

**(U) Chapter 2  
The SPACOL Plan and DEFSMAC  
(Early 1960s)**

**(U) Management Actions under the New DoD ELINT Directive**

(S) In March 1960, on behalf of the community, NSA prepared a joint "progress report" to OSD concerning the status of the transition of ELINT responsibilities to NSA. The portion addressing telemetry made the following points/actions.

(S) NSA had tasked the Air Force with processing and analysis for missile, satellite, and space probe telemetry, and had tasked the Army with processing and analysis of beacon and selected telemetry signals. NSA had redirected its effort, with JPL contractor support, to perform analysis on Soviet and space probe telemetry, and was continuing to develop processing and reporting effort for encrypted telemetry.

(S) In addition, NSA had created a processing coordination group to exchange technical data and eliminate unnecessary duplication of effort. This group soon became the Telemetry and Beacon Analysis Committee, or TEBAC. As part of this effort, NSA had created an ad hoc govern-

ment/industry group to develop standards for signal demodulation and analog production techniques and equipment.<sup>1</sup>

(S) During 1960 coordination of all-source collection against Soviet missile and space activities in the Pacific Ocean area improved considerably, with NSA Pacific (NSAPAC) performing a coordinating role for SIGINT activities. The effort was known by the covername PL 86-36/50 with PL 86-36/50 the covername for the SIGINT component. These were later changed to PL 86-36/50 USC 3605. Requirements had been outlined by the Critical Collection Priorities Committee of the United States Intelligence Board. Table 2-1 shows some of the collection platforms.

(S) There were also fixed and mobile Army, Navy, and Air Force COMINT assets. USAFSS and NSA provided technical support from Johnston Island and NSG and NSA at the Navy station at Wahiawa, Hawaii. Tip-off of impending events was usually done through encrypted Navy

(S) Table 2-1 Collection Assets Available for Pacific Broad Ocean Area (BOA) Activities in 1960

Service	Collection Platforms
Army	One PL 86-36/50 USC 3605 (ESGM) transportable TELINT system (usually deployed to Johnston Island) One ARPA-ARGMA C-130 aircraft
Navy	Two A3D-2Q aircraft PL 86-36/50 Two WV-2Q aircraft USC 3605 One DER (Radar "Picket Ship") One Special Platform PL 86-36/50 USC 3605
Air Force	One RB-47 PL 86-36/50 USC 3605

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HF broadcasts from Hawaii, i.e., the broadcast."

PL 86-36/50  
USC 3605

(S) In early 1960 the Navy P4M aircraft began operating from Shemya and CIA (U-2 aircraft telemetry collection mission) from Incirlik Air Base in Adana, Turkey, and Peshawar, Pakistan. There were fourteen U-2 flights flown from Adana along the Soviet border in 1959 alone. On a flight along the Soviet-Iranian border in 1959, one of the first U-2 flights was successful in intercepting telemetry from a Soviet ICBM during first-stage flight.

PL 86-36/50  
USC 3605

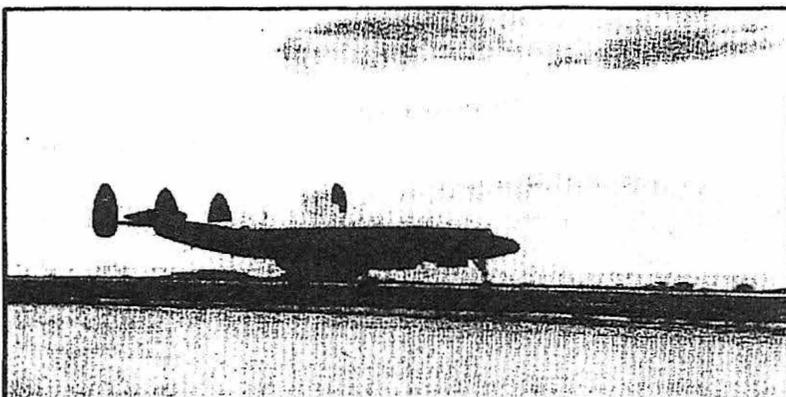
1.4(C)

tests were the "picket" ships that formed the ocean part of the Distant Early Warning (DEW) line of radars across the northern U.S., Canada, and Greenland. For DEW line support these ships came under the command of the Barrier Pacific Command (COMBARPAC); when supporting collection against Soviet ICBM test firings, they were subordinate to the Pacific Fleet (COMPACFLT) under the covername

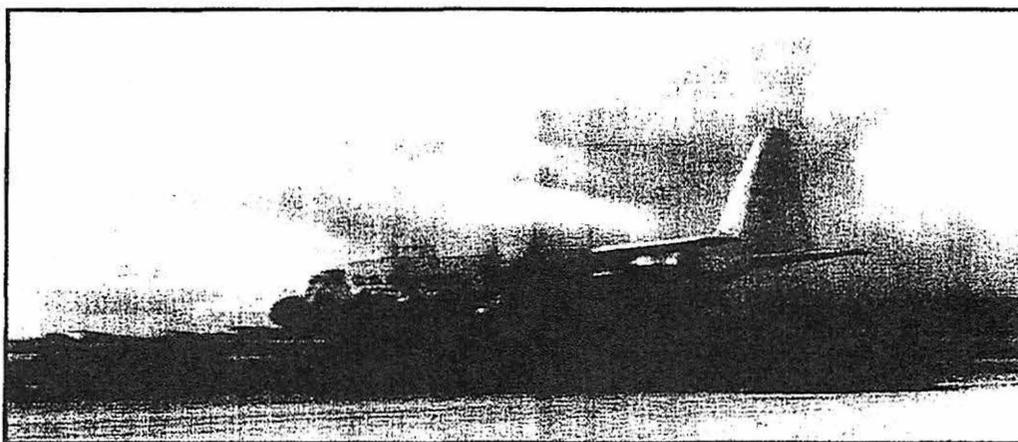
PL 86-36/50 USC 3605

PL 86-36/50 USC 3605

The U.S. Navy Destroyer Escort - Radar (DER) ships involved were the USS *Newell*, USS *Wilmhoite*, the USS *Lansing*, USS *Savage*, and USS *Vance*.



(S) Fig. 19. The WV 2Q (also named EC 121 Super Constellation) aircraft at Johnston Island in 1960. The SHF radar antenna was modified to act as an SHF intercept antenna for telemetry.



(U//FOUO) Fig. 20. One of the ARPA-ARGMA C-130 aircraft at Johnston Island in 1960

(U//FOUO) Part of the maritime assets included in Pacific Ocean deployments to collect intelligence from Soviet ICBM extended range

(S) In the southern European/Asian area, an RB-57F aircraft flew under operational control of the Navy with Army technical support, code-

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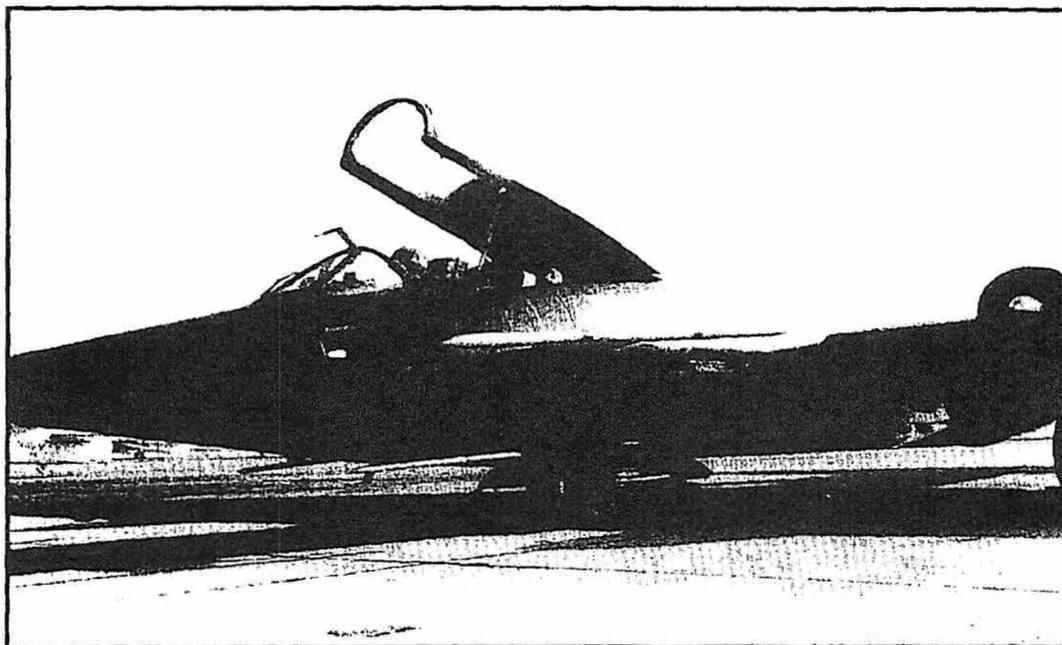
named **PL 86-36/50 USC 3605** The equipment was not "manned" in the usual sense, but controlled by the navigator. It initially flew from Turkey against KYMTR activity, but in the mid-1960s flew from Peshawar against the top priority Sary Shagan Soviet ABM testing site. NSA provided overall operational and technical SIGINT guidance through ASA.<sup>3</sup>

(S) Meanwhile, back at NSA, various organizations became involved with the "Telemetry

has, since 1957, mushroomed into a major NSA undertaking.

(S) The study noted that at least four to six major NSA PROD organizations were involved in collection and processing of telemetry signals, and three NSA R&D organizations were involved in developing equipment for telemetry collection and processing. (Soon there would be four R&D organizations when R6 was formed to implement the SPACOL program.)

(C) Fig. 21. An RB 57 **PL 86-36/50 USC 3605**



Problem" as a result of the new NSA responsibilities in ELINT. One of these efforts was a study by **PL 86-36/50 USC 3605** of the R4 (Research) organization in 1961 reviewing telemetry processing and analysis activities with a view toward highlighting additional activities that might/should be performed in the R&D area. As described by **PL**

The Soviet telemetry problem is a sprawling and articulated complex of COMINT and ELINT activities, agencies, equipment, and programme (*sic*), which

#### (U) The First Major General Collection Systems

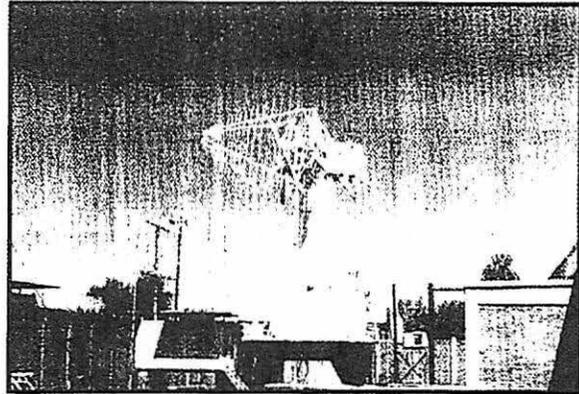
(C) In early 1960 NSA became aware that two satellite tracking stations with forty-foot dish antennas being built for ARPA by Collins Radio in Dallas, Texas, would not be needed for the U.S. satellite program and could be made available to the intelligence community. NSA had the systems modified to cover anticipated Soviet telemetry frequencies, and these became the BANKHEAD I system at Peshawar, to be operated by AFSS; and BANKHEAD II at Chitose, Japan, to be operated

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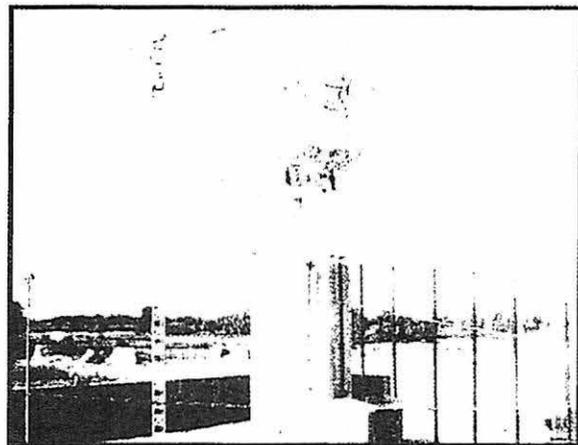
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by ASA. These were to be installed in the summer of 1961, but this was delayed until early 1962, and the systems did not become operational until 1963.

(C) BANKHEAD I's primary mission was to cover launches <sup>1.4(c)</sup> from KYMTR, and BANKHEAD II was to cover early orbits <sup>1.4(c)</sup> satellites from TTMTR as well as <sup>1.4(c)</sup> telemetry data from ICBM test launches. Dr. James A. Donnelly, later a senior executive at NSA, was a key participant in establishing BANKHEAD I in 1963 and in guiding the early operations there. He had the foresight to <sup>1.4(c)</sup>



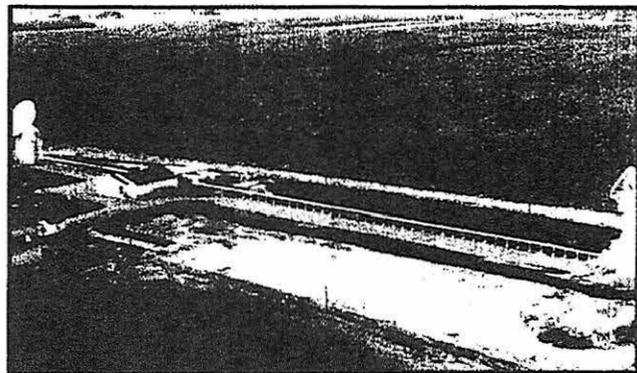
(U) Fig. 23. VHF "low-band" antenna



(C/NF) Fig. 24. SHF "high-band" antenna. At that time the BANKHEAD I collection equipment was integrated, but some of the telemetry processing was done in the U.S. exclusion area.



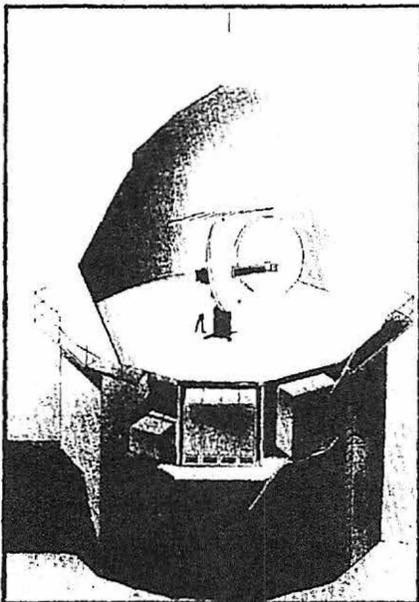
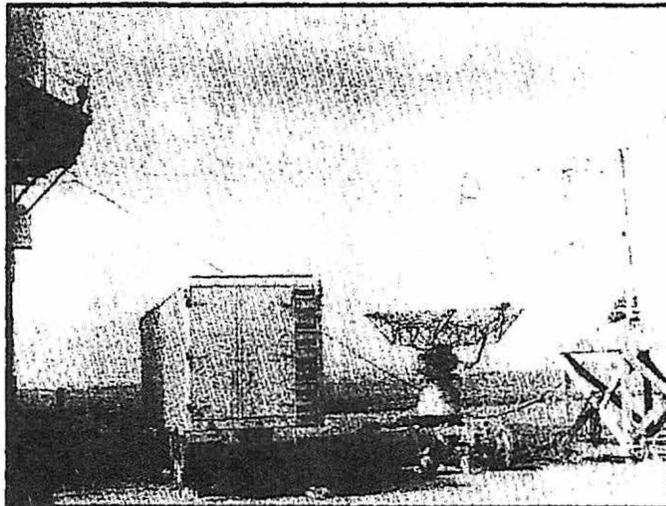
(U//FOUO) Fig. 22. An artist's concept of the BANKHEAD I compound



(C) Fig. 25. The initial BANKHEAD II facility at Chitose

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(S) Fig. 26. A modified MLQ-19 system next to the Arctic tower that he used the other ASA telemetry collection systems. An ESGM VHF Yagi antenna is to the right. By this time the ESGM system on Shemya had been upgraded.



(U//FOUO) Fig. 27. Artist's concept of the upgraded ESGM system that was installed at Shemya in 1962.

(E) Other ground site collection continued from Turkey, Iran, and Alaska. In 1960 ASA had arranged for EDL to move an MLQ-19 missile jamming system to Shemya to be used in a "passive" mode as a telemetry collector.<sup>5</sup>

(S//REL USA, UK) Frank Lewis informed GCHQ of NSA telemetry collection plans in May

of 1961 at a UKUSA systems conference and described the effort in progress. GCHQ later became an important partner, with facilities in

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#### (U) Land-Based Collection

(S) By 1962 the Soviets had launched eight satellites in the Cosmos series. Six of these were from Kapustin Yar that were not recoverable, and two from Tyuratam that were deorbited and recovered by the Soviets. CIA postulated that the ones from Kapustin Yar were probably scientific, as announced by TASS, but that

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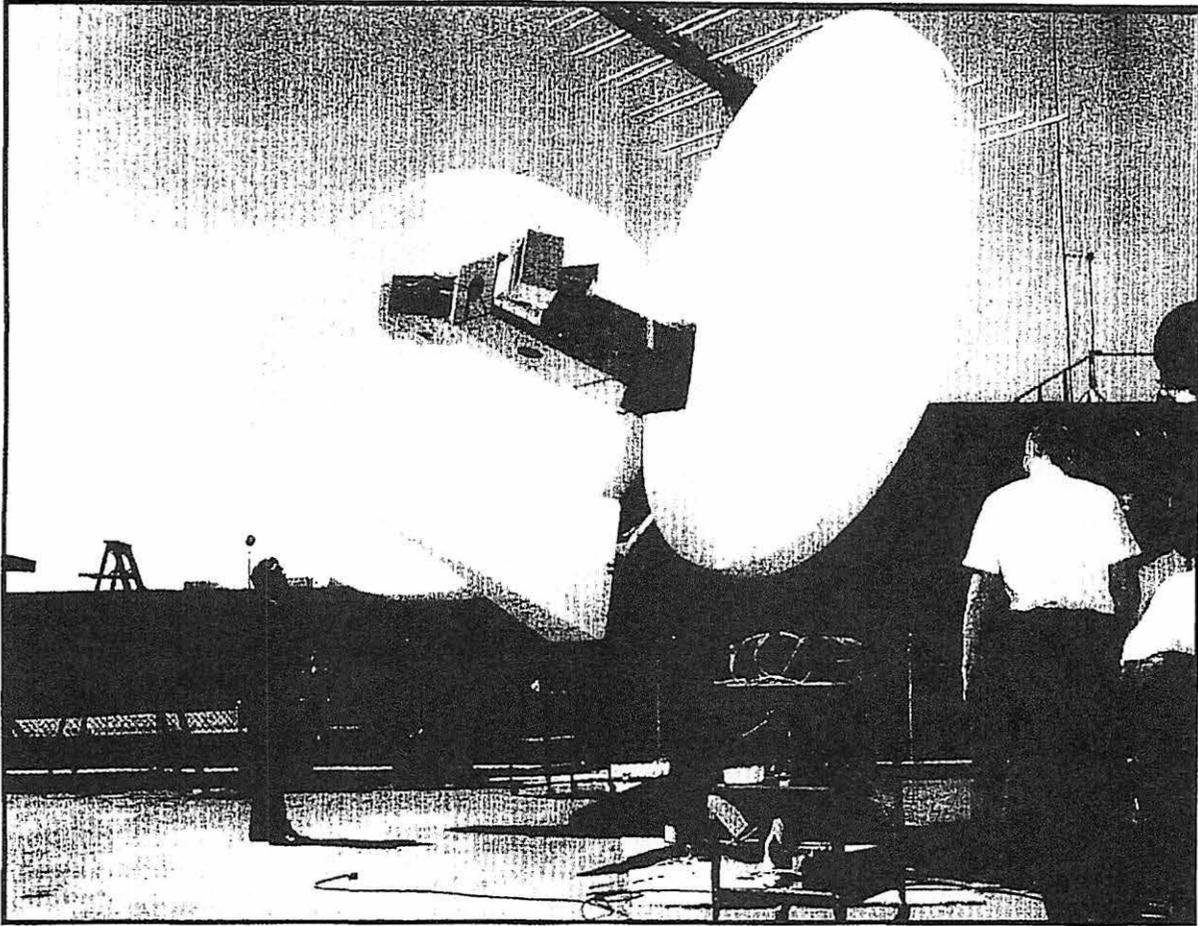
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This added urgency to collecting signals from Soviet satellites.<sup>7</sup>

(S) One aspect of this was the collection and processing of signals from those Soviet satellites that carried humans. The Soviet manned space program was not only of scientific interest, but was a military threat as well. Major Yuri Gagarin,

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of the Soviet Air Force, was launched into orbit on the VOSTOK-1 satellite on 12 April 1961.

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1.4(c) (based on the analysis of the TV the Soviets had used when they put two canines into orbit) put the U.S. intelligence community in a position to anticipate the television signal and keep the U.S. directly informed of his actions.

(S) When Gagarin's initial orbit was over the Pacific, the satellite-to-ground television signal at 83 MHz that focused on his activities inside the space capsule was intercepted both by the ASA

facility at Shemva, Alaska, and by the ASA PL 86-36/50 USC facility at Helemano, Oahu, Hawaii.

(S) The 83 MHz signal had first been intercepted in August 1960 by an AFSS site in Turkey and later by the CIA EGG SHELL site in Iran. The office of Collection and Signal Analysis and R&E engineers developed signal demodulation equipment that was sent to Hawaii and Alaska in anticipation of the use of the 83 MHz signal for space flight by the Soviets; they successfully intercepted the signal. 1.4(c)

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meteorological ducting, antipodal propagation and meteor scatter. The occurrence of each phenomenon depended upon location, time of day, month of the year, and often time in the solar cycle. Because of their different physical origins, their properties, statistics, and climatology were different. However, when present they could be exploited for SIGINT. While each method provided some potential for intercept, few of them provided continuous or reliable coverage when needed. It was... essential to recognize their limitations.<sup>12</sup>

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(U) In the late 1950s, N.C. "Nate" Gerson of the NSA R/D organization studied ways of increasing the reception of prelaunch and launch reception of VHF telemetry signals, particularly from Tyuratam. Bob Alde, of the then Research and Development (RADE) Group, had encouraged Nate by the comment "One good intercept is worth \$5M." As Nate recorded in an unclassified report in 1998:

To attack the problem I first examined natural causes that allowed propagation over extended ranges: sporadic E clouds at 110 km allowed extended ranges to 1,500-1,000 km; transequatorial propagation allowed 7,000-11,000 km ranges north-south via the ionosphere layer; high solar activity raised the upper frequency support limit of the ionosphere to 40-50 MHz for distances to 4,000 km. Other possibilities are auroral ionization, magnetic channeling (for VHF),

*(U) Sea-Based Collection*

(S) Some Military Sea Transport Ships (MSTS) USNS *Valdez* and USNS *Robinson* were converted for SIGINT use and manned by Naval

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Security Group and Army Security Agency operators. Along with the USS *Liberty*, the ships were used to cover Soviet ESV operations associated with the Soviet Space Event Support Ships (SSESS) off the coast of Africa. One of these ships intercepted telemetry from the re-entry phase of a Soviet ESV manned by Cosmonaut Titov in 1961.<sup>14</sup>

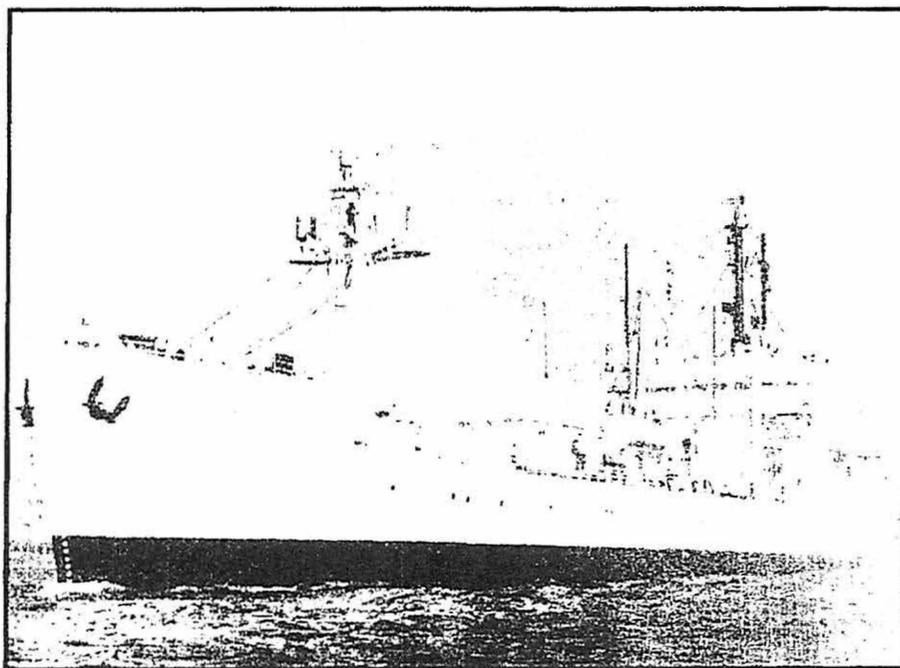
(S) In 1963 the U.S. Advanced Missile Range Instrumentation Ship (ARIS) USS *Timberhitch*, provided with temporary equipment shelters and manned by ASA personnel, operated until the Robinson returned to the Pacific area in mid-1963. Thus began a long stretch of using U.S. missile test range ships for collection of telemetry and other types of missile intelligence collection. JCS called this the ELEVENTH FATHOM program.

(S) These ships were soon replaced by the *Arnold* and the *Vandenberg* ARIS ships. The USN also outfitted four destroyer escorts (the

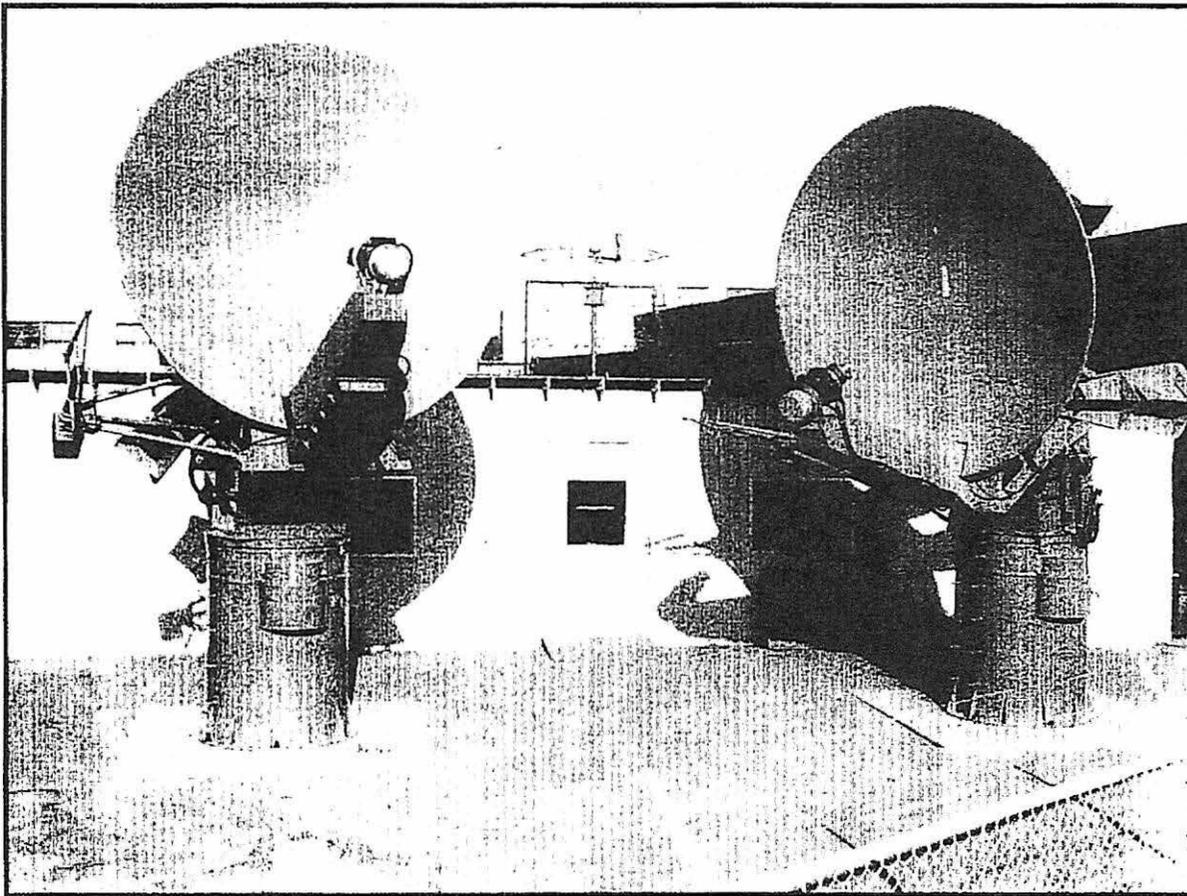
USS *Perry*, USS *Berry*, USS *McMorris*, and USS *Jones*) with missile intelligence collection sensors; these were called PL 86-36/50 USC (later PL 86-36/50 USC platforms and replaced the Destroyer Escort ships that had been doing limited RADINT collection against Soviet Pacific ocean missile test firings.<sup>15</sup>

#### (U) Airborne Collection

(S) Since all of the signals used for Soviet telemetry transmission were "line-of-sight" signals, U.S.-sponsored ground- or sea-based sites were not entirely able to collect the critical launch phase telemetry from missile and space launches, or later the re-entry/impact telemetry from missiles. Typically, aircraft collection was needed for the "first stage" and the "reentry" phases, and radar or infrared data were also necessary to obtain the full information needed by U.S. intelligence customers, particularly those involved in designing U.S. missile defense systems.



(U//FOUO) Fig. 29. An SHF tracking antenna that was part of the equipment installed on the *Valdez*

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~~(S)~~ Fig. 30. Two RASTAS (the Sylvania-EDL project name) antenna systems, one of which was installed on the ill-fated USS Liberty

(S) The "line-of-sight" limitations of ground- or sea-based collection platforms drove the requirement for airborne collection. Several platforms were configured for telemetry collection, but successful collection usually depended on COMINT warning of missile and satellite launch activity that indicated when to fly the aircraft. In-flight reception of U.S. encrypted broadcasts PL 86-36/50 giving the status of Soviet launches often allowed these airborne platforms to be at the right place at the right time.

(S) Some of the early efforts included Navy P4M and P2V aircraft, which had two propeller and two jet engines with tailored equipment configurations. The first of these flew in 1957.<sup>16</sup>

(S) PL 86-36/50 was a SAC EB-47E (TT), also called PL 86-36/50 flying from Adana, Turkey, along the Soviet-Iranian border; and by the early 1960s had signal recognizers for the VHF PPM/AM signals and for the Soviet missile tracking radars which contained a transponded signal from the missile to give the Soviets more accurate trajectory information. The PL 86-36/50 platform flew primarily against TTMTR events and had a restricted flight path since it was a "bomber" aircraft and was carefully monitored by the Soviets. Also in the mid-1960s, PL 86-36/50 aircraft flew from Wheelus AB in Libya against re-entry of Soviet manned space flights and from Hickam AFB in Hawaii and Wake Island against Soviet ICBM re-entries in the Pacific Ocean. One of the

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PL 86-36/50  
USC 3605 aircraft crashed while landing at Adana, Turkey, because of high crosswinds.<sup>17</sup>

the Pentagon gatekeeper at DDR&E, since the U.S. Navy PL 86-36/50 aircraft was just coming into the inventory with similar characteristics.<sup>18</sup>

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(S) The EB-47s had a limited technical capability, e.g., the antennas were on only one side of the aircraft, they had altitude limitations, and they had to fly conservative flight profiles along the USSR border. In general, PL 86-36/50 USC 3605 did not often collect any early "First Stage" powered flight telemetry from TTMTR launches. A proposal to replace the EB-47 PL 86-36/50 with a re-engined RB57F that could fly at an increased altitude came from the Air Force in 1965 but was turned down by Dr. Eugene Fubini,

(S) By 1963 the PL 86-36/50 USC 3605 RB57F had improved engines that allowed altitudes up to 60,000 feet, was flown by Pakistani pilots, and was codenamed PL 86-36/50 USC 3605 ASA and contractors provided ground support and telemetry processing. (The government of Pakistan required that these aircraft be flown by Pakistani pilots, which added another variable to the collection efforts.) This platform had 1 MHz bandwidth recording tapes. One of the aircraft, as well as the U.S. crew, was lost on a flight from Adana in 1966,

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possibly when the pilot's oxygen supply failed. The telemetry collection missions were not well loved by the pilot and navigator/equipment "operator" since they had to stay on pure oxygen for an hour before each flight as well as on the flight itself. 1.4(c)

1.4(c)

(S) Navy A3D SEABRINE/FARMTEAM aircraft flew from Adana and Peshawar. Still later, in the early 1960s Navy EA3B SEABRINE aircraft would fly in the Atlantic and Pacific areas, again manned by ASA SIGINT operators supervised by a Navy "evaluator." ASA called the effort FARM TEAM. All flights from Pakistan ceased during and after the 1965 war between Pakistan and India.<sup>30</sup>

*(U) Very Special Efforts*

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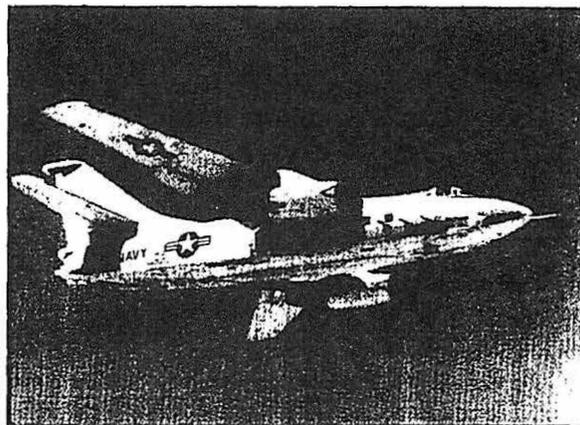
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(S) Another technique tried was to launch piggy-back satellites on U.S. space launches; one called SIVET (named after pioneer collector Charles Tevis - SIVET being Tevis spelled backwards) to see if telemetry could be at least recognized and recorded on 50 kHz bandwidth (the maximum then available on these packages) recordings and relayed back to the U.S. in order to "verify" that launches had occurred. The main test

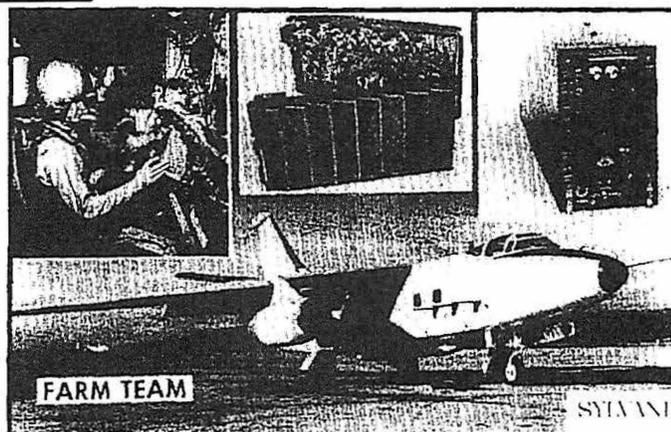
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(S) Engineers considered using missiles or gun-launched projectiles launched from Turkey to produce cesium clouds that could possibly reflect telemetry from KYMTR firings. This plan (Project BROADBENT) was never implemented because of the political considerations of firing a missile (albeit vertically) close to the USSR. Several other forms of "unusual" signal propagation modes were studied and tested. Nate Gerson in R/D at NSA did many of these studies.<sup>33</sup>



*(U//FOUO) Fig. 32. The A3D SEABRINE/FARMTEAM aircraft*



*(U//FOUO) Fig. 33. The antenna and payload were installed in the former bomb bay. The Navy and ASA operated the equipment, supported by Sylvania-EDL.*

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~~SECRET//NOFORN//X1, X6~~**(U) An NSA Plan Emerges**

(S) During early 1960 production organizations (primarily COSA and GENS) started reviewing intelligence requirements and making longer range collection plans. It soon became apparent other NSA elements and skills were required to develop a comprehensive plan. NSA adopted the usual solution to a complex management and technical problem – form a committee, in this case the Space Surveillance SIGINT Planning Board (SSSPB). The committee approach was NSA's first large effort at an across-the-board, end-to-end "system" planning effort (collection, processing, deployment, manning, training, logistic support, etc.) and – best of all – it worked!

(S) Although compiling an overall plan today sounds as if it should have been an obvious move, remember that until NSA was faced with this new form of SIGINT it had been relatively easy to just "add-on" to conventional COMINT, mostly HF, and ELINT conventional sites/systems as new signal types emerged.

(S) The study was chaired by Guy Stephens. Group members included Walter G. Deely (later deputy director for information security); <sup>PL 86-36/50</sup> <sup>USC 2605</sup> soon to be appointed chief of R6, the Office of SPACOL Management, which would implement the new systems recommended by the study); <sup>PL 86-36/50 USC</sup> already responsible for the BANKHEAD I and II systems); Melville J. Boucher from GENS (later a key manager in the Group A missile/space organization); and <sup>PL 86-36/50 USC</sup> <sup>2605</sup> and Thomas Dewey from R/D, both of whom later developed processing systems for missile/space telemetry applications.

(S) The SSSPB completed a draft plan in May 1961 and in December a new office – R6 – was formed in R&D. The original title was to be the Office of SPACOL Management, but was changed to "Office of Special Program Management" to protect the word SPACOL, considered CONFIDENTIAL in the early years. The new office was

to flesh out the plan, arrange for developing the systems, and achieve an operational capability by 1965.

(S) The U.S. intelligence objectives (included in the SSSPB study) against space targets for the mid-1960s were as follows:

**First priority – Soviet activities in and relating to space which contribute significantly to, or are indicative of, Soviet military capabilities.**

- 1) Space vehicle with a weapon delivery capability
- 2) Reconnaissance, weather, communication, ECM, ELINT, geodesy, and navigation satellites
- 3) Maneuverable vehicles, whether manned or not
- 4) Space platforms
- 5) Space order-of-battle inventory

**Second Priority – Soviet exploitation of space for scientific and psychological purposes to include**

- 1) Biological probes and satellites
- 2) Manned space vehicle
- 3) Lunar planetary probes (manned and unmanned)<sup>24</sup>

(S) The requirements were straightforward, but the USAF and NORAD (North American Air Defense Command, today part of the USAF Space Command) imposed a timeliness requirement on analysis and reporting of some of the data that was in many cases impossible to meet, given the state of the art in signal tracking, telemetry analysis and communications at that time. These requirements, however, drove the system design to do as much processing and reporting as possible at the point of intercept.<sup>25</sup>

(S) Another problem in getting the program started was posed by the DoD resource manager,

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Deputy Director of Defense Research and Engineering – DDR&E – Dr. Eugene Fubini. Only after many reviews and questions did he approve the approach but stipulated that NSA could have a total of only \$40M instead of the approximately \$80M estimated in the draft plan. Based on the fiscal “guidance” from Dr. Fubini, the “final” SSS Technical Development Plan (TDP) was completed in September 1962; and he released the funding for the program that October.<sup>26</sup>

(S) Now approved and funded, the TDP called for establishing a BANKHEAD III (soon to be called HIPPODROME) site/system at Sinop, Turkey.<sup>1.4(c)</sup> and a STONEHOUSE deep space telemetry system at Asmara, Ethiopia. BANKHEAD III and STONEHOUSE were to be operated by the Army Security Agency, since they already had field stations in those locations. Planning was deferred for the BANKHEAD IV system planned for Alaska. As it happened, the planned second and third STONEHOUSE sites were not funded at this point (and in fact never got funded or built). Contracts for<sup>1.4(c)</sup> and STONEHOUSE were in place in 1963 and for BANKHEAD III by early 1964.

(S//NF)<sup>1.4(c)</sup>  
<sup>1.4(c)</sup>  
<sup>1.4(c)</sup> Both goals were met, including an initial operating capability in early 1965. The BANKHEAD III (HIPPODROME) system ended up costing over \$7 million; STONEHOUSE cost over \$8 million. Each of the U.S.-managed sites was expected to require about 100 people to operate, including several contract technical and engineering representatives, and two to four NSA “expert” telemetry analysts.<sup>1.4(c)</sup>  
<sup>1.4(c)</sup>

### (U) Implementation

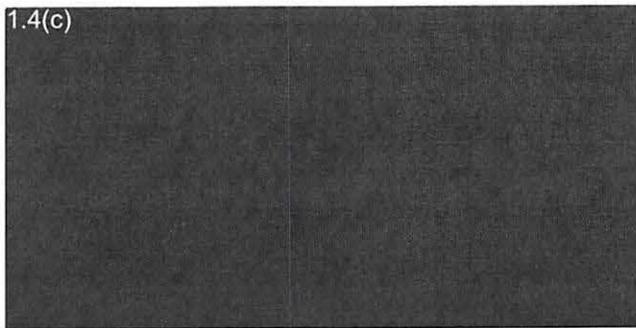
(U//FOUO) Fortunately, in parallel with development of the TDP, NSA R&D had EDL complete a design approach for “example” missile and satellite SPACOL sites. EDL was uniquely qualified to do this study because they were one of the few industrial organizations involved in processing and analyzing Soviet missile and space telemetry at that time and had built many of the existing collection equipment configurations already in the field.

(U//FOUO) This author joined R6 in August of 1962 as project manager of<sup>1.4(c)</sup>

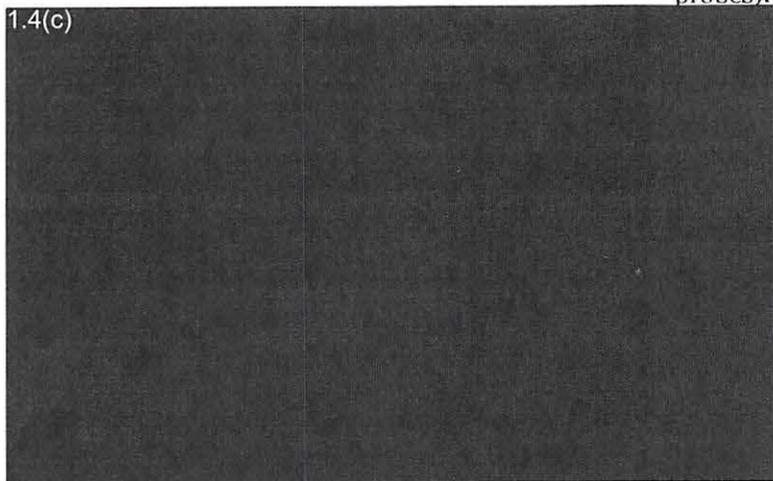
<sup>1.4(c)</sup>  
<sup>1.4(c)</sup> I was soon joined by PL 86-36/50 USC  
 PL 86-36/50 USAF, who became deputy project manager.  
 USC 3605

<sup>1.4(c)</sup>

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(S) One major change from the SSS TDP was the determination that a 150-foot dish system, called <sup>PL 86-36/50</sup> ~~USC 3605~~ would have to be added to the originally planned 85-foot antenna at STONEHOUSE in order to have enough antenna gain to receive the Soviet lunar deep space signal at 183 MHz as the probes arrived at Mars (the Soviet ZOND probes) or at the moon (the Soviet Lunik probes).



(S) The additional two contemplated STONEHOUSE facilities were never completed, but others were: the <sup>1.4(c)</sup>

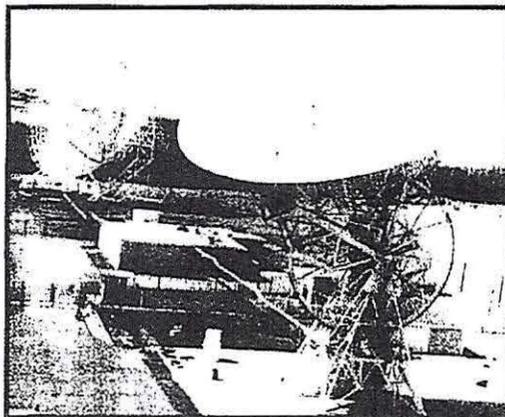
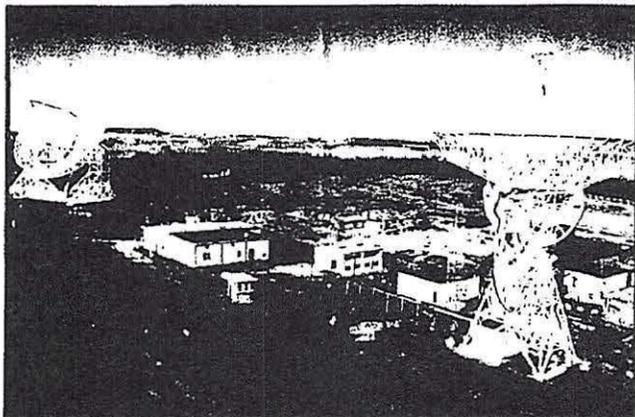


<sup>1.4(c)</sup> These were used in later years part time to obtain a portion of the data that would have been obtained by the other STONEHOUSE-type facilities.

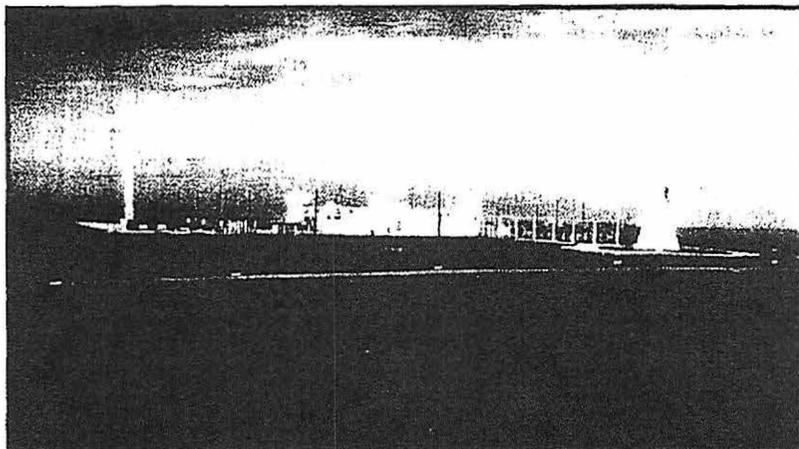
(S) In parallel with the EDL "BANKHEAD" study was one called STONEBANKS being done by Western Development Laboratories (WDL) on collection against "deep space" probes. This system required significantly larger antenna sizes and different equipment configurations for use against Soviet planetary signals and distance targets.

(S) A new site, at a nearby hilltop location close to the main compound at ASA Field Station Sinop, was selected for the BANKHEAD III facility, and given the name HIPPODROME. The initial installation was completed in 1966. The

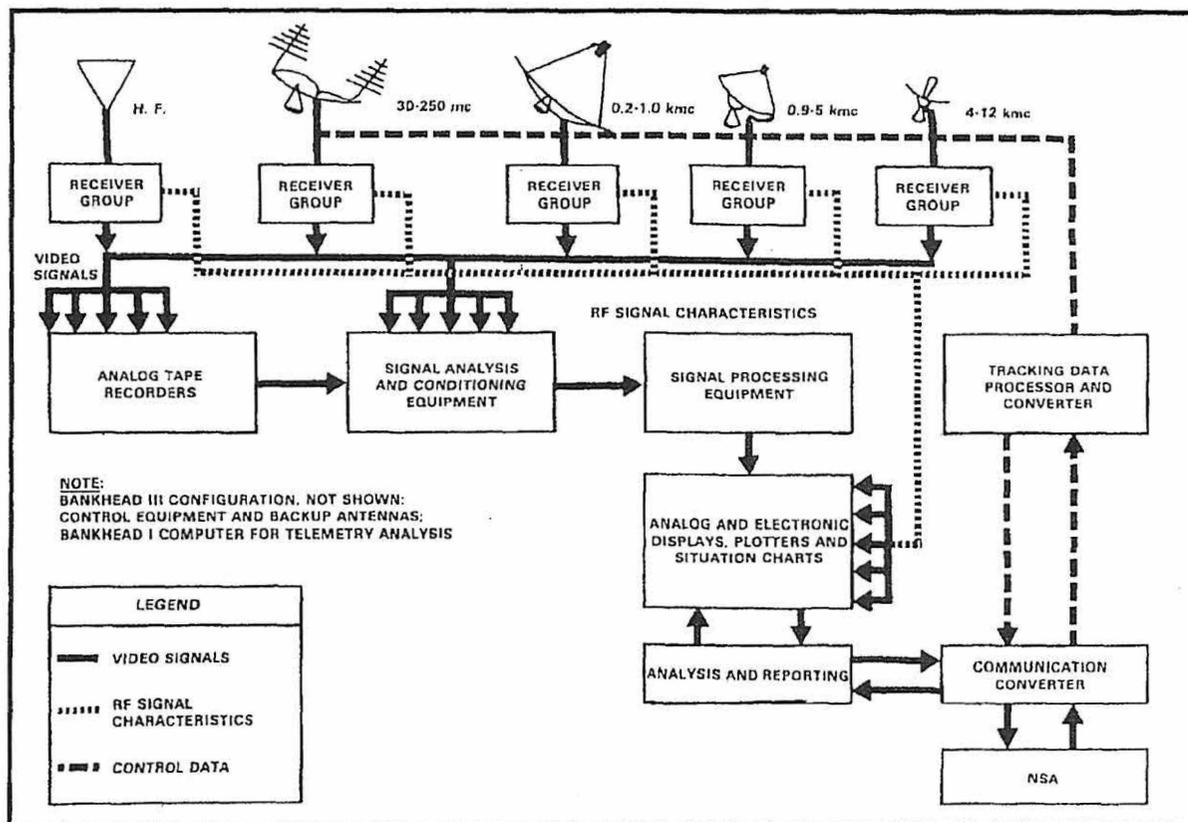
(U//FOUO) Fig. 36. (left) The STONEHOUSE site during system installation.  
(U//FOUO) Fig. 37. The completed facility in 1965



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(U) Fig. 38. The BANKHEAD III system as installed circa 1966



(C) Fig. 39. "Block diagram" of the BANKHEAD III system showing the breakdown of the antenna frequency ranges and other functions performed by the system

(U) Collection Operations Coordination Takes Shape

BANKHEAD III system contract was awarded to LTV Electrosystems in Greenville, Texas.

(S) The NSA SIGINT Missile Analysis Center (SMAC), spearheaded by Joseph P. Burke, was

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formed as A41 in 1963 based on a plan distributed in August of 1962. The plan called for fewer than twenty "high speed" (100 words/minute) OPSCOMM circuits, and estimated a total initial cost, including construction, of less than \$250,000, a rather modest beginning. The watch center was to be supported by a "SIGTRACK" ephemeris-processing center to process special tracking data. SMAC ended up with OPSCOMMs to sixteen collection facilities and customers.<sup>28</sup>

(S) In late 1963 CIA formed the Foreign Missile and Space Analysis Center (FMSAC) to pull together CIA coordination of collection and analysis/interpretation of data concerning missiles and space. Carl E. Duckett, a missile expert previously at Redstone Arsenal, was named first director. FMSAC was disestablished in 1973 when its analytic functions were merged into the Office of Scientific Intelligence (OSI) at CIA.<sup>29</sup>

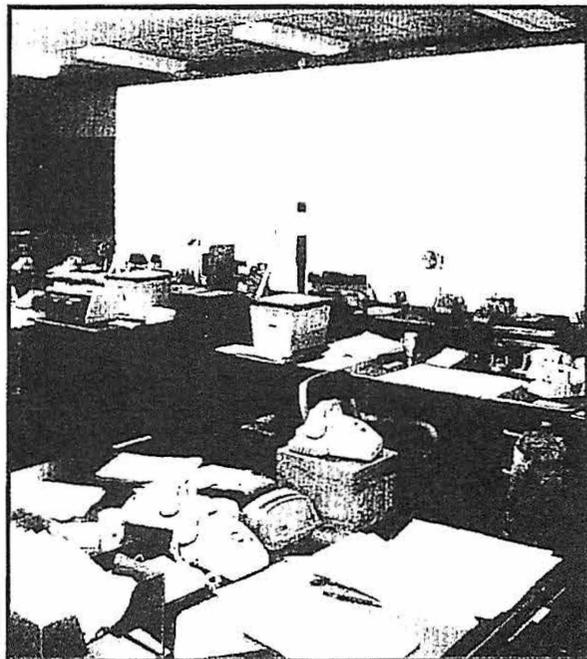
(S) Also in late 1963, DoD senior officials felt that further improvements were needed within the department for management and coordination of foreign telemetry collection and processing. On 25 September Roswell Gilpatric, deputy secretary of defense, tasked Dr. Eugene G. Fubini, assistant secretary of defense for DR&E, and DIA director Lieutenant General Joseph F. Carroll, USAF, jointly to review DoD management of missile and space intelligence activities, with DoD Directive 5105.28 as a reference.

(S) Gilpatric had previously discussed this topic with DCI John McCone, who sent a letter back to Secretary of Defense Robert S. McNamara on November 26, 1963, noting he had already formed FMSAC, to have primary responsibility for all-source collation and analysis of Soviet missile and space firings. McCone noted that the formation of FMSAC could present an opportunity for it to become the U.S. tasking authority for U.S. collection resources.

(S) On 19 December 1963, Dr. Fubini replied to the deputy director of Central Intelligence that

such an expansion of the analytic functions of FMSAC appeared to duplicate functions already being performed within CIA and DoD. Fubini suggested CIA should hold any such expansion in abeyance until the DoD study was completed and the results furnished to CIA. He noted that \$150M and over 5,000 DoD personnel were programmed to support missile and space intelligence activities in the FY-64 program.

(S) The DoD study, completed on 20 February 1964, recommended that the secretary of defense establish a Defense SMAC organization that combined DIA and NSA responsibilities.<sup>30</sup> Also at that time, Don Borrmann, assigned to the Intelligence Community Staff, became aware of the formation of CIA's FMSAC and recommended to the NSA Deputy Director for Operations (then Major General John J. Davis, USA) that NSA form a FMSAC-like organization to coordinate DoD missile and space collection assets. Borrmann and Colonel Max Mitchell, USAF, from DIA drafted the DEFSMAC charter.



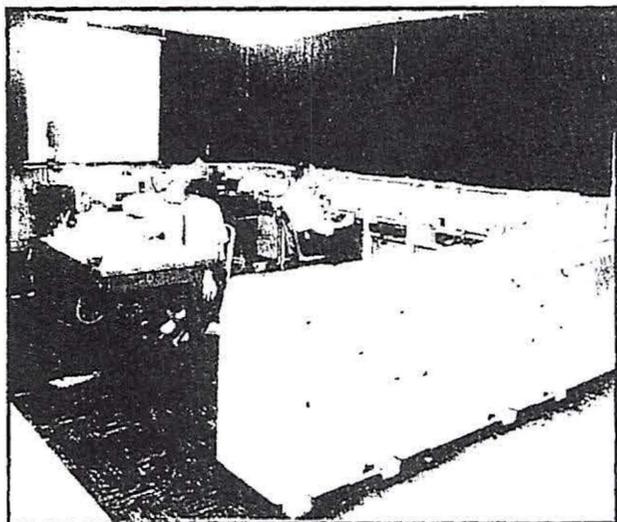
(S) Fig. 40. The "watch center" area in Defense/SMAC, circa 1966

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(S) Defense/SMAC was formed under DoD Directive S-5100.43 dated April 27, 1964, "Defense Special Missile and Astronautics Center" With "intelligence" reporting responsibilities (as opposed to SIGINT "information" reporting done by NSA). DIA assigned twenty-three billets to the organization. NSA assigned eighty-one,

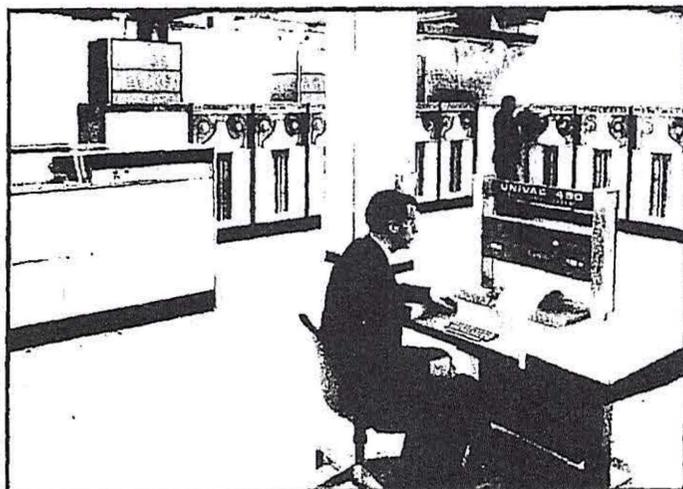
most of which were already filled by previously established NSA SMAC and "SIGTRACK" contingents. Charles C. Tevis from NSA was named director, and Colonel Max Mitchell, USAF, from DIA was appointed deputy director a few months later. Charles L Gordon was named chief of the A41 (SMAC Division) that provided the NSA people and administrative arrangements on behalf of NSA.<sup>31</sup>



(S) Fig. 41. The Defense/SMAC "tracking" area, some of the OPSCOMMs to NORAD and to some of the collection sites (1966)

(S) Key functions and responsibilities described in the DoD Directive were as follows:

1. Twenty-four-hour surveillance of foreign missile and space activities
2. Tasking and technical control of all DoD intelligence collection activities directed against foreign missile and space activities
3. Technical support, including tip-off, to all DoD missile and space intelligence collection activities and to assist them in the performance of their respective missions



(S) Fig. 42. The UNIVAC 490 in the basement of NSA that was used to generate 1.4(c) and process "tracking" data collected by the various SIGINT locations (1966)

4. Current analysis and reporting of foreign missile and space events based on data collected by DoD missile and space intelligence collection activities and received at Defense/SMAC up to 72 hours after the event<sup>32</sup>

(U//FOUO) Lieutenant General Joseph F. Carroll, USAF, signing as director, DIA, with Lieutenant General Gordon A. Blake, USAF, signing for NSA, promulgated an implementing Memorandum of Understanding on May 29, 1964, putting Defense/SMAC (later to be abbreviated DEFSMAC) in business. Charles C. Tevis, the first director of Defense/SMAC — which

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(S) Fig. 43. Summary of the methodology used by Defense/SMAC when it was formed

ties of interest. Defense/SMAC would notify SIGINT facilities at those locations via OPSCOMMs of information to be broadcast, and the HF transmitters at those locations would send the information in coded messages every ten minutes, alternating between various transmitting sites. Defense/SMAC had codenames for each; overall they were the FOXTROT broadcast.

1.4(c)  
[Redacted]

officially began operations on June 1, 1964 — promulgated the specific implementation plan for the Center on 4 June 1964.<sup>33</sup>

1.4(c)  
[Redacted]

(U//FOUO) In the summer of 1964, in order to improve the knowledge of key NSA and CIA managers on the capabilities of each other's collection efforts, Dr. Wheelon, DDS&T at CIA, He took CIA Statute  
CIA Statute Carl Duckett, head of FMSAC; Major General John Davis, USA, NSA Deputy Director of Production; Joe Amato, from NSA's A Group; and Charlie Tevis, director of Defense/SMAC, for a worldwide tour of telemetry collection facilities sponsored by both agencies.

1.4(c)  
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(S) Fig. 44. FOXTROT broadcast locations

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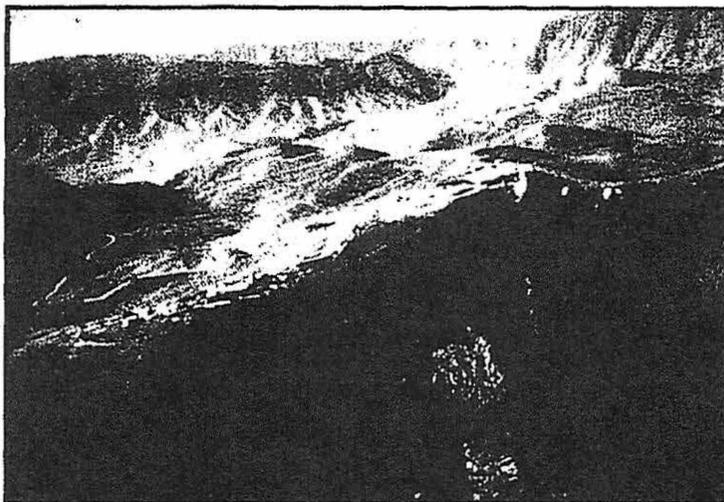
(E) In June 1965 NSA produced a comprehensive Space SIGINT Collection Plan based largely on the SSS TDP and the Defense/SMAC Implementation Plan. It was also derived from the current United States Intelligence Board Guided Missile and Astronautics Intelligence Committee (GMAIC) requirements, and took into account soon-to-be-operational SPACOL systems. The plan included specific requirements for passive tracking accuracy for the SPACOL systems. The plan drove the accuracy requirements for the next several years and led to development, design, and incorporation of monopulse tracking for the BANKHEAD II replacement system (JAEGER) in 1966 as well as the addition of signal Doppler tracking equipment and processing (called the <sup>PL 86-36/50</sup> <sup>LSC 3605</sup> projects) for several BANKHEAD systems and STONEHOUSE in the late 1960s.<sup>35</sup>

*(U) CIA and DoD Add Collection of Various Types*

(S) CIA was also very active in telemetry collection. The TACKSMAN I site in Iran continued to expand. By now, the Office of

Communications personnel had been transferred to the CIA Office of ELINT, which became responsible for both TACKSMAN sites in 1962. Each TACKSMAN site had an operating personnel complement of about twenty-five people.<sup>36</sup>

(S) For more complete coverage on Soviet space probes, where mission objectives normally were known (Mars, Venus, or the moon), several radio research stations were often requested to provide data. These facilities were the

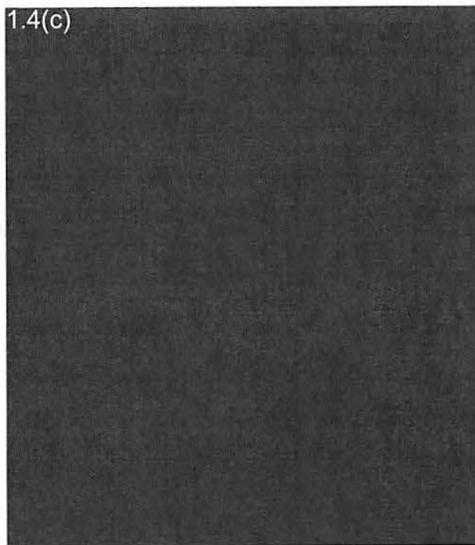


(S) Fig. 46. The TACKSMAN II facility. This site was much closer to Tyuratam, and also to Sary Shagan, where the Soviets began testing antiballistic missile interceptors.



(S) Fig. 45. TACKSMAN I facility, including the Shah's summer palace. In 1964 CIA established another site in Iran, called TACKSMAN II (also established as a clandestine site), on a remote mountaintop near Kapkan, Iran.

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When the U.S. Navy facilities were used to look for ELINT and telemetry signals that might be reflected from the moon, or "moon bounce" searches, the efforts were called PAMOR, an acronym for "passive moon reflections."

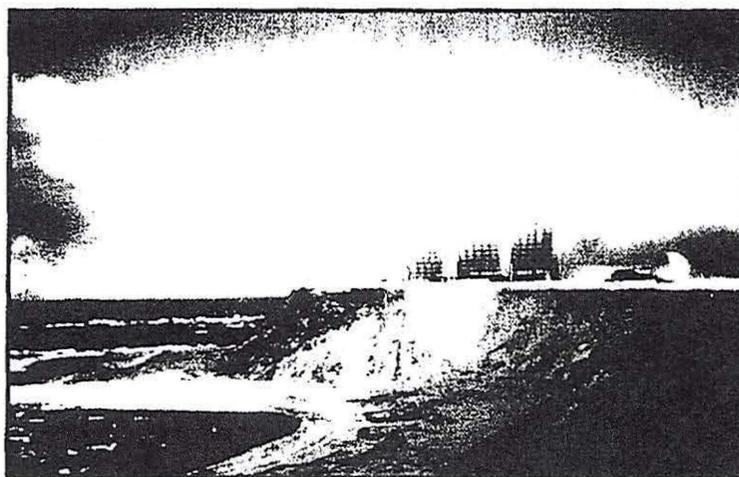
*(U) Other Foreign  
Missile/Space Technical  
Intelligence Sources*

(S) Intelligence from radar systems, initially operated by the USAF Security Service and tasked by NORAD, provided NORAD with essential information on foreign missile and space activity, and also was an important adjunct to Defense/SMAC on many events, particularly missile test firings. Fixed beam FPS-17 radar was located near Diyarbakir, Turkey, in 1956 and was followed by an eighty-five-foot dish FPS-79 tracking radar in 1964. The FPS-17, in addition to its initial mission to surveil missile launches from KYMTR, came to provide derivation of missile trajectories, identification of earth satellite launches, calculation of satellite ephemeris (position and orbit), and synthesis of booster rocket performance.<sup>37</sup> Similarly, there was an FPS-17 installed in 1959 and a later a sixty-foot antenna FPS-80 radar at Shemya, Alaska, in 1961. The Shemya radars covered TTMTR missile impacts on Kamchatka and firings into the Pacific Ocean, as well as launches of KYMTR satellites.



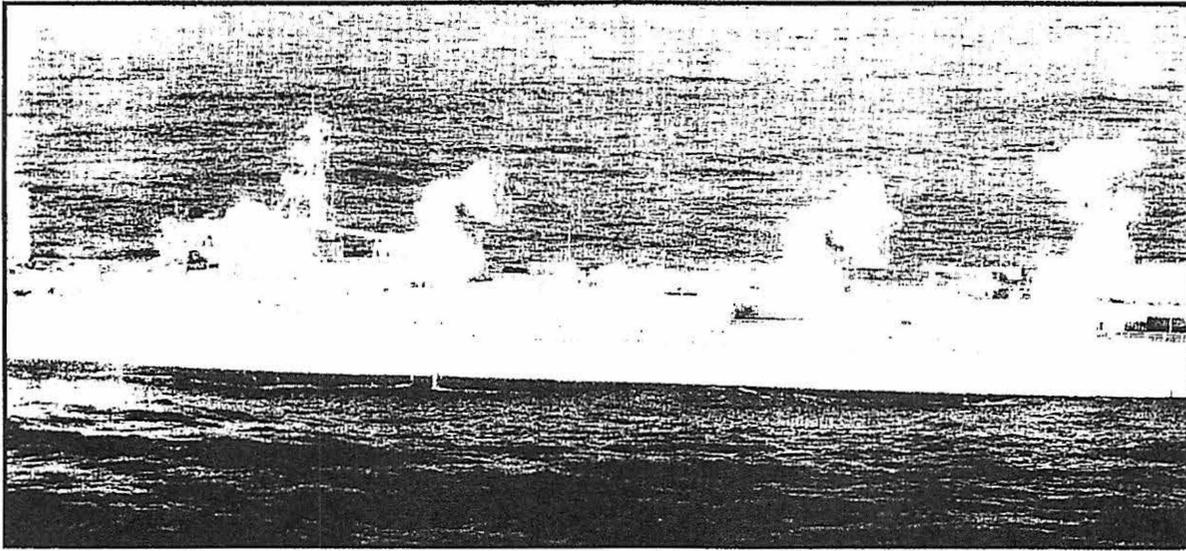
(S) Fig. 47. The Diyarbakir Radar facility. These radars were targeted primarily at the KYMTR missile launches and satellite launches from TTMTR.

(E) From time to time the TRADEX radar on Roi Namur, normally used to track U.S. missiles test fired from Vandenberg AFB into the Pacific test range, was used against Soviet missiles fired into the Pacific. Also, the ARIS ships *Arnold* and



(U//FOUO) Fig. 48. FPS 17 and FPS 80 at Shemya. The responsibility for operating these radars was transferred from USAFSS to the Air Defense Command (ADC), part of NORAD, in 1962.

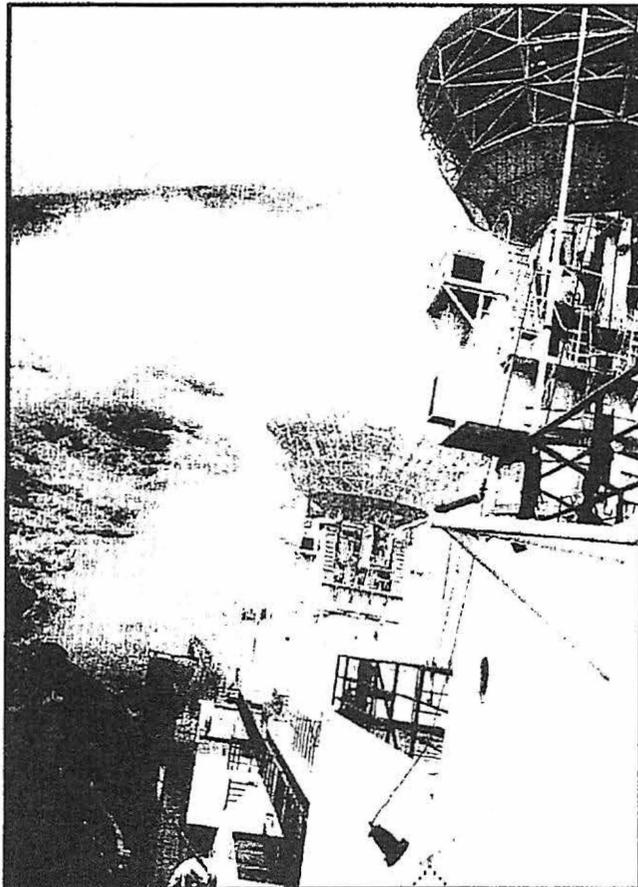
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(U) Fig. 49. The USNS Hoyt S Vandenberg ARIS during a "normal" cruise

Vandenberg had radar tracking capability and were deployed against Kamchatka and Pacific Ocean firings. At times the BMEWS radars at Clear, Alaska, and Thule, Greenland, provided data on TTMTR launches. Further, the Space Defense Center radars at Flyingdale's Moor, England; the FPS-85 at Moorstown, New Jersey; and the USAF Eastern Test Range radars at Trinidad, West Indies, and on Antigua, Canary Islands, were often helpful in locating and tracking Soviet satellites during their early orbits.<sup>38</sup>

(S) Systems to exploit over-the-horizon HF radar reflection data, giving missile trajectory information from Soviet missiles were also developed. These used both "forward-scatter" and "back-scatter" radar reflections. ASA operated stations in Peshawar, Ankara, and Adak called the PL 86-36/50 USC 3605 system, to collect missile reflections from Soviet tracking radars. The USAF had a "forward scatter" system that transmitted HF signals from Okinawa and the Philippines and had signal receiving stations at San Paulo, Spain; San Vito, Italy; Aviano, Italy; Foggia, Italy; and Salonika,



(U) Fig. 50. The Vandenberg ARIS during a Pacific storm in 1967

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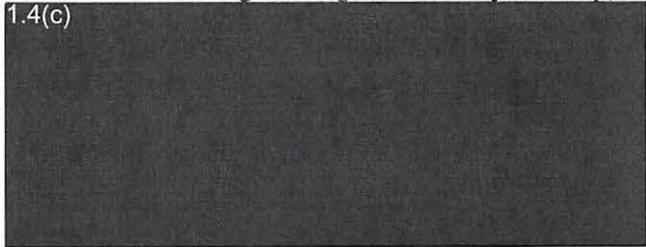
(and later) satellite systems and to better understand downlink telemetry, which usually reflected the uplink commands. One of the earliest attempts at uplink collection was performed by Lewis Franklin and Robert Phillips from Sylvania-EDL in early 1960, working from a C-130 aircraft with SHF radar modified to act as a signal collection antenna. The C-130 was deployed to the Pacific Ocean impact area for Soviet ICBM tests and where it was suspected that Soviet ships deployed to the area had a command "uplink" function.

(S) The results from these HF "radar" systems were not always usable by Defense/SMAC in the early years because trajectory tracking results were often not available within a seventy-two-hour reporting deadline. But the data and reports were used by NSA and other organizations in long-term missile assessment reports.

(S) Another source of data used for long-term missile analysis in the early 1960s was the ACOUSTINT data collected by ASA from Sinop and Ankara; Meshed and Teheran, Iran; Peshawar and Lahore, Pakistan; Chitose, Japan; and Taegu, Korea.<sup>39</sup>

(S) In a continuing effort to learn more about Soviet command uplinks to its satellites and space probes, the Command Link Intercept Program (CLIP) was established to use aircraft to look for and record these signals. A ground facility at Sinop,

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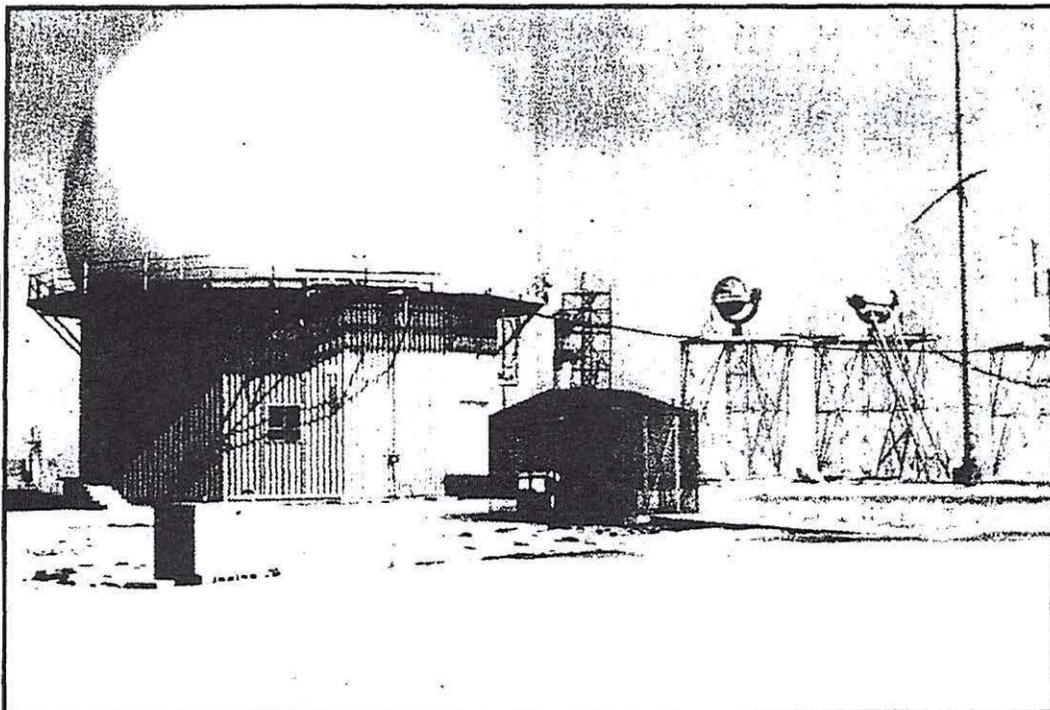


*(U) How About Those Uplinks?*

(S) Soviet uplink data were needed by the U.S. intelligence community to understand both missile

*(U//FOUO)*

*Fig. 51.  
PL 86-36/50  
100-2605  
as originally  
installed in  
the main  
operations  
compound at  
Sinop*



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(S) The U.S. Navy A3D aircraft often flew missions looking for uplinks (these were called BUSY SIGNAL when flown as CLIP missions in the Pacific). Much of this early work was sponsored primarily by the Army, which had the IRBM defensive mission in DoD, in order to get IRBM data that could be used to design U.S. defensive measures. The Army was supported by the Navy, which had aircraft that could perform the required collection flight profiles.<sup>40</sup>

*(U) Critical Results*

(U) In 1961 Dr. "Bud" Wheelon and Sidney Graybeal stated:

In point of fact, the telemetry contains most of the information the Soviet engineers themselves get from a shot. Our exploitation of this unique source, however, is less efficient than the Soviet because, first, we do not know which measurement is assigned to which channel, second, we do not have the calibration or absolute values of readings on the several channels, and third, we do not intercept transmissions covering the entire flight because of radio horizon limitations. Painstaking technical analysis has gradually solved many facets of the channel identification problems and making encouraging progress on calibration.

(S) During the 1957-1960 "Missile Gap" controversy in American politics about the balance of power in missiles between the U.S. and the Soviet Union, telemetry played a key role in determining if the Soviet Union was outstripping the U.S. in development and deployment of intercontinental ballistic missiles. The Director of Central Intelligence convened an Ad Hoc Panel on the Soviet ICBM Program. The "Hyland Panel" included Dr. Lawrence Hyland of Hughes Aircraft, Albert

Wheelon of Space Technology, and William Perry of Sylvania Electronic Defense Laboratory. This was followed by a detailed study by the Guided Missile and Astronautics Intelligence Committee (GMAIC) and a CIA Task Force series of studies that concentrated on the deployment status of the Soviet ICBM program.

(S) A U-2 aircraft, accompanied by an Air Force RB-57D Canberra, provided electronic intelligence to help solve the "Missile Gap" dilemma. Their flight along the Soviet-Iranian border achieved the first telemetry intercepts from a Soviet ICBM during first-stage flight, eighty seconds after launch.<sup>41</sup>

(S) These panels provided evaluations of data that led to the resolution of this controversy, primarily on the basis of the SIGINT/TELINT detection of test firings and results at a lower rate than would be expected for a crash program, and the lack of evidence of extensive operational locations for any deployed ICBMs, specifically the first generation SS-6.<sup>42</sup>

(S) After combining intercepts with valuable information contributed by the West's agent-in-place Lieutenant Colonel Oleg Penkovskiy, it was concluded that the Soviets had deployed a total of only four SS-6 ICBMs. Telemetry analysis, and the analysis of the Soviet ICBM test launch program, indicated that the Soviets were still in a development and testing phase for their ICBMs in 1960, and thus probably had not embarked on the extensive deployment phase that some intelligence analysts had projected during the "Missile Gap" debates.<sup>43</sup>

(S) In a similar way, during the Cuban Missile Crisis in 1962, telemetry provided significant assistance to the president and the crisis management team, albeit in a less direct way than in the "Missile Gap" situation. Charles Tevis from NSA was one of the first experts called to the Navy Yard to assist in evaluating photographic information from U-2 flights. Telemetry analysis was able to provide performance characteristics on the SS-4 MRBM and

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SS-5 IRBM missiles that gave the U.S. high confidence in its knowledge of the range and accuracy of those MRBM/IRBMs.<sup>44</sup>

*(U) Summary of the 1960s*

(S) In the early 1960s, NSA, other DoD components, and CIA took strides to improve intelligence information sources, particularly telemetry collection and analysis, and to coordinate those assets in order to get the maximum information from telemetry from Soviet, and later PRC, missile and space development efforts. The establishment in 1962 of NSA R6 to implement Phase I of the broad study of Soviet/PRC missile and space targets was a key management and systems development action by NSA. The formation of SMAC by NSA; then Defense/SMAC by DIA/NSA in 1964 (with a DoD multisensor collection coordination role and a joint DIA/NSA intelligence reporting role); and the establishment of FMSAC, also in 1964, by CIA are illustrations of these measures.<sup>45</sup> Table 2-2 lists some of the significant TELINT events of the early 1960s.

*(U) Lessons Learned in the Early 1960s*

(U//FOUO) Some of the most important "lessons learned" from the U.S. efforts to gain knowledge of foreign (primarily Soviet) missile and space activities in the early 1960s were these:

(U//FOUO) **Lesson 1:** When faced with a highly technical and complex problem, form an organization that has the technical competence and the charter to address at least a large part of the problem, a "lesson" repeated from the 1950s. This author believes NSA did this when the Agency formed the R6 Office of Special Programs with sufficient funding and with the flexibility to assign the right people to this effort, and then directed that all other necessary NSA and Service Cryptologic Agency elements support the effort.

(U//FOUO) R6 was given an internal staff of budgeting, accounting, scheduling, logistics plan-

ning and documentation specialists; a first for projects in NSA at that time.

(U//FOUO) This "lesson" was also applied by DoD, DIA, and NSA with the formation of the Defense Special Missile and Astronautics Center (Defense/SMAC) in 1964 to provide operational control and guidance to SIGINT and non-SIGINT collectors and early reporting on collection and field analysis results.

(U//FOUO) In a similar vein, CIA formed the Foreign Missile and Space Analysis Center (FMSAC) to bring together all-source analysis of foreign missile/space intelligence targets and also provide guidance to the CIA unique collection resources against those targets.

(U//FOUO) **Lesson 2:** In planning and implementing systems to be operated by an organization different than the one which develops it, and where the data are to be used by different organizations, involve those organizations in the planning and implementation phase of the effort. This was done by the NSA R6 organization to the maximum extent possible, and supported by the NSA PROD and ASA organizations to a significant degree. Both PROD and USASA assigned individuals either full time or part time to R6. CIA even assigned an integree for a period of time, who later became station chief at TACKSMAN II.

(U//FOUO) **Lesson 3:** Telemetry analysis results can often help resolve U.S. national crises. This was seen in both the "Missile Gap" controversy of 1960 and the "Cuban Missile Crisis" in 1962. Telemetry analysis provided great confidence on the U.S. knowledge of the MRBM performance characteristics and capabilities during the Cuban Missile Crisis. The contributions of the budding U.S. TELINT capabilities during these crises went a long way to sustaining an aggressive U.S. and partnership collection program during the next few decades.

~~SECRET//NOFORN//X1, X6~~**(S) Table 2-2 Significant TELINT Events for the Early 1960s**

<b>Year</b>	<b>Activity/Event</b>
1960	Initial NSA (PROD) study of SIGINT requirements against foreign space targets
1961	NSA established the Space Surveillance SIGINT Planning Board (SSSPB)
1962	DoD/DDR&E approval obtained for SPACOL program NSA R6, Office of Special Program Management, formed and implemented
1963	BANKHEAD II (Japan) began operations 1.4(c) [REDACTED] STONEHOUSE and [REDACTED] PL 86-36/50 contract awarded to Harris-Radiation BANKHEAD I (Pakistan) began operations
1964	Defense/SMAC formed by NSA and DIA BANKHEAD III (Turkey) contract awarded to E-Systems 1.4(c) [REDACTED] TACKSMAN II established by CIA

**Notes**

1 (U) Louis W. Tordella, Memorandum for the Secretary of Defense, "ELINT Activities," NSA Serial: No850, 1 March 1960.

2 (U) Captain Everett B. Gladding, USN, "Report on Special Collection Effort, September-October 1960, NSAPAC Serial 60/0153TSC, 14 November 1960.

3 (U) Louis W. Tordella, Memorandum to CNO, "Concept of Operations for [REDACTED] PL 86-36/50 USC 3605 NSA Serial N4245, 3 November 1960.

4 Johnson, *American Cryptology*, 304. Interview, James Donnelly, 29 July 1998.

5 (U) [REDACTED] PL 86-36/50 USC 3605 "A41-SMAC Division -- Office Secretary of Defense OSD Inspection," 28 October 1965. Interview, Robert Phillips.

6 (U) Frank Lewis, "Notes of a Talk on Space SIGINT given by Mr. F. Lewis, NSA, on Wednesday, 10th May 1961," Attachment E to GCHQ document M/8761/MA2018 of 9 May 1961. CCH Series File, Bernard Collection.

7 (U) Henry G. Plaster, "The Likelihood of a Reconnaissance Mission for the Soviet COSMOS Series

Satellites," Office of Scientific Intelligence memorandum no. 78, OSI-SM/62-2, 3 December 1962.

8 (U) Henry G. Plaster, "Snooping on Space Pictures," *Studies in Intelligence*, Vol. 8, no. 4, Fall 1964. Declassified version available at the National Archives and Records Administration, College Park, RG 263, Entry 27.

9 (U) [REDACTED] PL 86-36/50 USC 3605 "Spacecraft Passenger Television from Laika to Gagarin," *NSA Technical Journal*, Vo. XXI, no. 2, Spring 1976, p. 1.

10 (U) Gene Poteat, "Some Beginnings of Information Warfare -- Stealth, Countermeasures, and ELINT, 1960-1975," *Studies in Intelligence*, Vol. 42, no. 1, 1998.

11 (U) Interview, Lewis Franklin, 10 September 1998.

12 (U) N. C. Gerson, "SIGINT in Space," Report K-TSR-04-98, STINFO Document no. S-245, 785, 7 December 1998. Also published in *Studies in Intelligence*, Summer 1984.

13 (U) [REDACTED] PL 86-36/50 "Sporadic E Intercept of the On-the-Pad Telemetry," Memorandum for the Record, 1 July 1966. Marshall S. Carter, "LITTLE DUKE,"

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Memorandum to DDR&E, NSA Serial No560, 29 April 1966. Albert D. Wheelon and Sidney N. Graybeal, "Intelligence for the Space Race," *Studies in Intelligence*, Vol. 5, no. 4, Fall 1961. Declassified version available at NARA, RG 263, Entry 27. Interview, James Donnelly.

14 (U) <sup>PL</sup> ~~86-36/50~~ "A41-SMAC Division."

15 (U) Johnson, *American Cryptology during the Cold War*, 317.

16 (U) Interview, Lewis Franklin.

17 (U) Robert Hopkins, "The <sup>PL</sup> ~~86-36/50~~ Stratojets," *Air Enthusiast/Forty One*, no date.

18 (U) Carter, "LITTLE DUKE." Interview, Lewis Franklin.

19 (U) Tordella, <sup>PL 86-36/50 USC 3605</sup> Interview, James Donnelly.

20 (U) Johnson, *American Cryptology during the Cold War*, 314. September 1998 Interviews: James Donnelly, Lewis Franklin, Charles Empey.

21 (U) Gerson, "SIGINT in Space."

22 (U) Interview, Lewis Franklin.

23 (TS//SI) Marshal S. Carter, "CLASSIFIED TITLE," memorandum to DDR&3, NSA Serial No886, 27 July 1965. Gerson, "SIGINT in Space." Interview: Lewis Franklin.

24 (U//FOUO) H. D. Wagoner, *Space Surveillance SIGINT Program (U//FOUO)*. United States Cryptologic History Special Series No. 3, 1980.

25 (U//FOUO) Wagoner, *Space Surveillance*.

26 (U//FOUO) Ibid.

27 (U//FOUO) Ibid.

28 (U) Memorandum, "Plans for Establishment of a SIGINT Missile and Astronautic Center, NSA TS Control No. 62-03743, August 1962.

29 (U) Knapp, *The Central Intelligence Agency*.

30 (U) Eugene G. Fubini and Lt. Gen. Joseph F. Carroll, USAF, "Department of Defense Review of Missile and space Intelligence Programs of DOD Components," 20 February 1964.

31 (U) Johnson, *American Cryptology during the Cold War*, 345.

32 (U) Robert S. McNamara, "Defense Special Missile and Astronautics Center (DEFENSE/SMAC)," DoD Directive S-5100.43, 27 April 1964.

33 (U) Gordon A. Blake and Joseph F. Carroll, "Memorandum of Understanding between the Defense Intelligence Agency and the National Security Agency,

Subject: (U) Establishment of the Defense Special Missile and Astronautics Center (DEFENSE/SMAC)," 29 May 1964. Charles C. Tevis, "Defense/SMAC Memorandum No. 1," Serial A-4/079-64, 4 June 1964.

34 (U) <sup>PL</sup> ~~86-36/50~~ "A41-SMAC Division."

35 (U) Richard A. Schmidt, "Space Collection Plan," P2 memo P2/307-65, 9 June 1965. NSA GMAIC Requirements Working Group, "Space SIGINT Collection Plan FY 1967-1971, attachment to the above, March 1965.

36 (U) Corley Wonus, "The TACKSMAN Project," *Cryptologic Quarterly*, Vol. 12, 1993.

37 (U) <sup>PL</sup> ~~86-36/50~~ "A41-SMAC Division."

38 (U) Zabetakis & Peterson, "The Diyarbakir Radar."

39 (U) <sup>PL</sup> ~~86-36/50~~ "A41-SMAC Division."

40 (U) <sup>PL</sup> ~~86-36/50~~ "A41-SMAC Divisions;" (U) Interview: Lewis Franklin.

41 (U) James Harford, Korolev — *How One Man Masterminded the Soviet Drive to Beat America to the Moon*, 162.

42 (U) Leonard F. Parkinson and Logan H. Potter, "Closing the Missile Gap," in Michael Warner and Scott A. Koch, *Fifty Years of the CIA* (CIA Center for the Study of Intelligence, 1998), 111-33.

43 (U) Gerson, "SIGINT in Space."

44 (U) Interview: Lewis Franklin. Mary S. McAuliff, ed., *CIA Documents on the Cuban Missile Crisis*, 1962 (CIA History Staff, 1992).

45 (U) David S. Brandwein, "Telemetry Analysis," *Studies in Intelligence*, Vol. 8, no. 4, Fall 1964. A declassified version is available at NARA, College Park, RG 263, Entry 27.

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### (U) Chapter 3 The Major Systems and Early Results (Late 1960s)

#### (U) Expanding the Phase I SPACOL System

(U//FOUO) It was apparent by early 1965 that BANKHEAD I and II were not going to fully meet their original operational goals. The equipment in many cases was not completely suitable for the mission (since it had been designed for U.S. space vehicle telemetry collection); much of the equipment, particularly the hydraulic antenna drive systems, was not reliable; spare parts were not easy to obtain; and the equipment required maintenance skills not readily available to USAFSS and USASA.

A survey was completed by NSA and USAFSS and ASA that described these limitations as well as other operational, logistic, and training problems.

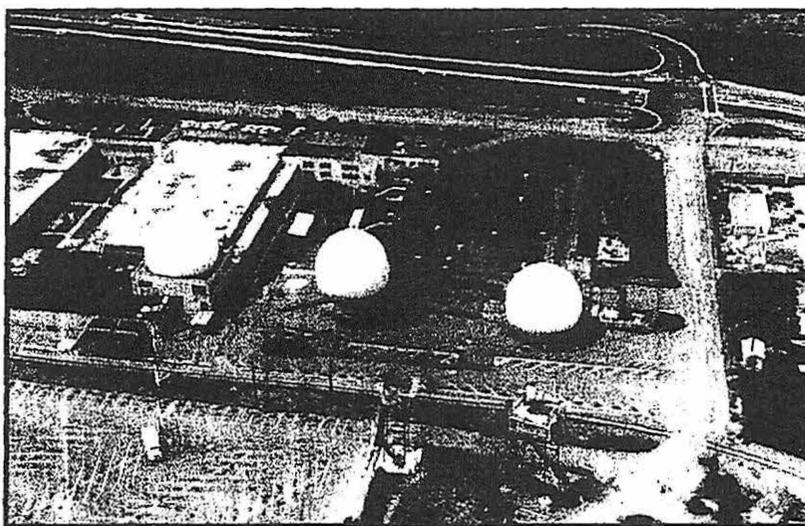
(U//FOUO) While this study was being evaluated, Sylvania-EDL submitted an unsolicited proposal to USASA describing replacing BANKHEAD II in Japan and the ESGM system at Shemya, Alaska, with systems similar to 1.4(c)

1.4(c)

1.4(c)

NSA and ASA agreed that this was a cost-effective and timely solution to the growing requirements for collection of Soviet earth-orbiting space vehicles. NSA (R6) was given responsibility for acquiring the systems, in conjunction with ASA planning and future manning.

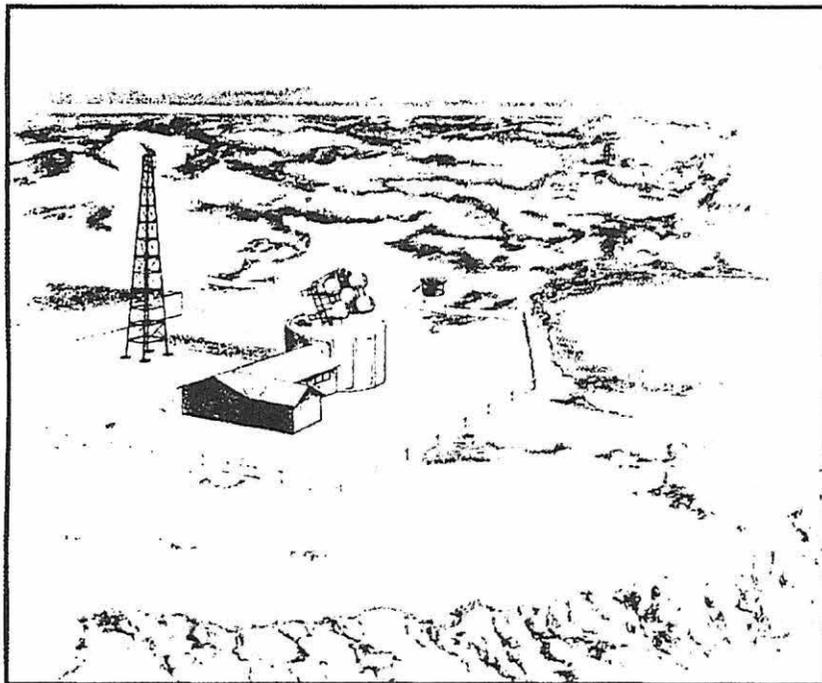
(C) The system to be located on Shemya was codenamed ANDERS (called HARDBALL I by EDL), and the one to replace BANKHEAD II at Chitose was PL 86-36/50 (called HARDBALL II by EDL). Sylvania-EDL was awarded a sole-source contract in 1966 based on refinements to their unsolicited proposal. This author became the R6 program manager for both projects, assisted by PL 86-36/50 USC 3605 USAF, on ANDERS and PL 86-36/50 USC 3605 or PL 86-36/50 USC 3605



(C) Fig. 52. The HARDBALL (ANDERS) PL 86-36/50 systems during final testing at the Sylvania-EDL Mountain View, CA, facility. Graham A. Grande was the Sylvania program manager and later joined NSA as a senior manager. The third radome contained the HARDBALL III very accurate monopulse passive tracking thirty-foot dish antenna that was added to the original Sylvania-EDL 1.4(c)

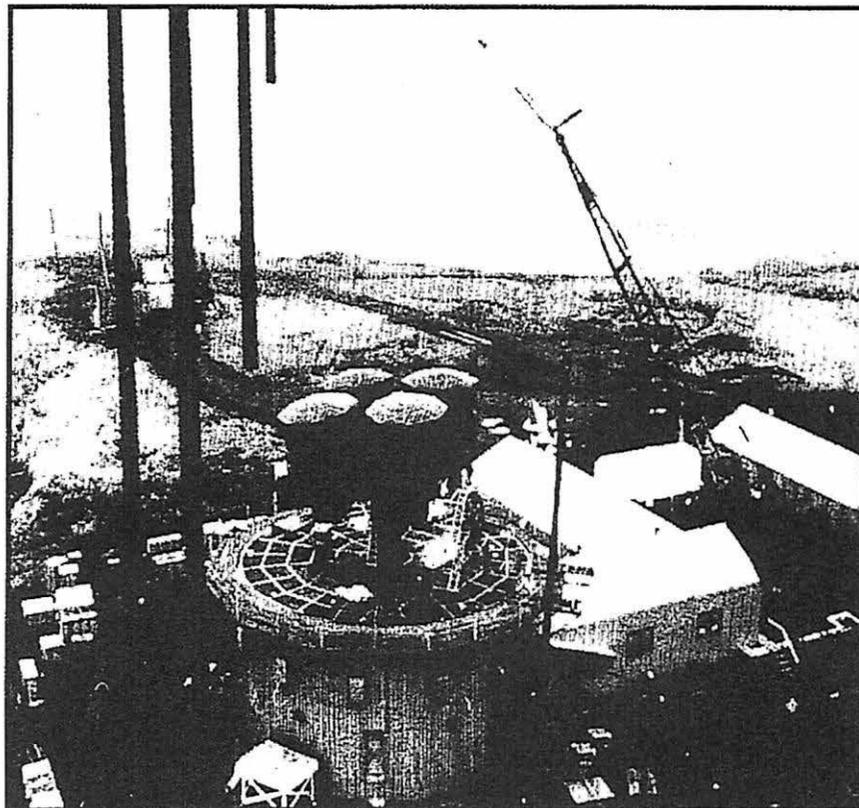
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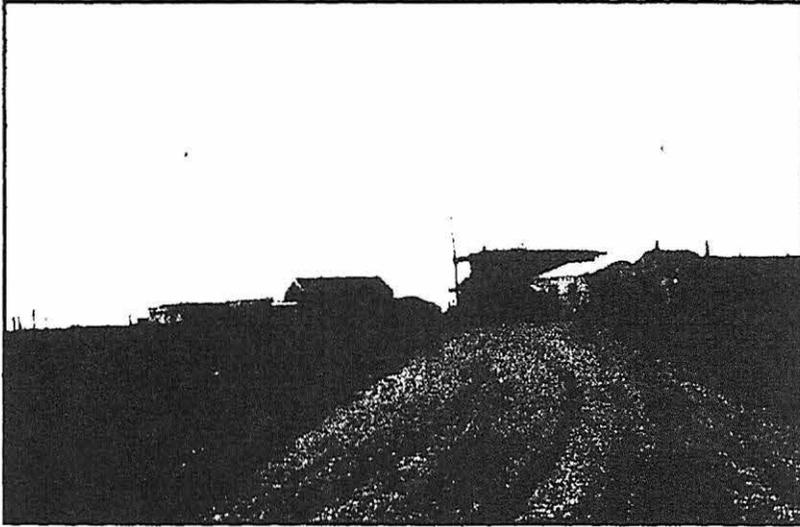
(U) Fig. 53. Artist's concept of ANDERS

(U//FOUO) Fig. 54. The ANDERS antenna system during installation at Shemya taken from the antenna calibration tower



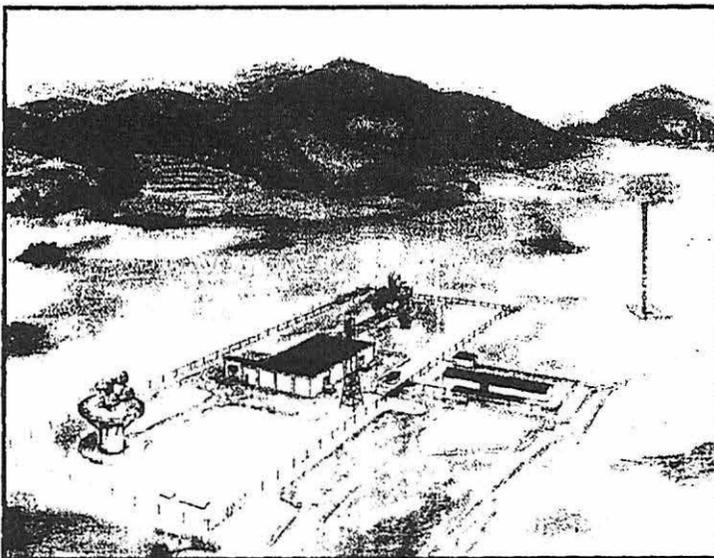
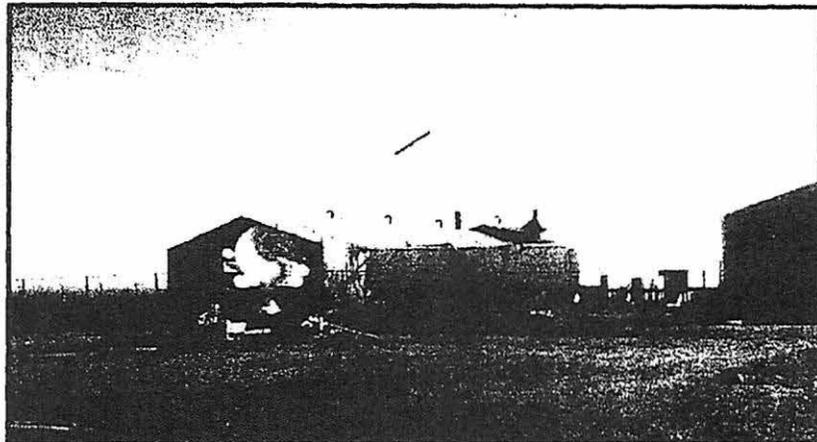
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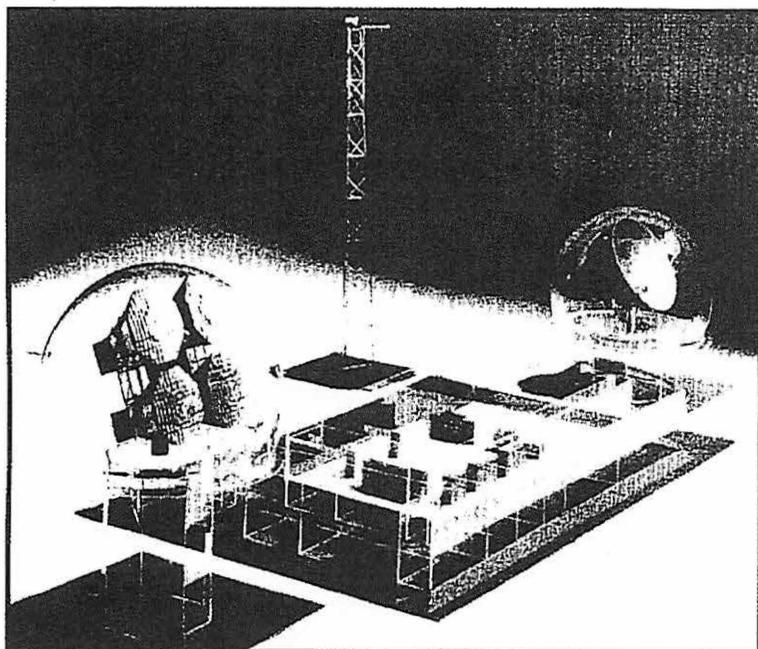
(U//FOUO) Fig. 55.  
 The completed ANDERS facility.  
 Captain Robert E. Baker, USA,  
 eventually to become an NSA  
 senior executive, was the opera-  
 tions officer at Shemya during  
 the ANDERS installation and  
 later became the maintenance  
 officer at PL  
96-00150

(U//FOUO) Fig. 56.  
 The CHAOS system which was  
 installed by USASA on Shemya to  
 provide coverage while the ESGM  
 Upgrade system was de-installed and  
 ANDERS was being installed in 1967.



(U) Fig. 57. Artist's  
 concept of PL  
96-0015

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(U//FOUO) Fig. 58. Model of the two  
 PL 86-36/5 antenna systems and the  
 operation building

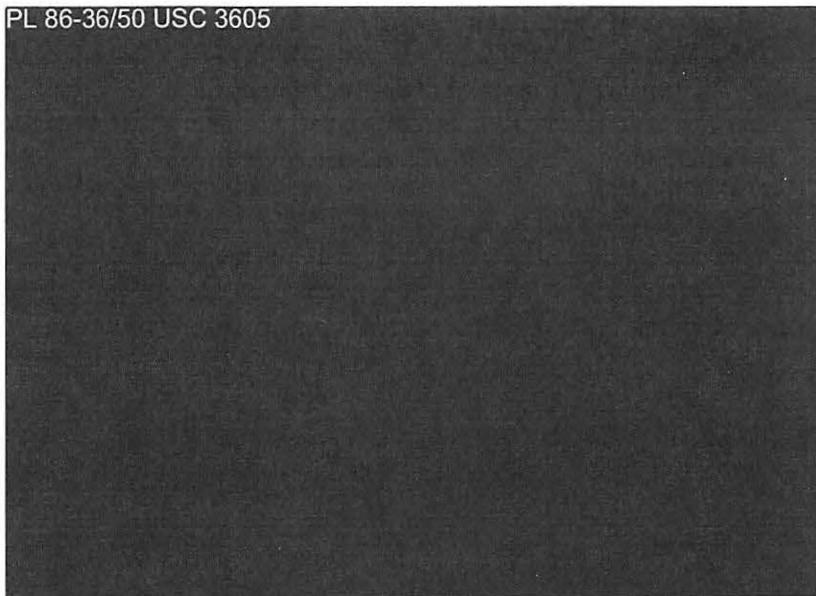
(C) After war between India and Pakistan broke out in late 1965, and U.S.-Pakistani relations deteriorated, it was becoming apparent that the USAF-SS tenure in Pakistan was limited, and no plans were made to upgrade the BANKHEAD I system. While the loss of BANKHEAD I would reduce coverage of Soviet and PRC missile and satellite activity, other collectors, particularly TACKSMAN II, filled in much of the loss.<sup>4</sup>

(U) NSA and Defense/SMAC Progress

(C) In late 1965 the Office of the Secretary of Defense conducted an "inspection" of Defense/SMAC to determine how effectively NSA was carrying out the DoD directive that established the center. At that time all of the operations elements of Defense/SMAC at NSA had been administratively centralized in the A4 organization, called

PL 86-36/50 USC 3605

(U) Fig. 59. Completed PL 86-36/50  
 installation in 1967

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the Office of Advanced Weaponry and Astronautics and headed by <sup>PL 86-36/50</sup> [REDACTED]. The component that directly supported the NSA component was designated the A41 Division under Charles L. Gordon. A41 had over seventy full-time people assigned to the Defense/SMAC mission and had control of over twenty full-time or call-up OPSCOMMs. OPSCOMMs included one to a <sup>USC 3605</sup> [REDACTED] 1.4(c)

1.4(c)

(S) Soviet missile and space activities were already at a significant level by 1965. Soviet missile/space events during 1965 included twenty-four ICBMs launched to Kamchatka and two to the Pacific Ocean; twenty-three ESVs, including the first Molniya communications satellite; a manned (VOSKHOD II) mission; six space probes and twelve shorter range missiles. During the first nine months of 1965, Defense/SMAC produced 1,012 electrical reports and 253 possible launch alerts. It also sent over 28,000 items over the OPSCOMM in support of the effort. Defense/SMAC received almost 300,000 messages over the formal message distribution system, and this number did not include the 2,323 batches of special tracking data received over the OPSCOMMs. While initially abbreviated Defense/SMAC starting in 1964, this later changed to DEF/SMAC, and (starting in about 1985) then DEF/SMAC, which is still in use today.<sup>2</sup>

(S) The Tyuratam Missile Test Range (TTMTR) was conducting missile test firings of ICBMs to Kamchatka and the Pacific ocean; training firings of operational SRBMs, MRBMs, and IRBMs by the Soviet Rocket Forces to Kamchatka; launching manned and communications satellites; and launching Mars, Lunar and Venus space probes. The Kapustin Yar Missile Test Range (KYMTR) was launching SRBMs, 1,000-nm MRBMs, 2,000-nm IRBMs, some SAMs, and some single and multi-

payload satellites. The Plesetsk Missile and Space Center (PMSC) in northwestern Russia was testing ICBMs and launching space vehicles, and the Northern Fleet Missile Complex (NFMC) was launching SLBMs, cruise missiles, and other naval missiles.

(S) The Sary Shagan Missile Test Range (SSMTR) was testing antimissile missiles, strategic SAMs (e.g., SA-5), and associated radar tracking systems. The Vladimirovka Advanced Weapons and Research Complex (VAWARC) tested air-to-air, air-to-ground, and surface-to-surface cruise missiles. The VAWARC included the Caspian Sea Special Test Range (CSSTR) that tested air-to-surface missiles for the Soviet naval forces. The Vladimirovka Lake Balkhash Test Range (VLBTR) (now considered part of VAWARC) conducted surface-to-surface cruise missile tests. The Soviets also had Missile Range Instrumentation Ships (SMRIS), Soviet Space Operations Control Ships, and Space Event Support Ships (SSESS) that required monitoring. The locations of these ships, along with their communications patterns, frequently gave good indications of upcoming Soviet missile/space events.

(S) NSA now often obtained Soviet missile and satellite tracking data in near real time. In addition to this, and later with near real-time passive tracking data from the SPACOL assets, NSA contributed significantly to NORAD's ability to determine if there was a threat from any of the events, as well as reconstructing the trajectory/orbits of Soviet missiles/satellites.<sup>3</sup>

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1.4(c)

More and more, the original contractors for the systems were requested to provide logistic support and on-site maintenance and engineering support, particularly at the "short tour" (one year) site at Sinop.

(S) By the end of 1967 both ANDERS and JAEGER were operational, and [REDACTED] and STONEHOUSE were performing their missions well. The original [REDACTED] system planned for JAEGER had been augmented by an additional thirty-foot tracking dish in order to assist NSA and NORAD with early orbit determinations ESVs and extended range ICBMs fired into the Sea of Japan or the Pacific Ocean. The new technical approach called HARDBALL III was a "broad band 2-channel monopulse" system invented by Sylvania-EDL, and it provided sufficiently

1.4(c)

*(U) Major Ground-Based Collection Systems*

(S) The ten-year lease for the site in Peshawar expired in 1968 and was not renewed by Pakistan; Peshawar was evacuated and closed by 1970. Some of the SEABRINE and [REDACTED] airborne operations continued from Adana. Fortunately, the CIA TACKSMAN sites in Iran were in operation by that time, and along with the soon-to-be activated RAINFALL system, could replace much of the Soviet telemetry collection then being done by BANKHEAD<sup>5</sup>

(U//FOUO) The maintenance and spare parts problems that had beset BANKHEAD I and BANKHEAD II unfortunately continued for BANKHEAD III and STONEHOUSE. Discussions with the U.S. Army Electronics Command (ECOM) determined that they were primarily logistics problems, most of which were inherent with "one-of-a-kind" operational systems at overseas locations.

(S) By the end of 1968 the SIGINT Space Surveillance (SSS) "SPACOL" plan was considered completed. R6 continued to perform system upgrades to major SPACOL systems for several years, but switched its emphasis to other major

(U//FOUO) Table 3-1 SPACOL Program Budget/Cost Summary

Project Name(s)	Initial Est.(\$K in 1962)	Final Est.(\$K in 1965)Final	Actual(\$K in 1969)
ANDERS	5,903	3,777	2,989
BANKHEAD III (HIPPODROME)	8,755	8,343	10,071
PL [REDACTED]	5,042	7,092	7,487
[REDACTED]			
(STONE-HOUSE Add-on)			
STONEHOUSE	5,861	9,051	10,357
PL 86-36/50 USC			
<b>Totals</b>	<b>29,850</b>	<b>34,547</b>	<b>37,383</b>

**Note:** Estimates and actuals include construction, government furnished equipment, NSA labor, and NSA travel costs.

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field collection and processing systems such as PL 86-36/50. By the end of the 1960s, NSA/R6 had expended most of the \$40,000,000 originally allocated for the SPACOL program. Table 3-1 shows this fiscal summary.

Over the years this platform, and its successors, produced data not available from any other source.

1.4(c)

(U//FOUO) The completed BANKHEAD systems all had similar features, but individual components varied. Table 3-2 shows a summary of the BANKHEAD system characteristics and a rough "quality" evaluation that was made in 1969.

(C) Table 3-2 BANKHEAD Systems Initial Subsystems Features

Subsystem	1.4(c)	BANKHEAD III(HIPPODROME)	ANDERS	PL 86-36/50
HF Receivers	1.4(c)	6	3	4
VHF Receivers		6	9	11
VHF Auto-track		Poor	Good	Good
UHF Receivers		2	1	3
UHF Auto-track		Poor	Good	Exc
SHF Receivers		1	7	4
SHF Tracking		Poor	Good	Good
Computer Control		Fair	Good	V. Good
Recording		Good	Good	Good
Analysis (GFE)		Fair	Good	Good
Multiple Target Capability		Fair	None	V. Good
Doppler Tracking		None	None	Good

## (U) Added Collection Assets

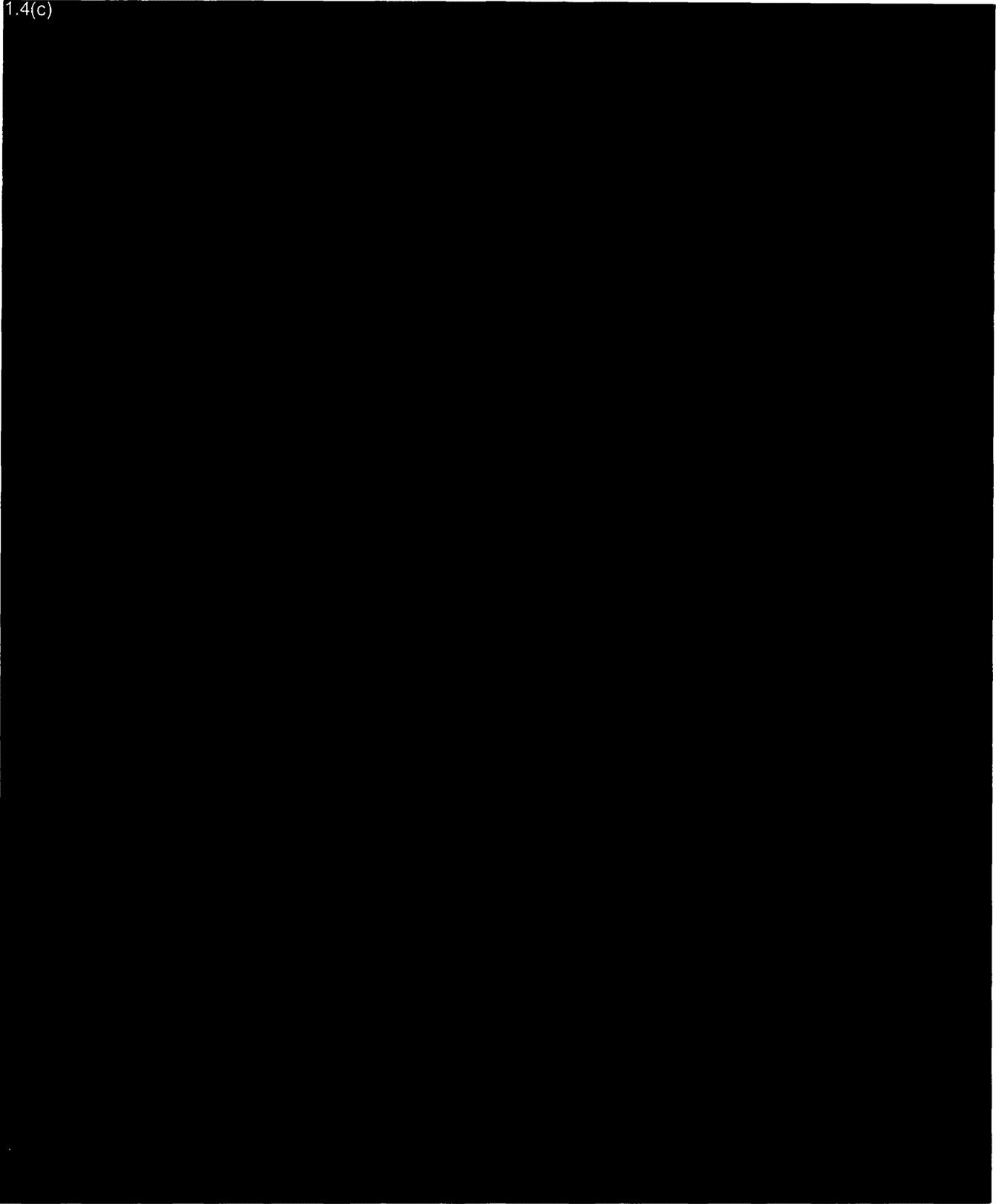
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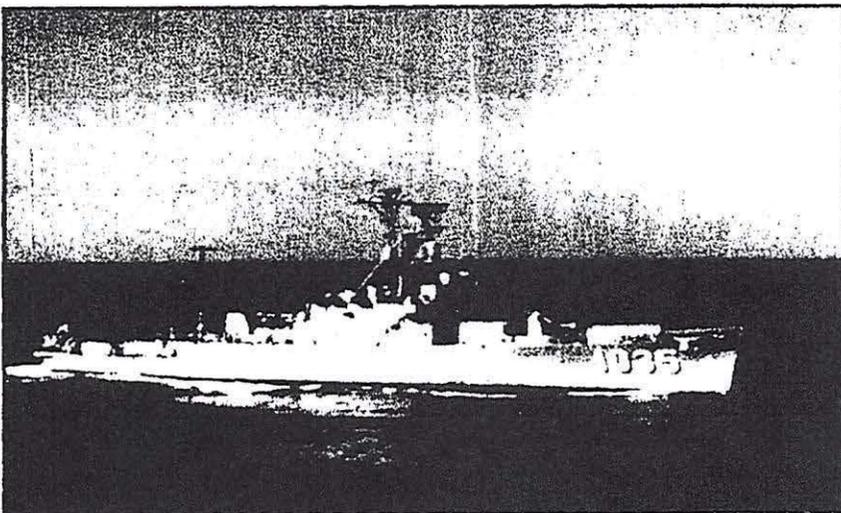
(S) Starting in 1968, the USAF modified three EC-135 aircraft to be specifically configured to receive COMINT, ELINT, TELINT, and optical information from missiles test fired into Kamchatka or the Pacific Ocean. They had the PL 86-36/50 USC 3605

(S) By 1967 NSA also often used U.S. Navy large high-gain dish facilities on an ad hoc basis for certain high-priority collection against Soviet space events. One of these, called PL 86-36/50 by NSA, was the Naval PL 86-36/50 USC 3605 facility PL 86-36/50 USC 3605 to collect space vehicle telemetry, and other signals being down-linked to Soviet ships in the Atlantic Ocean. The Naval Security Group participated by providing equipment operators and a communications van and operators. Field analysis and reporting were done by NSA personnel.<sup>4</sup>

(S) In the mid-1960s the U.S. Navy A3B aircraft were replaced with SEABRINE A3D platforms in the Pacific, based at Atsugi, Japan, but usually flying missions from Shemya, Alaska. In the Atlantic A-3s were based in Rota, Spain, but usually flew only missions from Adana, Turkey, and Peshawar. The four destroyer escorts, codenamed PL 86-36/50 USC one of which is shown in Figure 63, and the two ARIS ships remained active.



(S) Fig. 64. COBRA BALL I missile intelligence collection aircraft, initially called WANDA BELLE and then RIVET AMBER before successive upgrades to the COBRA BALL configuration.



(S) Fig. 63. PL 86-36/50 destroyer escort missile intelligence ship

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1.4(c)

tics from U.S. missile/space development programs.

(S) The sheer volume and time needed to produce these analogs soon exceeded the ability of NSA and the intelligence community S&T centers to keep up with the increasing volume and importance of the data. NSA and CIA began converting data into digital form and providing computer analysis wherever feasible. In January 1962 the Digital Decommuration Facility (DDF) started operations, and in July 1965 digitizing equipment called PL 86-36/50 began operations at NSA. PL 86-36/50 could produce both analog display output and a digital tape for further selected computer processing.<sup>10</sup>

(S) A VHF telemetry collection position was established on Ascension Island at the Air Force Eastern Test Range (AFETR) site and was equipped and manned by NSA "as-needed" by temporary teams of operators and signal analysts. This was called PL 86-36/50 USC 3605 and was used to obtain telemetry collection from Soviet space vehicles and planetary probes on their first orbit or during the injection phase for planetary probes.

#### (U) Processing the Telemetry Data

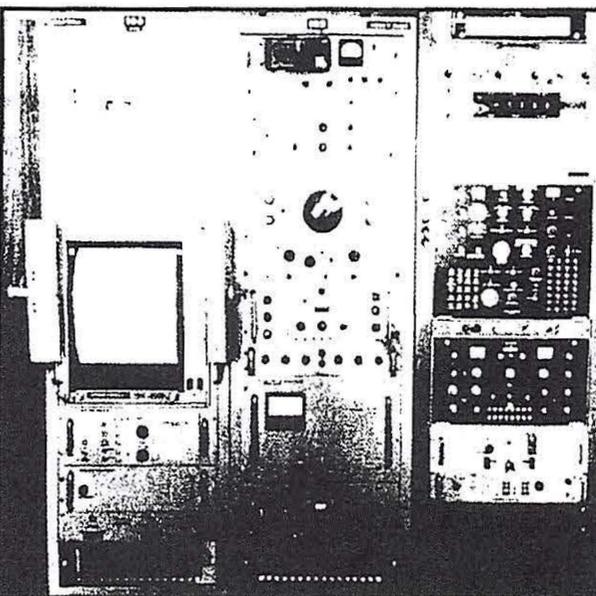
(S) Early processing of telemetry data consisted primarily of demodulating the signal, decommutating the telemetry and producing an analog display of each telemetry channel for an analyst to review.

1.4(c)

1.4(c)

This process was, with no imagination added, called producing "Analog."

(S) Analog could be produced photographically by displaying data on the face of a CRT and then passing light-sensitive film or paper in front of the tube. Digital analogs were prepared by digitizing the telemetry in a format for computer processing and then displaying the data on photo recordings. In the early 1960s up to twelve channels of data could be presented on one analog chart/scroll. Analog was the best portrayal of the data for analysis, particularly to U.S. missile/space experts, who were accustomed to seeing similar characteris-



(S) Fig. 65. A P 136 1 and a P 136 4 telemetry demodulator in a rack layout along with the ZURO analog chart display unit (in the left rack) at the 1.4(c)

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has it that the "P" designated units had been designed by <sup>PL</sup> [REDACTED] and the 136 designated was developed within the C136 organization.)

(S) Telemetry processing formats were initially set by the Ad Hoc Telemetry Engineering Committee (AHTEC) and later by the Astronautics and Missile Signals Engineering Group (AMSEG), both related to the Telemetry and Beacon Analysis Committee (TEBAC) chaired by NSA. Distribution of "analogs" and digital tape copies to U.S. and U.K. analysis organizations is established by TEBAC.

#### **(U) Significant Collection and Analysis Results**

(S) During early operations the STONEHOUSE system collected signals from and tracked several Soviet lunar and Mars probes, and intercepted for the first time special signals from the Soviet Molniya-1 communications satellite. STONEHOUSE was also tasked to look for "moon bounce" reflections of the Sary Shagan <sup>1.4(c)</sup> [REDACTED]. The intelligence results of the STONEHOUSE (and other collectors) efforts against the Soviet Lunar probe Luna 9 in early 1966 were included in an article written by James D. Burke (a JPL scientist under contract to NSA and CIA for many years as an expert on planetary explorations) and published in CIA's *Studies in Intelligence*.

(S) <sup>1.4(c)</sup> [REDACTED]

<sup>1.4(c)</sup> [REDACTED] ANDERS was credited with being the first site to intercept a special signal from <sup>1.4(c)</sup> [REDACTED]

ocean-area" firing. <sup>PL</sup> [REDACTED] <sup>86-36/50</sup> also confirmed data from Cosmos 192 and obtained additional intercepts of these data.<sup>12</sup>

(S) A 1969 quarterly (April - June 1969) evaluation of JAEGER noted that 311 wideband telemetry tapes were sent from the site to NSA. These data included limited reentry telemetry from <sup>1.4(c)</sup> [REDACTED] ICBMs launched from TTMTR, and zero-orbit telemetry from four ESVs launched from TTMTR and six from PMSC.<sup>13</sup>

(S) By now telemetry and beaconry signal collection was showing significant progress compared to the late 1950s. Almost 20,000 "wide band" (1 MHz at 120 IPS) fourteen-track MINCOM CM-100 tapes were sent to NSA for analysis, and this was only 60 percent of what had been initially intercepted by all of the assets. Eventually 75 percent, or about 15,000, of the tapes were processed and "analogs" distributed for telemetry/beaconry analysis, much of which was done under contract to companies with expertise in missile or space telemetry, often with experience from U.S. telemetry and U.S. missile and space systems.<sup>14</sup>

(S) <sup>1.4(c)</sup> [REDACTED]

(C) By the late 1960s, a significant effort was being made to automate storage and use of the data needed for record keeping and collection management, collection results, and DEFSMAC or NSA reporting of collection results, particularly missile trajectory data. Table 3-3 summarizes some of these computer applications.

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Table 3: DEFSMAC Computer Processing Support

Approx. Date	Project Name	Computer Name	Program Functions
1963	PL 86-36/50 USC 3605	UNIVAC 490/494	PL 86-36/50 USC 3605
1965		IBM 360	
1966		NSA-built	
1966		IBM 7094	
1967		CDC 6400/6600	
1967		???	
1968		APD-30	
1968		IBM 360	
1969		UNIVAC 490/494	
1969		UNIVAC490/494	

*(U) Summary*

(S) The late 1960s were characterized by completion and initial operations of all of the approved major ground-based SPACOL systems, namely, 1.4(c) STONEHOUSE, BANKHEAD III (HIPPODROME), ANDERS, and PL 86-36/50 USC 3605 by NSA and USASA. Also it was characterized by the expansion and operations of the TACKSMAN I and TACKSMAN II facilities by CIA and the full operational status of Defense/SMAC. The late 1960s were also marked by the addition of several airborne platforms and several ships. Table 3-4 provides highlights of significant events in the 1960s.

*(U) Lessons Learned in the Late 1960s*

(U//FOUO) Lesson 1: The Service Cryptologic Agencies were overly optimistic that the military departments could provide adequate "logistic support" to "few-of-a-kind" complex electronic systems like the BANKHEAD systems and STONEHOUSE. This became even more apparent when the systems had to be modified almost continuously to meet evolving TELINT requirements, usually with state-

of-the-art equipment. NSA and ASA had to adjust engineering and logistic support plans to involve the primary system contractor and subcontractors more closely as well as provide added logistic support from NSA resources. NSA had proposed this approach as part of the original SPACOL system planning, and the locations that readily adopted it had the fewest problems with the engineering aspects of system operation. Having adequate on-site, or on-call, engineering support from civilian and industry "experts" was a prime factor in successful telemetry analysis at field sites.

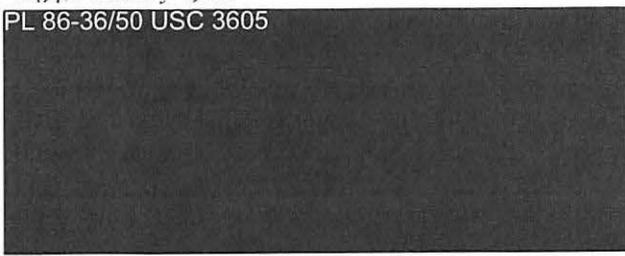
(U//FOUO) Lesson 2: Once a plan is in existence, keep it updated. The rapid expansion of Soviet space activities in the late 1960s, the approval of the initial SPACOL network, and the formation and operation of DEFSMAC all called for a review of telemetry collection and data processing planning. This was accomplished in 1965, based on United States Intelligence Board requirements and the NSA Guided Missile and Astronautics Intelligence Committee Requirements Working Group. This plan then served as the basis for planning for the late 1960s by NSA and other organizations.

Table 3.4 Significant SIGINT Events for the Late 1960s

Year	Significant Event
1965	1.4(c) [REDACTED] STONEHOUSE (Asmara, Ethiopia) began operations. All airborne collection from Pakistan ceased. First digitizing of telemetry began at NSA [REDACTED] PL 86-36/50 USC 3605
1966	BANKHEAD III (Sinop, Turkey) began operations. 1.4(c) [REDACTED]
1967	ANDERS (Shemya, Alaska) began operations. PL [REDACTED] Chitose, Japan) began operations. 1.4(c) [REDACTED]
1968	SPACOL Plan (Phase I) considered complete. First telemetry collected from Sary Shagan Missile Test Range.
1969	BANKHEAD I (Peshawar, Pakistan) closed. COBRA BALL I started operations at Shemya, Alaska.

Notes

- 1 (U) H. D. Wagoner, *Space Surveillance SIGINT Program*, [REDACTED]
- 2 (U) [REDACTED] A41-SMAC Division." PL 86-36/50
- 3 (U) Ibid.
- 4 (U) Vincent A. Las Casas, *NSA's Involvement in U.S. Foreign SIGINT Relationships through 1993* (Center for Cryptologic History, Series VI, Vol. 4, CCH-E32-95-01, 1995).
- 5 (U) Johnson, *American Cryptology during the Cold War*, 387.
- 6 (U) Craig G. Roberts, "Broad-band Two-Channel Monopulse Tracking System," Sylvania Electronic Defense Laboratories, Technical Report ECOM-0181-E134, February 1968.



- 8 (U) Ko6/K3, "project [REDACTED] (U) Operations Plan for [REDACTED] (U)," May 1968. PL 86-36/50 USC 3605
- 9 (U) "COBRA BALL and COBRA EYE - Alaskan Observers," n.d., probably about 1990.
- 10 (U) [REDACTED] "Computer Processing of Soviet Telemetry," *NSA Technical Journal*, Vol. XIII, no. 3, Summer 1968. PL 86-36/50 USC 3605
- 11 (U) James D. Burke, "Seven Years to Luna 9," *Studies in Intelligence*, Vol. 10, no., Summer 1966. A declassified version is available at NARA, RG 363, Entry 27. Interview: James Donnelly.
- 12 (U) Wagoner, *Space Surveillance SIGINT Program*.
- 13 (U) "K47 Evaluation Report No. 020-69 for US-46s [REDACTED]" 3 October 1969. PL [REDACTED]
- 14 (U) [REDACTED] "A Review of Telemetry Processing and Analysis," 26. Boucher, "Talomatry and How it Grew."

