely Growth," *Fairbanks Daily News-Miner* 11 November 1959, 112. Peter Kiewit Co. won the contract for the dorm/mess hall in August 1959. The vehicle maintenance shop on Fort Greely was a separate contract that went out for bid in January 1960. Both projects were scheduled for completion in September 1960. Memo, *Design Schedule for Project MIDAS, North Pacific*, Col. W.C. Gribble, Jr. to Chief of Engineers, 19 Oct 1959, NARA 077-64A-2125-23 folder 1. Re cost, AAC Installations Inventory, 30 June 1960, Elmendorf AFB History Office.

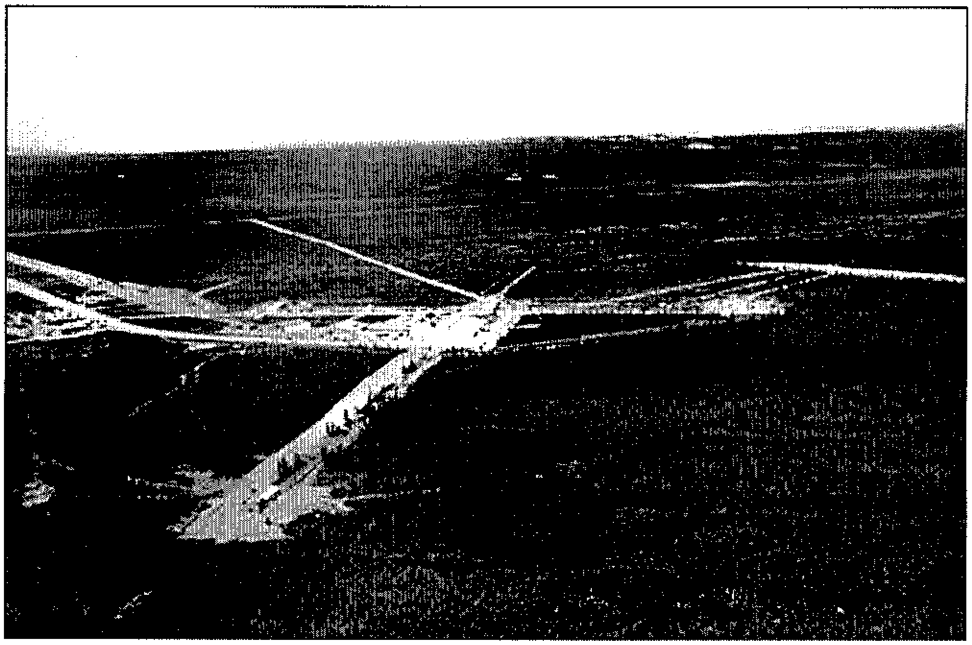


Figure 18. Receiver area under construction, 20 July 1960. Construction camp visible on far left. NARA Pacific Alaska Region (Anchorage) RG 77-NEGS-96-297N.

As the buildings became ready, technicians began to install the complex technical equipment for the MIDAS station. This included a 60-foot antenna dish, cutting edge computers, telemetry and timing equipment. By March 1961, enough of the work was complete so that the station could be designated Operating Location 3. No information was located regarding the cost of the equipment installed at Donnelly, although the CDC 160A computers of the early 1960s were said to cost $100,000 each.[56] No doubt the equipment at the site was a major expense, raising the total investment in the station well beyond the $5.48 million infrastructure cost.

[56] Douglas W. Jones, The Control Data Corporation 160 Computer, electronic document, *http://www.cs.uiowa.edu/~jones/cdc160/.*

CHAPTER 7.0 Facility Descriptions

The Donnelly Flats MIDAS station was designed to be a significant element in the eventual operation of a MIDAS system. The facilities constructed at the site reflect that initial vision. The information presented here was compiled from Corps of Engineer records, Lockheed Facilities Master Plan, Parsons design materials, and historic photographs.[57]

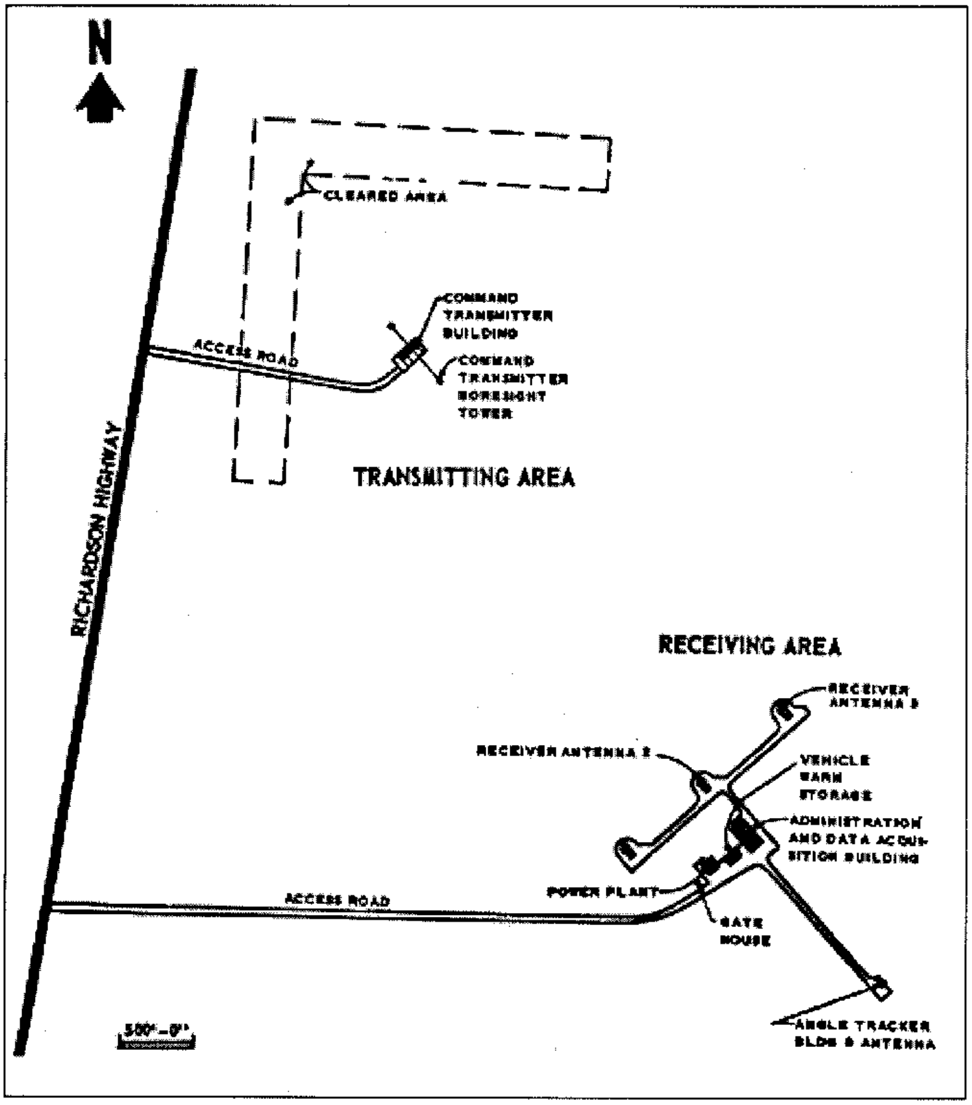


Figure 19. Site plan, Lockheed report 1961. Also see Appendix C as-built site plan.

[57] Information compiled from Lockheed Facilities Master Plan; As-built drawings on file with U.S. Army Corps of Engineers, Alaska District; Final Design Analysis for Tracking and Acquisition Station, Donnelly Flats, Alaska, U.S. Army Corps of Engineers, Alaska District; Ralph M. Parsons Co, Tracking and Acquisition Radar Station Design Analysis, DA95-507-ENG-1346 27 May 1959, on file with USACE Alaska District; and Ralph M. Parsons Co, Master Plan, Detachment 1, HQ 6594th Aerospace Test Wing, Donnelly Flats, Alaska, AF 04(695)-808, 1966.

7.1 Receiver Site

The receiver site is located at the end of an unpaved access road about one half mile east of the highway. It originally consisted of eight buildings laid out in a modified T configuration. These included three receiver buildings with attached radomes, an administration and data acquisition building, an angle tracker building, a power plant, vehicle warm storage, and small gatehouse. There were also three boresight towers at the site: one to the north of Receiver No. 2 and two others associated with the angle tracker building.

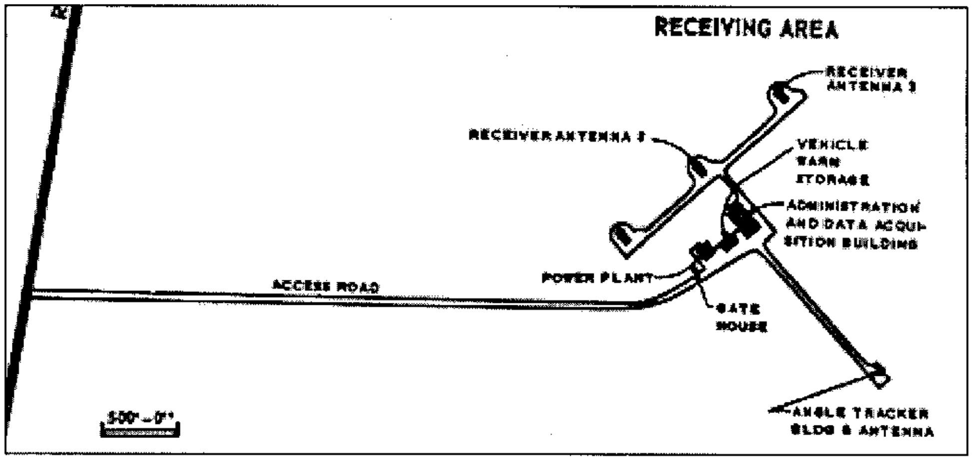


Figure 20. Receiving area, Lockheed diagram, 1961.

The three receiver buildings were laid out on an east-west axis based on magnetic north. The central receiver building (Receiver No. 2), the admin. and data acquisition building, and the angle tracker building were lined up to form the stem of the "T". The power plant, warm storage building and gatehouse sat just to the west of the data acquisition building. The power plant and vehicle warm storage building were connected to the data acquisition building by an above-ground, enclosed exterior passageway.

During construction, a temporary construction camp also existed on the south side of the access road halfway in to the site. This camp was removed when the receiver site was completed. The camp area is marked on some site plans as a borrow pit.

Administration and Data Acquisition (ADA) Building

This was the largest building in the complex. Measuring approximately 118 feet by 202 feet, it was a rectangular one-story, steel frame building with concrete block exterior walls and a corrugated sheet metal roof.

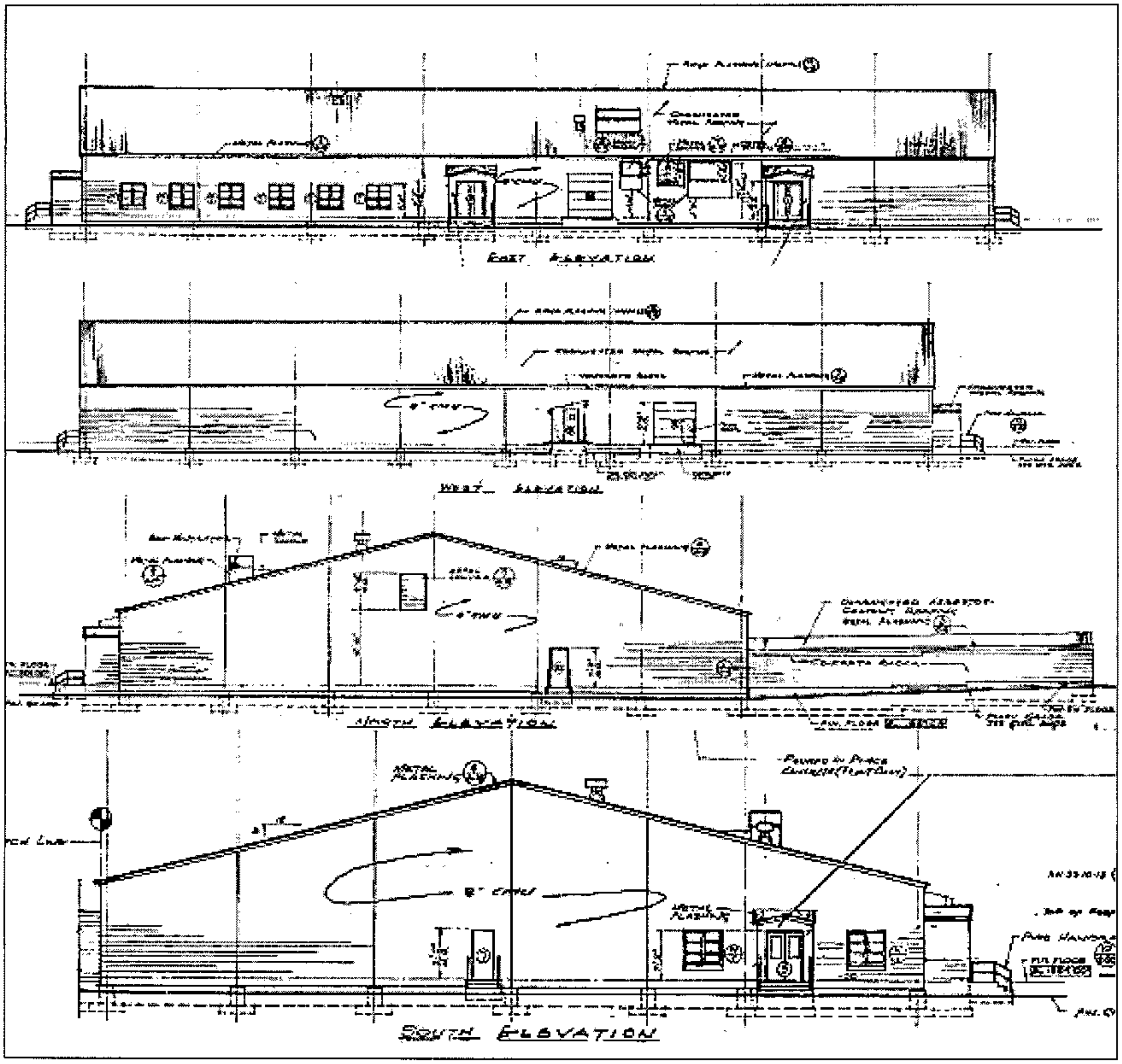


Figure 21. ADA Bldg architectural elevations As-built AW-30-05-08. See Appendix C for expanded version.

The east elevation had two entryways and one overhead door. The northern end had no windows; ventilation to the equipment room there was through louvers and hooded screens. Offices were located at the southern end, and there were six sets of six-paned windows in that area, one for each office. The north elevation was plain except for a ventilation louver in the data conversion area and an exit door. The south elevation had a small door in the center. On the east side, near the offices, there was an entryway with a two-panel door flanked on each side by a set of six-paned windows. The west elevation was mostly plain except for an overhead door with a concrete ramp and a passageway that connected to the adjacent vehicle warm storage building. This connecting passage was eight feet wide, of concrete block construction with corrugated asbestos-cement roofing, with one south-facing window. The ADA building's entryways had concrete steps and pipe handrails.

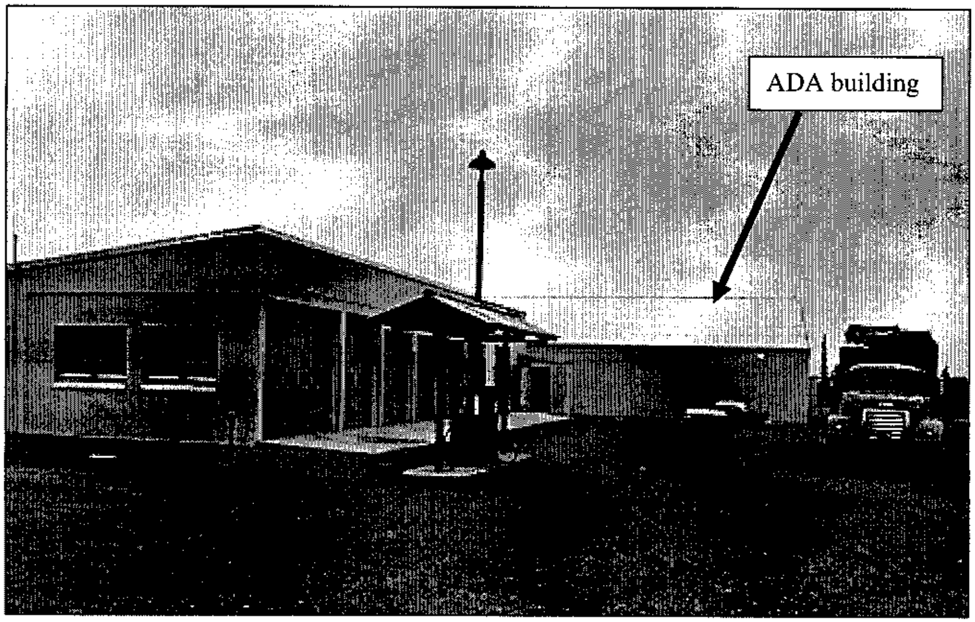


Figure 22. ADA bldg in rear, partial view of west elevation. Warm storage in foreground, Sept 1960. Washington National Records Center, RG 77, 077-64A-2125-23 neg 162.

The ADA building was the center of the operation, designed to accommodate as many as fifty-eight people per shift. It had over thirty rooms, including fifteen small offices, a conference room (ready room) with kitchenette, and restrooms with showers. The following specialized rooms were included in the original structure: Ground & Space Communication Control, Interstation Communication, Crypto Vault, Terminal Equipment room, Data Conversion, and Calibration and Instrumentation. A room listed on the original design as a MIDAS Operation room became the test director's office.[58]

[58] The as-built drawing varies slightly from the floor plan in the 1961 Lockheed Facilities Master Plan.

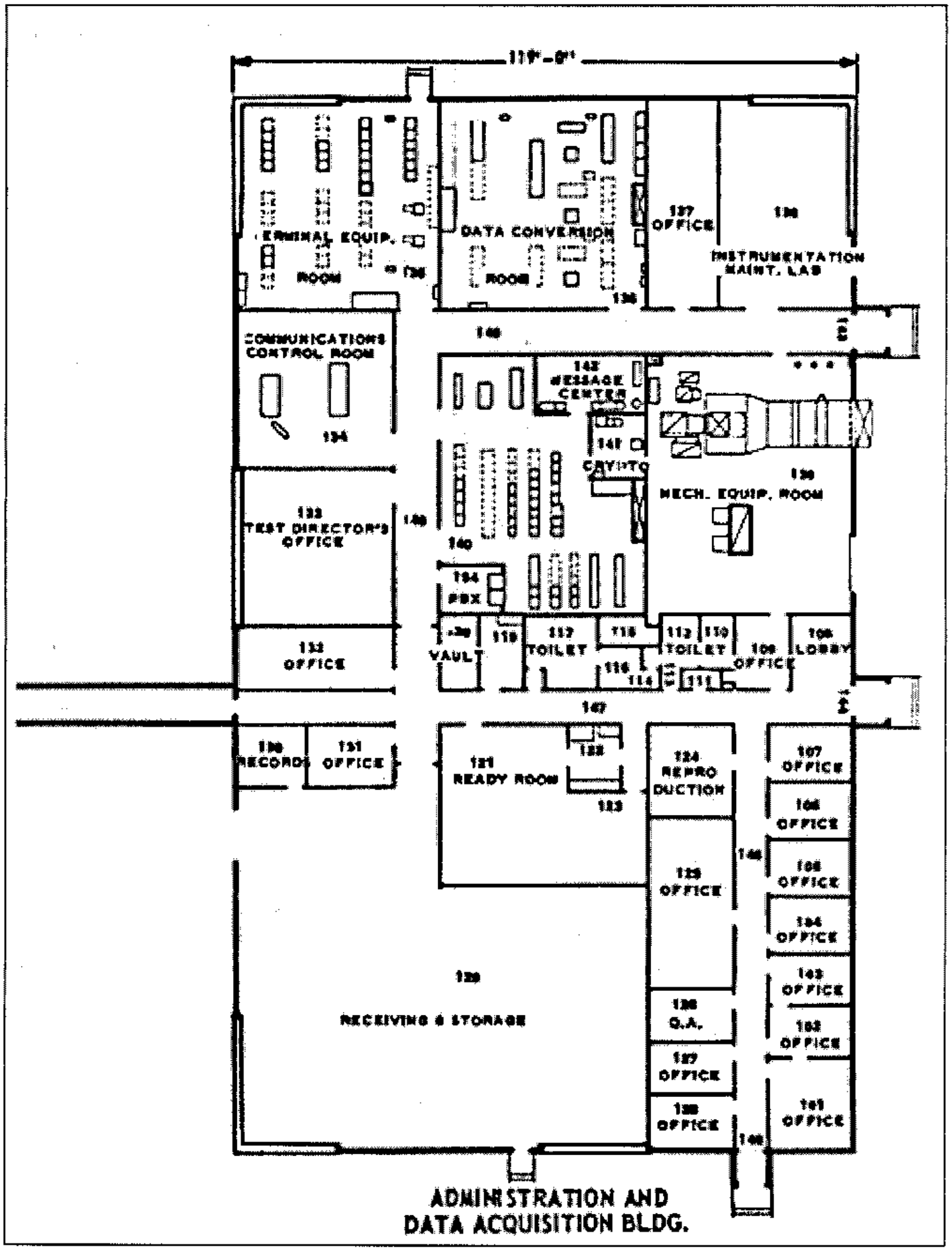


Figure 23. Floor plan for ADA bldg, Lockheed 1961, pg 4-505.

Receiver Buildings

The Donnelly Flats MIDAS site had three receiver buildings with attached radomes, originally intended for multiple satellite support. Only one of these, Receiver Bldg No. 2, was ever equipped and put to its intended use. However, each of the attached buildings was identically constructed.

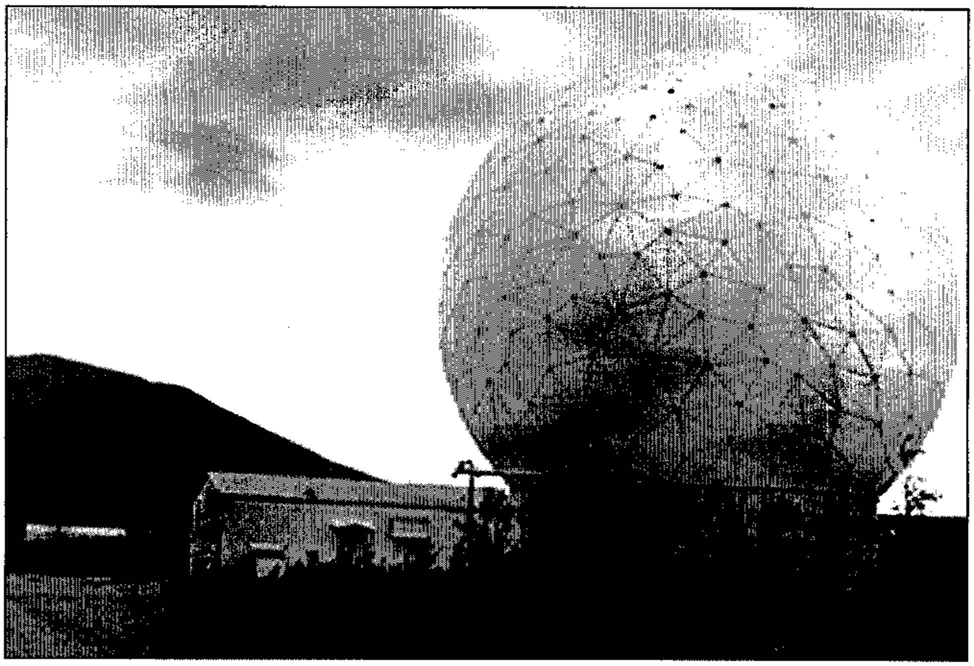


Figure 24. Receiver Bldg No 2. Courtesy Bob Siptrott.

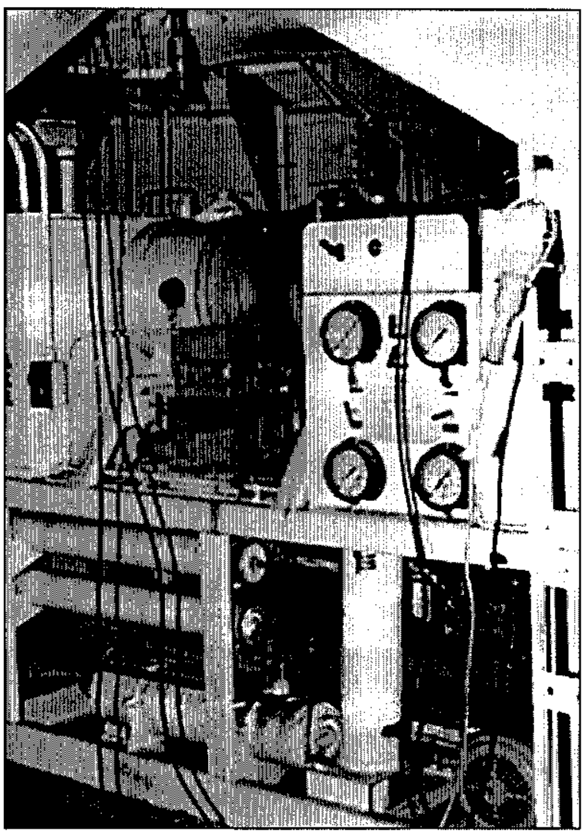


Figure 25. Donnelly equipment, possibly inside receiver building. Courtesy Bob Siptrott.

Each receiver building was a one-story rectangular steel-framed building approximately 55 feet long. The exterior was concrete block, and the building was topped with a corrugated metal gable roof. A concrete radome support structure was attached to a connecting passageway on the north side. Inside, the receiver building contained a receiver room with technical equipment, a small office, and mechanical room. There were no windows except in the entry door. Hooded exterior vents protected with metal screening provided ventilation.

The radome supports were circular, cast-in-place reinforced concrete structures approximately 18 feet high and 38 feet in diameter. Each was topped by a 110-foot diameter rigid radome which could enclose a 60-foot antenna dish. The radome itself was made with an aluminum space frame with polyester-bonded fiberglass panels.[59] In the center of the radome support there was a 16 x 16 foot square concrete structure to support the antenna base. A steel staircase reached about 18 feet to the top of this internal support structure, and a pipe railing ran along the top. This was where the antenna base and antenna dish would go, although only Receiver Bldg No. 2 ever had an antenna installed.

[59] LMSC 4-502.

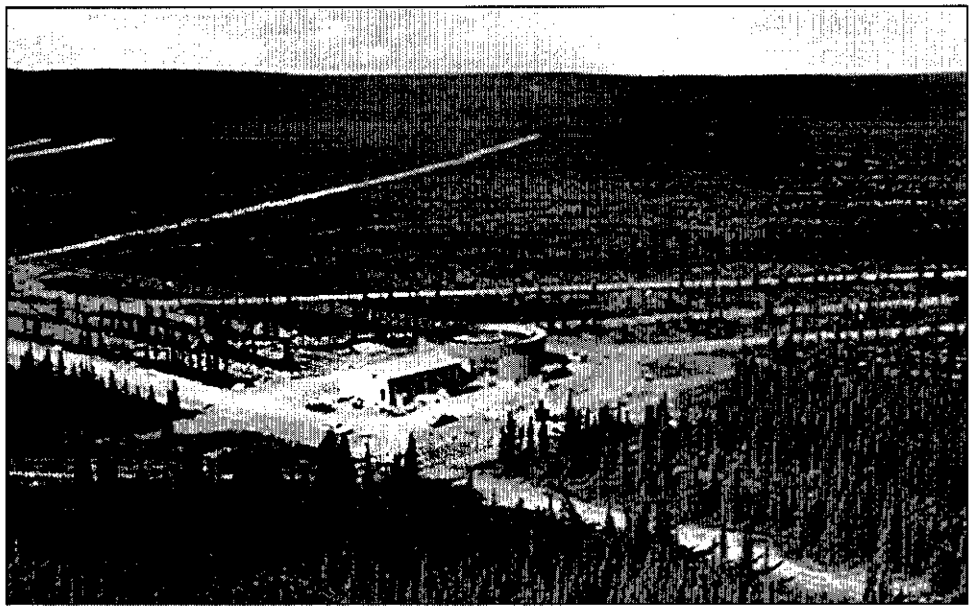


Figure 26. Receiver building under construction, 20 July 1960. NARA Pacific Alaska Region (Anchorage) RG 77-NEGS-96-297N.

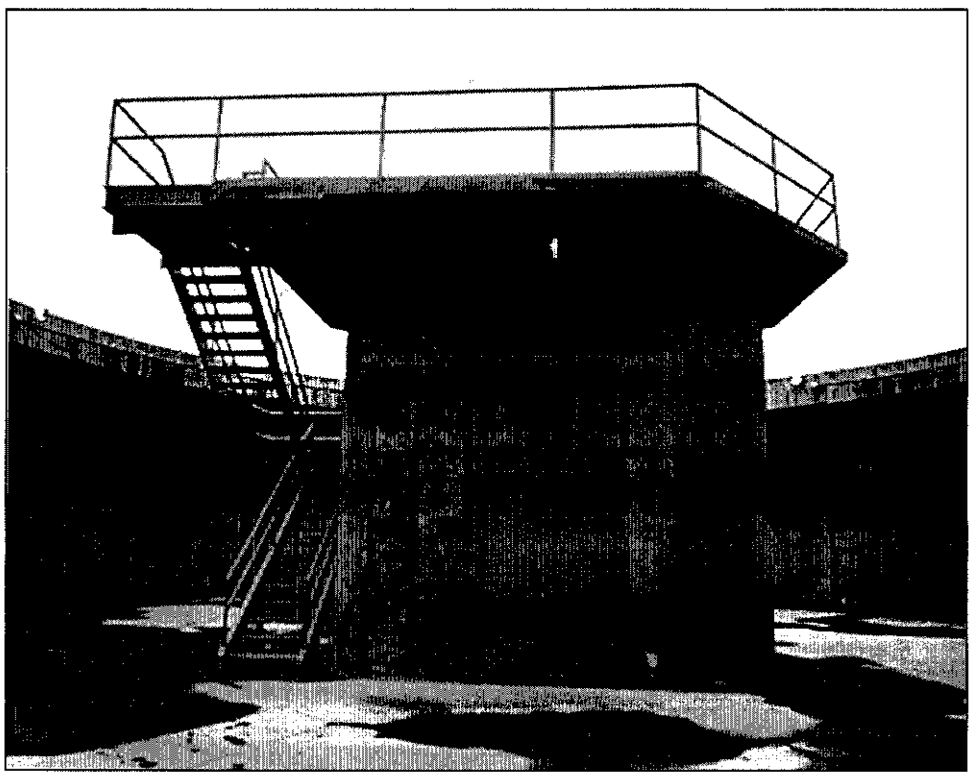


Figure 27. Antenna support base inside radome support structure, prior to installation of radome. Washington National Records Center, RG 77, 077-64A-2125-23 DA1346 neg 155.

Figure 28. Top section of antenna support and underside of antenna dish inside Donnelly radome. Courtesy Bob Siptrott.

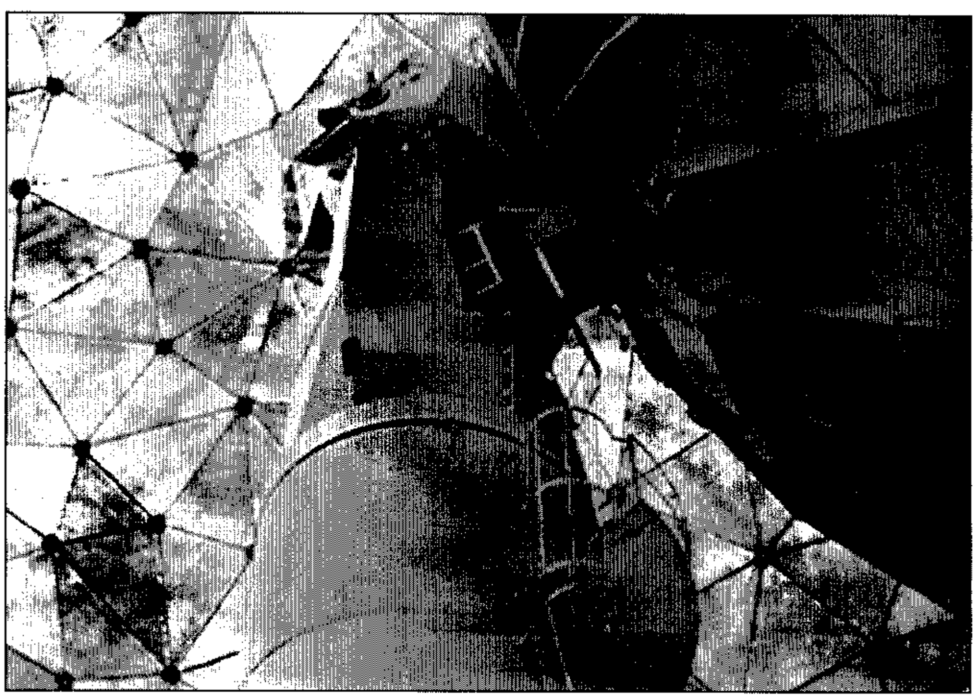


Figure 29. Antenna base and dish. Courtesy Bob Siptrott.

Angle Tracker Building

The angle tracker building was located at the southern end of the "T". It was similar to the receiver buildings, but slightly smaller, measuring 24 feet by 74 feet. The angle tracker building was a rectangular concrete-block building with a corrugated metal gable roof. It had two doors on the west elevation and louvers instead of windows on the north and east elevations. On the south end there was a cast-in-place concrete radome support structure. This radome support was considerably smaller than the main receiver radomes at the other end of the site, and was square rather than circular. The south elevation of the building had a door in the center, similar to the one seen on the left side of the photo below. Apparently there was no antenna installed here and the facility was not used for its original purpose. The Lockheed report of Dec 1961 states that it was used for storage or shop space at that time.

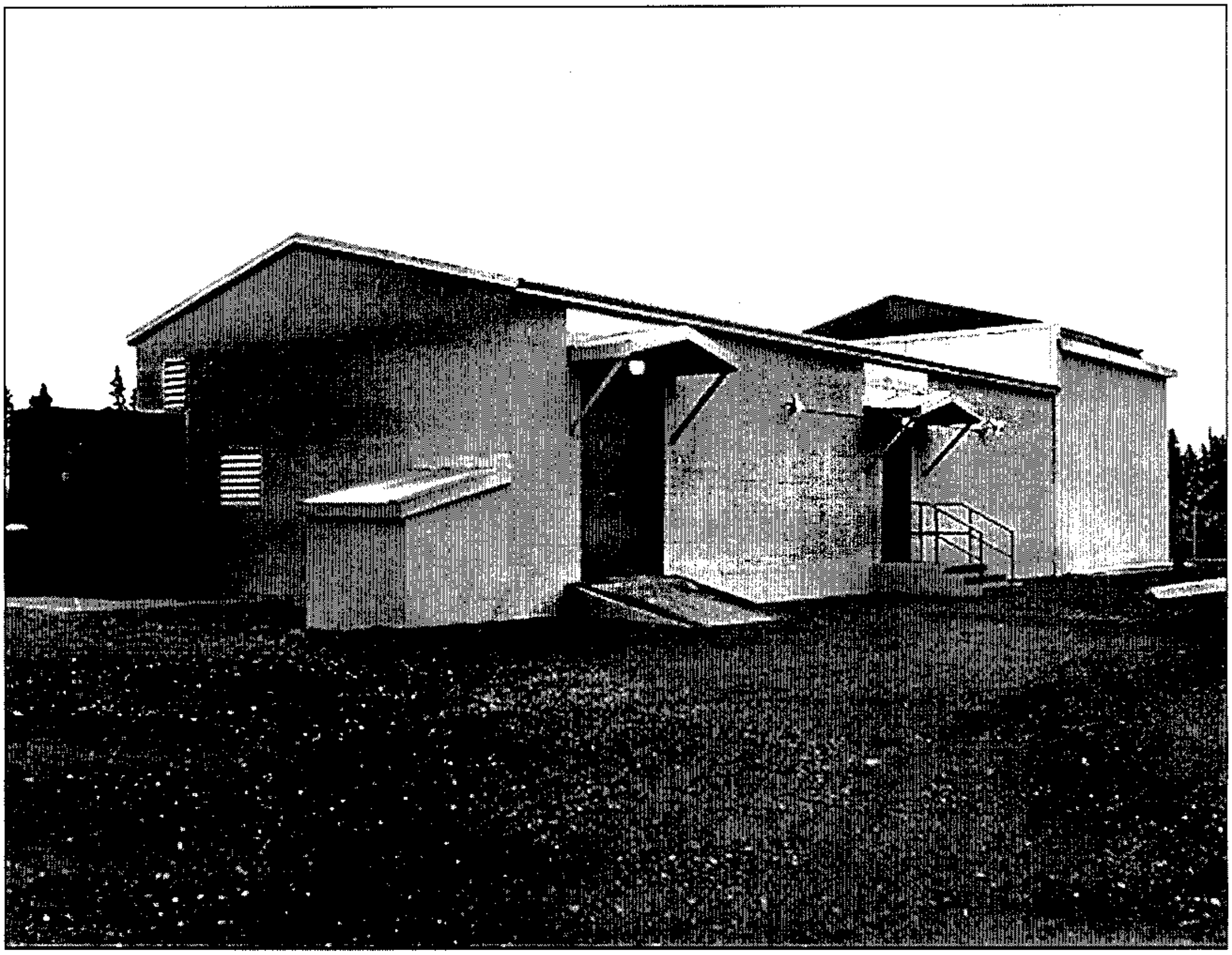


Figure 30. Angle tracker bldg, Sept 1960. Washington National Records Center, RG 77, 077-64A-2125-23 neg 161.

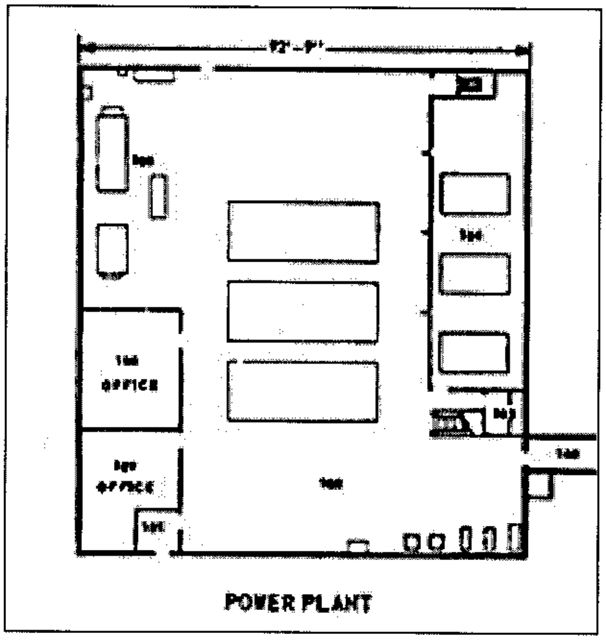


Figure 31. Floor plan, Donnelly power plant. LMSC 4-506.

Power Plant

The Donnelly Flats power plant is still extant at the site. It is a large, one-story gable roof building, measuring 119 feet by 93 feet. The exterior walls consist of two layers of corrugated metal with insulation between the layers. The roof is corrugated metal. Unlike the other buildings at the site, it had a partial basement on the east end. The north elevation had a hooded louver vent and a personnel door. The south elevation had a personnel door and a 12-foot high overhead door. The west elevation is plain. The east elevation has a louver vent on the south side. Three square exhaust vents jut out from the roof, and just below them are three rectangular openings used as air intake for the generators.

Because of the specialized tracking and data processing equipment at the site, the electrical system had to meet higher than normal reliability and voltage regulation requirements. Power was generated by three specialized diesel-driven 1250-kw generators originally designed for the SAGE project.[60] SAGE, or Semi-Automated Ground Environment, was an early computerized air defense system that is not directly related to the MIDAS program. However, SAGE was a leading-edge technology in its day. Power reliability issues may have been similar in both cases. The generators were modified for use at Donnelly Flats.

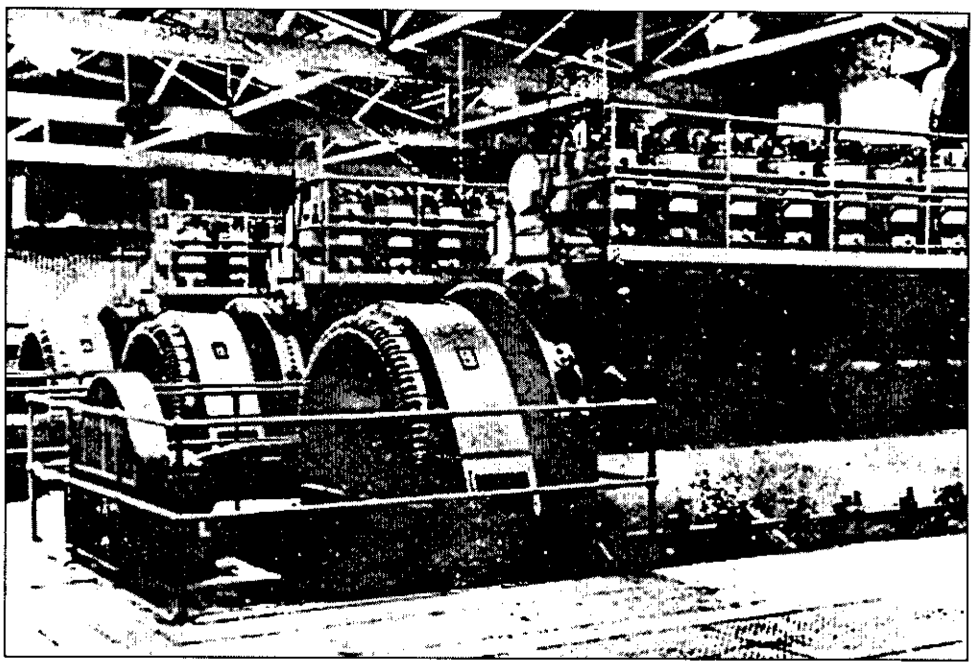


Figure 32. Diesel electric generators inside Donnelly power plant building ca 1961. LMSC rept, 4-508.

[60] The citation did not indicate whether the generators had actually been used in the SAGE project, only that they had been designed for it. Parsons Design Analysis, 42.

Vehicle Warm Storage

The vehicle warm storage building was a one-story building, 100 feet by 52 feet. Unlike other buildings at the site which had gable roofs, it had a slanted shed roof 16 feet high at its highest point. Most of the exterior was poured concrete, with a few sections composed of concrete blocks. The east and west elevations had two banks of three-paneled windows. The south elevation featured overhead doors of various sizes. A small island with a gasoline pump was located in front of the building, on the southwest side. This is believed to be a generic design, widely used at other Alaska facilities such as Nike sites and AC&W stations.[61]

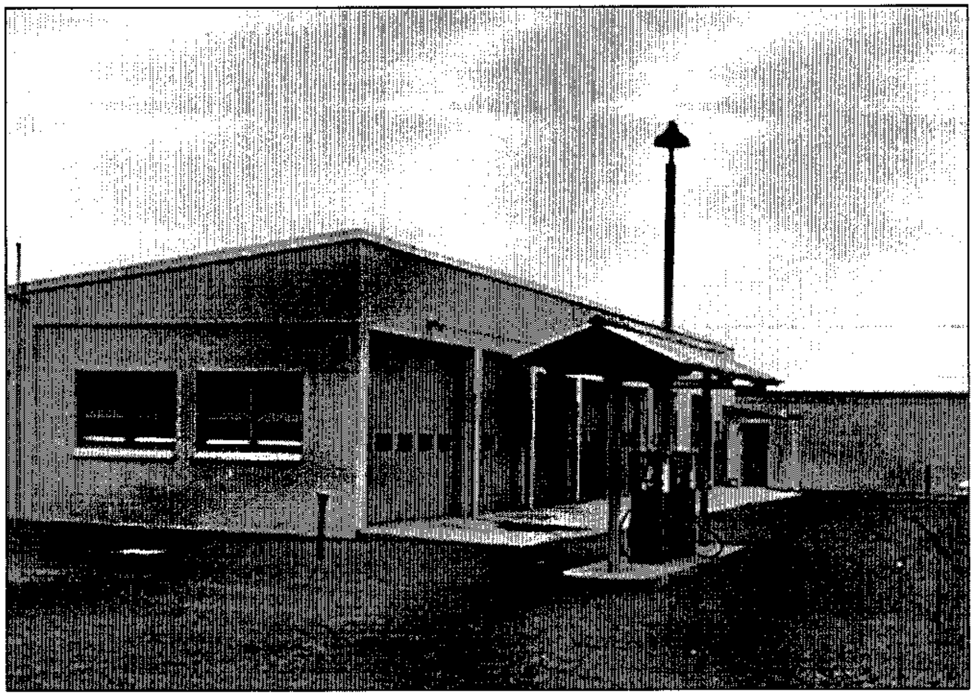


Figure 33. Detail, warm storage bldg, south and west elevations. ADA bldg in rear. Washington National Records Center, RG 77, 077-64A-2125-23 neg 162.

Gatehouse

The gatehouse was located immediately west of the power plant on the north side of the access road. It was a 48 square foot building, probably identical to the gatehouse pictured in Figure 36.

[61] Russ Sackett, email to author, 6 February 2006.

Boresight Towers

The purpose of the boresight towers was to assist in calibrating the antennas and calculating the direction they should point to acquire the satellite. Two were located in the vicinity of the angle tracker bldg and one was located to the north of Receiver No. 2.

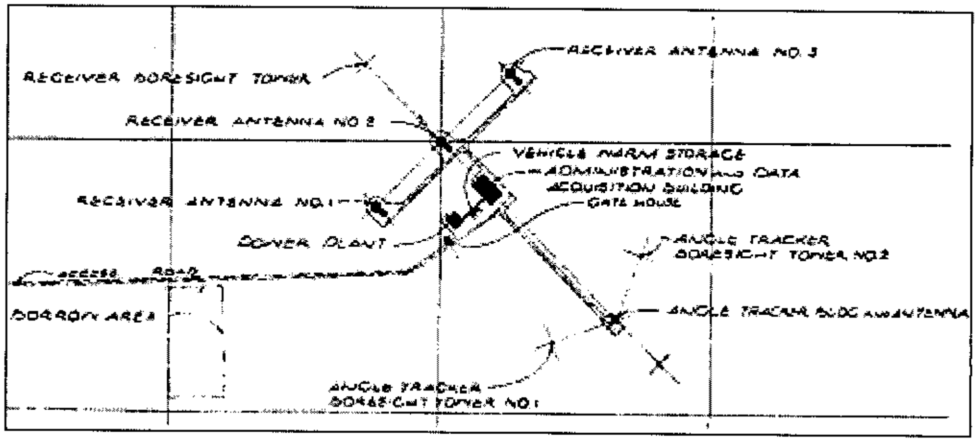


Figure 34. Location of receiving area boresight towers.

Transmitter Site

The transmitter site was located approximately one mile northwest of the receiver site. Its facilities were also aligned with magnetic north. It consisted of a short access road, gatehouse, command transmitter building, a boresight tower, and a large right-angle-shaped clearing, which is believed to be part of a drop zone predating MIDAS. The transmitter building was surrounded with perimeter fencing.

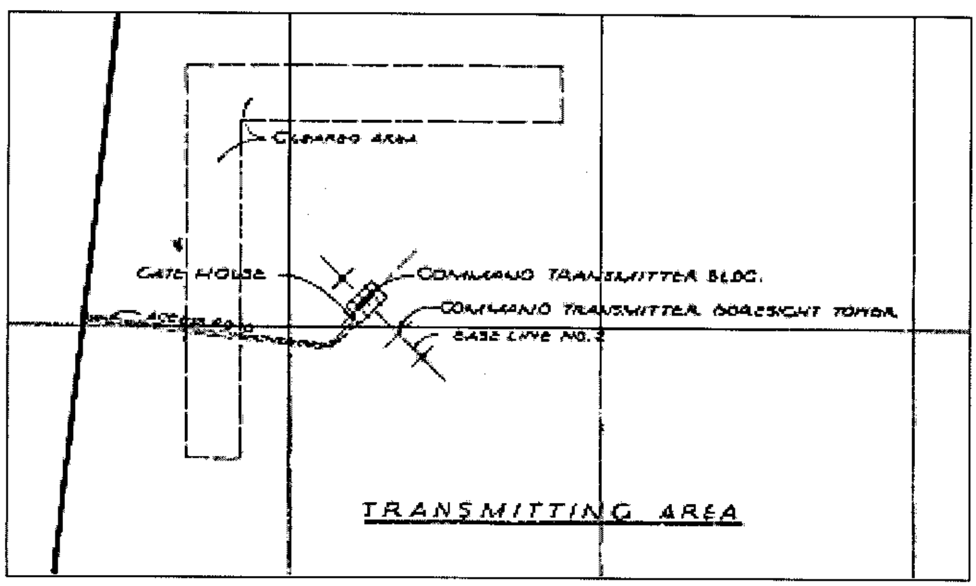


Figure 35. Detail, transmitting area, as-built drawing (survey marks removed). March 1961, AW-11-01-1000.

Command Transmitter Building

This was similar in appearance to the buildings at the receiver site. It was a rectangular one-story building probably about 148 feet long, with a concrete radome support at each end. The building had concrete block exterior walls and a corrugated metal roof. The north elevation had the same metal louvering and metal hoods found on similar buildings at the receiver site. It was intended to have a radome at each end, but these probably were never installed.

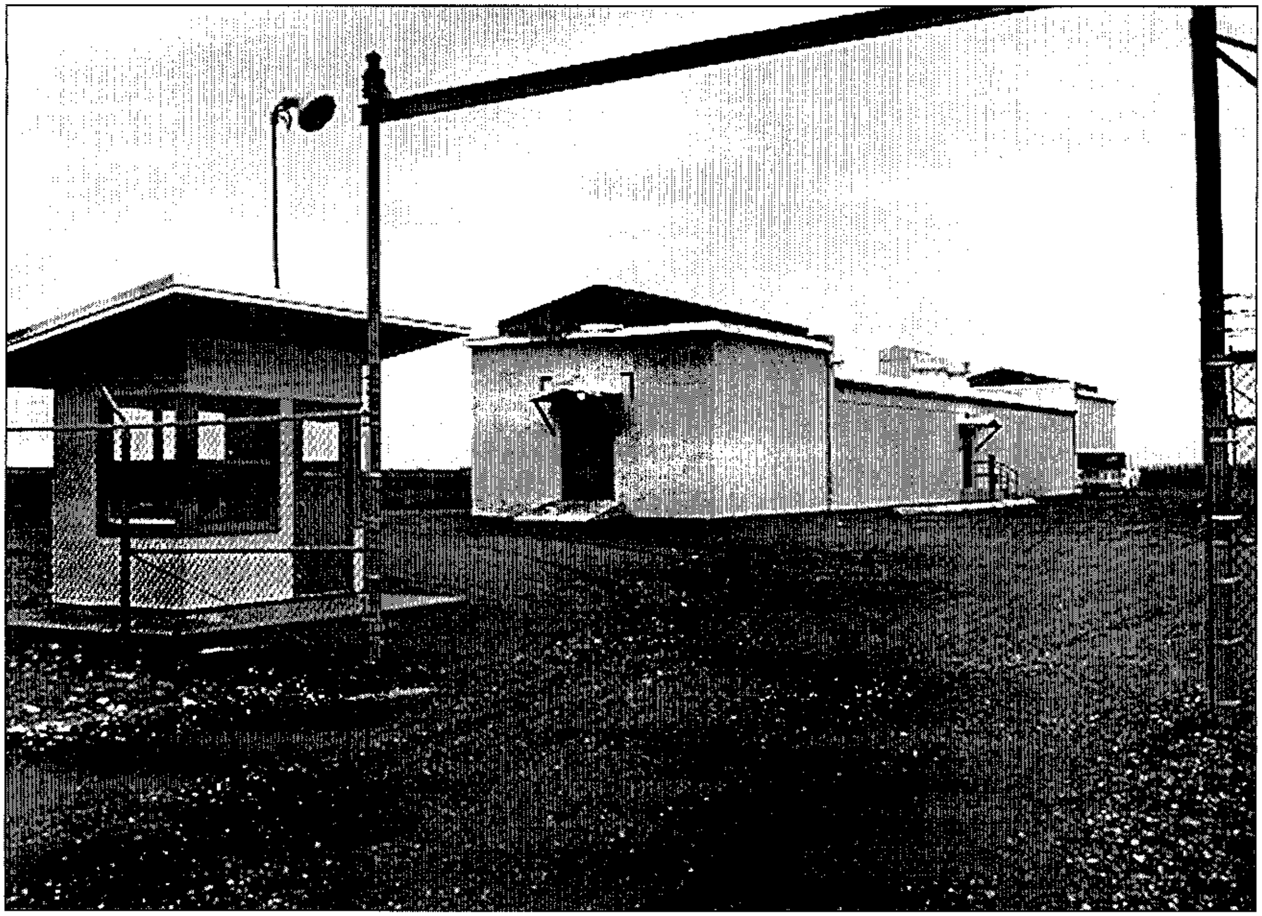


Figure 36. Command transmitter bldg and gatehouse, Sept 1960. Washington National Records Center, RG 77, 077-64A-2125-23.

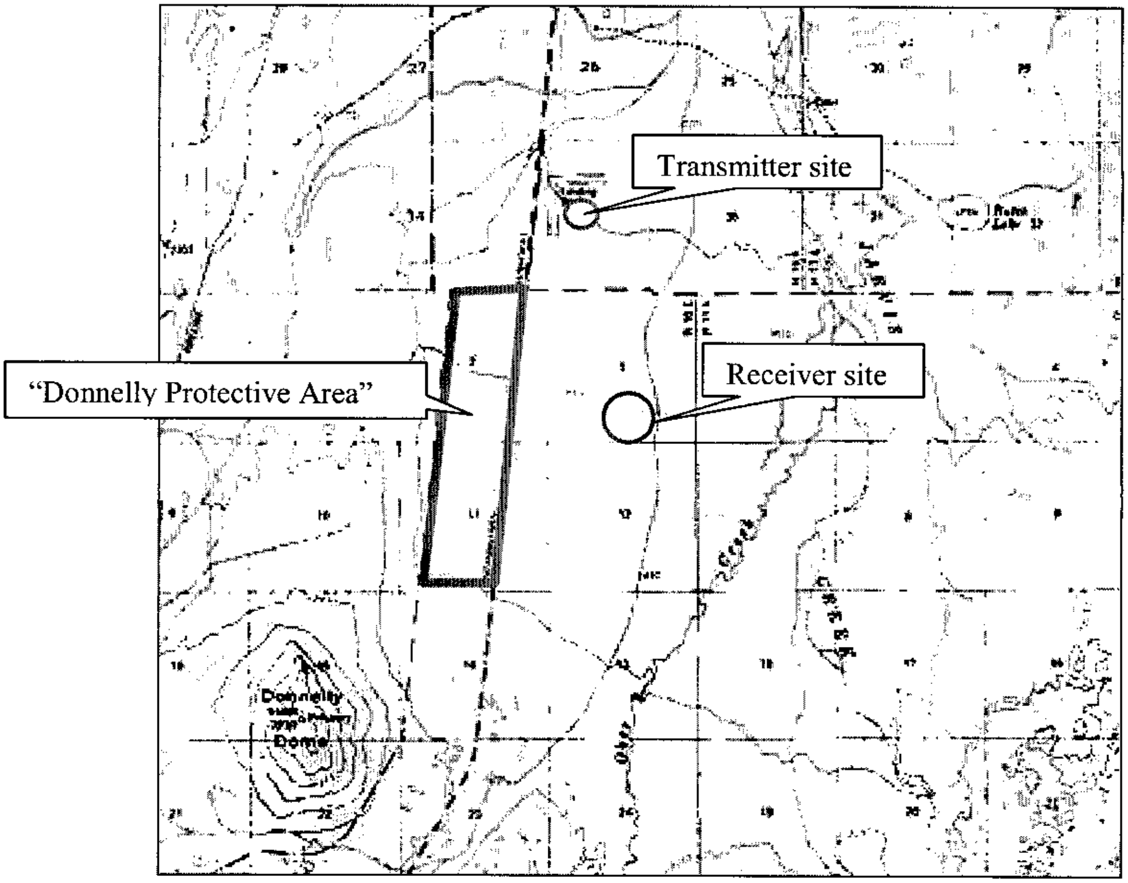
Boresight Tower

One boresight tower was located to the south of the command transmitter building. No additional information was located about this feature.

7.2 Associated Areas

Donnelly Protective Area

The so-called "Donnelly Protective Area" was a geographic area associated with the Donnelly Flats MIDAS site. Because the MIDAS site required a buffer zone free of electrical interference, the Air Force requested a "protective area" near the receiving site. This protective zone covered 640 acres adjacent to the site on the west side of the Richardson Highway along Donnelly Ridge. At the time, this area was public domain. There were four trade and manufacturing claims in this area, covering about 35 acres. The claims were extinguished and in 1963, the land was withdrawn for military purposes and assigned to the Army.[62]



Map 3. Donnelly Protective Area.

Communications Links

A Master Plan dating from 1966 describes some of the communications features at the site. For standard telephone access, Donnelly Flats was connected by buried land line to the ACS telephone system in Delta Junction. Unlike Chiniak, which apparently relied on a single line during its early years, Donnelly had capacity for 200 telephones. All the major buildings were connected to the system. The station also had a 100-word per minute teletype as well as a 1,200 bit per second duplex data link, which was advanced technology for the time. All three methods could be used to communicate with Sunnyvale.[63]

The station was also connected to the neighboring Donnelly Radio Relay Site. The Donnelly Radio Relay Site was located on a 42-acre parcel on Donnelly Dome to the west of the MIDAS site. Constructed in 1960, it was part of the White Alice network. Although it was not one of the MIDAS facilities, it provided essential

[62] Public Land Order 2948, 20 February 1963. Correspondence, Thomas E. Smith, U.S. Army Engineer District, Alaska, to Bureau of Land Management, Fairbanks, 31 August 1962. U.S. Army Engineer District, Alaska, "Real Estate Acquisition Planning Report, Donnelly Flats Air Force Station Protective Zone," 15 February 1962.

[63] Ralph M. Parsons Co, Master Plan, Detachment 1, HQ 6594th Aerospace Test Wing, Donnelly Flats, Alaska, contract AF 04(695)-808, 1966.

communications links for the station, presumably including the 1,200 bps data link and the planned operational link to NORAD.

Fort Greely Support Facilities

The Fort Greely main post also had two support buildings associated with the MIDAS program. The "MIDAS Hotel" was a 200-man barracks and mess hall in the heart of the cantonment on Arctic Avenue. Single MIDAS personnel, who were primarily civilian contractors, were quartered here and commuted daily to the site.

Today the barracks is known as Bldg 660. It is a standard-design three-story barracks. It was constructed for use by the MIDAS program and later turned back to the Army for Fort Greely's use.

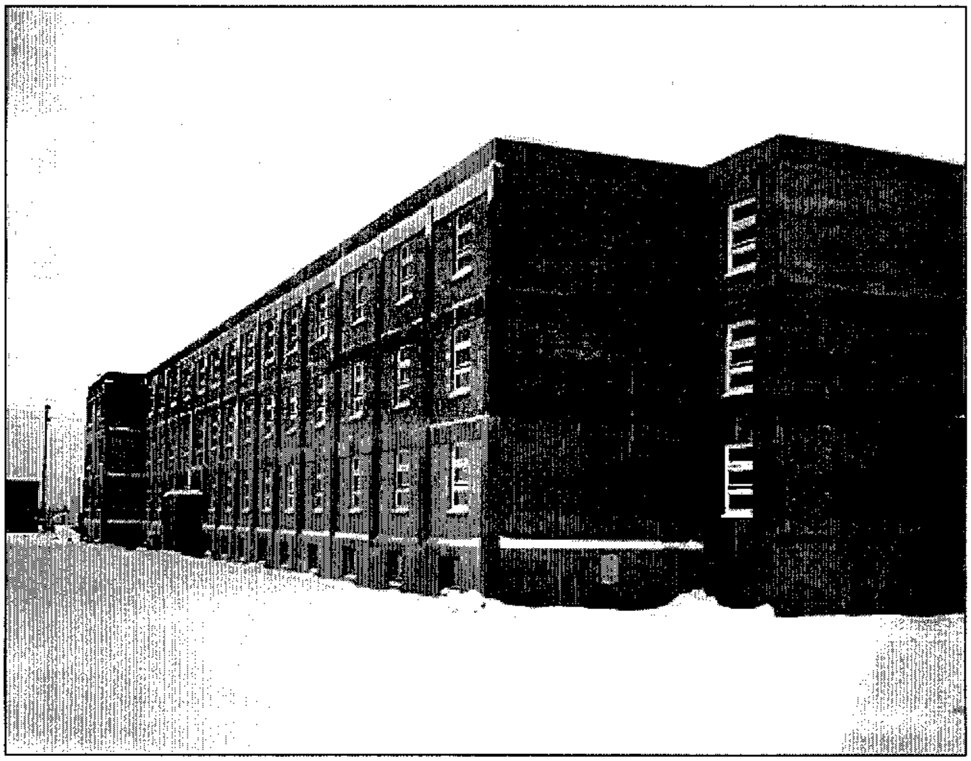


Figure 37. Bldg 660, Nov. 1960. Washington National Records Center, RG 77, 077-64A-2125-23 DA1354 neg 28.

The other MIDAS facility on Fort Greely was a vehicle warm storage building located one block to the north, on Fifth Street.

Figure 38. Vehicle maintenance shop nearing completion, Fort Greely, Sept 1960. Washington National Records Center, RG 77, 077-64A-2125-23 DA1402 neg 8.

As the MIDAS program was shifted to R&D status and then terminated in favor of the second-generation DSP, Donnelly Flats became increasingly irrelevant as a potential operational site. In the end, Donnelly was not destined to play a major role in the operation of missile warning systems. None of this was clear when the site was built, however, and the investment in design, construction, and operational capability was substantial.

CHAPTER 8.0 Running the Station, 1961-1967

Although the MIDAS program was considered experimental, it required substantial ground support. The Donnelly Flats station played an important part in this program support at various times between 1961 and 1967.

8.1 General Operations

The receiving area was the heart of the complex. Primary support activity occurred in the center of the complex, at the ADA building and the nearby Receiver No. 2.

As part of its original configuration, Donnelly was to have three sets of receivers. Two would always be available for satellite support while one was freed up for maintenance. However, before the antennas were installed, the MIDAS program changed and only one receiver was installed. This was located in the center radome, designated on site plans as Receiver No. 2.

The main processing building was just to the south of the active receiver. This was the operational headquarters, with an office for the commander and other staff. This was also where the computer banks and data conversion areas were housed. The building also contained two concrete vaults, the ground-space communications room, and a "MIDAS operations area."

Station operation required two types of support: technical, and facility maintenance. Technical support and operational staffing fell under the purview of the Air Force agency that supervised the MIDAS program. They contracted this out through Lockheed, the prime contractor for the MIDAS program, but retained authority for the operation through a special unit, the 6594th Aerospace Test Wing. Lockheed in turn subcontracted some of its remote operations to Philco, a company specializing in radio technology and operations. Philco provided the technical staff to man the operations at Donnelly. Other technical firms such as Control Data Corporation, the computer manufacturer, had representatives on-site as well.[64]

In addition to the tech reps, there were also facility maintenance and operations personnel assigned to the station. The tactical Air Force command for the region, the Alaskan Air Command (AAC), was assigned this responsibility. The AAC coordinated with the Corps of Engineers during the construction of the site, oversaw engineering issues that arose after construction, and contracted out with various firms to provide general "Operations and Maintenance" (O&M) support at Donnelly Flats.

As technically advanced as the station was, it relied heavily on the mundane work the O&M contractors performed. In Alaska's cold winters, for example, radomes had to be heated. One former employee recalled that the main radome, or "bubble,"

[64] The Air Force organization changed names and configuration several times. At first it was the Western Development Division (WDD) 1954-1957, then the Air Force Ballistic Missile Division (AFBMD) 1957-1961, followed by the Space Systems Division (SSD) 1961-1967, then Space and Missile Systems Organization (SAMSO) 1967-1979. It is presently the Space and Missile Systems Center (SMC). History Office of the Space and Missile Systems Center website, *http://www.losangeles.af.mil/SMC/HO/* Ground stations and the AFSCN were under the control of the Air Force's 6594th Test Wing, established in 1959. Philco eventually became the prime contractor for all AFSCN ground support. Arnold, 83, 86. Re Control Data Corp contractors, "Satellite Station Near Delta Will Be Closed," *Fairbanks Daily News-Miner*, 3 April 1963, 1.

had four "great big heaters" putting out 2 to 3 million btus each. Technician Gene Micek remembered that the winter of 1961-62 was extremely cold, as temperatures fell well below minus sixty. In those conditions, materials change their properties. "The kerosene heaters in the radome would not ignite," he recalled. "When we turned on the hydraulic system to move the motors that moved the antenna, the hydraulic lines blew at [their] fittings and sprayed the antenna with red hydraulic fluid. What a mess to clean up."[65]

A visiting tech rep recalled another frustrating wintertime incident. "[T]he snow-plow had hit a fire hydrant and a geyser of water was building a giant mountain of ice in the sub-zero weather," Marv Sumner wrote. "Workers were using chainsaws to cut a channel down to the shut-off valve. Once they succeeded there was no water service on the site (no kitchen & no bathrooms) for the duration of our visit. A bummer!"[66]

Problems weren't limited to the wintertime. Interior Alaska experiences temperature extremes at both ends of the scale, so air conditioning was also a significant concern at the station. The computers of that era put out a lot of heat and had to be kept cool. Apparently the air conditioning system caused some headaches for the Alaskan Air Command, which supervised station maintenance contracts.[67]

Men at the station also had their share of wildlife encounters. Technician Jimmy Pitts recalled seeing moose, lynx, brown bears, wolverines, and wolves during his tour. Even the rabbits made an impression. "The rabbits that year were so plentiful that you hit at least one a day on the way to work," Pitts recalled. Gene Micek remembered the rabbits and other hazards of highway travel. "On one trip to Fairbanks..., we hit and knocked a buffalo into the ditch and then further down the road in ice fog, slid under a moose." Marv Sumner recalled that once, "There was a dead moose just outside the fence; killed by a bear. The crew wanted to hop the fence and recover the antlers, but the commander said no – the bear was known to return for lunch occasionally and might prefer warm Tech-Rep in place of cold moose."[68]

8.2 Donnelly Flats Operation, 1961-1964

According to an AFSCN report, Donnelly Flats came on line on 15 March 1961, in time to support the launch of MIDAS 3 in July of that year. The station received upgrades to accommodate multiple satellite support in 1962. It remained in operation, supporting program launches through the summer of 1963. Sometime during the following year it went into caretaker status, although it is not clear when this occurred. Local news reports indicate that this was planned for the summer of 1963, but at least according to the Alaskan Air Command, this did not happen until sometime in 1964.[69]

The actual number of people working at the station during this period is hard to pin down. A Philco report from February 1962 called for 199 people to handle technical, administrative, support, and supervisory tasks. Philco expected that when the

[65] Leigh Dennison, phone conversation with author, 14 March 2005. Gene Micek, email to author, 2 March 2005.

[66] Marv Sumner, email to author, 14 March, 2005.

[67] History of the Alaskan Air Command, 1 July – 31 December 1966, 178.

[68] James Pitts, email to author, 31 March 2005. Also Micek, Sumner emails.

[69] MSgt. Roger A. Jernigan, "Air Force Satellite Control Facility Historical Brief and Chronology 1954- Present," [no date], 135. When it came online, Donnelly took over Annette's former designation as OL-3. Re upgrade, engineering plans on file with Fort Greely DPW, "MULTISAT – F.G.S." Re closure, "History of the Alaskan Air Command, 1 Jan – 31 Dec 1964," 90.

station was in full operation, it would require 99 technical maintenance people spread over three shifts per day. Some of the specialties they called for included: automatic tracking radar technicians, communications technicians, data processing technicians, instrumentation technicians, and precision measuring equipment technicians. Newspaper reports from the summer of 1963 state that Philco had sixty technical employees on site. Control Data Corporation and Chrisdart Co. had ten technical staff, while the Budson Co. employed thirty-four facility maintenance contractors. The newspaper also reported monthly operating costs at the station of $120,000 or more. Although station operation fell under the purview of the Air Force 6594th Test Wing, it is not clear how many uniformed personnel were present at the site.[70]

During the station's first phase of MIDAS support from 1961 to 1963, difficulties with the satellites and the launch vehicles meant that very little actual satellite support took place. However, there was still a lot of preparatory work going on at the station. Since support equipment was essentially still being invented and debugged, this was an important task, although it is easy to overlook. Jimmy Pitts, a former tech rep at the station in 1961, worked on the timing equipment, an essential component of satellite support. He reported that he "spent every day trying to get it operational." Others worked on the antenna and other ground equipment. These invisible efforts on the ground at remote stations like Donnelly did play a role in the eventual success of satellite command and control. Lessons learned with the equipment at Donnelly no doubt led to later improvements in MIDAS and its successor systems.

8.3 Donnelly Flats Operation, 1965-1967

In March 1965, the Air Force began preparations to bring Donnelly back on line to support the RTS-1 flights. Program managers had considered using the Chiniak station on Kodiak Island to support these test flights, but that was not possible. The RTS-1 program required the full utilization of its ground station, and Chiniak was busy covering other needs.[71]

This time, Donnelly was designated OL-8. Once again, Philco held the contract for technical support. Its first job was to upgrade and check out the equipment at the site. On April 6, 1966, Donnelly Flats reached "operationally ready status."[72]

Again, only the center radome and its 60 foot antenna were used. This time, according to a tech rep, one of the remaining radomes contained banks of 300-watt heat lamps. These were used as ground targets to help calibrate the infrared sensors on the satellites.[73]

Probably this was the most active period at the site. The first RTS-1 launch in June failed, but the second and third satellites were successful, remaining in orbit well over three hundred days each. The third and final launch on 5 October 1966 resulted in a satellite orbit lasting 372 days, which accounts for Donnelly Flats remaining active through November of 1967. It is also possible that Donnelly supported other

[70] Philco Western Development Laboratories, "Program 239A Tracking Station Maintainability Evaluation Plan," 28 Feb 1962. "Satellite Station Near Delta Will Be Closed," *Fairbanks Daily News Miner*, 3 April 1963, p 1; "Donnelly Station Not Fully Closed," *Fairbanks Daily News Miner*, 12 June 1963, p.1, 9.

[71] Robert E. McClellan, "History of the Space Systems Division, January-June 1965", Vol. II, Space Systems Division Historical Division, Nov. 1966, 29.

[72] Jernigan, 135.

[73] Wayne Strickland, email to author, 4 June 2005.

satellite programs besides MIDAS. This aspect of Donnelly's history is unclear, but reliable sources suggest that the station may also have assisted programs like CORONA.[74] In any case, the station was up, and it was humming with activity.

These flights were the last of the prototype polar-orbiting warning satellites. After that, the book was closed on MIDAS and 461, and the DSP with its high-orbit geostationary configuration moved ahead in its place.[75]

8.4 Pass Support

There are no firsthand accounts available that describe active pass support at Donnelly. But based on information from MIDAS program plans and from AFSCN and Chiniak histories, it may have worked like this.

Prior to launch, the station crew would have rehearsed their various roles for several weeks. As countdowns proceeded, AFSCN Sunnyvale would send technical data to the remote stations and conduct readiness checks. After launch, the booster rocket propelled the payload toward orbit while downrange tracking locations in the Pacific kept tabs on its position. As the final engine thrust placed the satellite into orbit, stations like Donnelly were standing by, prepared to pick up its signal as it passed over.

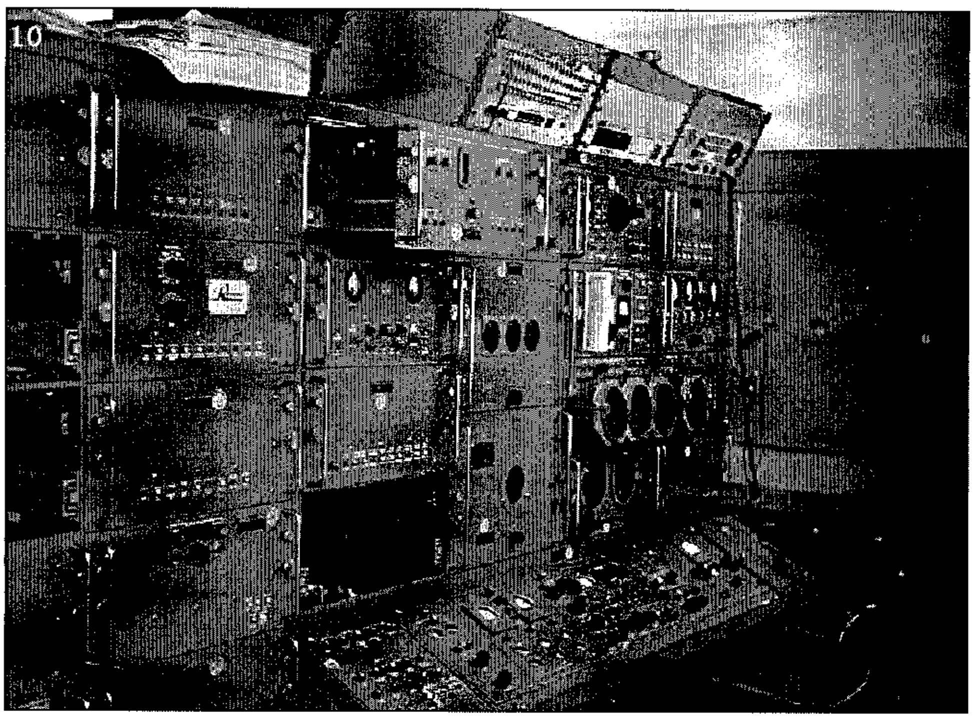
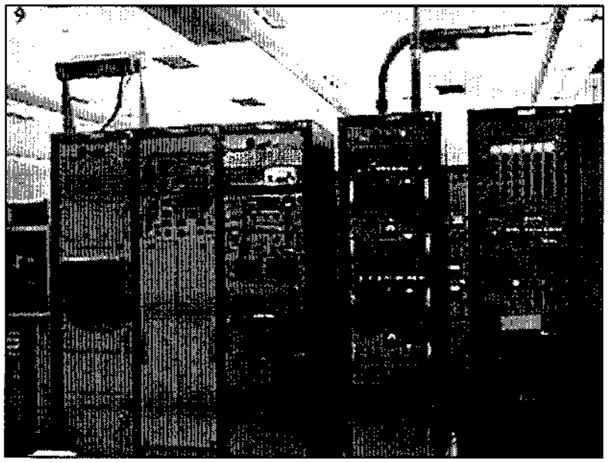


Figure 39. Prelort radar console, Chiniak. Donnelly might also have had Prelort equipment. Courtesy Bob Siptrott.

[74] Michael Binder, email to author, 11 Feb 2005, referencing R. Cargill Hall, former NRO historian.

[75] Program 949 operated in the interim, with four satellites launched between Aug. 1968 and September 1970. Michael Binder, email, 30 May 2006. Donnelly Flats did not support this program.

With the data Sunnyvale sent, station technicians knew where to direct the antenna. As the satellite came into range, the antenna would lock on and the station would begin to receive its telemetry and readout data. The on-site computers would process telemetry and run orbital calculations to forward on to Sunnyvale.



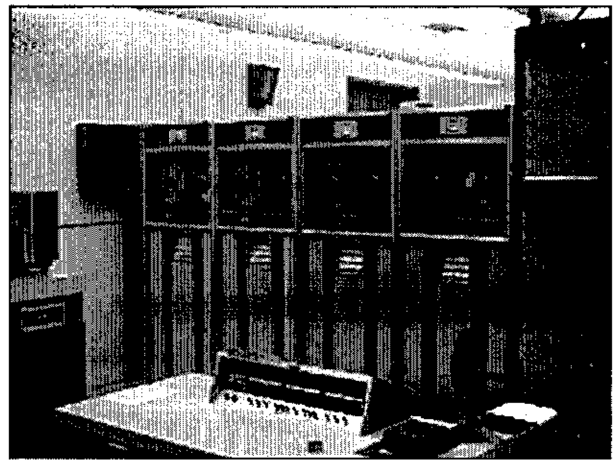


Figure 40. CDC 160A and peripherals at Chiniak. Similar equipment was used at Donnelly. Courtesy Bob Siptrott.

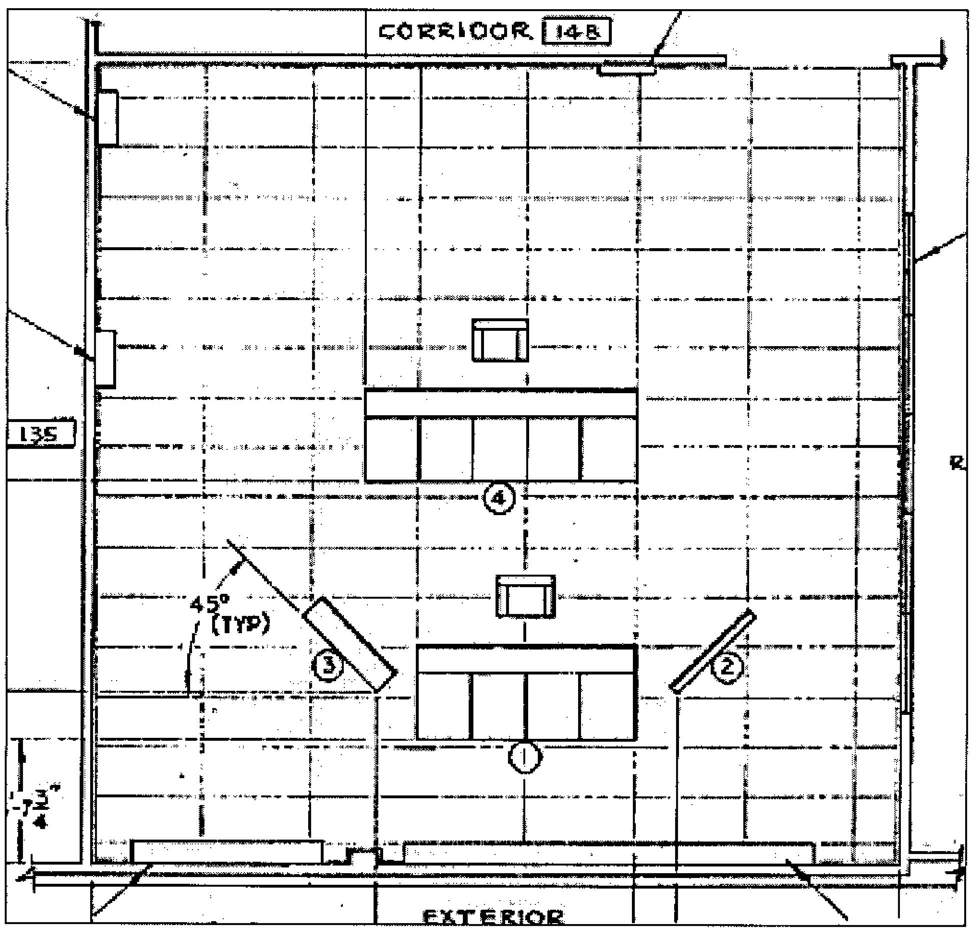


Figure 41. Control room configuration at Donnelly. Key: (1) Master control and data console, (2) Status board, (3) Plot board, (4) Supervisor's console station.

THERE WILL BE A QUIZ...

In its earliest configuration, Donnelly Flats was equipped with a PAM-FM (pulse-amplified FM) receiving system. Apparently the PAM-FM signal was complex enough to defy traditional methods of enemy jamming and spoofing at that time, and may have been one of the most complex elements of the support system. According to the abstract for the PAM-FM ground station's theory of operation manual:

"The purpose of the PAM-FM Ground Station is to receive, process, record, and present for on-line, real-time readout PAM-FM telemetered information from a vehicle....The Ground Station consists of a Receiver, Base Band Unit, Demultiplexer, Digitizer (Datrac), Record and Reproduce Electronics, a Magnetic Tape Recorder, Sample and Hold Output circuitry....The input to the receiver of the Ground Station is a PAM-FM signal. The receiver output is an amplitude-modulated pulse train proportional to the pulse train delivered to the vehicle transmitter by the vehicle multiplexer. This pulse train is amplified, band-limited, and delivered to the Datrac for digitization. Each pulse of the pulse train...is digitized into a nine-bit binary word and delivered to the Magnetic Tape Recorder for parallel recording in Non-Return-to-Zero (NRZ) form. The pulse train is also delivered to the Demultiplexer for separation into individual channels corresponding to the channels of the vehicle multiplexer. The information from the Demultiplexer is used for real-time readout on visual display equipment."[76]

Donnelly was designed to have tracking capability, receive telemetry and infrared readout data, compress and communicate that data, and record it on tape backup. Unlike Chiniak, Donnelly did not send commands. Also unlike Chiniak, Donnelly's communication systems were designed to send real-time data to force commanders. Under MIDAS plans, the three northern stations would pass satellite warning signals to the TCC in Iowa and from there directly to NORAD's Cheyenne Mountain. Since MIDAS never went operational, this never occurred. Instead, the experimental MIDAS system would have sent its signals to a simulated MOC at Sunnyvale. Obviously, this ability to compress and relay data immediately was the key to MIDAS' usefulness. However, little is known about how this would have worked at Donnelly, other than the fact that Donnelly's ADA had dedicated communications areas and the site had a direct link to the White Alice relay system on the neighboring ridge.

[76] Lockheed Missiles and Space Co., abstract of report for PAM-FM Ground Station Vol II, 1 September 1960, contract AF 04(647)-347, accessed on Defense Technical Information Center STINET. Jim Harpring, phone communication, Fort Richardson, 14 March 2005.

8.5 Closure and Disposition of Facilities

In the end, Donnelly never became part of an operational warning system, and the site was closed for good in November 1967. When it was closed, Donnelly reportedly employed between 50 and 100 civilians and two Air Force officers, with monthly operating costs reported to be over $100,000.[77]

The eventual disposition of equipment and facilities took some time. When the station closed, technicians pulled out the most useful equipment for use in other AFSCN ground stations. One tech rep recalled that the last computer at Donnelly Flats, a GE 2000, was sent to California and used by an aerospace company as a payroll computer for another ten years. The University of Alaska also obtained some of the movable equipment in 1968, reportedly for use at the Poker Flats rocket range.[78]

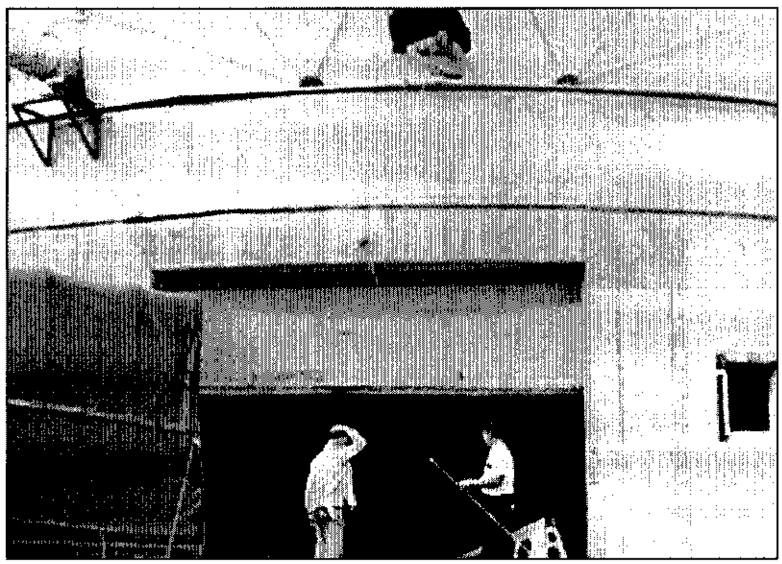


Figure 42. Equipment removal at Donnelly, ca 1970s. Courtesy Bob Siptrott.

The remnants of the station sat empty along the Richardson Highway until the early 1980s. Some equipment was still on site in the late 1970s when technicians arrived to strip gearboxes. By then, the buildings had fallen into disrepair. A visiting technician reported that the radome had been shot full of holes but "was amazingly still sound considering 11 years of neglect, three foot holes cut out of the base ring, and one hell of a wind blowing through."[79]

[77] Elmendorf History Office Chronology, July 1967.

[78] On at least one occasion, pieces of Donnelly's equipment were sent to the OL-9 station in the Seychelles, which had the same type of antenna. Email posting, A. Lagenour, 16 April 2002, on *http://209.165.152.119/af_track/bob_greely.html.* Gene Micek also recalled that Donnelly Flats parts were sent to Seychelles after the 1963 mothballing. 02 Mar 2005. Re GE 2000, Wayne Strickland, 04 June 2005. According to word-of-mouth, an earlier version of the Donnelly Flats computer ended up at the University of Alaska's Ballaine Lake research station where it remained for many years. Neal Brown, email to author, 10 March 2005. Dale Pomraning, phone conversation with author, 23 February and 10 March, 2005. The University also acquired the station's D7 cat, road grader, and strato-boom. Neil Davis 01 Dec 2004. Individuals also obtained some of the surplus materials. A radome now on display along the Steese Highway near Fairbanks is reportedly one of the Donnelly radomes.

[79] Lagenour email.

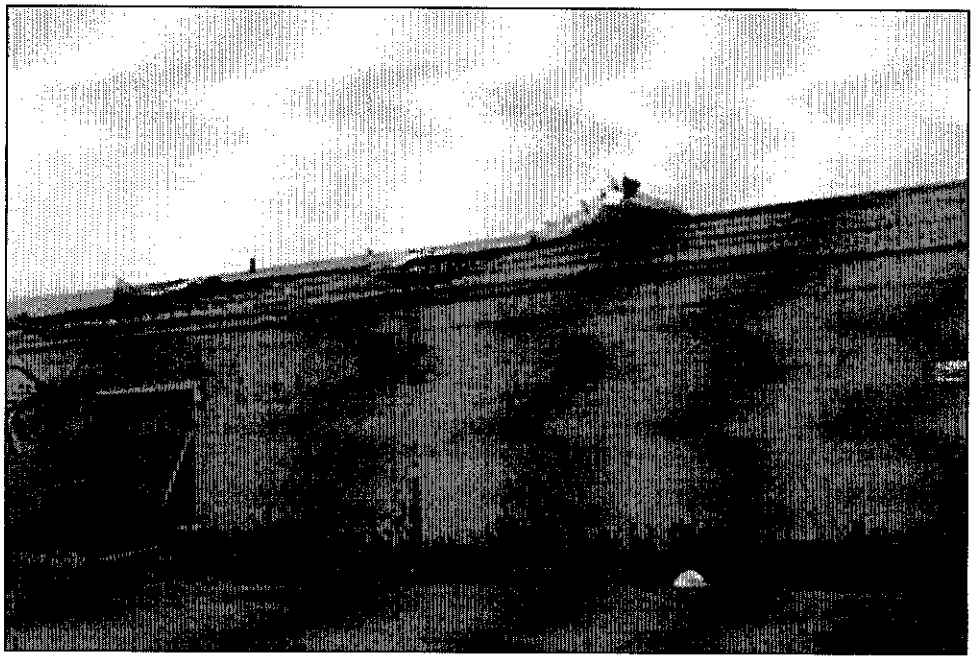


Figure 43. ADA building showing effects of abandonment, ca 1970s. Courtesy Bob Siptrott.

In 1982, the Army Corps of Engineers put out a request for bids on the sale and removal of buildings at Donnelly Flats. A Delta Junction resident, Nick Colombo, won the contract and purchased the buildings for $16,618.80. The contract covered removal of the fencing, miscellaneous power plant equipment, and all the buildings on the site except the power plant. Apparently the contract did not require demolition of the cast-in-place concrete structures or concrete block walls. Correspondence indicates that Fort Greely engineering personnel took down the concrete block walls, and there was a plan to re-use them as rip-rap on the Delta River to protect a range site. The cast concrete was more difficult to remove. A former engineering employee at Fort Greely recalled that a few years later, a military explosives team came to blow up the concrete radome supports, and "they had people running for cover up to a mile away." For unknown reasons, the team did not complete the job, and several of these features are still extant at the site.[80]

[80] U.S. Army Engineer District, Alaska, invitation for bids 82-2, Fort Greely Directorate of Public Works files. Memo, LTC H.A. Froehle, Director of Facilities Engineering, 15 June 1982, Fort Greely DPW files. Re explosives team, Ron Potwin, Fort Wainwright DPW, email 22 Dec 2005.

CHAPTER 9.0 Donnelly Flats Today

On May 11, 2005, Kathy Price and four members of the Donnelly Training Area archaeology crew visited the Donnelly Flats site. Site information and photographs are presented below, grouped by location.

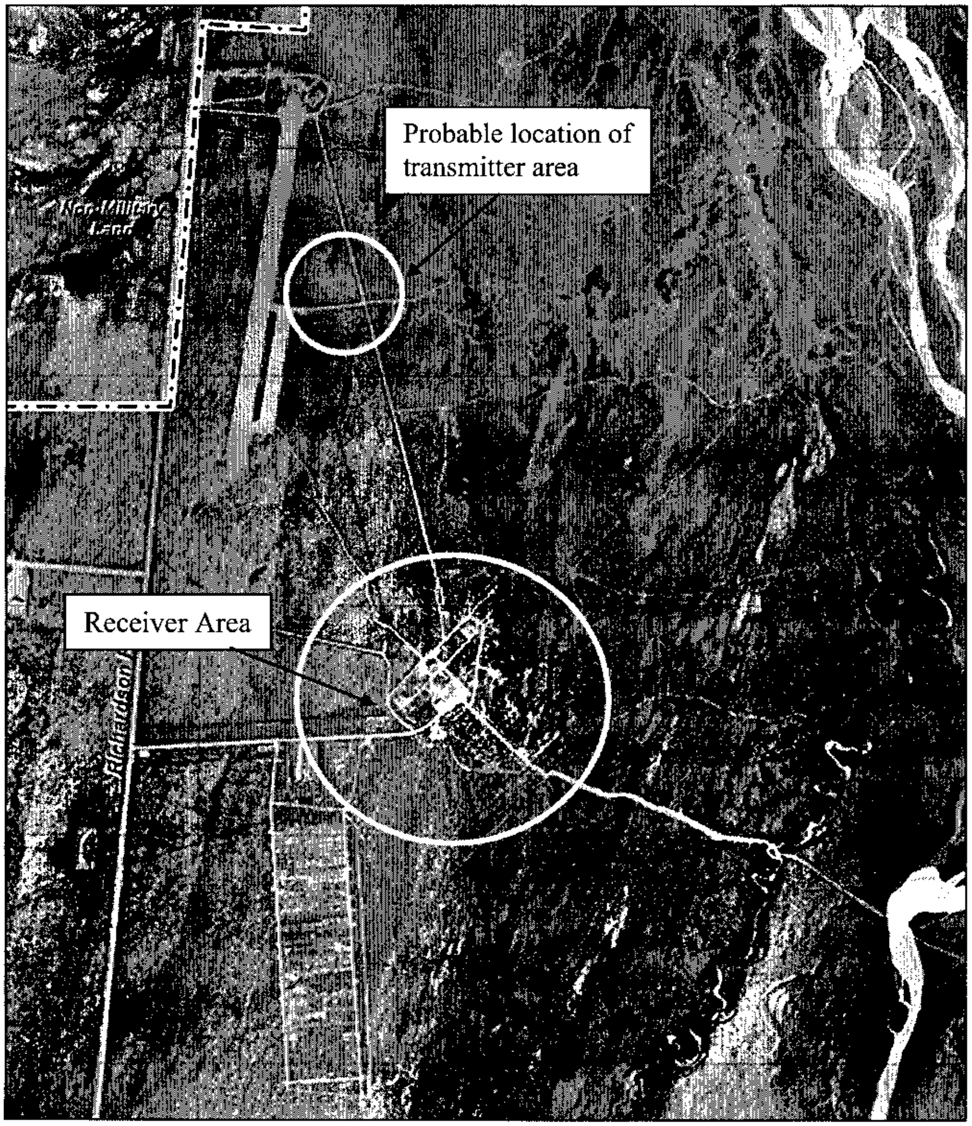


Figure 44. Aerial photo of Donnelly Flats area. Courtesy USAG-AK GIS.

9.1 Receiver Site

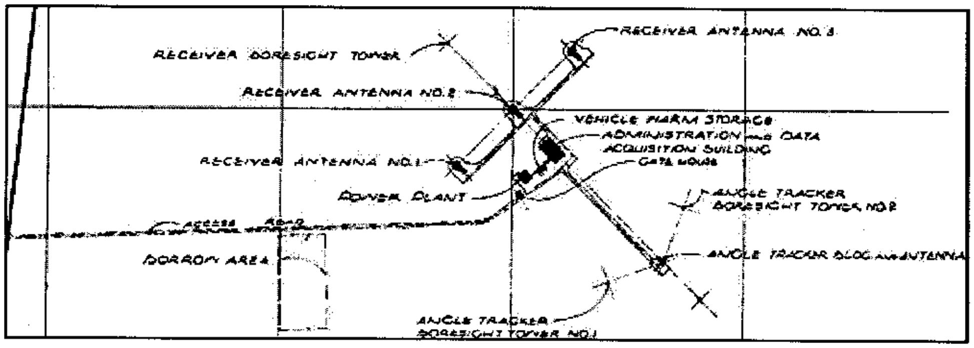


Figure 45. Receiving area with boresight tower locations, as-built diagram, 1961. Survey marks removed.

Feature	Status	Comments
ADA bldg	Demo'd	Remnants include foundation, concrete shells of vault and crypto vault, and bathroom tile.
Receiver 1	Demo'd	Remnants include concrete radome support and adjacent concrete bldg foundation.
Receiver 2	Demo'd	Site consists of earthen mound with metal fragments protruding from top.
Receiver 3	Demo'd	Remnants include concrete radome support and adjacent concrete bldg foundation.
Vehicle Warm Storage	Demo'd	Concrete foundation remains exist.
Power Plant	Extant	Shell extant, interior gutted and full of rubble.
Angle Tracker bldg	Demo'd	Remnants include foundation and concrete radome support.
Boresight towers	Not extant	No evidence of this feature observed.
Gatehouse	Not extant	No evidence of this feature observed.
Fencing	Not extant	No evidence of this feature observed.
Access road	Extant	Additional dirt roads/trails traverse the area.
Construction camp	Not extant	Removed prior to site occupancy in 1961.

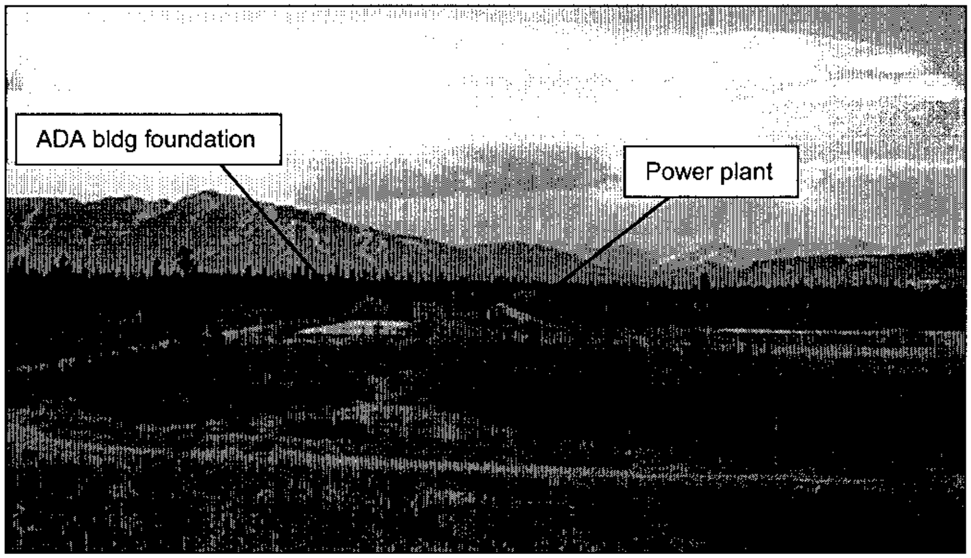


Figure 46. ADA foundation and power plant. View looking south from Receiver 2 mound.

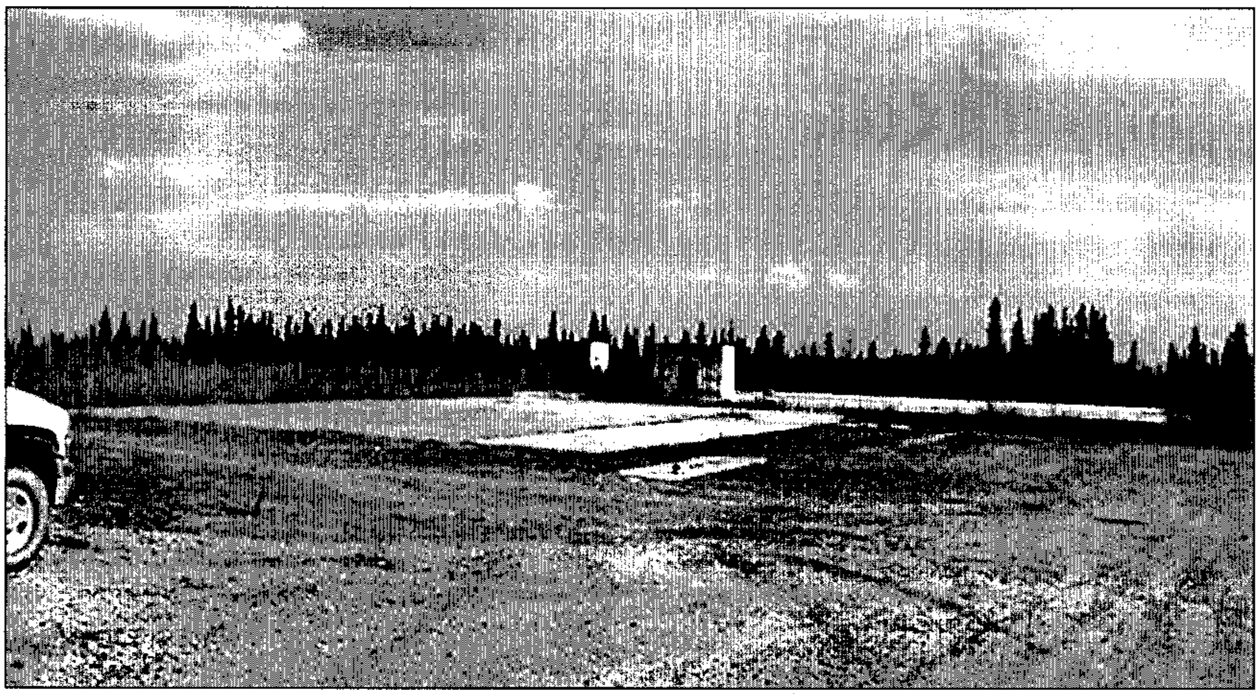


Figure 47. Foreground, warm storage foundation. Background, ADA foundation. View northeast.

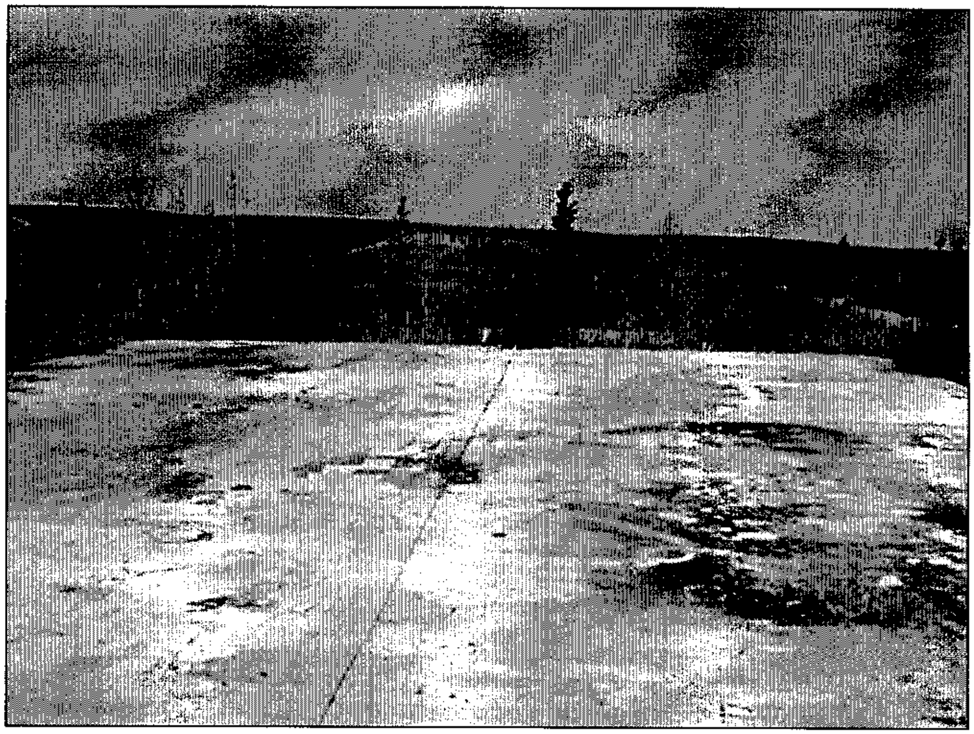


Figure 48. ADA foundation, instrument calibration area. View looking north.

Figure 49. Vault remnants, ADA bldg, view looking east. Note brush which has reclaimed the western side of the foundation area.

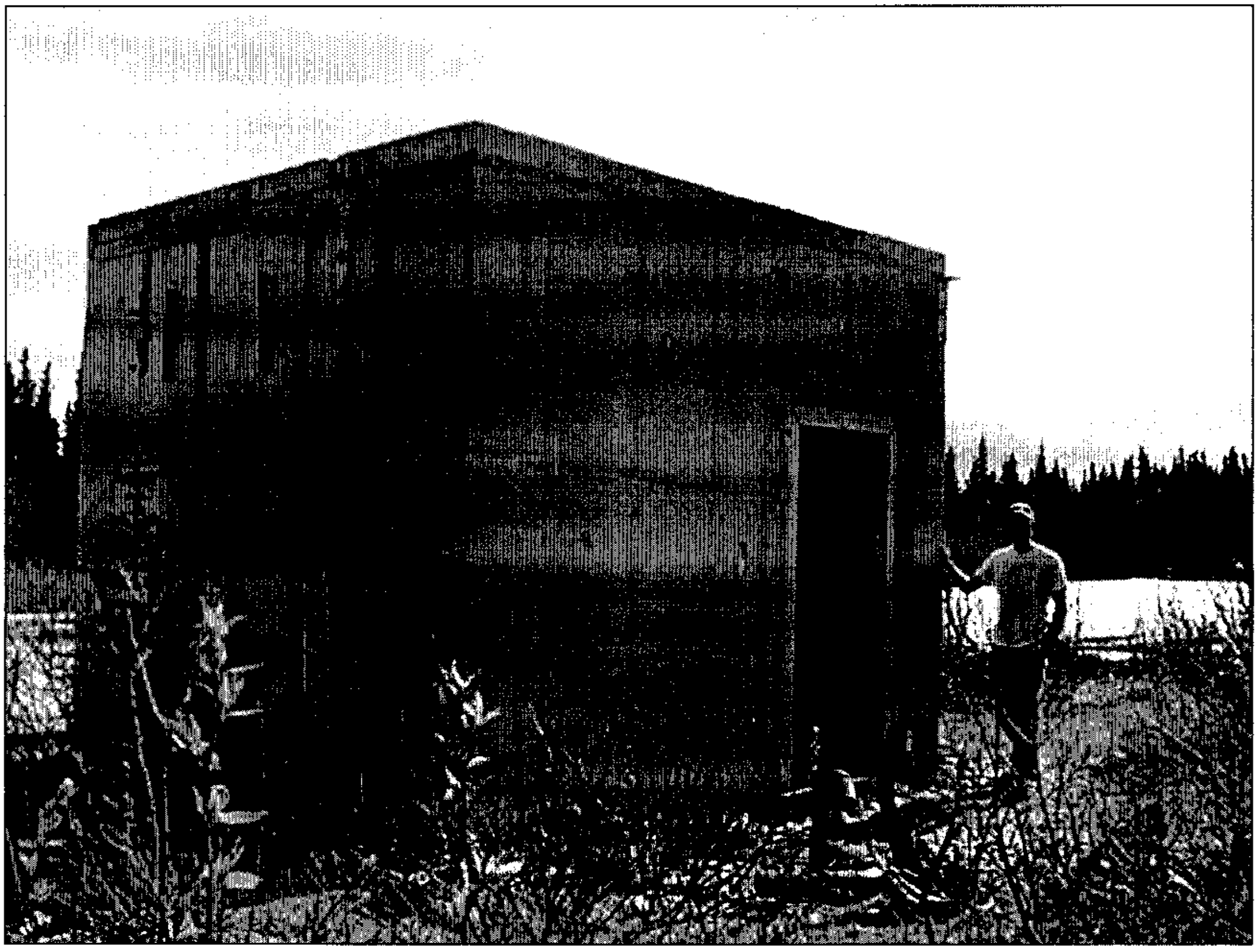


Figure 50. Crypto vault shell, north and west sides.

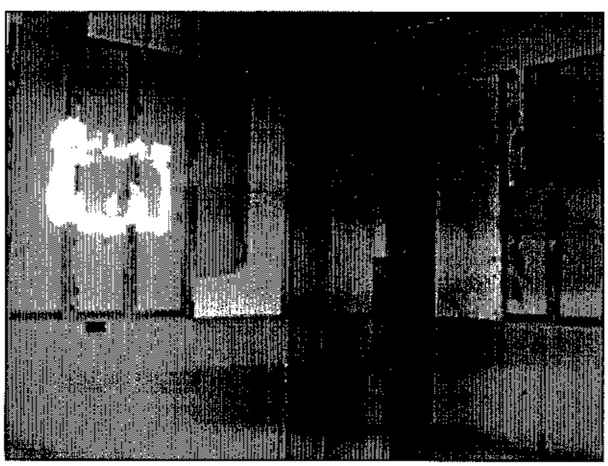


Figure 51. Interior, crypto vault remnant.

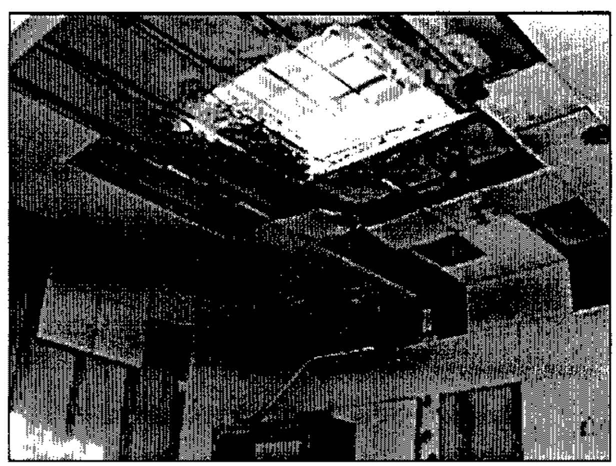


Figure 52. Interior ceiling, crypto remnant.

Figure 53. Receiver 1 radome support. View looking southwest.

Figure 54. Receiver 1 radome support.

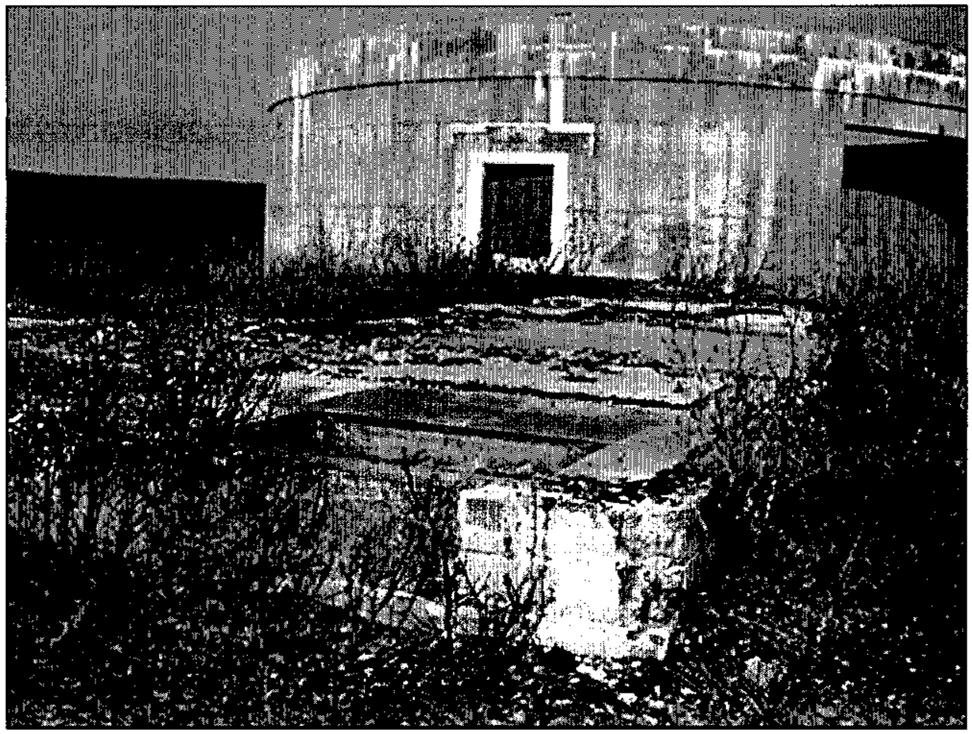


Figure 55. Receiver 1 radome support and bldg foundation.

Figure 56. Flooring remnants, Receiver 1 support bldg.

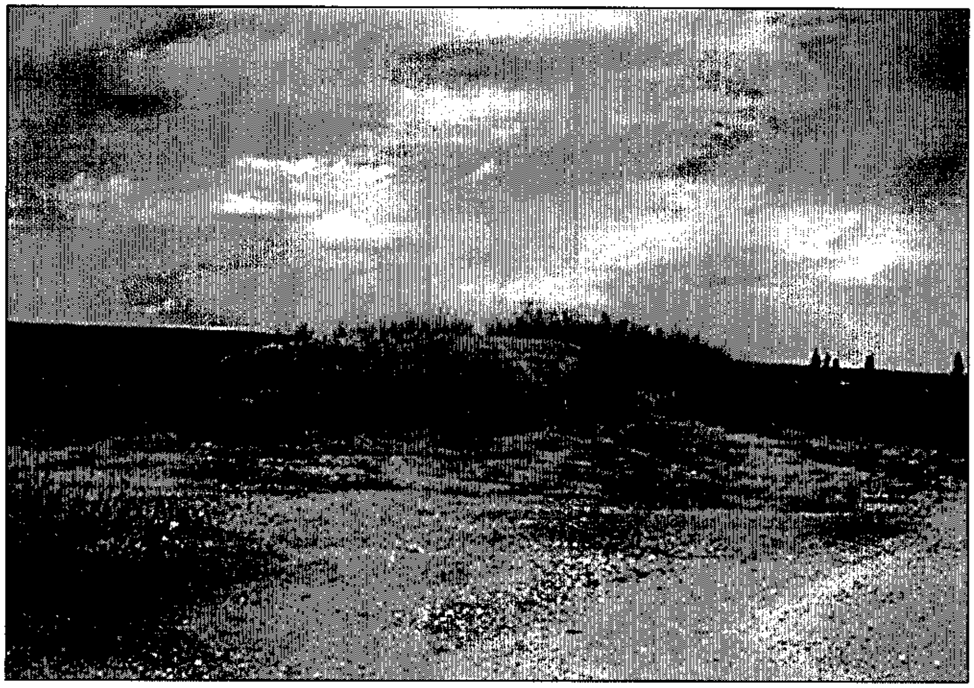


Figure 57. Location of Receiver 2.

Figure 58. Receiver 2 mound and Receiver 1 radome support.

Figure 59. Debris embedded at top of Receiver 2 mound.

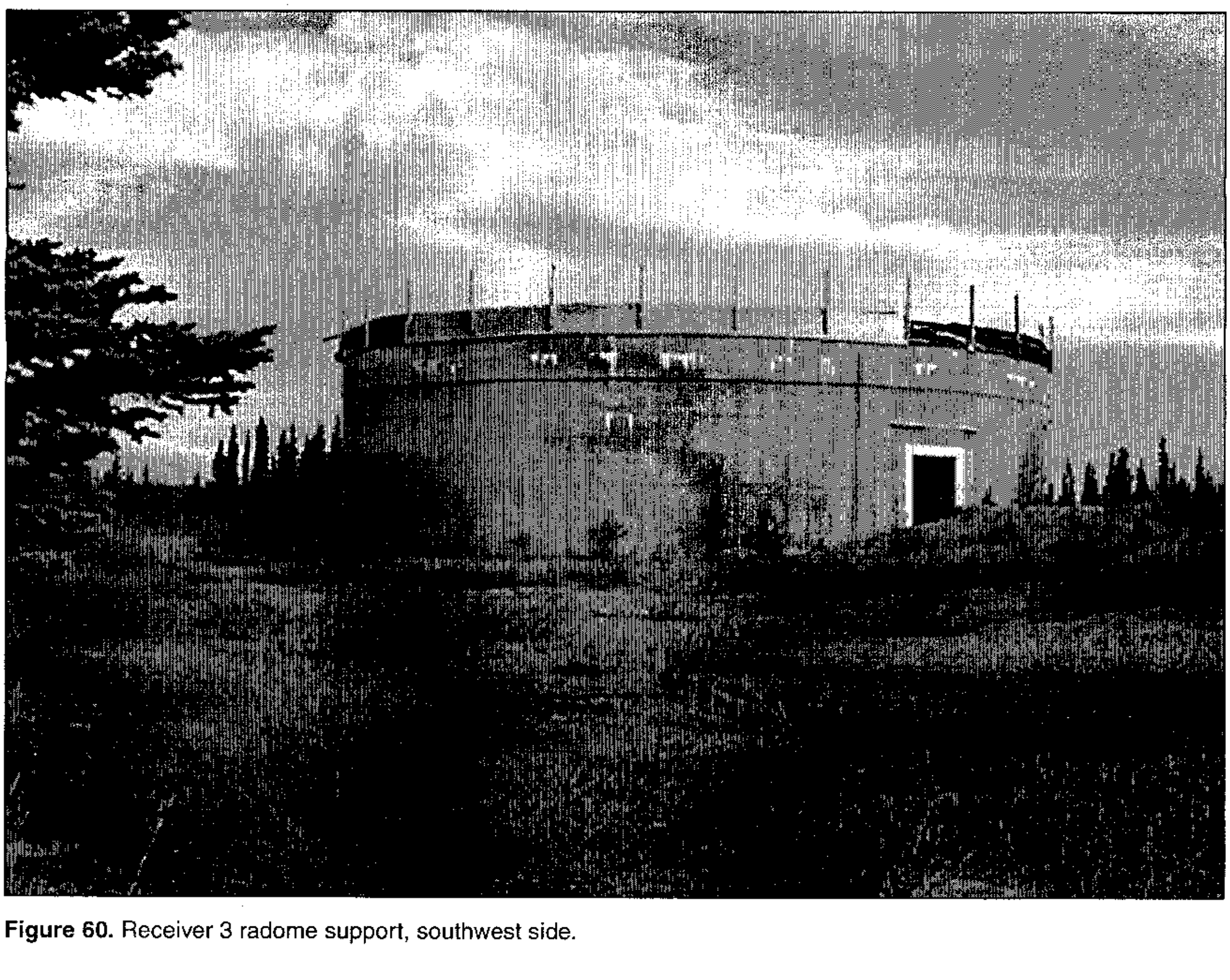


Figure 60. Receiver 3 radome support, southwest side.

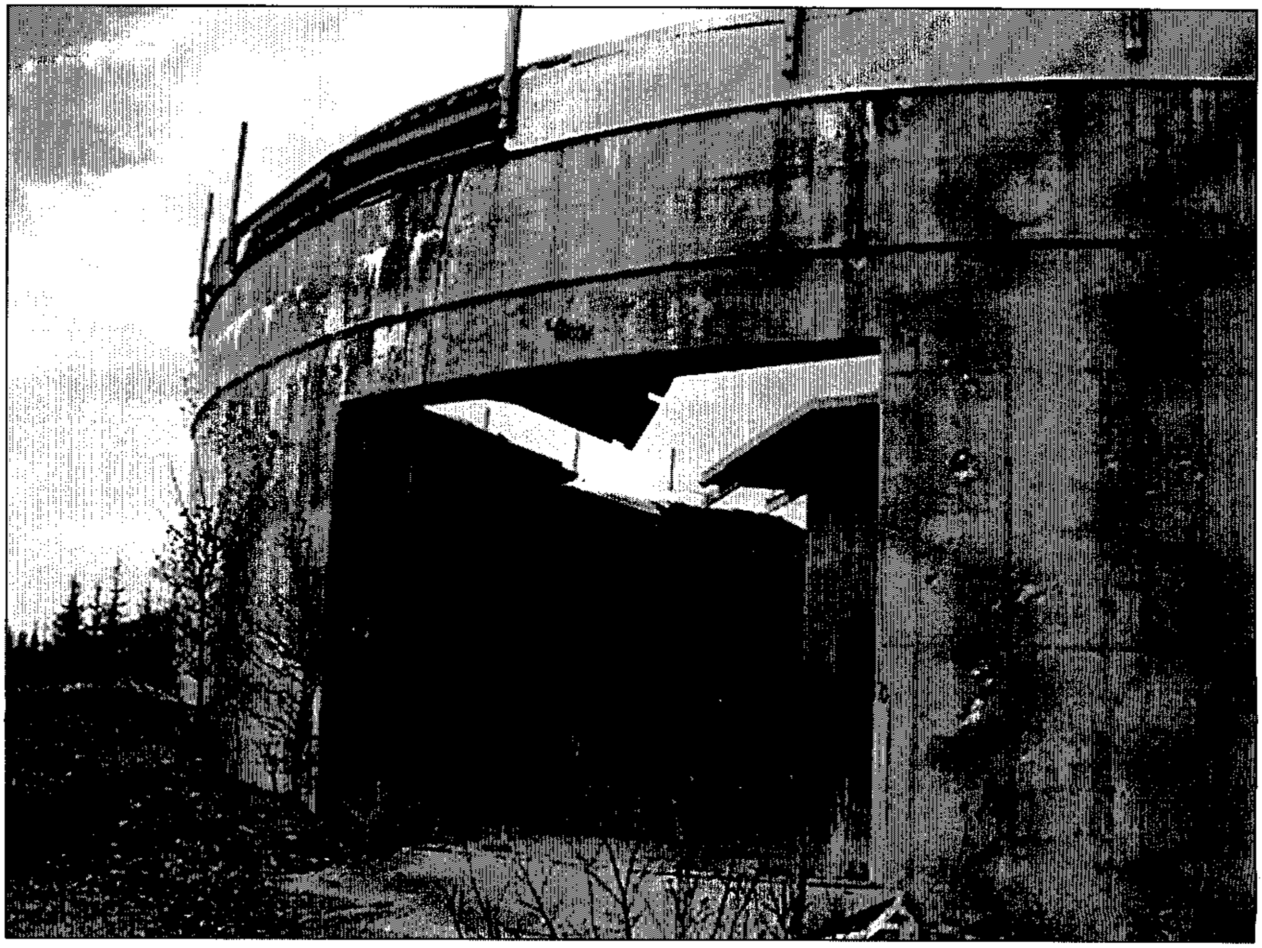


Figure 61. Receiver 3 radome support.

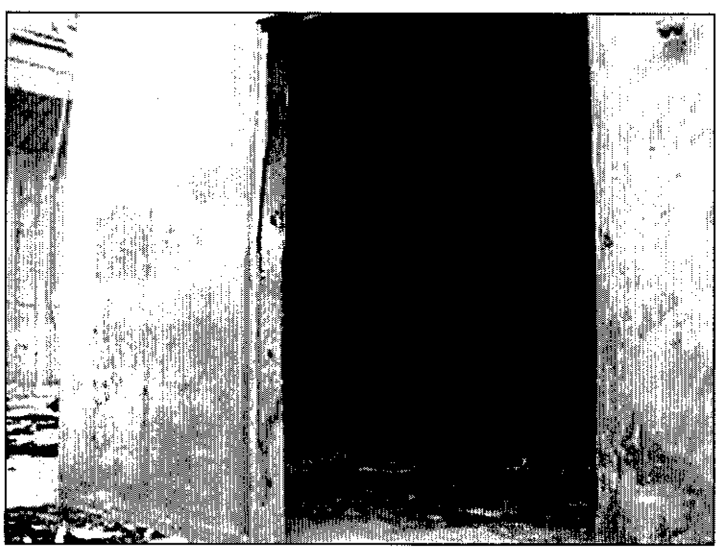


Figure 62. Antenna base, inside Receiver 3 radome support.

Figure 63. Detail, interior antenna base.

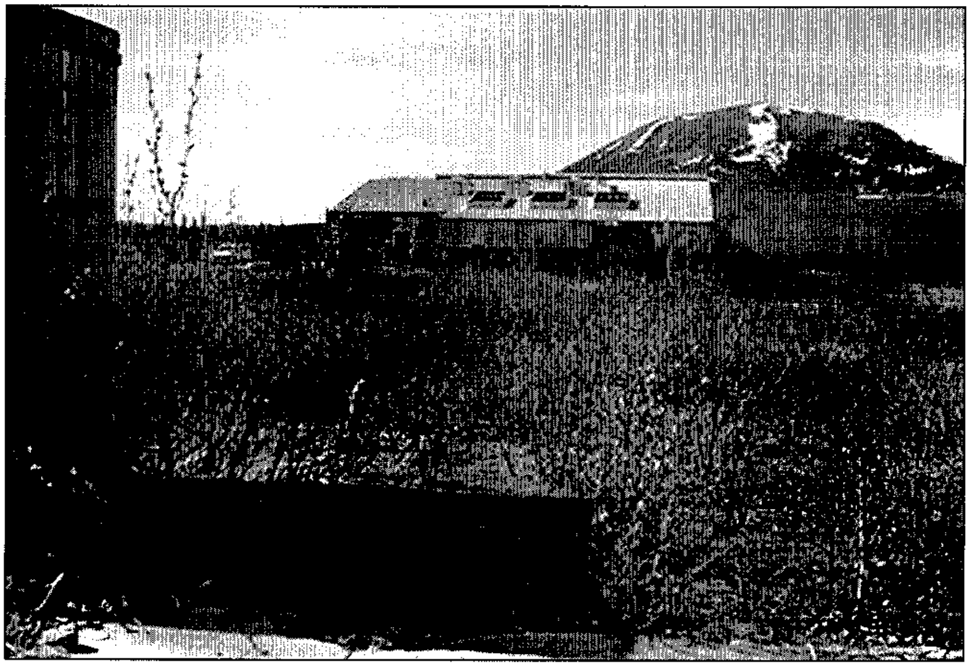


Figure 64. Power plant, east elevation.

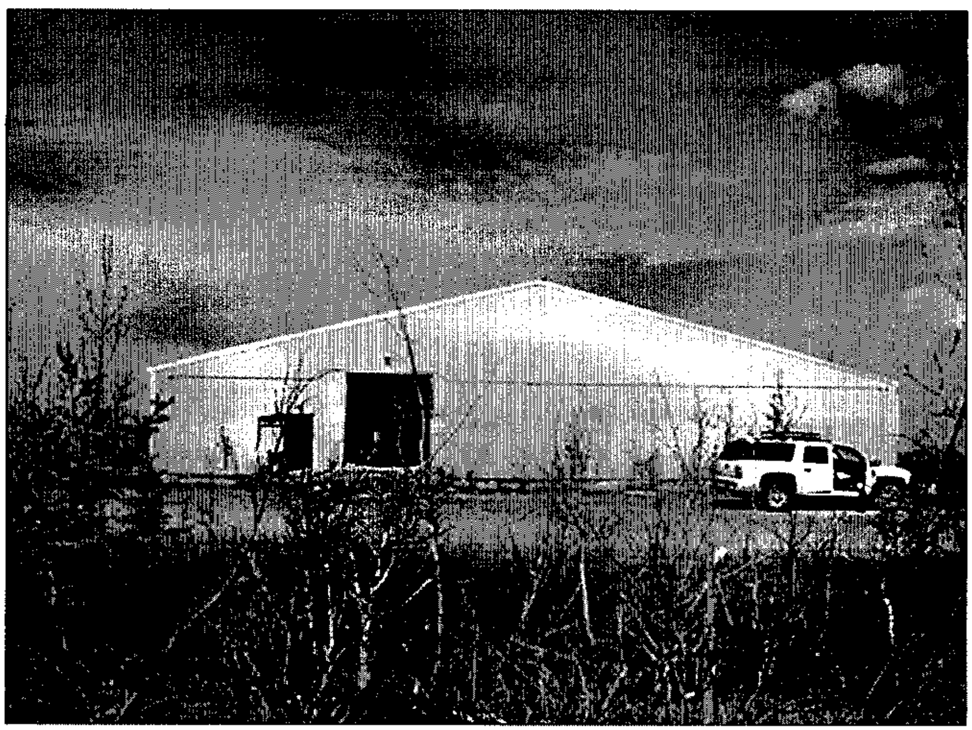


Figure 65. Power plant, south elevation.

Figure 66. Power plant interior looking north.

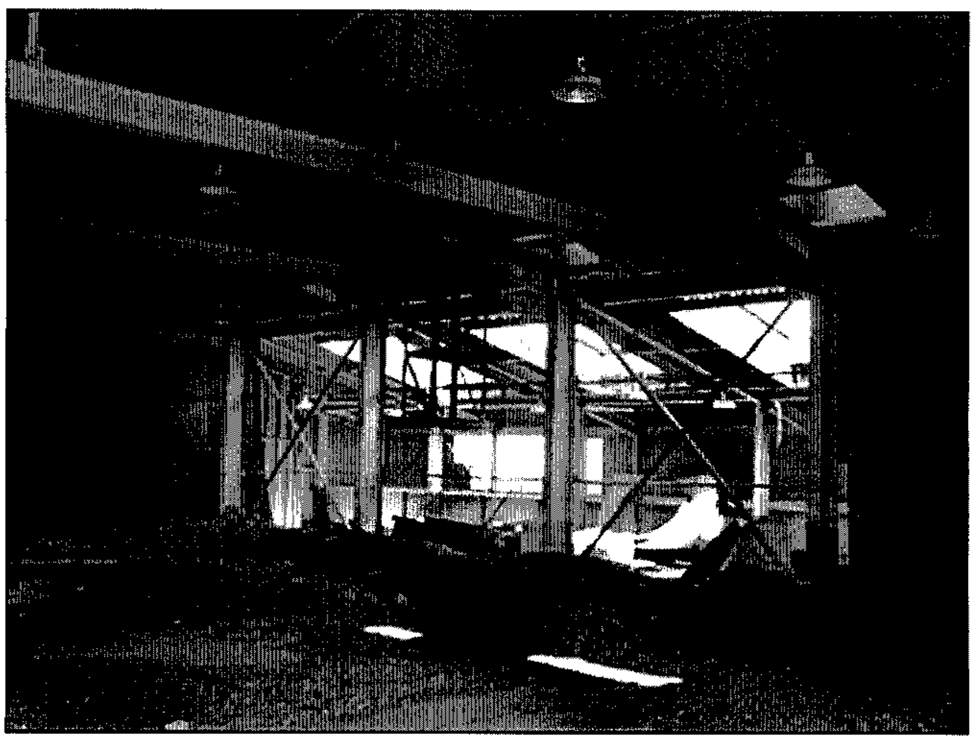


Figure 67. Power plant interior, looking northeast.

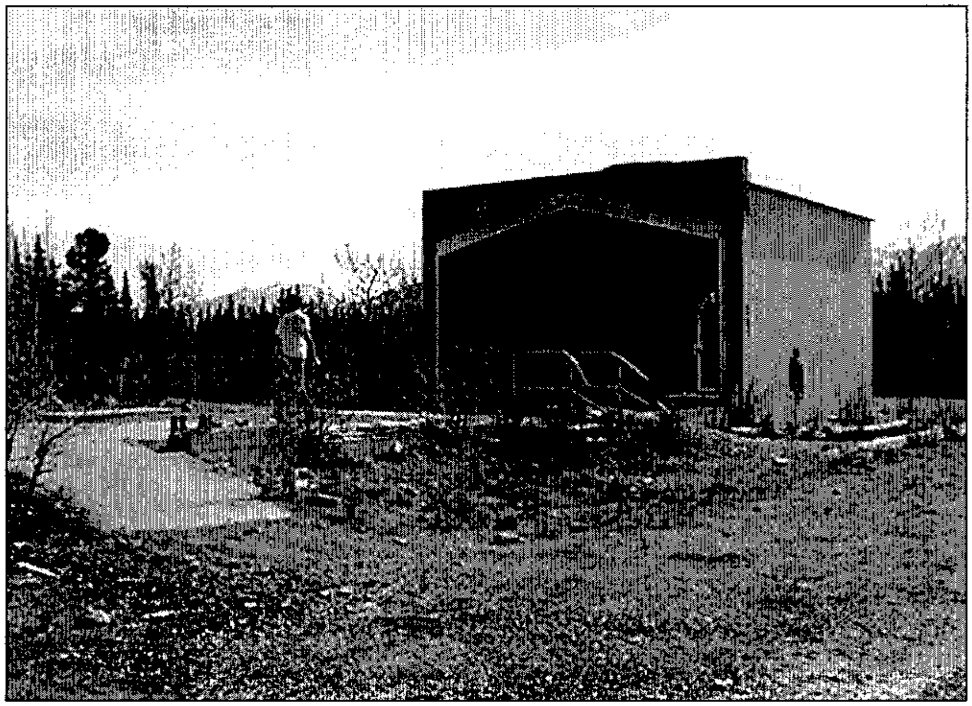


Figure 68. Angle tracker bldg foundation and radome support remnant. View looking east.

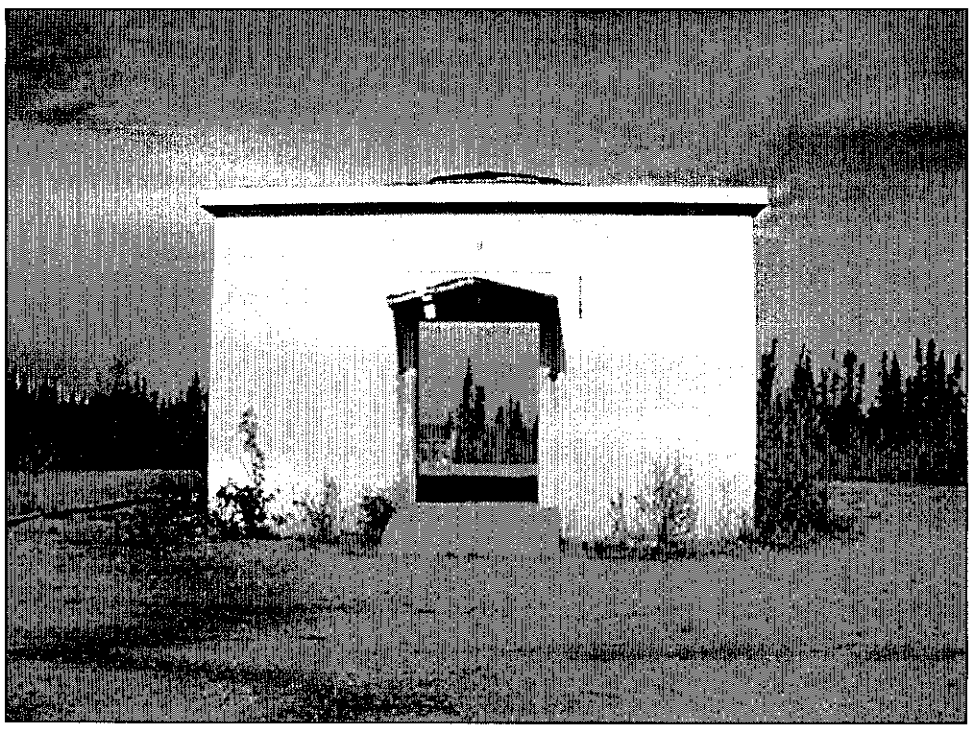


Figure 69. Angle tracker radome support, south elevation.

9.2 Transmitter Site

After extensive searching, no trace of the transmitter site or its foundations was found. It appears that the transmitter site was completely razed. Clearings and dirt roads associated with the Donnelly Drop Zone training area are the only features presently extant at that location.

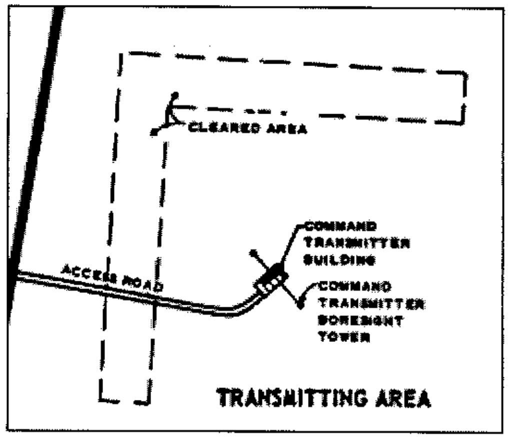


Figure 70. Transmitting area, LMSC 1961.

Feature	Status	Comments
Command transmitter bldg	Not extant	No evidence of this feature observed.
Gatehouse, fencing	Not extant	No evidence of these features observed.
Boresight tower	Not extant	No evidence of this feature observed.

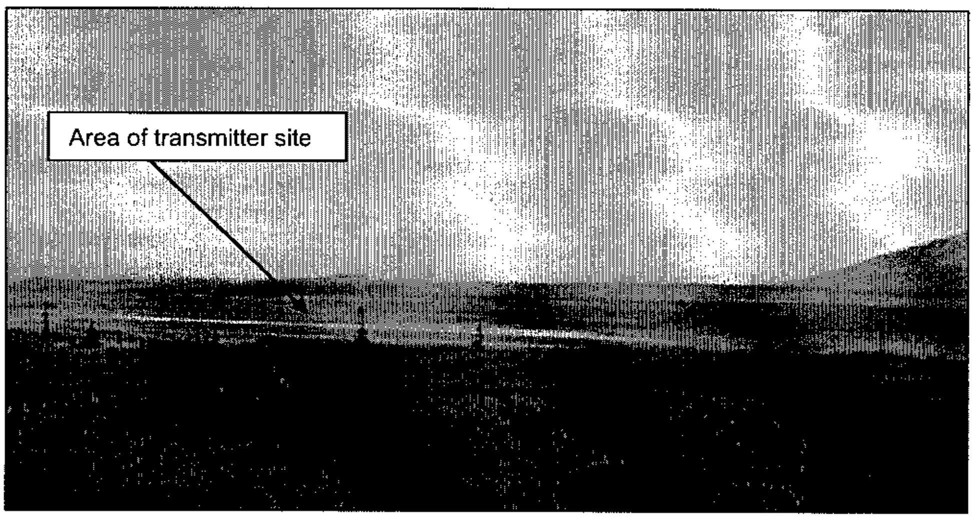


Figure 71. Approximate location of transmitter site, view from Donnelly Ridge.

9.3 Associated Areas

Feature	Status	Comments
Barracks, Bldg 660	Extant	SMDC facility
Vehicle maint, Bldg 628	Extant	SMDC facility
Donnelly Ridge communications site	Not researched	n/a

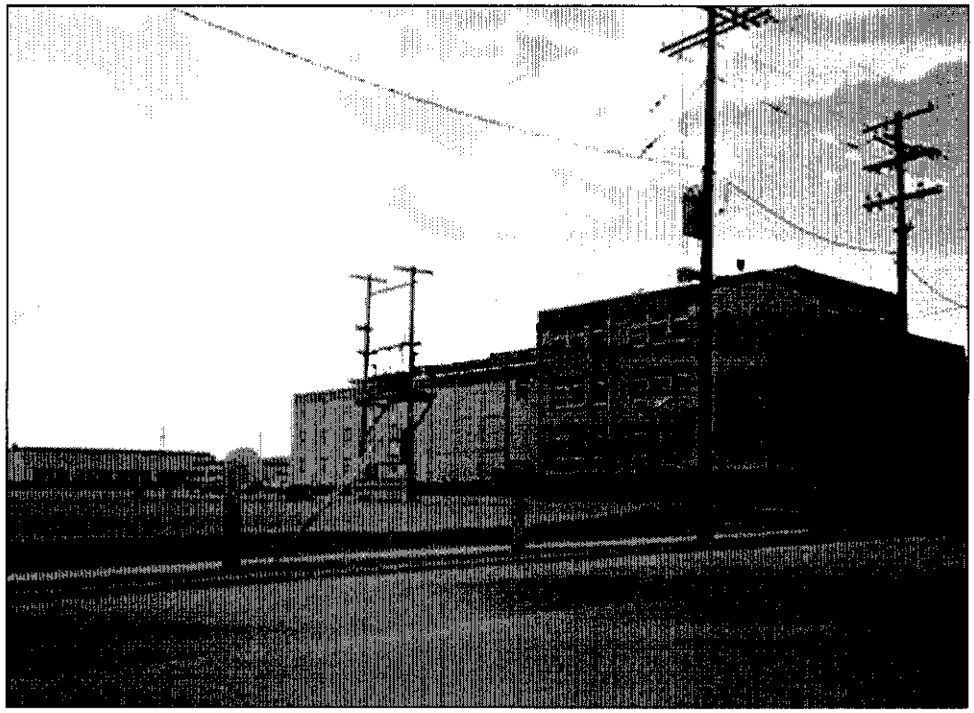


Figure 72. Bldg 660, former "MIDAS Hotel."

Figure 73. Bldg 628, vehicle maintenance.

9.4 Determination of Eligibility

Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of undertakings on properties eligible for listing in the National Register of Historic Places (NRHP). Before assessing the effects of proposed undertakings, properties must be identified and evaluated according to NRHP criteria to determine whether they are eligible for the NRHP. [36 CFR 800.4(c)]

The NRHP criteria state that "The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction (i.e., a historic district); or

D. That have yielded, or be likely to yield, material information important in prehistory or history.[81] [36 CFR 60.4]

The Donnelly Flats MIDAS site was a complex of facilities designed to support a specific satellite program. When the program was discontinued, the site was abandoned. Over the ensuing years, nearly all the structures at the site were removed.

This report provides information showing what facilities were once extant at this site, and which facilities would have been used in the satellite support mission. With this material, we can draw informed conclusions about the site's integrity and eligibility.

At the present time, the only building still extant at the site is the former power plant. All the other buildings have been removed at various times in the past, leaving only the virtually indestructible concrete radome supports, vault shells, and some foundation elements.

In order for this type of site to retain integrity, the elements that were used in satellite support missions should be extant. Here, this would include the ADA building and the structures associated with Receiver No. 2. Both of these critical elements are gone. The power plant by itself does not convey enough of the site's character to overcome the loss of the other features. Foundations and footprints are also insufficient, since the site's associations would be with the buildings where the activity took place.[82]

This site has lost its integrity through previous building demolitions, and is therefore not eligible for the NRHP. Consequently it is not necessary to determine whether it would have significance under the NRHP criteria, nor whether it would meet the exceptionality requirement for properties less than fifty years old.

This finding does not address the extant support facilities on the Fort Greely main post, which are not under USAG-AK management.

[81] National Park Service National Register Bulletin, *How to Apply the National Register Criteria for Evaluation*, 2.

[82] Due to nature of site's history, criteria D would not apply. Archaeological investigation would be unlikely to add to our knowledge of the site. Documentary research and oral history would serve as more effective methods at this point.

CHAPTER 10.0 Conclusion

CORONA. SAMOA. MIDAS. To aficionados of space history, the names of these satellite programs still evoke the high drama of a James Bond cloak-and-dagger thriller. And no wonder. The space "front" was one of the most high-stakes aspects of the Cold War confrontation between the U.S. and the Soviet Union. In many ways, the technological competition served as an alternate battleground. As Air Force General Bernard A. Schriever stated at the time, "Today the kind and quality of systems which a nation develops can decide the battle in advance and make the final conflict a mere formality – or can bypass conflict altogether."[83]

MIDAS and CORONA were born out of the need to provide the military and intelligence communities with critical information at a time when Cold War tensions were high. The lessons learned in the MIDAS program led to the success of subsequent space warning systems. Today, we take these for granted. But in the 1960s, when reconnaissance satellites were the very first sentries in space, their presence helped to stabilize the hair-trigger standoff of the Cold War.

Ground stations like Donnelly Flats were part of that larger story. These small remote stations with their advanced equipment and high stakes missions provided essential support for these developing programs. The Donnelly Flats station, under its various names – North Pacific Station, OL-3, OL-8, Fort Greely station, or just "Donny" – supported MIDAS research and development. By doing so, it contributed to the United States' space capabilities during the Cold War.

To a motorist passing by the former North Pacific Station today, there is no indication of what the site once was. Local residents remember the radomes, or "golf balls" as landmarks of mysterious military activity, silent sentinels visible in the valley for years, but now those are gone as well. The site has reverted to Army control and is adjacent to a drop zone used for training exercises. It is unlikely that either the soldiers training near this site nor the Missile Defense personnel at Fort Greely are aware of the role this site played in the history of military space systems. Although most of the site has been dismantled, its history can be preserved and awareness of this military heritage can be passed on.

Space historian David Arnold wrote, "One may hope that when historians write about the American space program in the future, they will not neglect the satellite command and control system that made those space firsts possible because, in short, no satellite command and control system, no space program. What stays on the ground is at least as worthy of study as what goes into space."[84] Certainly, it is worth remembering the contributions that were made down in the valley beneath Donnelly Dome, in a place that has been a communications corridor and observation point for millennia, which now has a connection to the earliest human endeavors in space.

[83] Schriever, 230.
[84] Arnold, 280.

BIBLIOGRAPHY

Books and Articles

"New Missile-Spotting Net Will See Over Pole, Push into Space," *Business Week*, 2 April 1960, 4.

Baucom, Donald R. "Technology and America's Cold War Strategy," in Hall and Neufeld, 53-58.

Bradburn, Maj. Gen. David D. "Evolution of Military Space Systems," in Hall and Neufeld, 60-65.

Cloe, John Haile, and Michael Monaghan. *Top Cover for America, the Air Force in Alaska 1920-1983.* Missoula: Anchorage Chapter-Air Force Association with Pictorial Histories Publishing Co., 1984.

Corliss, William R. *Spacecraft Tracking*. Washington, DC: National Aeronautics and Space Administration, 1968.

Hall, R. Cargill and Jacob Neufeld, eds. *The U.S. Air Force in Space, 1945 to the Twenty-first Century: Proceedings of the Air Force Historical Foundation Symposium Andrews AFB, MD, September 21-22, 1995.* Washington, DC: USAF History and Museums Program, 1998.

Hall, R. Cargill. "Civil-Military Relations in America's Early Space Program," in Hall and Neufeld, 18-31.

_____. "Missile Defense Alarm: The Genesis of Space-based Infrared Early Warning," *Quest: The History of Spaceflight Quarterly*, Spring 1999, 5-17.

Hayes, E. Nelson. *Trackers of the Skies*. Washington, DC: Smithsonian Institution, 1967.

Hobbs, Marvin. *The Basics of Missile Guidance and Space Techniques*, vol. 2. New York: John F. Rider Publishing, 1959.

Johnson, Stephen B. "The U.S. in Space: Cooperation and Coercion," *Policy Options*, April 2002, 57-63.

Klass, Philip J. "Lack of Infrared Data Hampers MIDAS," *Aviation Week and Space Technology*, 24 September 1962, 54-55, 57.

_____. *Secret Sentries in Space*. New York: Random House, 1971.

McDougall, Walter A. *The Heavens and the Earth: A Political History of the Space Age*. New York: Basic Books, 1985.

McLucas, John L. "The U.S. Space Program Since 1961: A Personal Assessment," in Hall and Neufeld, 77-101.

Peebles, Curtis. *Guardians: Strategic Reconnaissance Satellites*. Novato, CA: Presidio Press, 1987.

Richelson, Jeffrey T. *America's Space Sentinels: DSP Satellites and National Security*. Lawrence, KS: University Press of Kansas, 1999.

Schaffel, Kenneth. *The Emerging Shield: The Air Force and the Evolution of Continental Air Defense 1945-1960.* Washington, DC: Office of Air Force History, 1990.

Schriever, Lt. Gen. Bernard A. "The Operational Urgency of R & D," *Air University Quarterly Review*, vol. 12, Winter/Spring 1960-61, 229-236.

Simmons, Fred and Jim Creswell. "IR Eyes High in the Sky: The Defense Support Program" Crosslink, vol. 1, no 2, Summer 2003, 18-25. *http://www.aero.org/publications/crosslink/summer2000/03.html*

Spires, David N. *Beyond Horizons: A Half Century of Air Force Space Leadership* (revised ed). Air Force Space Command in association with Air University Press, 1998. *http://space.au.af.mil/books/spires/*

Watkins, N.W. "The MIDAS Project: Part I, Strategic and Technical Origins and Political Evolution 1955-1963." *Journal of The British Interplanetary Society*, vol. 50 pp 215-224, 1997.

Woodman, Lyman. *Duty Station Northwest: The U.S. Army in Alaska and Western Canada, 1867-1987*, vol. 3, 1945-1987. Anchorage: Alaska Historical Society, 1999.

Worden, Brig. Gen. Simon P. and Maj. John E. Shaw. *Whither Space Power? Forging a Strategy for the New Century.* Maxwell AFB, AL: Air University Press, 2002.

Reports

Cleary, Mark C. *The 6555th: Missile and Space Launches Through 1970.* 45th Space Wing History Office, nd. *https://www.patrick.af.mil/heritage/6555th/6555fram.htm*

Denfeld, D. Colt. *The Cold War in Alaska: A Management Plan for Cultural Resources, 1994-1999.* U.S. Army Corps of Engineers, Alaska District, August 1994.

Hoffecker, John F. and Mandy Whorton. *Historic Properties of the Cold War Era: 21st Space Wing, US Air Force Space Command,* Argonne IL: Argonne National Laboratory, 1996.

Jernigan, MSgt Roger A. *Air Force Satellite Control Facility Historical Brief and Chronology, 1954-Present*, Sunnyvale CA: Air Force Satellite Control Facility History Office, nd.

Lockheed Aircraft Corporation, Missiles and Space Division. *MIDAS Facilities Master Plan*, contract AF04(647)-787, 15 Dec 1961.

McClellan, Robert E. *History of the Space Systems Division, January-June 1965*, Vol. II, U.S. Air Force Space Systems Division Historical Division, Nov. 1966.

Perry, Robert L. *Origins of the USAF Space Program, 1945-1956.* Originally printed as Volume V, History of Deputy Commander (AFSC) for Aerospace Systems, 1961. Reprinted by History Office, Space and Missile Systems Center, 1997. *http://www.fas.org/spp/eprint/origins/index.html*

PHILCO, Western Development Laboratories. *Operational MIDAS Ground Stations*, contract AF04(647)-532, 1 Sept 1961, vol 1.

_____. *Program 239A Tracking Station Maintainability Evaluation Plan,* contract AF04(647)-829, 28 Feb 1962.

Reynolds, Georgeanne. *Historical Overview and Inventory: White Alice Communications System.* Anchorage: U.S. Army Corps of Engineers, 1988.

U.S. Department of the Interior. National Park Service, Cultural Resources. 1997. *How to Apply the National Register Criteria for Evaluation.*

Waldron, Harry. *The MIDAS Program.* Space and Missile Systems Center History Office, December 1998.

Winkler, David F. *Searching the Skies: The Legacy of the United States Cold War Defense Radar Program*, Headquarters, Air Combat Command, June 1997. *http://www.cevp.com/docs/COLDWAR/1997-06-01955.pdf*

Woodman, Lyman. *The Army Corps of Engineers in Alaska*. Elmendorf AFB, Anchorage: U.S. Army Engineer District, Alaska, 1973.

Electronic Sources

"Air Force Satellite Control Facility", *http://209.165.152.119/af_track/bob_afscf_index.html*

"Air Force Space Command History and Heritage", *http://www.peterson.af.mil/hqafspc/history/Opening%20Page.htm*

"Historical Overview of the Space and Missile Systems Center", USAF Space and Missile Systems Center History Office. *http://www.losangeles.af.mil/SMC/HO/INDEX.HTM*

"KH-1 CORONA," *http://www.globalsecurity.org/space/systems/kh-1.htm.*

"Kodiak Tracking Station's First Pass Supports," electronic document, *http://209.165.152.119/af_track/bob_chapter3a.html*

"The MIDAS Project", Patrick Air Force Base, 45th Operations Support Squadron, Complex 14 Heritage. *https://www.patrick.af.mil/45OG/MIDAS.htm*

"MIDAS – America's First IR Ballistic Missile Early Warning Satellite Program – Declassified", Press release, Los Angeles Air Force Base, Space and Missile Systems Center (AFMC) Office of Public Affairs, no. 99-01, March 10, 1999. *http://www.losangeles.af.mil/SMC/PA/Releases/nr9901.html*

"MIDAS" *http://www.globalsecurity.org/space/systems/MIDAS.htm*

"MIDAS" *http://www.astronautix.com/craft/MIDAS.htm*

"Online Air Defense Radar Museum, *http://www.radomes.org/museum/index.html*

"On Line Community for Tech Reps, Ex Reps, their families and friends." Jay Clark, webmaster. *http://www.exreps.com/*

"Space Surveillance Overview" *http://www.globalsecurity.org/space/systems/track-overview.htm*

"W-17 Infrared Early Warning Sensor" National Air and Space Museum, Space History Division, Artifacts. *http://www.nasm.si.edu/research/dsh/artifacts/MS-w-17.htm*

"W-37 Infrared Early Warning Sensor" National Air and Space Museum, Space History Division, Artifacts. *http://www.nasm.si.edu/research/dsh/artifacts/MS-w-37.htm*

Douglas W. Jones, *The Control Data Corporation 160 Computer*, electronic document, *http://www.cs.uiowa.edu/~jones/cdc160/.*

Archival Collections

Elmendorf AFB, 3rd Wing, 11th Air Force, and Alaska Command History Office
Elmendorf History Office Chronology
Alaskan Air Command histories

Fort Greely Directorate of Public Works
Building files

National Air and Space Museum
MIDAS program photographs

National Archives, Alaska Region
RG 77, U.S. Army Corps of Engineers, Alaska District

U.S. Army Corps of Engineers, Alaska District Office, Elmendorf AFB
As-built drawings, design reports

U.S. Army Corps of Engineers Alaska District Realty Office, Elmendorf AFB
Fort Greely real estate audit files

Washington National Records Center, Suitland, MD. RG 77, U.S. Army Corps of Engineers

Other

Arnold, David C. *Supporting New Horizons: The Evolution of the Military Satellite Command and Control System, 1944-1969.* Ph. D. Diss., Auburn University, May 2002.

Aviation Week and Space Technology

Fairbanks Daily News-Miner

APPENDIX A Acknowledgments

This project relied heavily on help and encouragement from many people. In particular, the author would like to acknowledge several contributors whose generous assistance made it possible to locate and interpret some of Donnelly Flats' missing history.

Michael Binder, who is currently with the U.S. Air Force Declassification Office working at the National Archives in College Park, graciously offered his time and expertise on the MIDAS program throughout the project, providing articles, citations, information, and answering questions. He also researched D.C. area NARA and Corps of Engineers records for documents and photographs, and located photographs at the National Air and Space Museum. The material he provided was invaluable for describing construction of the Donnelly site and for educating the author about the MIDAS program in general. This report could never have been completed without his assistance. Thanks also to Ms. Sheila Dunston at the Army Corps of Engineers headquarters for providing access to obscure records; to Jeff Richelson, who forwarded research material via Michael Binder; and to D. Colt Denfeld.

Bob Siptrott, formerly a technician at Chiniak, was also very generous with photographs and materials he collected on AFSCN operations from the technicians' point of view. His website on the Chiniak tracking station is a treasure trove of snapshots, technical information, and reminiscences from some of the people at the site. The information and photos he provided through emails and his website brought the station history to life. And, although he was not aware he was being so helpful, Dr. David Arnold provided invaluable information on Air Force ground stations in his dissertation on that topic. Without this background, this report would not have been able to place Donnelly Flats in as much context as a ground station.

Compiling information on Donnelly Flats required the help of many others as well. James Short, records manager of the Alaska District, Corps of Engineers, located Donnelly Flats as-built drawings and assisted in having those copied. Dennis Kennedy at the Fort Greely DPW helped locate additional site drawings. Angie Gori, of the Corps of Engineers Realty office at Elmendorf AFB, provided access to property files that expanded the picture to include the Donnelly Flats Protective Area. Bruce Parham and Diana Kodiak of the National Archives in Anchorage located and provided copies of site photographs. Mr. John Cloe, historian with the 3rd Wing History Office at Elmendorf AFB, provided access to Alaskan Air Command historical reports. Judy Triplehorn, of the UAF Geophysical Institute Mather Library, located citations on MIDAS contracts which were extremely helpful. Neil Davis, Neal Brown, and Dale Pomraning provided information on the re-use of Donnelly's equipment.

A number of people assisted in locating technicians who worked at Donnelly Flats, a task which seemed impossible early in the project. Joyce McCombs of the Delta Junction Library and Augie Hiebert suggested contacts. John Shippley at Onizuka AFS and Ernie Brown tracked down some former technicians. The webmasters at

Radomes.org and ExReps.com posted requests for information. A special thanks to former tech reps who replied with emails: Gene Micek, Ron Larson, Joe Lobis, James Pitts, Wayne Strickland, and Marv Sumner. Thanks also to Leigh Dennison of Delta Junction and Jim Harpring of Fort Richardson for providing their assistance.

The report also benefited from thoughtful and courteous reviews from Michael Binder, John Cloe, Lee Griffin, Julie Raymond-Yakoubian, and Russ Sackett. Michael Binder, Lee Griffin, and Jim Harpring also patiently answered technical questions.

Staff at the USAG-AK Directorate of Public Works assisted in locating information, reports, and contacts: Brian Adams, Lee Griffin, Joe Malen, Ron Potwin, Ellen Clark, and Amanda Shearer. The USAG-AK cultural resources program and the CSU Center for Environmental Management of Military Lands (CEMML) supported the project. Thanks to Aaron Robertson and the Donnelly Training Area archaeology crew, Russ Sackett, Jennifer Elsken, and Cal Bagley.

This report would not have been possible without the help of all these individuals and organizations, including those who may have inadvertently been left off this list. Thanks to all.

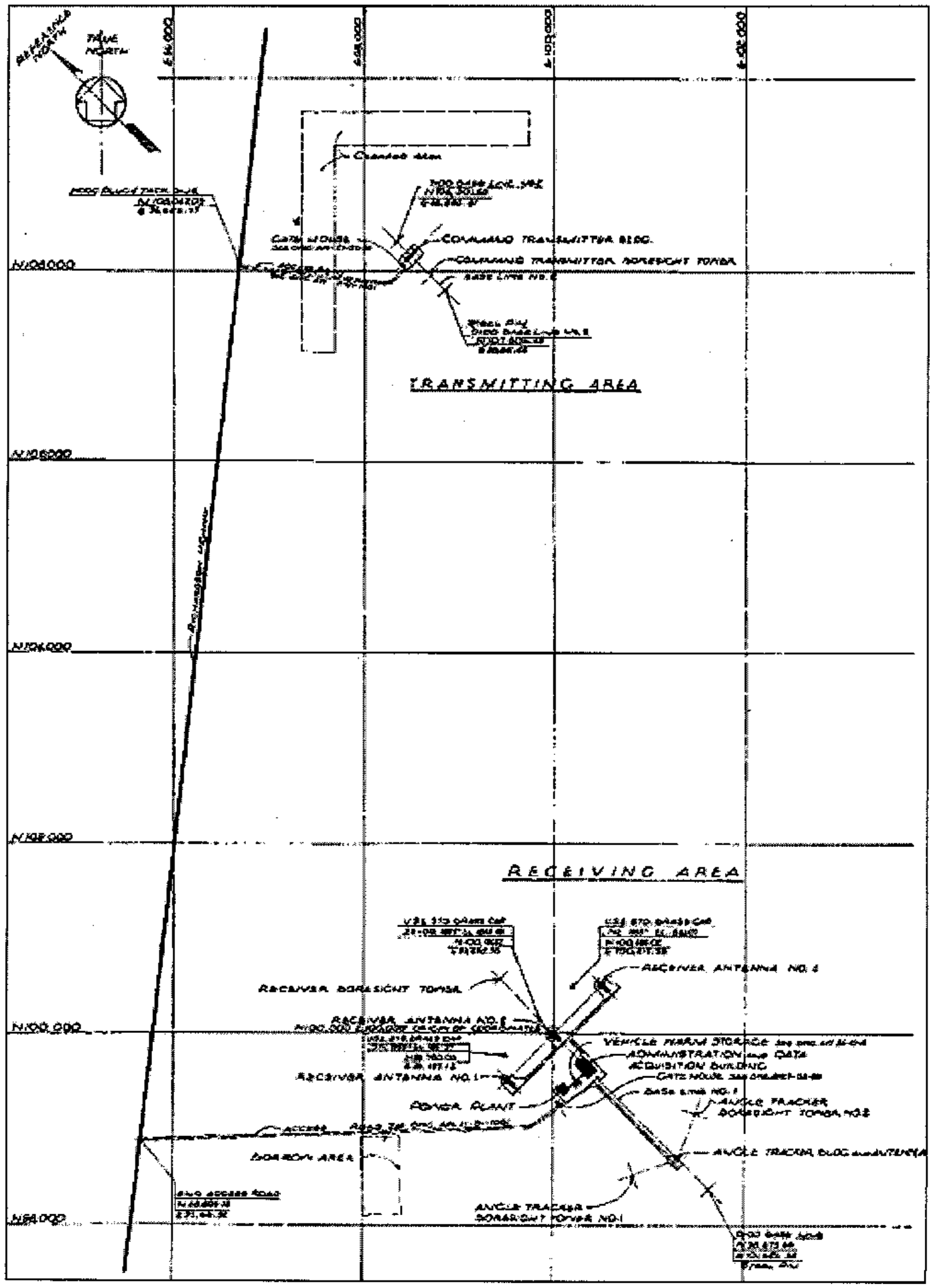
APPENDIX B Acronyms

AAC	Alaskan Air Command
AC&W	Aircraft Control and Warning
ADA	Admin and Data Acquisition
AFB	Air Force Base
AFBMD	Air Force Ballistic Missile Division
AFS	Air Force Station
AFSCF	Air Force Satellite Control Facility
AFSCN	Air Force Satellite Control Network
ALSIB	Alaska-Siberia (Lend-Lease route)
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
BMEWS	Ballistic Missile Early Warning System
CDC	Control Data Corporation
DA&P	Data Acquisition and Processing
DEW	Distant Early Warning
DPW	Directorate of Public Works
DSP	Defense Support Program
DTA	Donnelly Training Area
ICBM	Intercontinental Ballistic Missile
IGY	International Geophysical Year
LMSC	Lockheed Missiles and Space Company
MIDAS	Missile Defense Alarm System
MOC	MIDAS Operations Center
NARA	National Archives and Records Administration
NAS	North Atlantic Station
NASM	National Air and Space Museum
NHPA	National Historic Preservation Act
NORAD	North American Air Defense Command
NPS	North Pacific Station
NRHP	National Register of Historic Places
OL	Operating Location
PAM-FM	Pulse-Amplified FM
R&D	Research and Development
RTS	Research Test Series
SAC	Strategic Air Command
SAGE	Semi-Automated Ground Environment
SAMOS	Not an acronym. Project name taken from Greek Island.
SMDC	Space and Missile Defense Command (Army)
SMC	Space and Missile Systems Center (Air Force)
STC	Satellite Test Center
TCC	Tracking and Control Center
UKS	United Kingdom Station
USAF	United States Air Force
USAG-AK	United States Army Garrison, Alaska
U.S.S.R.	Union of Soviet Socialist Republics
WAMCATS	Washington-Alaska Military Cable and Telegraph System

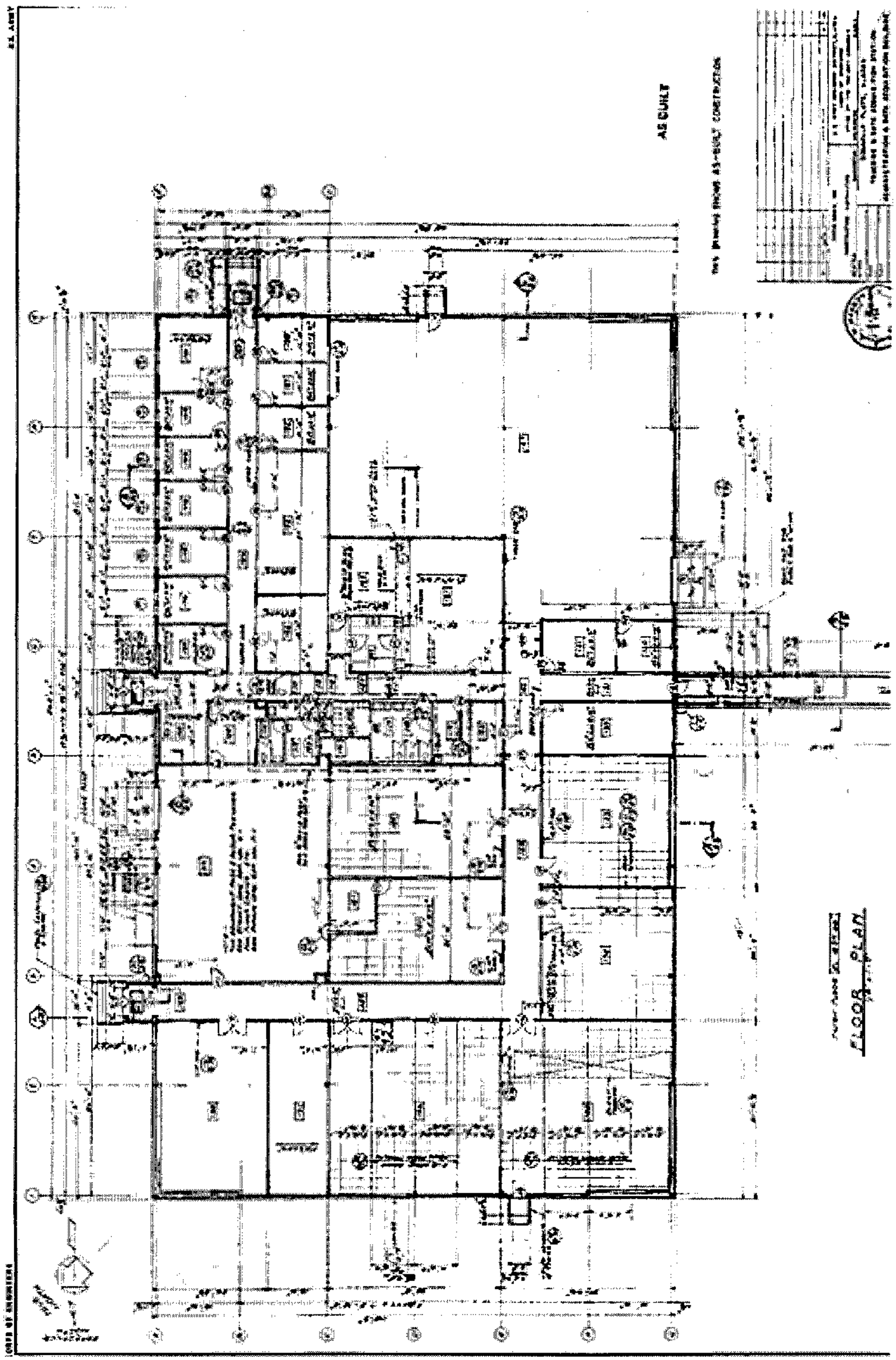
APPENDIX C

Sample As-built Drawings

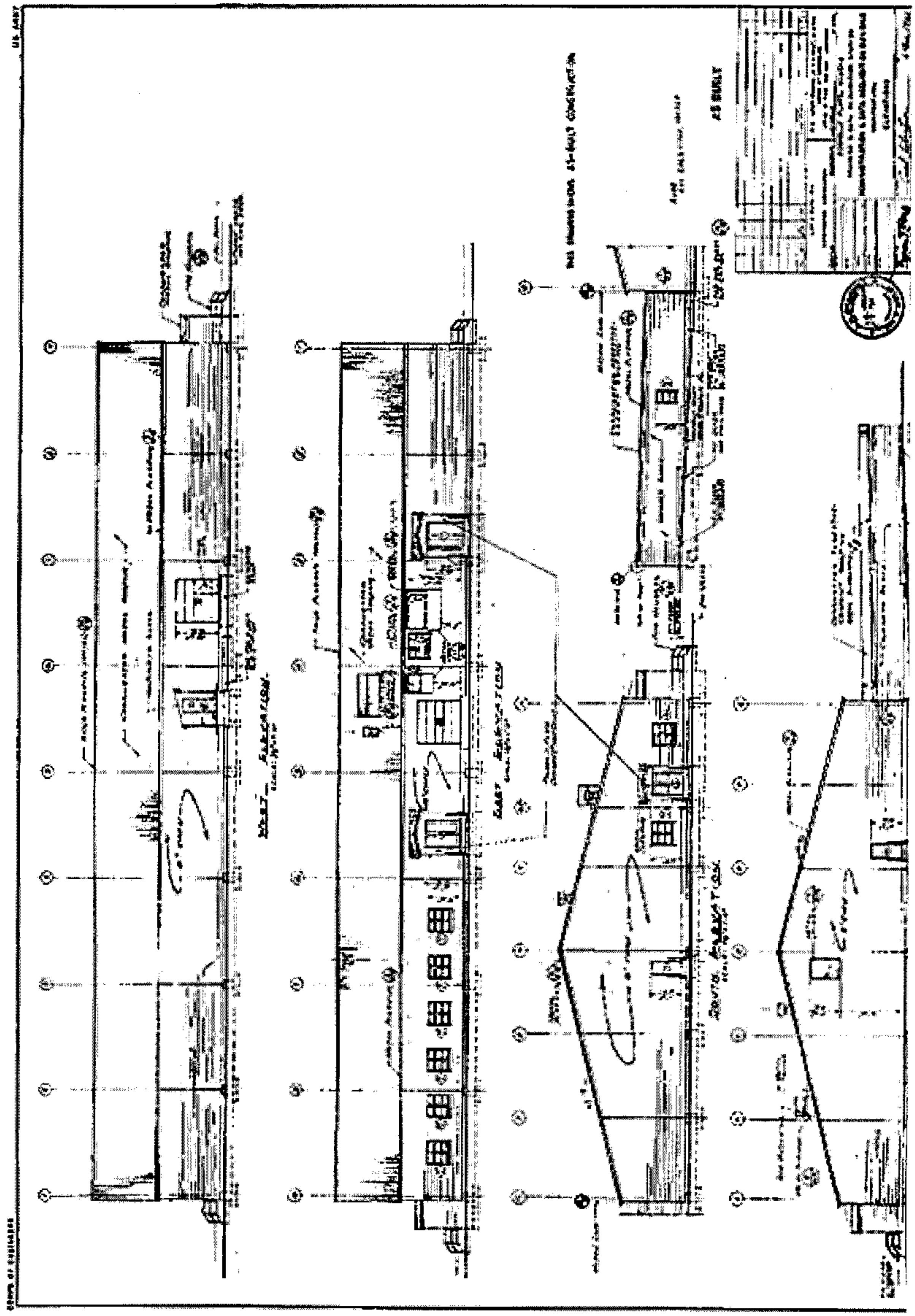
Site Plan, cropped



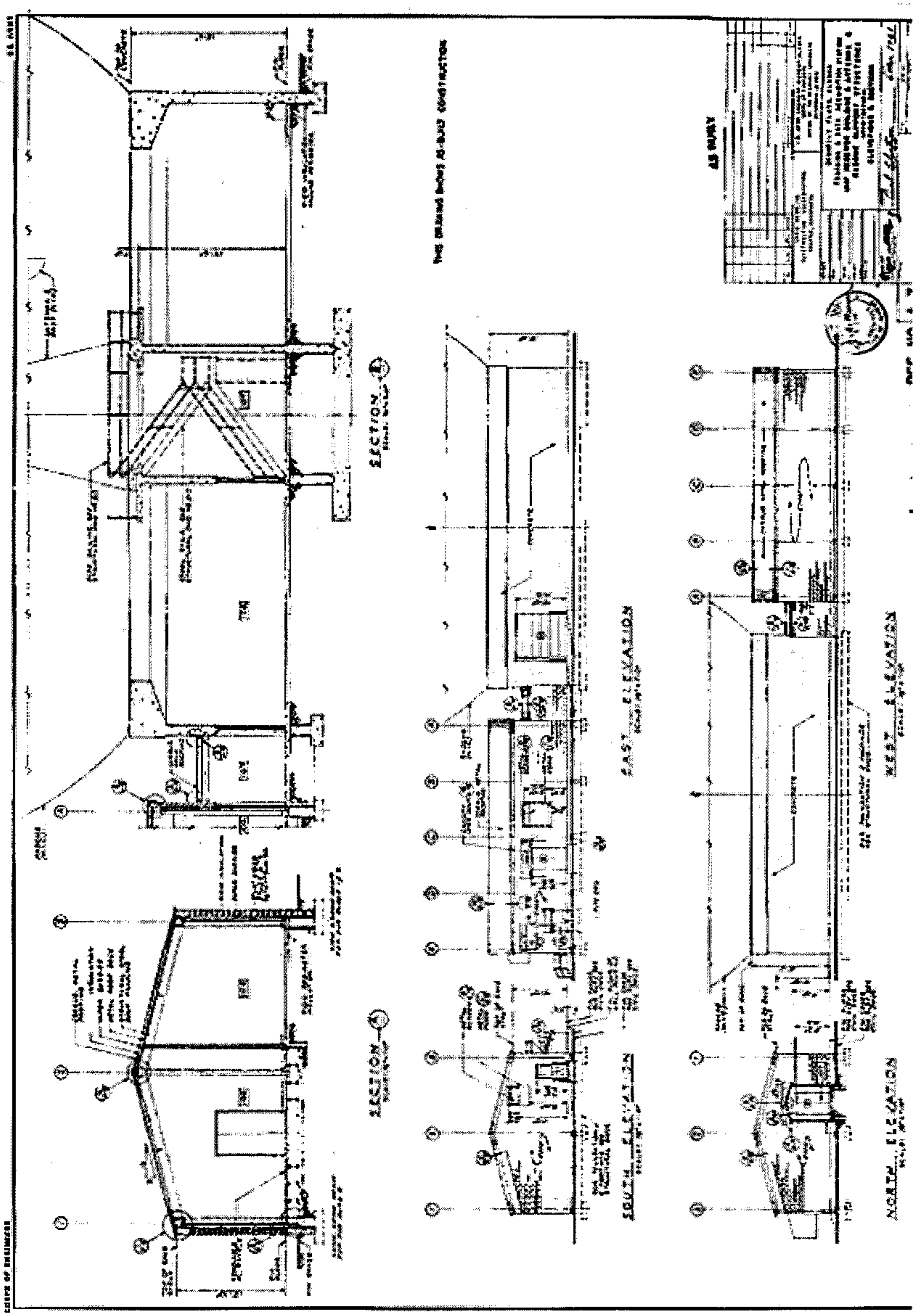
Administration and Data Acquisition, Floor Plan



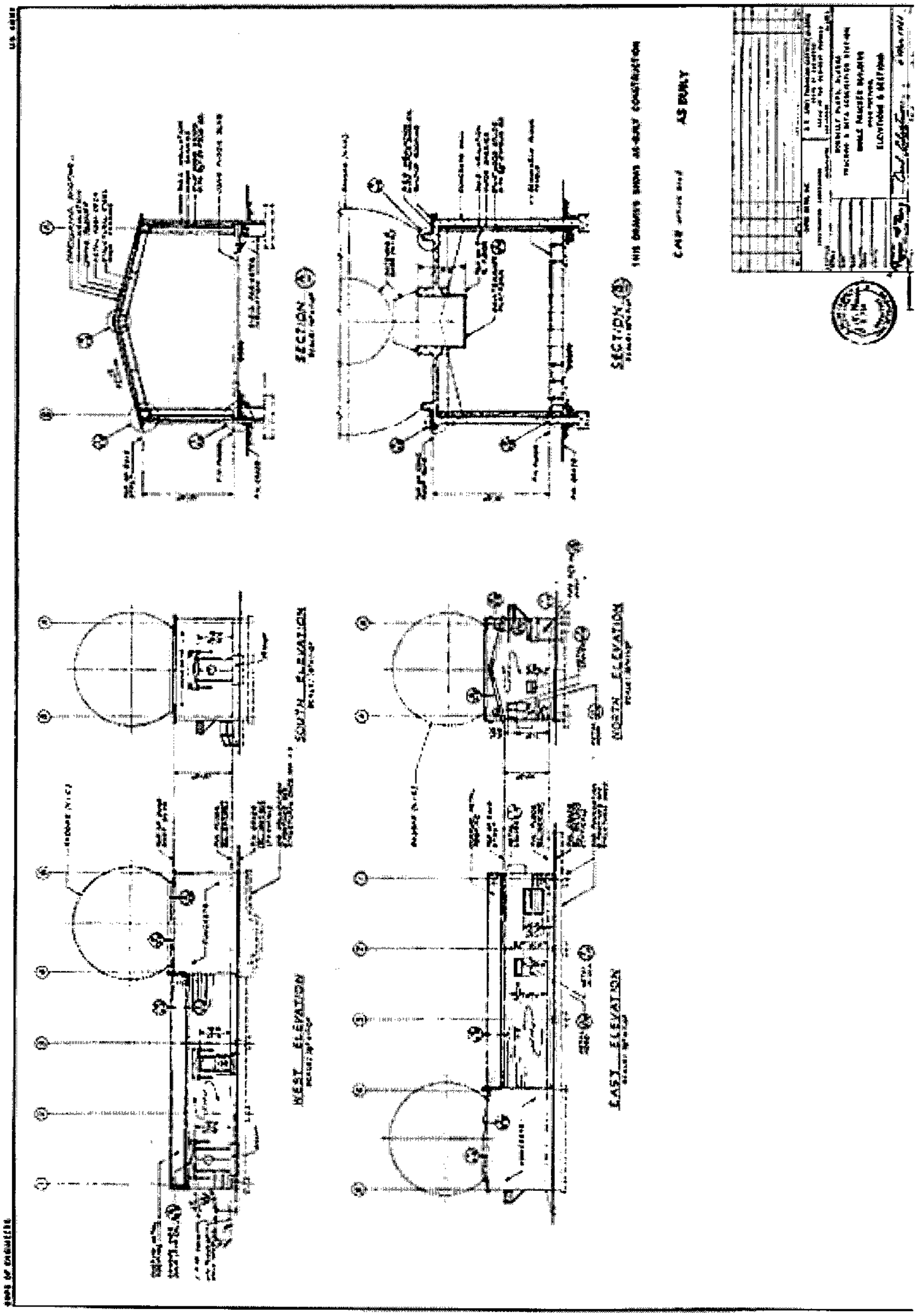
Administration and Data Acquisition, Elevations



Receiver Building Elevations (radomes not included)



Angle Tracker Building Elevations



Power Plant Elevations