

The **STONEHOUSE** Story

-Telemetry Collection from Soviet Space Probes - - From Beginning (1957) to End (1975) -

- Prepared By -

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- NSA Transition from USASA Team Manager (1970 - 1973)
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(Included 18 months on-site and multiple trips to the site)
- Key Planning Team member of the NSA conversion (1970-1973)
- Deputy Station Chief and Operations Chief (1973 - 1975)

James Wine – NSA Project Manager (1963-1964)
- On Site NSA Technical Manager (1965-1966)

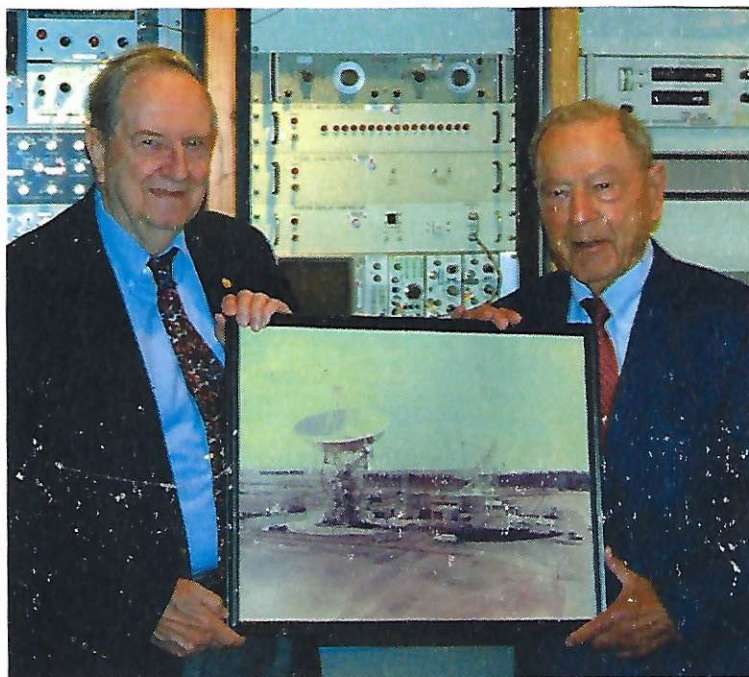


Photo by John Garcia

*Richard Bernard donating a large photo of **STONEHOUSE** to the National Cryptologic Museum Foundation President, Eugene Becker, in 2010*

*This document has been reviewed and approved as **UNCLASSIFIED** and
for Public Release under NSA PP-16-0399 on July 19, 2016*

Preface

All material in this version of this document has been derived from CIA, NSA, or USASA unclassified, FOIA reviewed and released documents, commercially published material that is unclassified, or from unclassified recollections of the authors.

The completed document has been processed through the NSA pre-publication process so that it may be released in public forums.

A subsequent classified version of this document is planned to be completed and may be published in the NSA Cryptologic Quarterly.

Acknowledgements

This document would not have been possible without the assistance of Don Dement, Lew Walls and Jim Wine. Walls, Dement and Wine were very key participants during the planning, contract, installation, and the beginning of operations.

Jim Boone also assisted in the preparation. Jim was closely associated with the start of the project from 1963-1966, and was the R&D representative at NSA Europe during that period and supported the installation and initial operations.

Many other individuals who it was not possible, or feasible, to contact are mentioned in the text.

Special tribute goes to the final NSA and Harris contractor personnel who departed Asmara for Addis Abba on the State Department plane in March 1975. They were the final STONEHOUSE group to evacuate Asmara. Most remained in Addis Abba through April assisting in transportation arrangements for the equipment return to the U.S., along with Harry Barbee, the Harris facilitator stationed in Addis Ababa.

Dave Williams	NSA Facility Chief – (Deceased)
Lew Walls	NSA Deputy Facility Chief and Operations Chief
Carol Walls	NSA Facility Administrator
George Hajduk	NSA Senior Engineer (Deceased)
Larry Hall	NSA Signals Analyst (Deceased)
Bob Buckman	NSA Signals Analyst (Deceased)
Brenda Bland	Harris Administrative Officer
Harry Barbee	Harris Facilitator

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Introduction

The Space Surveillance SIGINT (SSS) Program, planning started in the early 1960s, as Soviet projects to launch earth satellites and space probes began. The Soviets has already launched three space probes to the moon in 1959 that included a lunar impact (LUNIK II) and a circumlunar orbit (LUNIK III)

The initial SSS program included planning a series of missile and space telemetry collection facilities around the periphery of the Soviet Union, and initially propose three locations to collect telemetry from Soviet space probes. The approved program was budgeted at \$40 million over three fiscal years in the mid-1960s.

In addition to telemetry data collection, the overall U.S. effort to gather information about Soviet Space activities included active surveillance (radar systems). At that time the Army (Doplock), Navy (Spasur) and Air Forec (Spacetrack) had operational radar systems. There were also to be other additional technical means used to collect and assemble data.

Many of the early efforts were performed in response to a 1960s Memorandum of Agreement between NASA and DoD. This unclassified agreement between NASA and DoD covers a broad and general agreement that particularly provides satellite imagery from DoD to NASA. The agreement was not highlighted at that time but covered, at classified levels, cooperation between NASA, (and their JPL contractor) and DoD elements.

Program Background (1957-1961)

An initial description of the scope of the program was completed by the USAF AFCIN-Z organization in the fall of 1957. AFCIN-Z was the DoD focal point for electronic intelligence (ELINT) that included telemetry intelligence (TELINT) then.

In January of 1958 the DoD Director of Guided Missiles requested the Secretary of the Navy to establish a working group to assess the overall problem and the Director of Advanced Research Projects Agency (ARPA) requested the effort be expanded. The 1959 NSCID No 6 brought the National Security Agency (NSA) into the act since it assigned U.S. ELINT responsibilities to NSA. (Ref 1 pp 3-4)

In early 1960 NSA secured two satellite tracking stations that became available from ARPA and began modifying them to collect Soviet earth satellite telemetry. On 13 January 1961 DoD and NASA completed an agreement where NORAD was given responsibility for military space detection and tracking and (in somewhat vague language) stated the DoD program would provide for augmentation of space vehicle intelligence including electronic surveillance and examination of foreign space vehicles. (Ref 1 pp 5-7)

The SSS and STONEHOUSE Planning (1961-1964)

In March 1961 NSA formed the Space Surveillance SIGINT Planning Board (SSSPB) with representation from the operations organization, engineering organization, and research and development (R/D) organization. The Board was to complete an initial plan by May 1961 and a final plan by June 1961. Approval of the full final plan called for a budget of \$110 million over 3 years, including Military Construction costs. This plan called for three STONEHOUSE facilities, each at separate locations around the earth.

When the full plan was presented to Dr. Eugene Fubini, the DDR&E (then the focal point at the DoD level for budget and planning, as well as other reviews) an extensive and detailed review ensued. Three different plans emerged. The plan that was approved was budgeted at \$20.6

million for Fiscal Year 1963, distributed in the NSA, Army and Air Force budgets for RDT&E, Procurement, and Military Construction. It was assumed that the overall cost of the system development, construction, and installation would be about \$40 million and only one STONEHOUSE.

NSA established a new Office level organization within the R/D organization called the "Office of SPACOL Management" (SPACOL was a acronym that expands to "space collection") and the Office had the designator R6. The Office included staff from several NSA elements. (Ref 1 pp12-13)

The final Technical Development Plan (TDP) for the program began preparation in late 1961. The TDP and the overall SSS program was reviewed by Dr. Fubini and his staff on a quarterly basis. The TDP was completed by September 1962 and the program total of \$43,559,400 was budgeted in the DoD budget. Approximately \$9,940,000 of the \$43 million was budgeted for STONEHOUSE planning, development, construction, and installation at the US Army Kagnew Station near Asmara, Eithopia (Ref 1)

The contract for STONEHOUSE was awarded to Radiation Inc (commonly called "Radinc") of Melbourne, Florida, on 1 August 1963. This included the 85ft diameter dish antenna and the 150ft antenna, initially called BAYHOUSE.

The estimated cost of shipping the overall system to Kagnew Station was \$787,500. This included a ship charter, a cartage contract to supplement the motor pool at Kagnew Station, a haulage cost to transport the dissembled antennas within the U.S., and the shipment of special vehicles to Massawa and at Asmara. (Ref 1, p 21)

In April 1964 a major review of the SSS program was presented to DDR&E that covered the first 18 months of the program, which had been designated as "Phase I". The Phase I review also included an update to the TDP and recommended budget reallocations were: Phase I was funded with FY63-64 funds in the amount of \$7,091,000. (\$431,000 in Military Construction, \$3,389,000 in Procurement, and \$1,731,000 in RDT&E funds). The personnel "billets" authorized for Phase I were 24 USASA, 5 contractor, and 2 NSA. (An unrealistically low number in this writer's judgment.)

Developing the Facility and the Equipment System (1963-1964)

Developing a system with both an 85-foot dish antenna (with an x-y mount) shown of the right, and a 150-foot dish antenna (with an az-el mount) shown of the left, along with all of the attendant electronic equipment was a complex endeavor. The system, as it was being installed at Kagnew Station in late 1964 and early 1965, is shown on the next page.

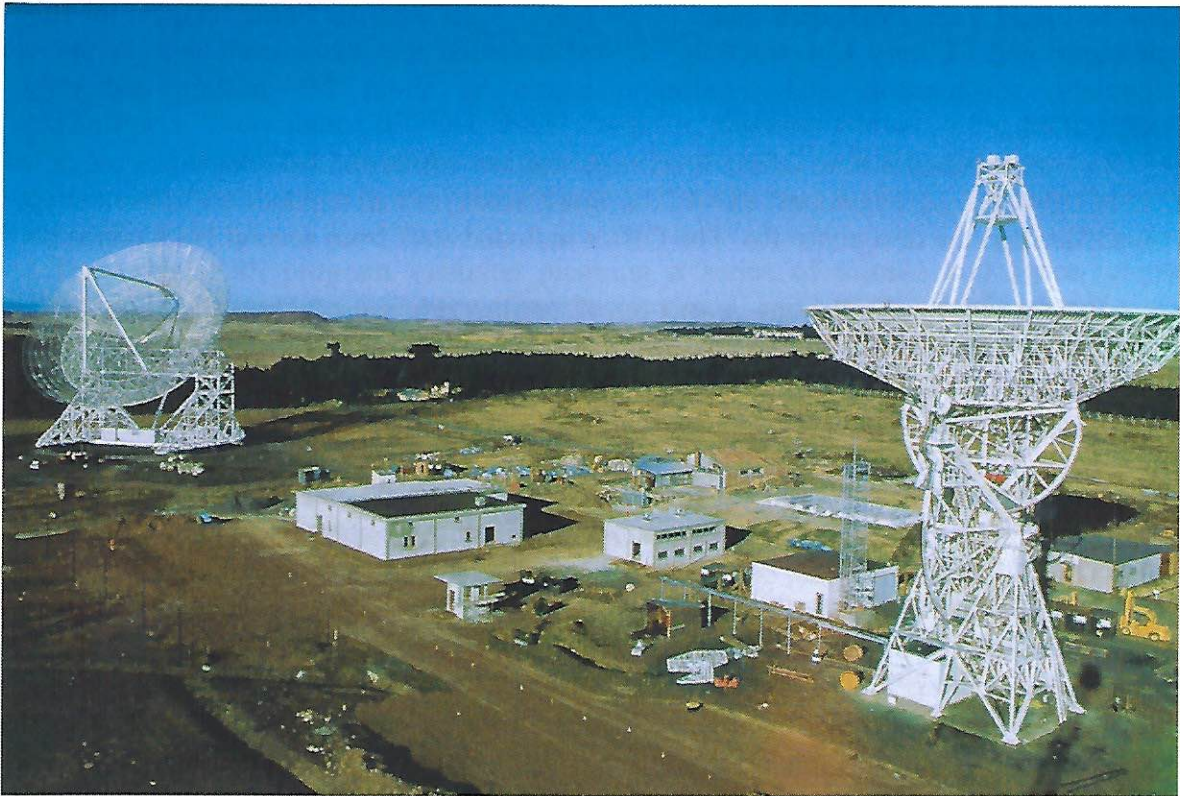


Photo by Donald Dement

STONEHOUSE Facility during 1964-1965 Installation

The STONEHOUSE system was designated in the military equipment system register as the AN/FRR-65(V), primarily to use the military supply system to obtain spare parts, since the system was to be operated and maintained by the U.S. Army Security Agency (USASA)

The initial NSA Project Manager in R6 starting in 1962 was Alden Weeks, followed shortly by James Wine, and then by Donald Dement in late 1964 thru 1965. Both Jim and Don were COTRs at different times. Jim was also the "Chief Engineer" at the operating site from 1965-1966, with Lewis Walls as his lead assistant.

Don remembers:

"I started as the integration engineer for the low-noise front end of the 85ft system signal chain. When close to completion at NSA (and 13 instruction manuals were in editing) I inherited the Program Manager job as well. On TDY in Asmara for installation in Nov 1964-Jan 1965 meant being assigned as COTR over the "holidays" at the site - one day off in 3+ months. Radinc engineers and families celebrated together. Working off dozens of incomplete items while starting up missions, plus integrating unexpected new equipment made it busy but interesting."

The block diagram showing types of equipment in the system is shown below.

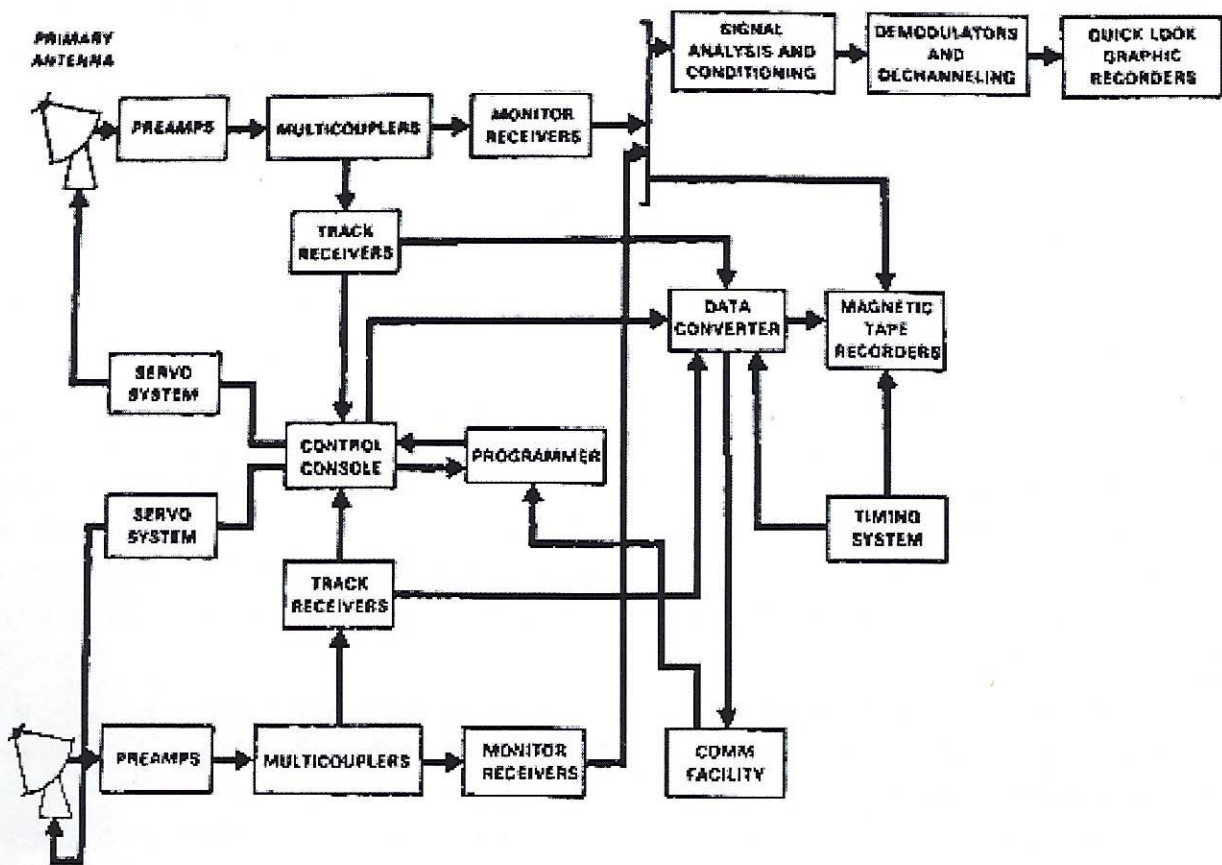


Photo by Richard Bernard

STONEHOUSE Overall System Block Diagram

Staging and testing a large set of complex electronic equipment, without the benefit of staging the 85ft and 150ft antennas in the U.S. was part of the approved package. These antennas did not have to be assembled in the United States and tested since the both had been designed and fabricated and tested for other applications under Radiation, Inc (commonly referred to as "Radinc.") contracts and subcontracts.

One of the most unique and difficult engineering problems was the antenna feeds and preamplifiers for 85ft STONEHOUSE. Available "maser" preamplifiers could only provide radio coverage from 2 GHz to 3 GHz. Additional frequency coverage was required and R&D developments were pursued at NSA and other organizations.

Lew Walls recalls that a control system for one TWT amplifier was fabricated at the NSA Headquarters R&D organization. It was reconfigured to operate with the existing system Don Dement had designed, with the exception of addition parametric amplifiers configured to be compatible there were no changes made to this second system.

Don noted:

“Integration of complex equipment between two designer sources was tricky. Government-Furnished Equipment (“GFE”) consisted principally of low-noise preamplifiers and supporting test equipment that were installed in a building at the foot of the 85ft antenna. During design at NSA, Radinc took few chances that Government equipment in the signal chain wouldn’t easily integrate onsite, contributing both ends of connector pairs. Early in design, a lead engineer (Bill Quinlivan) sat a multi conductor connector on my desk saying that if we each used one side of that very connector, it should all hook up OK in Ethiopia. It did.

For cost efficiency, GFE also included several large precision tape recorders. Radinc was wary of our probable delays in delivery, but when special NSA efforts made to deliver them early succeeded they complained, saying now they’d have to charge rent. (They didn’t).”

To suit the unforeseeable missions, the antenna systems were special mechanically and electronically to continuously track overhead satellite passes, the 85 was built with an “X-Y,” rather than the traditional “Az-El,” mount. This heavier design together with the needed slow and precise tracking motion led to using hydraulic motors driven by large electric motors. This tested the capacity of the local power supplier. Getting missions started before the site was complete required borrowing a large US Navy van with three big generators to temporarily handle the loads.

The whole system was designed for versatility because of the uncertainty of each mission. When traditionally configured, radio energy at the 85 was reflected from the main dish back toward the focus where a variety of feeds and preamps could be mounted. The heavier maser was mounted inside a cone at the center of the dish. To use the maser, the system was reconfigured with a second “Cassegrain” reflector at the focus. For sometimes unforeseeable deep-space missions, this reconfiguration needed oversight by technically-qualified persons from various sources.

The unusual design of the antennas made installation and operation physically demanding. The “front-end” RF subsystem integrated the antenna feeds and preamps with down-converters and cables to the ops building. This equipment was mounted inside a wide but low-ceilinged room on the back of the antenna. Access to some RF equipment meant maneuvering a cherry picker between the beams of the antenna, then a climb and a crawl inside, finally to sit on the floor or inside the maser cone to do the work.”

Jim noted:

“Another challenge was to decide what frequency range to use for the 150ft antenna. Initially it was not known what some of the primary target frequency(s) might be used for expected targets, but it was thought that foreign targets frequencies might NOT be the same as U.S. practices and thus might not have been developed by U.S. industry.

The basic 150ft dish design had been used for the Stanford Research Institute (SRI) facility and a similar 142ft dish the U.S. Navy NRL research facility at Chesapeake Bay, Maryland. NSA engineers and Radinc knew that Rohr Corporation in San Diego CA, had developed both the antennas and Rohr was chosen to fabricate the STONEHOUSE 150ft antenna”.

The hydraulic drives for both previous two facilities were actually U.S. Navy drives for 5 inch naval gun mounts. Additional units were no longer available “free” from Navy surplus for the STONEHOUSE antenna. Fortunately Radinc engineers developed a solution to one of the key problems that was known to exist with the Navy design and this was later installed on the SRI dish.

Parabolic dish antennas require an external “boresight” tower that meets certain engineering criteria. For the STONEHOUSE 150ft antenna the tower needed to be a considerable distance from the antenna and 400 feet high. This was a physical challenge to both construct and the install the radio transmitter, and later service it and the aircraft safety lights, at the top of the tower.”

The operating console for the 150ft antenna control and pre-amplifier “Technical Operations System” was installed in a small building at the base of the 150ft antenna for “local” antenna control appears below. (Later, during installation of the 85ft computer control computer software was added to be able to control the 150ft antenna “remotely” from the main operation’s building.)

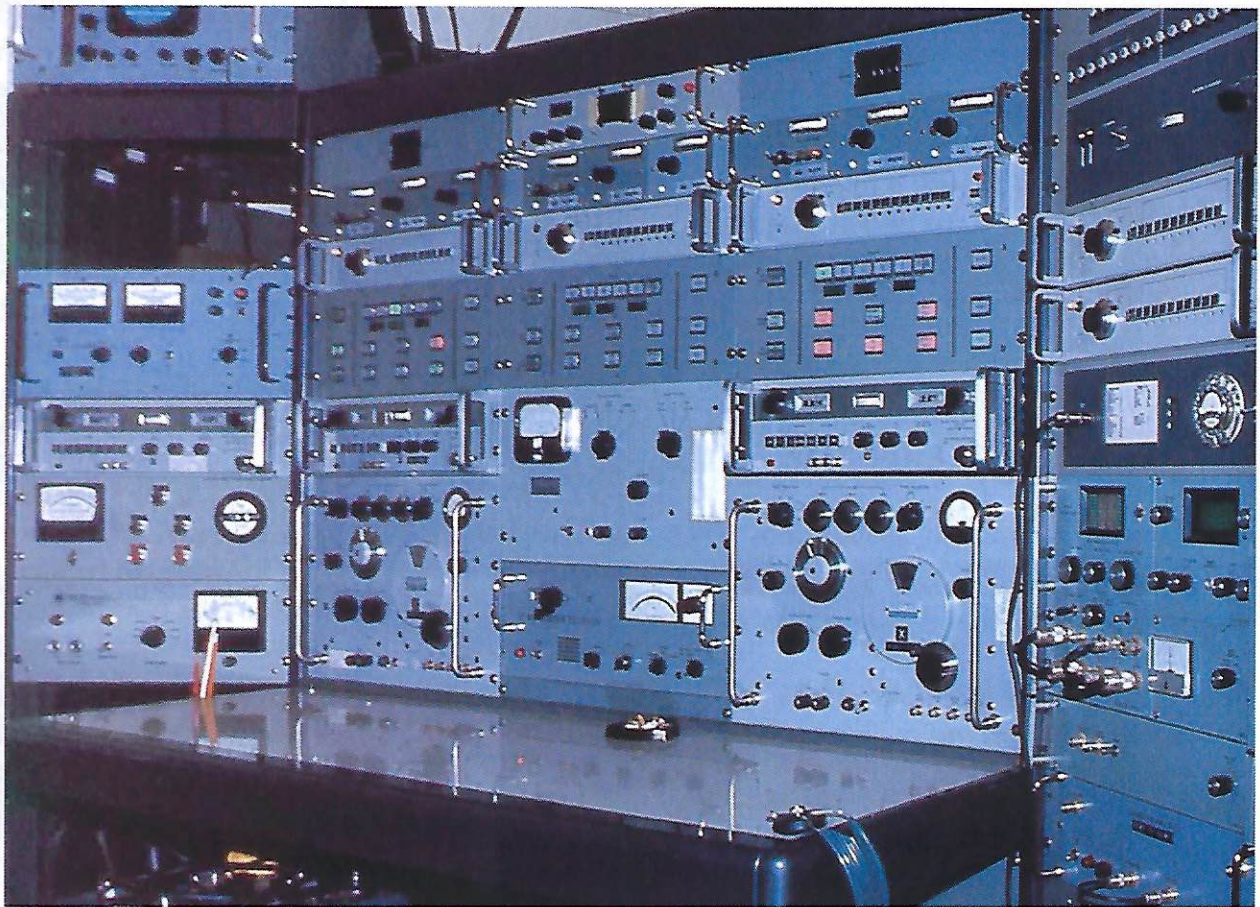


Photo by Donald Dement

STONEHOUSE 150ft Antenna Technical Operations Console

Computer software development to meet antenna control, target following, and other mission requirements for this large two antenna system was a complex and challenging task. The software programming, led by Jim Wine, continued long in to the installation phase at the

installation site. The computer was the primary antenna control for the 85ft as-el antenna. It was probably a Scientific Data Systems SDS-910 model and only had a 5-level punched paper tape input/output unit for the tracking data, and an IBM typewriter. The only software programs provided by SDS were limited to a Fortran compiler and a set of utilities.

Jim remembers:

“These limitations were the source my frustrations in attempting to do anything other than drive the antennas. For instance, located at 15.x degrees north the x-y mount will sort of track the stars, with only y movement, but not for long. A sidereal drive program would have been nice. Or better yet, a moon tracker software program would have been nice and even operationally useful. We never were able to develop to either one, but did get some additional computation utilities.

When you think about the programming process in the mid-1980s time frame: (1) figure out the math, (2) write a Fortran program to do it, (3) load a utility to punch tape from the typewriter, (4) punch the tape, (5) load Fortran compiler, (6) load and run data tape, (7) then see what results. If there are any errors in compiling step you then start over. Once the program successfully compiles: (1) load the assembler, (2) then run the output tape as data to produce a self-loading program. Finally see if it performs the intended functions. A very frustrating sequence of actions even when it works right the first time.

So far as I know STONEHOUSE was the first time that a general purpose computer was used for antenna control. Both bidders had originally proposed to build special hard wired controllers, so just having a flexible software controlled computer was a great asset. Jim Wine also remembered that his only way to seek technical support and advice from NSA was a send-receive teletype secure circuit operating at 80 words a minute. Not a useful method of having a software discussion. !!”

Dick comments:

“While Jim may be right, one of my projects that started in 1963 on a related type of system built in the same time frame also used an SDS-910 to perform similar functions. In addition it included some aspects of controlling the “auto-tracking” of the antenna based on the strength of the primary signal being collected.

A few years later magnetic tape drives were added to the SDS-910 for additional computer programs, data input and output data manipulation, and data storage.

Later the size of the initial internal memory of the SDS-910 was doubled. A contractor computer engineer and I spent many “night shifts”, when system operations use was a minimum, and it was very quiet working, to connect the MANY MANY core memory wires from the second memory plane in parallel with the initial memory plane. A very precise, frustrating, job that required that required exacting wiring connection accuracy.

In the 1966 time frame other similar systems were built using SDS-920 main frames. . In that time frame SDS was the premiere computer manufacturer producing “real time” antenna and other equipment computer control and Fortran was still the computer language of choice”.

STONEHOUSE System Installation and Testing (1964 – 1966)

A Department of Defense news release in January, 1964 unveiled plans for a new deep-space research site—Department of Defense News Release – follows:

“Experimentation in the peaceful uses of space will receive added impetus in Africa with the installation, at Kagnew Station, of additional equipment for space communications research and for future study of radio receiving and transmitting techniques. The new equipment, now ready for installation, will consist of two rotatable parabolic antennas, one 85 feet in diameter and the other 150 feet in diameter. These modern antennae are designed to further the study of long-range communications and to facilitate the study of the effects of the ionosphere on communications. The selection of Asmara for this important new space research activity resulted from extensive surveys to find an area combining relatively quiet electronic environment, and suitable topographic features and climate characteristics, near the equatorial belt. Kagnew Station is a particularly appropriate site to receive the new antennas in light of the stations past contributory research into natural electronic phenomena. The new equipment will expand Kagnew's communications research capability and will permit scientific measurement of unusual transmission characteristics in outer space communications research. United States interest in this research activity is based on the desire to improve long-range communications world-wide. The new installation will make an important contribution to man's expanding knowledge of the mysteries of outer space. Materials for the new antennas will begin to arrive at the seaport of Massawa in early May. From there, they will be truck-hauled to Asmara. The installation is expected to be completed in 1965 and during phases of its construction should employ many Ethiopian workers. Arrangements will be made for groups of visitors to tour the new facility during its construction in accordance with past practice at other parts of Kagnew Station.”

Jim Wine remembers that when he and 1-2 others made the initial site selection trip to Asmara the US Army Corps of Engineers office in Livorno, Italy, (who managed all African projects) said the only assistance they could provide to the STONEHOUSE project was to wish the team “Good Luck” with the effort. (Ref JW)

The installation of STONEHOUSE, on a 7,000 foot plateau in Asmara, Ethiopia, that included assembly of very large antenna structures included some unique problems. The Red Sea small seaport of Massawa has very limited facilities. The road from the port up to the Asmara plateau had almost continuous 180 degree switchback turns as the road moved up the mountain to the Asmara plateau. A railroad also went from Asmara down to Massawa, and is shown on the upper photograph on the next page.

The antennas were trucked from Massawa to Asmara in large parts. The truckers encountered one bridge that was too low for the parts to pass through and a road was constructed through the dry river bed next to the bridge as shown in the lower photo n the next page



Photo from Internet

Eritrean Road and Rail Line from Asmara to Massawa

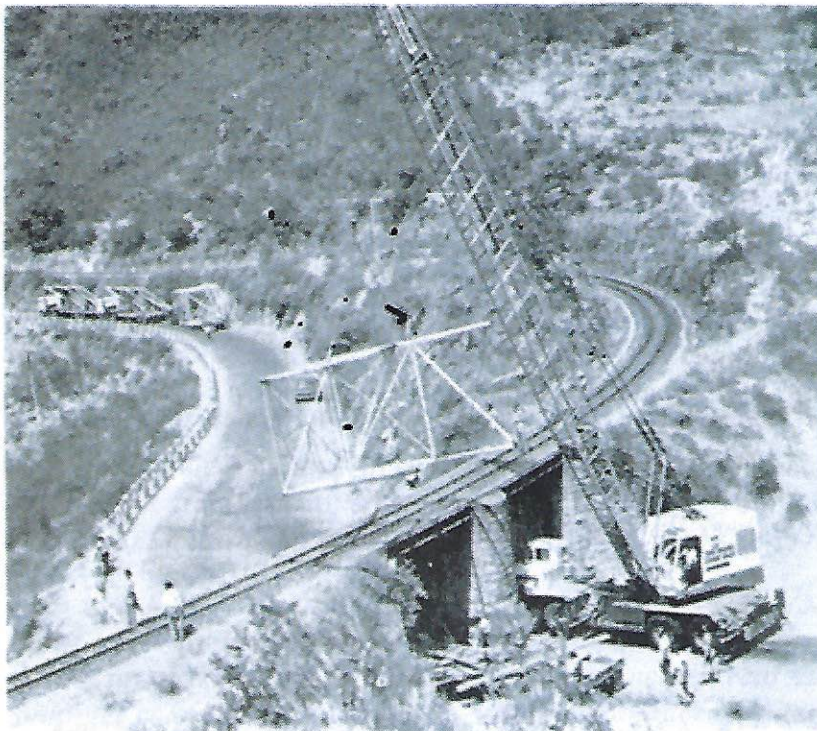


Photo from Internet

Crane Lifting Antenna Segment over the Massawa to Asmara Rail Line

Don remembers:

“Using a helicopter to fly between Kagnew Station and Massaws could be “interesting”. On Asmara’s plateau, morning temperatures could be a dry 55F, while down in Massawa it was common to be a humid 105F and higher. A helicopter ride from one to the other required the pilot to find a hole in the cloud blanket that formed below the plateau. I remember once dropping down through a hole in the clouds when the pilot suddenly turned the plane on its side (with the cargo door left on the ground, but with the passengers strapped in (thank goodness) and spiraled down toward the mud huts below that was an exciting, if scary moment. Cold lenses fogged up making cameras that some of the passengers brought along worthless until they heated up. The Red Sea area had its red-hot temperatures, but the ride back up to Kagnew watching the pink sunset clouds through the open door made up for it.

Onsite, the 400ft-tall “boresight” tower climbers bonded into a special group. For calibrating the RF boresight of the antennas, Radinc built two towers in the adjacent field that could transmit signals toward the antennas. To avoid ground reflections they were tall: 200ft and 400ft. Equipment had to be installed and checked out at the top, so climbing and carrying material up the towers was a necessity. This spawned a group of those who made it to the top of the 400ft tower and they called themselves the “400 Club.”

Jim’s comments:

“One antenna problem was that three or four times a year liquid nitrogen was needed for the maser pre-amps and the filled steel flasks had to be shipped in from Frankfurt. It took several revisions of the transportation plan for the shipments to arrive at the site with the liquid nitrogen still in liquid form, and useable!!! Jim Boone helped resolve that problem.”

Another antenna installation problem was that in preparing the 135ft circular diameter foundation for the 150ft antenna required 154 cubic yards of concrete were needed, when standard concrete mixers at the time in Ethiopia had only ½ cubic yard capacity for each mix. The solution was to use MANY local inexpensive Ethiopian laborers and lots of concrete mixes.”

After on-site testing in 1964 and early 1965, by the government and the Radiation, Inc. contractor to ensure that the system met the specification of the contract, the system was accepted from Radiation Inc. on 17 May 1965. At this juncture a total of 51 USASA, Contractor, and NSA personnel were actively testing and performing operation missions of opportunity with the STONEHOUSE equipment, with USASA managing the facility and training for system full operation. Eight of the 51 personnel were civilians. There were five Radiation, Inc contractor technical personnel under contract to USASA performing maintenance services.

There were many management and technical problems that remained before the facility could properly perform its operational mission, however, Category III operational testing began immediately but was often interrupted by “mission” activities, including training of the operational personnel and timely supply of spare parts to repair critical and unique technical equipment. Completion of “operational” testing was delayed by priority mission tasking through the remainder of 1965 and the first half of 1966. This continued with little improvement and for all practical purposes formal engineering testing was abandoned in 1968.

Jim Wine was the senior NSA engineer assigned to STONEHOUSE during the latter part of installation and served as the senior engineering manager from 1965 to 1966. He had previously been the NSA Project Manager during to formative staged of the system development and had an extensive engineering background at NSA. Lew Walls was a key engineering team participant.

Lew recalls:

“There were times when I was the only NSA Rep on site, and during the accepting testing phase of the contract Radinc engineers would described to me what the results of the acceptance tests should be and when they were OK I signed for those items. I was concerned that I did not have enough experience at the time to do other than accept their word for the results. As I gained more experience I learned that they had been totally honest with me. This was especially true when I accepted the servo system for 150ft antenna. To gain experience and further test the system, during my solo time on site, I spent a number of hours manually tracking a US probe to the moon using the 150ft antenna when the tracking computers were not yet operational.

One day I was looking out of the operations building window and noticing the 85' foot antenna starting to slowly rotate towards the ground, before the stops were installed, and seeing one of the Radinc engineers run at full speed to set the brakes. No harm was done; however sometime after the system went operation the 85-foot antenna did “run away”, strike the pad, and was damaged. (Ref LW)”

Don noted:

“The 85-ft antenna’s upward pointing accuracy was first tested using a box lid and a radio star. Some knowledge of radio astronomy was helpful in testing real-life system sensitivity. With the steering hydraulics not yet ready, one night the RF guys found a way to use a big electric drill coupled to the gear train to move the 85. Sighting across a square box lid aimed across the front of the antenna and 90 deg away toward the “W” constellation, Cassiopeia - the strongest radio noise source - turned out to work well. Don did the sighting and Lew moved the antenna while watching a meter for a rise in noise. We got the theoretical noise increase from Cass A, wrote down the direction where we were pointed and phoned the mechanical engineers who were playing poker that we had done their job. (Later, scientists discovered that Cass A is the black hole at the center of our galaxy.)”

The upper photo on the next page shows the antennas and other facilities that were constructed and had equipment installed during the 1964-1965 time period.

The lower photo shows USASA Kagnev Station with the STONEHOUSE facility and its two large antenna’s in the upper center of the photo.

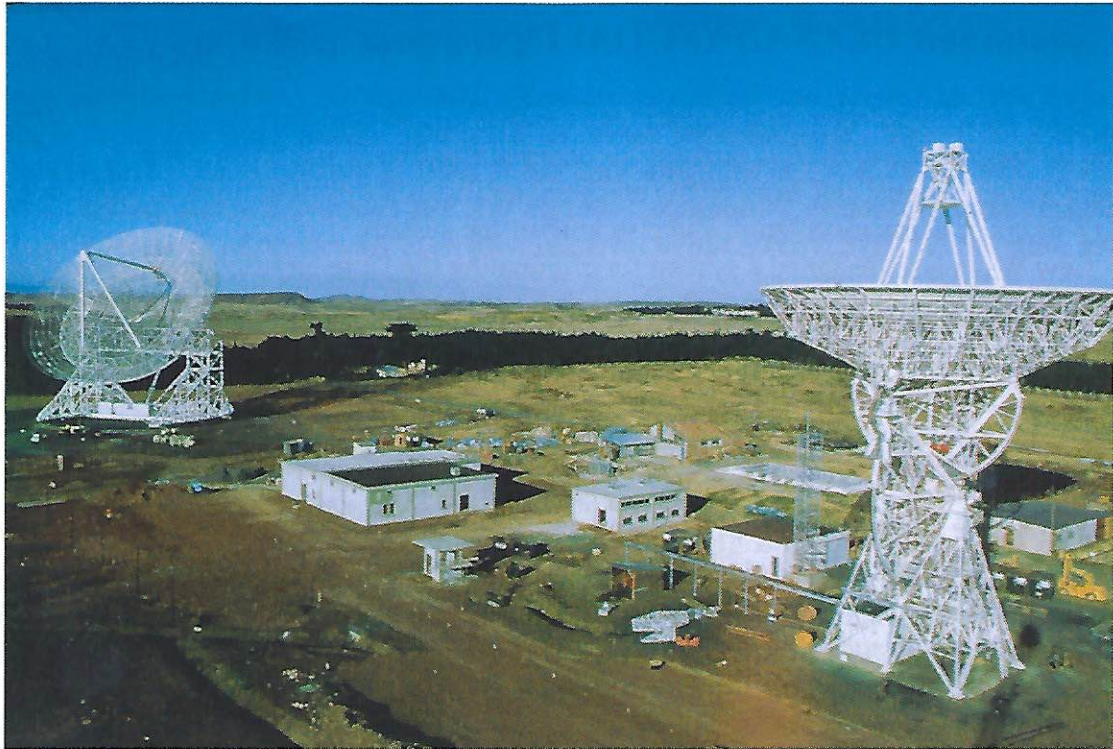


Photo by Donald Dement

STONEHOUSE Facility during 1964-1965 Installation



Photo from Internet

STONEHOUSE Facility at Kagnew Station in Eithopia

Sustained USASA/INSCOM Operations (1966 to 1973)

Soon after installation and operations commenced, several new equipment features were installed at the site. Lew Walls, assisted by computer software specialist John S., and on-site engineer George Hajduk, (all from NSA) designed and built the system. John S. came over to the site TDY to assist in the installation and checkout of the system.

Lew Walls also designed a system for eliminating the Doppler effect to improve the signal to noise ratio in some of the signal analysis equipment, fabricated by Radinc technicians.

During sustained operations starting in 1966 STONEHOUSE was able to intercept Soviet space transmissions on three narrow bands, both uplink and downlink; carrying satellite control, lunar telemetry, and imaging channels.

Don noted:

“Operation of the system by USASA privates required keeping the high technology equipment system as straight forward as possible. Low-noise measurements had to be made frequently to assure that adjustments were proper to optimize operation. The RF tech ops equipment (see previous photo) was designed at NSA with lighted, colored buttons that operated a cable matrix to connect the right test equipment for each mission; and a single meter was mounted at the desk as a monitor of overall RF performance.

Turning more than one knob while reading a meter was deemed impractical for field operations, Maser amplifiers require a high-frequency radio “pump” source to be tuned along with the maser’s own tuning, while observing performance on instruments. The design requirement was to integrate these two actions into one. Off-the-shelf servo systems were modified to simultaneously turn both knobs up in the antenna base, creating the world’s first “one-knob” maser. The contractor for the maser was RCA in Camden NJ (Lou M.) under NSA’s co-designers Bobby W. and Nils M.

Some Army trainees longed to go to work at home rather than learn the technology at the site. Training US Army privates how they must work in a complex technology was frustrating. Using a jeweler’s screwdriver lying on their back while watching a meter powered by a distant receiver was different for them but not interesting. Thinking we might have some young men ready for some engineering after a few months on the job, we asked one what he saw in his future. He replied he wanted to get out of the Army as soon as possible and join his father’s used-car company.

The US-based designers and onsite operators had to learn who was in charge of what mission functions. Working from the site with people in the U.S. with knowledge of a specific mission and how the system was designed to meet unpredictable situations had some bumps in the road. At NSA, an urgent call to engineering one day to come to the NSA communications terminal illustrated the interagency differences. Knowing the mission, some technical setup directions were sent to the site using the slow teletype over the fading HF links. A sharp and unexpected response from the Army operations people onsite was: “tell us what you think is needed for the mission, but not how to do it to us.” Lesson learned” by both groups.”

Throughout the 1966 to 1970 period the U.S. Army Security Agency (USASA), later to be designated U.S. Army Intelligence Command (INSCOM) managed Kagnew Station and operated and maintained (with Radinc contractor assistance) the STONEHOUSE facility. NSA provided technical support for STONEHOUSE as needed.

Dick comments:

“Information related to the STONEHOUSE telemetry data collection starting in 1966 from Soviet deep space activities was mostly classified at some security level. The U.S. Freedom of Information Act originally passed in 1966. It has been amended in 1974, 1976, 1986, 1996, 2002, and 2007. Among other provisions the Act includes mandatory declassification reviews, and thus began a release of previously classified material about STONEHOUSE mission activities in addition to other FOIA provisions.

CIA soon built up a major process of releasing declassified and other FOIA materials to the U.S. Archives, and most of the material has been stored at the Archives facility at College Park Maryland. The project name is CIA Records Search Tool (CREST).

In 1985 an independent non-governmental research institute and library located at The George Washington University. Among other activities, the Institute compiles Briefing Books in electronic format on intelligence topics.

On February 4, 2015, the Archive published Briefing Book No 501, “U.S. Intelligence and the Soviet Space Program,” edited by Jeffrey T. Richelson. This compilation has many CIA and NSA FOIA released documents and other unclassified material related to STONEHOUSE. A listing that includes several of the documents electronically attached to the Briefing Book is listed in the last section of this document, including the URL for many of the documents and interviews.”

NOTE: Various paragraphs in this section of this document, and several other sections in the document, extract information from some of these National Security Archive documents. As requested by the Archive, the copyright release is: “These materials are reproduced from the Archive web site with permission of the National Security Archive.”

Facility and Operations Transition to NSA (1970-1973)

The planning at NSA for the elimination of Kagnew Station as a support base for STONEHOUSE was both extensive and complex. Here was a full operating overseas military base in a remote area location that was being evacuated and decommissioned. It should be noted that there were several other “tenants” at Kagnew, including essential U.S. satellite communications facilities that had to either be relocated or given a way of maintaining their operations.

The Army had started to plan to close down the station by June 1976 when it was clear that the political situation in Eritrea was becoming untenable and that the annual cost of operating Kagnew in the heart of Africa with little local support capabilities had risen to \$12,000,000 a year.

The station had provided full civilian support for almost 6,000 total personnel (in the 1960s) with food, Commissary, APO, PX, water, housing, school (K-8), recreational activities, motor pool, and medical clinic. The essential support for the American enclave on the Asmara plateau included a high performance, high altitude, model to be able to operate down at the Massawa seaport and at the 7,000 foot high Asmara plateau.

A major trip to NSAEUR and Asmara was made by Bernard, Walls, and William Reed in late 1972 to establish, or confirm, the parameters of the transition with Kagnew Station management, and NCEUR regarding any support needed to maintain effective STONEHOUSE operations.

A substantial portion of the transition actions at Kagnew Station where the military were completely evacuating and shutting down all base facilities fell under the purview of the current Station Commander, Lt. Col. Clarence O. Light, USA (now retired). There could not have been a

better Station chief to work with during the transition. He continuously made decisions and took actions that always were to the benefit and assistance of NSA (and with Harris/Radinc contractor) management and operation of STONEHOUSE. (Radiation, Inc. became part of Harris Corporation in 1970)

U.S. activities at Kagnev included a U.S. Navy communications station (NAVCOMSTA), a U.S. Army STRATCOM Defense Communications Activity (DCA), a small Diplomatic Telecommunications Service (DTS) operation and the U.S. Consulate for Asmara. An overall plan had started some planning to completely close Kagnev Station by June 1976 but the emergency closure in early 1975 came as an unpleasant surprise. (Ref 2 p 21)

Following the departure of USASA the NAVTELCOM assumed the responsibilities of the base on 30 June 1973, and renamed the base NAVCOMSTA, Asmara, and assumed the functions of the Army STRATCOM facility. The DTS facility was closed and the function moved elsewhere. The Ethiopian Government used the closed portions of the Station for housing and use by the Ethiopian Navy and the Ethiopian Army's Second Division. (Ref 2, p 20-21)

NSA Management and Operations (1973-1975)

NSA management of the STONEHOUSE facility on Kagnev Station began in 1973 with extensive support by the Radinc portion of the Harris Corporation under contract to NSA. The mission remained the same, and almost all aspects of the support previously performed by Kagnev Station were performed by the NSA/Harris team.

The photograph below shows the informal "logo" that the station personnel developed once NSA took over responsibility for STONEHOUSE. The original logo was designed by the Station Chief, Mr. David Williams, and was produced in Ethiopia on cloth and the emblem in needlepoint. The parabolic representation in blue represents to STONEHOUSE antenna and the small lion as the dish "antenna feed" was used in a traffic circle marker in Addis Abba, and the bottom segment represents an elephant. Some of these cloth/needlepoint logos were framed and are inscribed with a "The Parabolic Lion of Judah" nameplate mounted on the photo frame.



Photo by Richard Bernard

The Parabolic Lion of Judah

The photo below is of a hand carved "Lion of Judah" which was symbolic of Ethiopia, and was one of the titles held by Emperor Haile Selassie. It was a product of the Olive Wood Store in Asmara and was usually inscribed with the year of their visit. It was also used by station personnel as a memento of their assignment to the station.



Photo by Richard Bernard

The STONEHOUSE Lion (Actual size is about 7" inches long by 3" high)

The Emergency Shut Down and the Evacuation (1975)

Political Background and the Conflict Start

Kagnew Station was established in 1953 with 25-year base rights. The Eritrea (tribe) joined Ethiopia (Amharas tribe) in 1962 as a province.

Lew Walls was told by local Asmara friends that the Eritrean parliament had an armed Ethiopian soldier standing behind each parliamentarian who was coerced into voting to federate with Ethiopia. Almost immediately The Ethiopian Liberation Front (ELF) and the Popular Liberation Force (PLF) rebel groups desiring that Eritrea become an independent nation were formed.

The Haile Selassie led Ethiopian government fell to an internal military takeover in September 1974. Civil war broke out in Asmara between the Ethiopian Army and the Eritrean rebels on 31 January 1975. Soon thereafter water and power failures started in Asmara, although the telephone system remained relatively reliable between Asmara and Addis Ababa.

Operations Stopped – Dependent Evacuation Begins

With the onset of the conflict, STONEHOUSE ceased operations but the U.S. State Department did not approve the official closure of the Project at that time. Dependents were sent home as quickly as possible. The remaining NSA and Harris contractor personnel moved into the U.S. Asmara Consulate 3-4 weeks after the war began and after each person's household goods were shipped Addis Ababa. STONEHOUSE personnel had complete freedom to travel within the city from 0600 until 1800hrs until the last day they were in Asmara. However, the Ethiopian Army maintained a very strict curfew after 1800 hrs. Locals who were caught violating the curfew were shot. Lew Walls knew one who was. (Ref 2, page 21, and LW)

Immediate action was taken to evacuate all dependents. Day-to-day operations ceased at STONEHOUSE and destruction of classified equipment and materials commenced, keeping only essential communications security equipment in operation; primarily KW-7 equipment at STONEHOUSE and at the Consulate. The destruction of the communication security equipment required the use of thermite destruction material, and at time the use of sledge hammers to insure there could be no useful recovery of the classified electronics in the equipment. Dismantling of mission electronic equipment and household goods commenced using the minimal on-site packing materials that were available.

On 3 February two Ethiopian Airlines charter flights left Asmara for Addis Ababa with dependents. This was fortunate since all dependents lived in Asmara city and another Ethiopian and rebel firefight broke out on 4 February. The State Department allowed dependents to leave Addis Ababa in small groups on commercial flights back to the U.S. so as not to appear that the U.S. was not completely evacuating Asmara.

In 1974, with foresight and practical management planning, Facility Chief Dave Williams acquired and installed a 7-station VHF transceiver network with The STONEHOUSE operations building as the "Control Station" with other stations at the Consulate and at the homes of three senior managers and the doctor. The stations were portable and to be used only for emergencies, and could quickly be relocated. Toward the end of the drawdown four of the sets were moved to the Consulate and could also be used there as an intercom with the Marine guard force. The Marine Guard chief had telephone communication to other locations, as well as "local" communications networks, and the communications networks available to the Consulate and the U.S. Navy local

communications. This network provided a solid communications capability for all the major organizations still operating at Kagnew Station during the remainder of the drawdown. The STONEHOUSE circuit to NSA Headquarters was also moved to the Consulate (Ref LW)

Mission Equipment Recovery

NSA engineering and operations planning personnel were anxious to recover as much equipment as possible to reconstitute the STONEHOUSE mission at other locations. With the very limited on-site personnel and packing equipment, and the Asmara nighttime curfew that placed a tremendous pressure on the few personnel remaining at the site. In the end, over 800 pieces of equipment that was valued at over \$2.5 million dollars (at original cost), over 4,500 pounds of spare parts valued at \$500,000 and 850 reels of magnetic tape valued at \$100,000 were recovered. As it turned out, the repair and re-calibrations of much of the equipment outweighed its value so all of the equipment was not redeployed to other locations. The cost of the transporting the equipment back to the U.S. was \$183,000 for the special airlifts, and \$245,104 for the 11 MAC "Channel" flights. The total weight included 114,325 pounds of household goods. Only a very few pieces of equipment or personal items did not arrive in the U.S.

Eventually three C5A emergency special airlifts were made from Addis Abba, since NSA crisis team thought that the use of Asmara airport might be too dangerous for the military aircraft. The missions were performed by the USAF Material Airlift Command and the cost charged to NSA for dependents belongings and NSA equipment from STONEHOUSE. Extra packing supplies (e.g. over 100 crates) were shipped to the site on the special C5A missions. By 21 February only eight STONEHOUSE personnel remained at the site; three from NSA and five contractor personnel.

Official Station Closure

Official authorization to close STONEHOUSE permanently and evacuate all personnel was granted on 23 February. By 4 March all but three contractor personnel had left Asmara – a radio operator, a Teletype repairman and the medical doctor at the request of the Consul General (Ref 2 p 22). The official facility closure date is recorded as 4 March 1975. Most of the NSA and Harris (Radinc became part of Harris in 1971) contractor STONEHOUSE personnel, now in Addis Ababa, remained there through April sorting out and preparing material to be shipped back to the U.S. Ethiopian Airlines DC-6 chartered aircraft moved dependents furniture and NSA equipment from Asmara to Addis Ababa, and were also used by the Ethiopian Army to move troops to Asmara. The Harris doctor remained in Asmara through June.

NSA Headquarters Closure Activities and State Department Actions

At NSA, Mr. Dick Findley (the head of the "Field" organization at the time) and I were picked as co-managers of the NSA team. Dick Findley and team (including Dick Wilson) handled State Department Liaison, and Dick Wilson and I spent 24 hours a day for many days leading the NSOC team planning and coordinating with the STONEHOUSE facility; and then later with the Asmara Consulate when communications terminal and remaining STONEHOUSE personnel moved there. Dave Williams (the site chief) and Lew Walls (the Deputy Chief) were the key NSA people at the site.

The State Department Deputy Consul General at Asmara was Mr. Robert Perry. Mr. Perry was a top-notch diplomat as well as a practical manager and had an excellent relationship with the STONEHOUSE managers. He made major contributions to keeping things calm between Americans and Ethiopians. The STONEHOUSE managers have high praise for Mr. Perry's actions and cooperation during the shutdown and evacuation.

After all household goods had been removed from NSA and Harris rental homes/ living quarters (all were outside of Kagnev Station). STONEHOUSE personnel and communications equipment were eventually moved to the Consulate and the remaining people resided there each evening until each morning while the curfew was in effect. Lew Walls recalls that during the day STONEHOUSE personnel had complete access within the city and he does not remember any NSA/Harris personnel being concerned for their safety.

While there was sporadic gunfire and rocket fire at night in the Asmara area no Americans were targeted or injured, including any U.S. military assignees or civilians at Kagnev Station.

Personal Remembrances

Following are recollections of some of the important events during the evacuation by Lewis Walls, in April 2016, over 40 years after the April 1975 events:

Lew recalls:

"In preparing the equipment to be returned to NSA (if it was feasible as the drawdown and evacuation progressed) after a few tries we became quite accomplished in wrapping and foaming the equipment into triple walled boxes. Carol quickly learned to drive the fork lift bringing packing supplies from the warehouse to the Ops building and then loading the packed boxes onto trucks for the trip to the airport. In conducting the destruction of the cryptographic equipment we were surprised at the effort that was required to destroy the equipment with the thermite destruction devices we had been provided"

Most of SH dependents had been taken to Addis on Saturday morning. The rest of us immediately began packing our household goods and equipment from the site. Dual wall cardboard boxes, plastic film and two part foam canisters and mixing equipment were used to pack the site equipment. I don't remember how these items came in either by C-141 aircraft or by Ethiopian airlines. I do know all the equipment and household goods were shipped to Addis in Ethiopian DC-4 or 6's for repackaging into containers by a professional packing company for shipment back to the states. C-141 aircraft were used for the flights out of Addis.

We all remained in our homes until the last few weeks of our stay in Asmara. We had free run of the city during the day but had to be off the street by 1800 hrs. Sometime after I returned to Asmara from Massawa where I was when the shooting started, I got a call around midnight from one of the dependent wife asking me to get her a hospital as she thought she was having a heart attack. I don't remember why she was still in Asmara. I took my night guard and found an Ethiopian soldier who escorted us to her house, on to the hospital and then back home without incident. She was suffering from a bad case of nerves. During our stay at the Consulate random shooting occurred almost every night. We stayed indoors to avoid any rounds that might fall into the compound. As I remember none did."

Note: Carol Walls was the STONEHOUSE Facility Administrator who reported directly to Dave Williams and was responsible for NSA facility administrative matters.

NSA Leadership at the Top During the Closure

Dick remembers:

“Lt. Gen. Lew Allen, USAF was the NSA Director at that time. He made it clear to Dick Findlay and myself that he wanted to be kept up to date on how the phase down of the operations and the facility were progressing, with emphasis on how our NSA/Contractor team was doing. We arranged to have him briefed at the NSA early morning staff meeting each morning if we did not do that ourselves. He made it clear that if our people were injured or in imminent active danger to contact him immediately day or night. It is my opinion that it was clear to me that if any hostile attempts involved our personnel that he would have authorized complete evacuation of our personnel immediately despite what position the State Department might take.”

After all the activities were over, the NSA closure team and the NSA site personnel put together a framed picture of the original cloth station Logo and many of us signed the mat around the logo and presented it to him. When his tour at NSA ended he personally returned it to me. I made sure that it was kept in a four drawer fireproof safe thereafter. When all of those safes (that were then in DEFSMAC) were turned in a couple of years ago I made sure the photo was placed in a separately secure area where it would not be damaged in any terrorist attack at the Agency. (Ref RB)”

The logo appears below, and was described previously in this document:



Photograph provided by Richard Bernard

The Parabolic Lion of Judah Logo

The 40-Year Aftermath (1975-2015)

The 40 some years since the closure and evacuation of STONEHOUSE has brought tremendous changes to the “deep space” programs of the Soviet Union, and now Russia and many countries of the world. The U.S. has a continued interest in the programs of adversarial nations, but the technical challenges have not diminished. Some technical intelligence information gained from events of the 1965 to 1975 are being released but current information is still classified. In 2014 the NSA National Cryptologic Museum (NCM) at Fort G.G. Meade in Maryland updated its “Cold War” display and it now contains examples of foreign telemetry data collection and data processing.

Also, in 2014 STONEHOUSE information was included a part of a current Smithsonian Air and Space Museum exhibit in Washington DC. NSA supported the Air and Space exhibit development with the loan of two equipment racks along with information about telemetry and supported the inclusion of the STONEHOUSE information.

The text for the exhibit is as follows:

“The STONEHOUSE deep-space receiving station at Asmara, Ethiopia, operated from 1965 to 1975. It intercepted signals from Soviet lunar and planetary spacecraft and communications satellites. Other stations around the world continue to perform signals intelligence.”

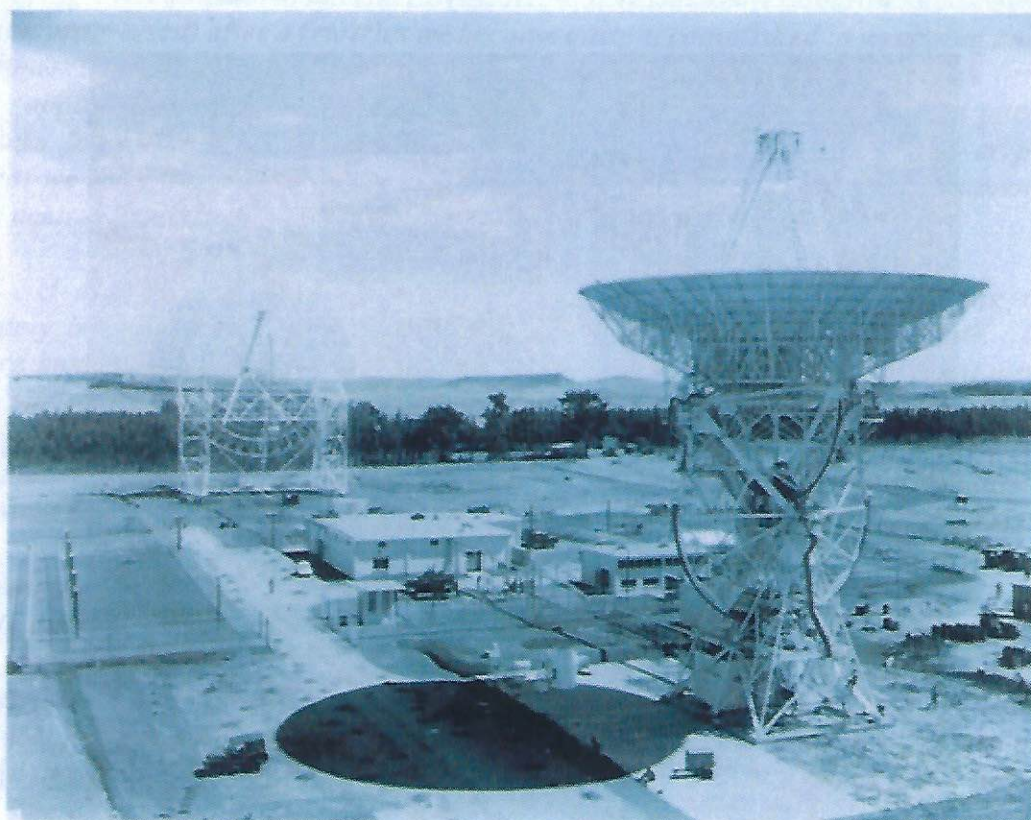


Photo SH400-L51P5 provided by INSCOM

STONEHOUSE Facility at Kagnew Station, Asmara, Ethiopia

References and Related Documents

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Ref 1

Space Surveillance SIGINT Program (Redacted 1980 NSA History Document)
<https://www.nsa.gov/public_info/files/cryptologic_histories/space.pdf>

RB Note: FOIA Redacted document (DOCID 4035972Case 48025 02-28-2013) of NSA/CCH originally SECRET/HVCCO history of SPACE SURVEILLANCE SIGINT PROGRAM by H.D. Wagoner, 1980. Presents program history from 1957 through 1968 including fiscal information. 51 pages, Processed as NSA DOCID FOIA Case #48025 and released on 02-28-2013. Most STONEHOUSE pages are not redacted.

Ref 2

(PDF)[Stonehouse - National Security Agency – Article in NSA Cryptologic Quarterly](https://www.nsa.gov/public_info/files/cryptologic_spectrum/stonehouse.pdf)

https://www.nsa.gov/public_info/files/cryptologic_spectrum/stonehouse.pdf

National Security Agency (Dave Williams Quarterly article)

Kagnew Sration as NAVCOMMSTA Asmara. ... in Asmara numbered about 6,000 persons, including ... deteriorated quickly, and STONEHOUSE did not resume.

RB Note: This article was written in 1975 by the former NSA Station Chief at STONEHOUSE, Mr. David Williams (now deceased). Presents the project and country background and describes the closure of the station in 1975 in some detail. Redacted under FOIA Case #7319 for release on 09-18-2007. (Also available from Ref 3)

Ref 3

[U.S. INTELLIGENCE AND THE SOVIET SPACE PROGRAM](#)

Feb 4, 2015 ... Text references material from a 1986 CIA assessment of Soviet military and space

Declassified Records Trace U.S. Monitoring and Analysis of a Critical Area of Cold Was Competition,

The monograph is titled :National Security Archive Electronic Briefing Book No 22. systems in

broader **SIGINT** effort to support **space surveillance**

is ...nsarchive.gwu.edu/NSAEBB/NSAEBB501/

RB Note: “Book 501” (and also “Book 22”) by Jeffery Richelson in the National Security Archive opens like a normal URL. Many of the sub-items URL’s from that document are listed below. If you open the above URL you can directly access many of the documents, in addition to others, within each Book. Mr Richeleson, now a research person at the National Security Archive has combined many FOIA or other documents to construct very plausible scenarios in the intelligence field. He has also written a history of the NRO a well as a “Book” on DEFSMC in his Archive series. Each of the briefing books has full text footnotes that can be electronically access as well as complete documents used as references that can be viewed using a their included URL.

Ref 4

The US Deep Space Intelligence Collection Program

www.svengrahn.pp.se/trackind/Deepspac/Deepspac.htm

A network of stations was set up, but the main station was placed at **Asmara** ... The **Asmara** station, code-named **STONEHOUSE**, operated from 1965 to 1975 (Sven Grahn Article).

RB Note: In addition to above article Mr. Grahn has a web page "Sven's Space Place" which includes information on mission results, some of which references James Burke's articles.

Ref 5

Kagnew Station - Wikipedia, the free encyclopedia

https://en.wikipedia.org/wiki/Kagnew_Station

Wikipedia Kagnew Station was a United States Army installation in **Asmara**, Eritrea on the ...
The dishes were used at **Stonehouse**, the military's "Deep Space Research ...

Interviews

Ref RB – Information obtained from Richard Bernard

Ref JB – Information obtained from James Boone

Ref DD – Information obtained from Donald Dement

Ref LW – Information obtained from Lewis Walls

Ref JW – Information obtained from James Wine

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The Soviet d~space performance in the spring of 1964 went as fo-nows: 21 ...

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File Format: PDF/Adobe Acrobat (Released to NARA by CIA 2014/09/10 C00624300)

James D. Burke. At 0635 GMT on 9 November 1983, a 21-year-old intelligence problem

was solved. Two Soviet spacecraft in orbit about the planet Venus

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Soldiers, Spies and the Moon: Secret U.S. and Soviet Plans from the 1950s and 1960s

Briefing Book 479 nsarchive.gwu.edu/NSAEBB/NSAEBB479/

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Intelligence Center Tracks Missile Launches Worldwide 24/7

nsarchive.gwu.edu/nukevault/ebb489/

"Little known" **DEFSMAC** Created to Cover Soviet Launches, Now Alerts and ...
DEFSMAC: NSA's Missile and Space Launch Warning and Reporting Center.
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CIA Documents Approved for Release

(Available under CIA CREST document files at the U.S. Archives Maryland Facility)

Intelligence for the Space Race

(Prospects and methodology for supporting a symbolic Olympian technological duel.)
Albert D. Whellon and Sidney N. Graybeal, Volume 5, Issue Fall, Year 1961

Telemetry Analysis

(Some of the ways in which Soviet flights and the missiles themselves can be reconstructed by monitoring their signals.) David S. Brandwein, Volume 8, Fall 1964

Snooping On Space Pictures

(Highlights of our scientists' success in interception and reconstruction the video from Soviet spacecraft.) Henry G. Plaster, Volume 8, Issue Fall, Year 1964

Seven Years to Luna 9

(How intelligence has monitored the Soviet program for lunar and planetary probes.)
James Burke, Volume 10, Issue Summer, Year 1966

The Missing Link

(Through the third, fourth, and fifth dimension in search of ????)
James D. Burke, Volume 22, Issue Winter, Year 1978

The Missing Link Revealed (Significantly redacted as released)

(Soviet signals from Venus)
James D. Burke, Volume 28, Issue Spring, Year 1984 (Released 2014/09/10)

RB Note: All of the documents listed above were initially published in the CIA Studies in Intelligence, "A collection of articles on the historical, operational, doctrinal, and theoretical aspects of Intelligence." Documents were released in 1994 release of documents from the CIA Historical Review Program. Many of the documents listed above are used as references and/or attachments to National Security Archive publications.

