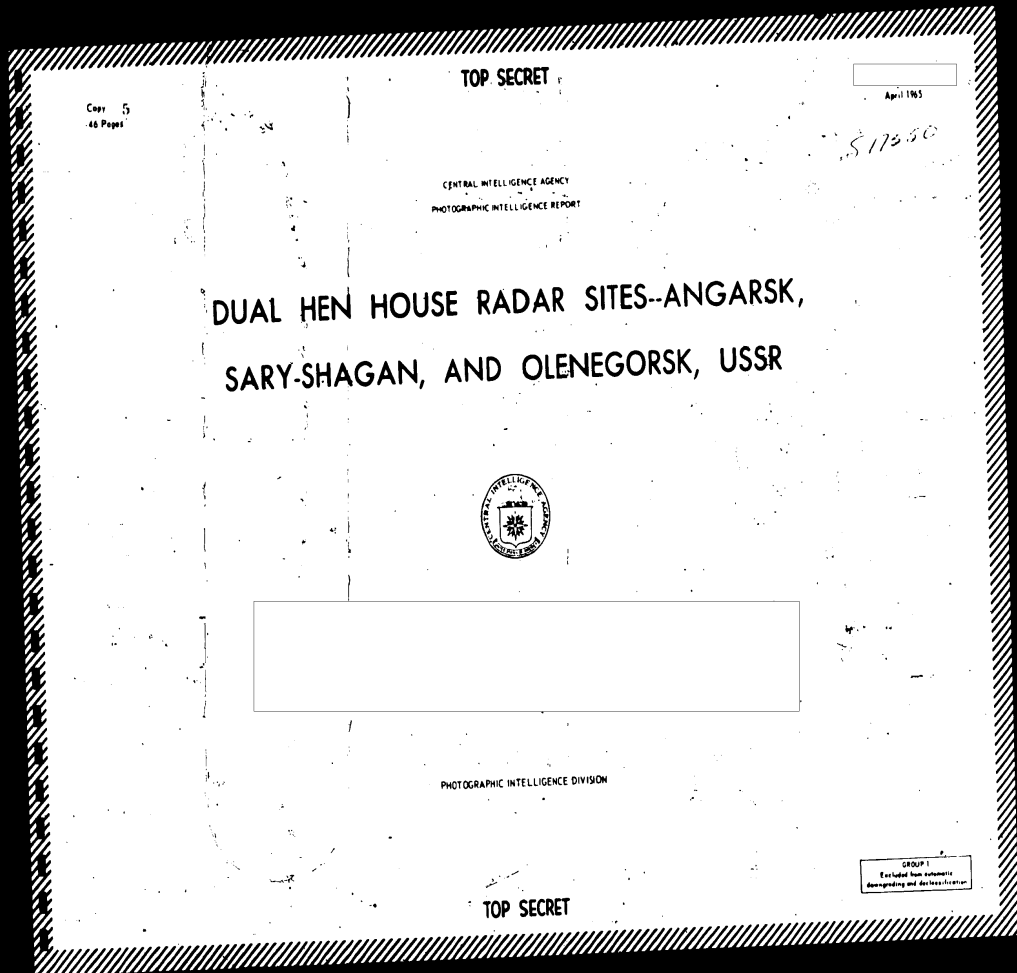


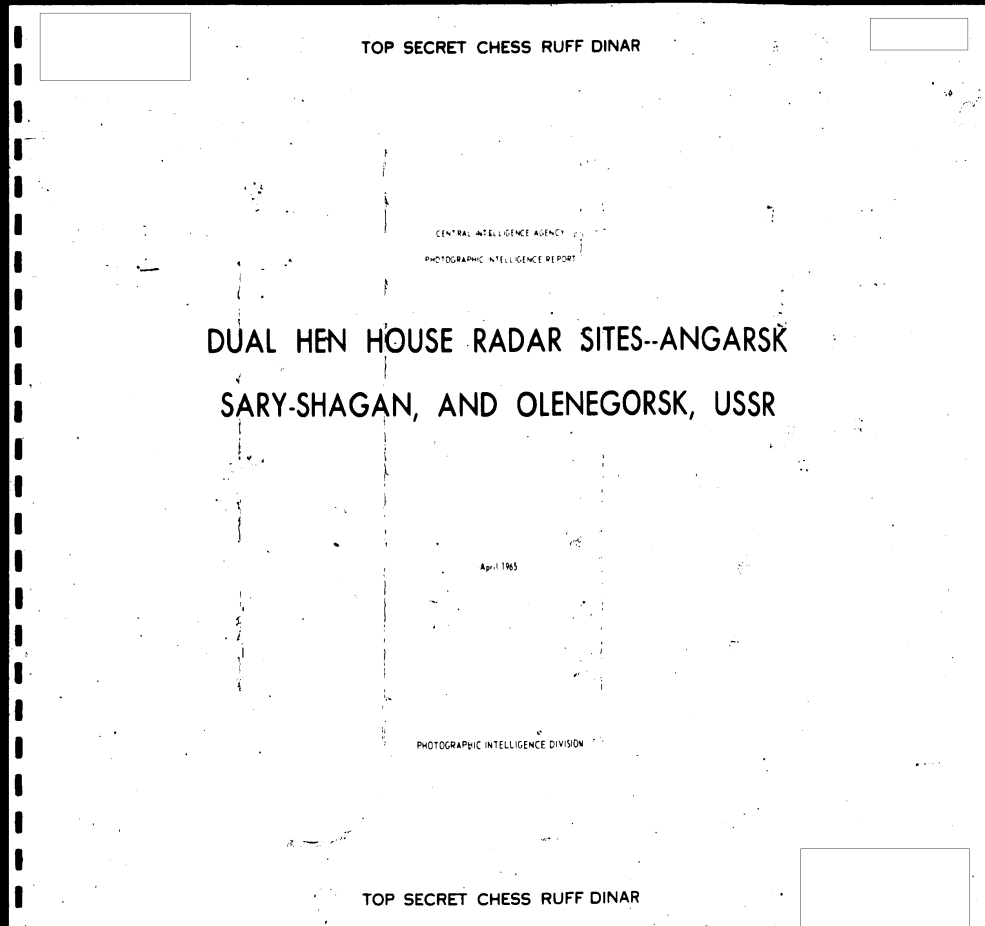
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PREFACE

This report is in response to requirement C-RR4-81,7, which requested (1) annotated photos of the Angarak facility from KH-7/8 Mission 4007, (2) description and measurement of linear installations and associated structures, (3) line drawings of linear installations and associated structures, indicating roads, trails, powerlines, security fencing, ground scarring, (4) indication of status of construction of each of the linear installations and nature and extent of progress, (5) detailed description of face of structure, including angle of slopes, length and width of possible faces, (6) determination of nature and status of third linear installation reported. It is also a response to requirement C-SI4-81,881, which requested line drawings and analysis of an installation located north-northwest of the HEN HORSI-type installations at Sary-Shagan Site 13, to requirement C-SI4-81,900, which requested data regarding structural differences among the various Dual HEN HORSI structures at Sary-Shagan Site 13, Angarak, and Olenegorsk, and to requirement C-104-81,873, which requested a complete analysis of the possible connection between the building triad and the HEN HORSI facilities at Sary-Shagan Site 13, including correlation with the Angarak Dual HEN HORSI facility.

Critical measurements, including all azimuths, heights, and angles of elevation presented in this report were accomplished by the NPG Technical Intelligence Division (TD). The remainder of horizontal measurements were accomplished by the CIA/PID project analyst, using scale factors derived from the NPG/TID measurements. Azimuths are considered by NPG/TID to be accurate within plus or minus 1 degree. NPG/TID generally consider accuracy of mea-

urements as follows: Horizontal distances computed from KH-7 and TAI-1N1 photography on the order of plus or minus 5 feet or 5 percent, whichever is greater. With good quality KH-4 photography, plus or minus 10 feet or 5 percent, whichever is greater. The percentage of error decreases as distance increases and vice versa. Height accuracy is dependent on a number of variables other than photo quality. Under favorable conditions, with an uncomplicated object, accuracy is similar to that for horizontal distances; however, this is seldom the case with complex electronic devices or where height measurement is dependent on determination of angular components and location of plumb points with unusual structures. Measurements performed by the CIA/TID project analyst have an accuracy factor which is generally similar to that of the NPG/TID measurements used for scale factors; however, they should be considered as approximate only.

Throughout this report dates of information are cited without specific references, in many instances, to the mission numbers from which the information was derived. The mission number and other pertinent photographic data may be obtained from the references at the end of the report.

(Cut-off dates for this report are as follows:)

- Angarak Dual HEN HORSI Radar Site
- Olenegorsk Dual HEN HORSI Radar Site
- Sary-Shagan Site 13
- Sary-Shagan Radar Sites 1 and 2

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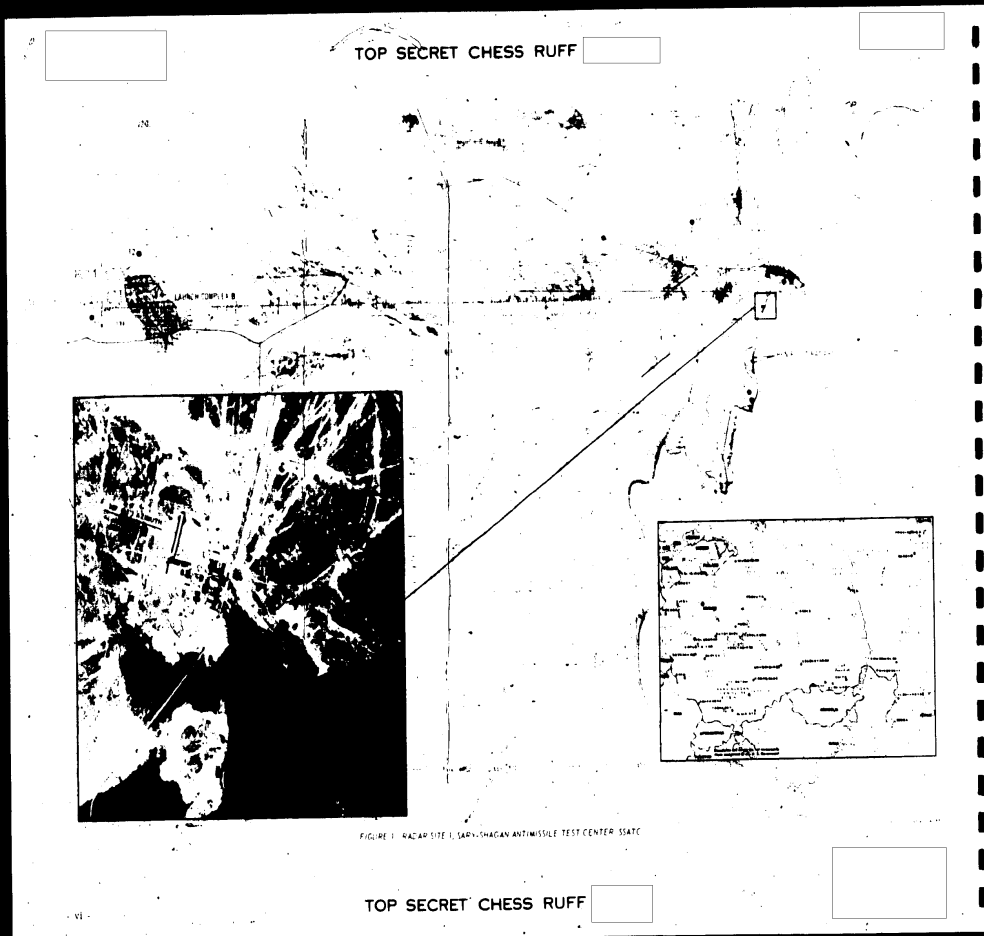


FIGURE 1. RADAR SITE 1, SARAVALI ANTIMISSILE TEST CENTER, SSATC

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### INTRODUCTION

The Angarsk Dual HEN HOUSE Radar Site (52-53N 103-15E), consisting of Dual HEN HOUSE-type antennas with adjacent support areas, was 1 of 3 known installations of this type under construction in the Soviet Union as of October 1964. The other 2 are located at Sary-Shagan Antimissile Test Center (SSATC) Site 13 (46-05N 74-32E) and at Olenegorsk (68-08N 33-54E) in the Murmansk area. Though this report is concerned primarily with Angarsk and Sary-Shagan Site 13, certain information on the prototype HEN HOUSE and HEN HOUSE installations at Sary-Shagan Radar Sites No 1 and 2 will be included. A report on the Olenegorsk Dual HEN HOUSE Radar Sites contained in NRIC R-355/04.

The detailed descriptions of the Angarsk and Sary-Shagan facilities in this report are based primarily on an analysis of KH-7 photography accomplished

respectively. Information on construction progress since the KH-7 missions were accomplished is based in each case on 2 subsequent missions employing the KH-4 system. In the case of Angarsk, additional coverage was secured in August and September 1964, while Sary-Shagan site 13 was photographed twice in October 1964.

To facilitate discussions of specific site components, the Dual HEN HOUSE facilities at each site are identified alphabetically in the sequence of their appearance. Individual HEN HOUSE antenna structures are numbered 1 and 2, with the former being the more northerly antenna. Where support facilities occupy more than a single area, the areas are numbered sequentially.

### HISTORY OF THE HEN HOUSE INSTALLATIONS

#### RADAR SITE NO 1, SARY-SHAGAN ANTIMISSILE TEST CENTER

Prior to the discovery of the Angarsk activity in January 1964, the only known HEN HOUSE antenna in the Soviet Union was located at Radar Site 1, SSATC

(45-58N 73-08E) (Figure 1). The activity at Angarsk could not at that early date be confirmed as electronics, though there were some strong suspicions regarding the unusually long excavations for probable structure foundations. In April 1960 the prototype HEN HOUSE at Radar Site 1 consisted of a single antenna structure, 915 feet long, 88 feet wide, 57 feet high and housing 41 lighted panels, each measuring approximately 40 by 20 feet, in a face 842 feet long, having a bore-sight angle of elevation. These dimensions and angles are portrayed in Figure 2 and represent a correction of dimensions and angles originally shown in FRC/BR-1010/61. Attached

to the left side of this antenna structure was a control building, 130 feet long. An addition to the control building, 100 by 75 feet and approximately 35 feet high, was constructed between the summer of 1962 and spring of 1963. This facility was first photographed by the only KH-7 coverage of Sary-Shagan.

Subsequent KH-7 photography has revealed 2 additional developments. September 1964 photography revealed construction work on a new triangular shaped installation adjacent to the HEN HOUSE control building. Additional missions in the following months revealed that

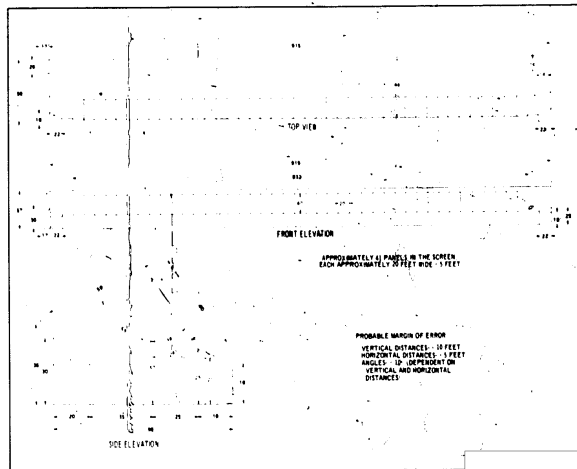


FIGURE 2. ELEVATIONS AT SSATC RADAR SITE 1.

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the new installation consisted of a 75- by 45-foot possible equipment building, 15 feet high, and a smaller suspect feed house at the apex of a flat, suspect ground plane (Figure 3).

In plan view, the suspect ground plane appears triangular with stepped or notched sides. Its surface is very light in tone and is raised possibly 8 to 10 feet above the ground. A rectangular, 245-foot-wide and 110-foot-high suspect reflecting surface is erected at the eastern side of the suspect ground plane, approximately 225 feet from the possible equipment building. The suspect reflecting surface faces on the same azimuth as the adjacent HENHOUSE antenna face. It is suspected that a perpendicular to the western facing surface has a small elevation angle above horizontal, however, the angle is too small to measure photogrammetrically. It is further suspected that this new addition is an over-the-horizon-type radar device, possibly being tested against missiles launched from Chelkar, Makat, or Kapustin Yar Missile Test Range to the Sarayagan impact area. No changes have been noted in this unique facility since April 1963.

Probable modification of the HENHOUSE antenna face, the second development, was first noted when a 190-foot section of the antenna face appeared black. The black section consisted of 6 regularly spaced panels whose dimensions suggested the replacement of previously installed light-toned panels with larger black panels (Figure 3). Permitted confirmation of the fact that the entire face was black.

At sun angles of 30 degrees 14 minutes and 30 degrees 15 minutes placed the antenna face in shadow. Consequently, appearance of the face could not be determined despite a favorable perspective for the forward camera.

Missions between June 1963 and February 1964 also failed to reveal the face of the HENHOUSE because of unfavorable perspective ray azimuths and relatively poor ground resolution. Revealed no change, the face remaining black. Though the June 1963 photographs revealed separations between individual black panels, the more recent photography does not permit detection of sectionalized paneling, despite relatively excellent KH-4 photo quality.

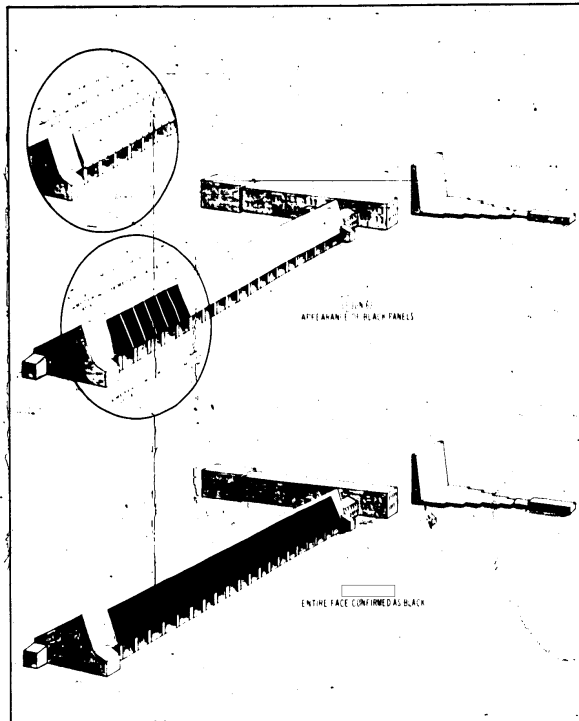


FIGURE 3. HENHOUSE AT RADAR SITE 1, SSATC.

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FIGURE 4. SSATC SITE 13. Possible Antenna - 14 Dia. HEN-HOUSE Radar Site

**SITE 13, SARY-SHAGAN ANTIMISSILE TEST CENTER**

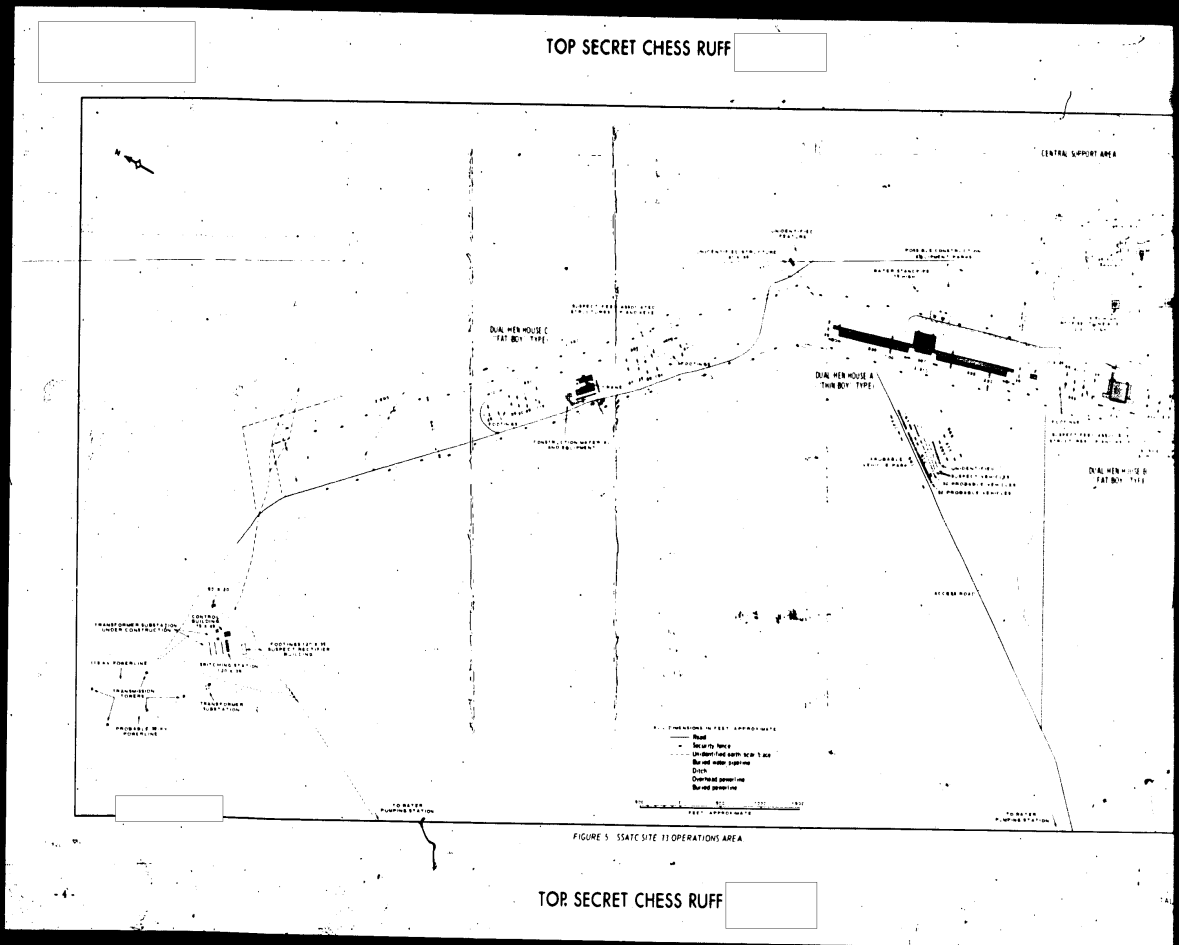
Sary-Shagan Site 13, located on the shores of Lake Balkhash, approximately 52 nautical miles (96 miles) northwest of the SSATC Support Base, did not exist on 4 April 1969 when TAI LNI [redacted] photographed the area. Activity at the site possibly had not started as [redacted]

Four photographs provided a more positive statement. First evidence of activity was secured by photographs [redacted]. This mission revealed construction activity on a triad of buildings, which following missions confirmed as 1 of 4 unique installations having a counterpart around the city of Moscow, and believed to be possibly ABM-associated, 4 1/2 ft. [redacted] For nearly 2 years, while construction activity continued, this possibly ABM-associated triad of buildings and a small support area constituted the only significant features at Sary-Shagan Site 13.

[redacted] photography revealed that what had appeared to be a small borrow pit for the past 2 years was now being expanded by extensive excavation activity. As this new activity coincided with the construction of a new support area south of the building triad, and as [redacted] Angarak Dual HEN-HOUSE construction activity had not yet been discovered, the true purpose of this new excavation activity at Sary-Shagan Site 13 still was not identified. Photography [redacted] revealed further expansion of this excavation, and at this time there was suspicion that the activity did in fact correlate with the proposed HEN-HOUSE facility at Radar Site No. 1, SSATC.

Photography [redacted] revealed that the Sary-Shagan Site 13 construction activity had continued at a rapid pace. What is now recognized as Dual HEN-HOUSE Radar Installation A was under construction approximately 1,000 yards northwest of the possible ABM-associated building triad, with a second, similar installation Facility B under construction in line with and just south of the first. Dual HEN-HOUSE. A portion of the control house superstructure was erected at Dual HEN-HOUSE A, while footings for a probably similar building could be seen at the more southern facility. Probable superstructure could be seen at antenna A-1, while footings were probably in place for antenna A-2 and possibly for antenna B-1. The control build-

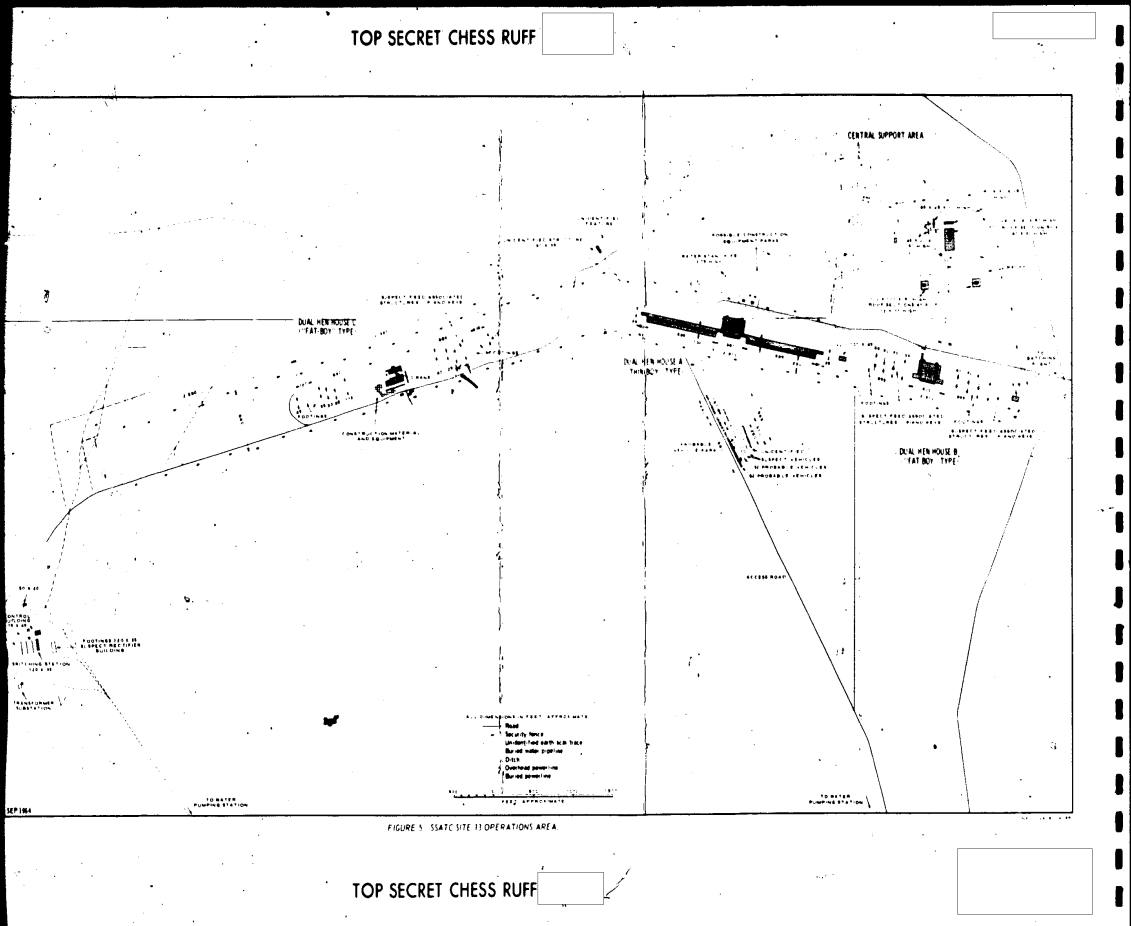
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ing for the second Dual HLN HOUSE was being constructed approximately 1,000 feet west of the possibly ABM-associated building triad facility. The HLN HOUSE construction activity at Sary-Shagan Site 1X, which began sometime [redacted] continued throughout the remainder of 1963 and through the winter and spring of 1964. Construction of a third Dual HLN HOUSE facility (Facility C) was initiated [redacted]

Photography [redacted] revealed that a dark-toned surface was being installed on the face side of the west side of HLN HOUSE A-1. It is suspected that this surface is made up of dark panels similar to those installed on the prototype HLN HOUSE antenna at Radar Site No 1 in 1963. Bore-sight from this face would be on an azimuth [redacted]

The rate of construction progress on all 3 Dual HLN HOUSE installations appears similar, with comparative progress relating to the different starting dates. Photography of 16 July 1964 revealed that the face of HLN HOUSE Antenna A-2 would be on the same side as that of A-1 and on [redacted] reveals the probability that the west side of HLN HOUSE A-2 is also receiving black paneling. Thus, bore-sights from both antennas at Dual HLN HOUSE A will be oriented westward. Excellent KH-4 photography [redacted] and fair quality KH-7 coverage [redacted] confirmed the presence of a dark-toned face on both A-1 and A-2, with both on the same side, facing west (Figure 4).

The photography accomplished during the months of September and October 1964 made possible more detailed analysis of this facility. The line drawing of the operations area (Figure 5) reveals numerous details regarding waterlines, buried powerlines, and other features. It is now possible to determine that an uncompleted double security fence encloses the building triad with the 3 Dual HLN HOUSE installations. The security fence extends a sufficient distance to the north to accommodate a fourth Dual HLN HOUSE. In view of this security provision, and a buried powerline which approaches this open space, it is believed that the Soviets have planned the construction of Dual HLN HOUSE D adjacent to Dual HLN HOUSE C. [redacted] there was no evidence of excavation or other construction activity in the area probably set aside for the fourth

Dual HLN HOUSE. Extensive cloud coverage of this portion of the site [redacted] prevented further analysis.

A study of line drawings (Figures 5 and 6) reveals that plan dimensions and overall height of both HLN HOUSE structures at installation A are similar, however, they differ as to the location of the ridge-line, the pitch of roof and face and the height of vertical sections front and rear. At Dual HLN HOUSE B, the separation of linear footings and the placement of internal suspect feed-associated structures (to be referred to as piano keys) differs from that seen at Facility A.

Footings for Dual HLN HOUSE C indicate that it probably will be similar to Dual HLN HOUSE B. Of particular significance is the relative size and placement of suspect transmitter and terminal buildings on each end of the various HLN HOUSE structures and their relationship to the

internal piano keys. (See Figures 5 and 7.)

Transmission towers for a probable 65-kv electric powerline and a 110-kv electric powerline can be seen approaching electric power transformer substations located approximately 2 km northeast of Dual HLN HOUSE B (Figure 5). Presence of cables cannot be determined. Construction activity at the larger substation probably still continues as of October 1964. The powerlines will tie into the main transmission lines running between the Balhash area and the Sary-Shagan Main Support Base. The probable 65-kv line serves the town of Gulistan.

A probable buried water pipeline to the power substations from the water pumping station southeast of Gulistan is probably started sometime between [redacted]

Buried electric powerlines from the substation area northwest of the site can be traced down as far

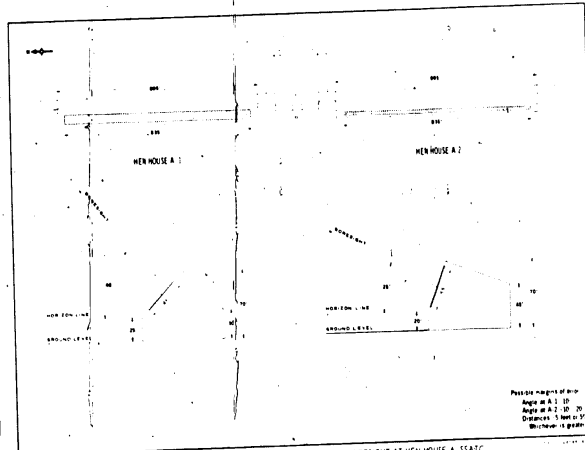
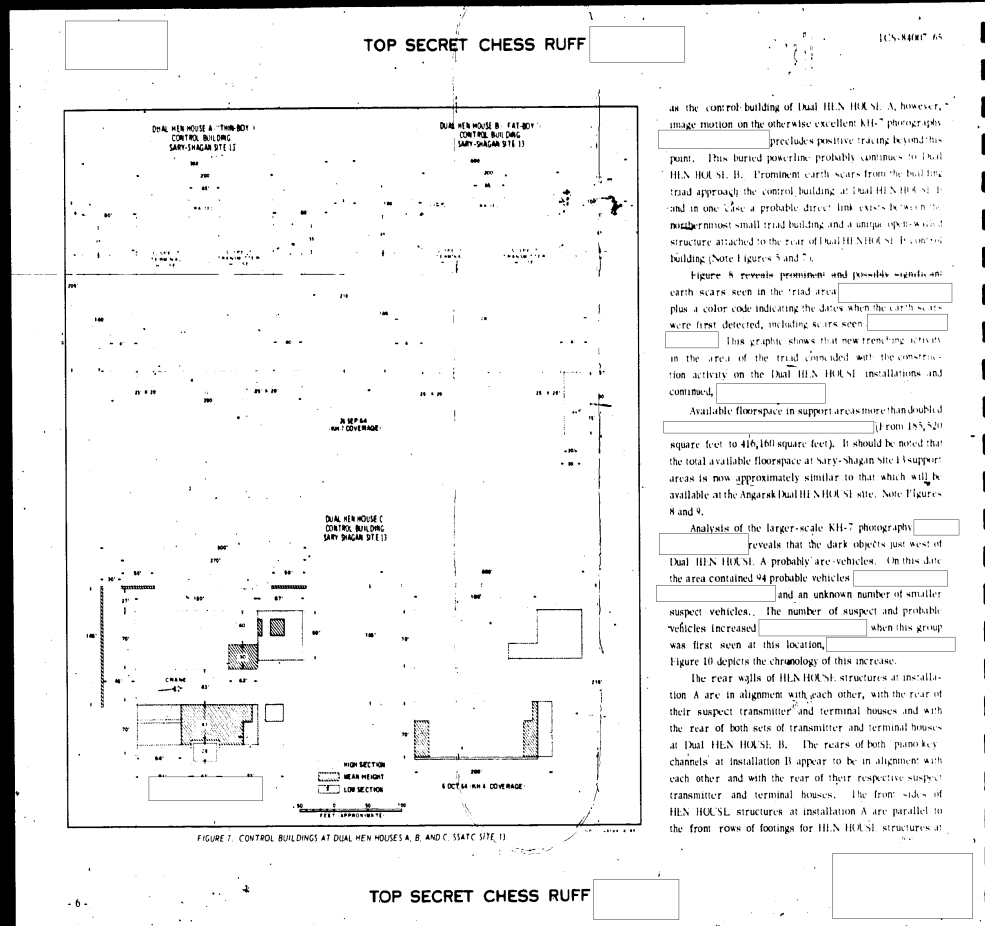


FIGURE 5. SIDE ELEVATION DIMENSIONS AND ANGLES OF BORE-SIGHT AT HLN HOUSE A. SSATC.

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as the control building of Dual HEN HOUSE A, however, image motion on the otherwise excellent KH-7 photography precludes positive tracing beyond this point. This buried powerline probably continues to Dual HEN HOUSE B. Prominent earth scars from the building triad approach the control building at Dual HEN HOUSE B and in one case a probable direct link exists between the smallest small triad building and a unique open-sided structure attached to the rear of Dual HEN HOUSE B control building (Note Figures 5 and 7).

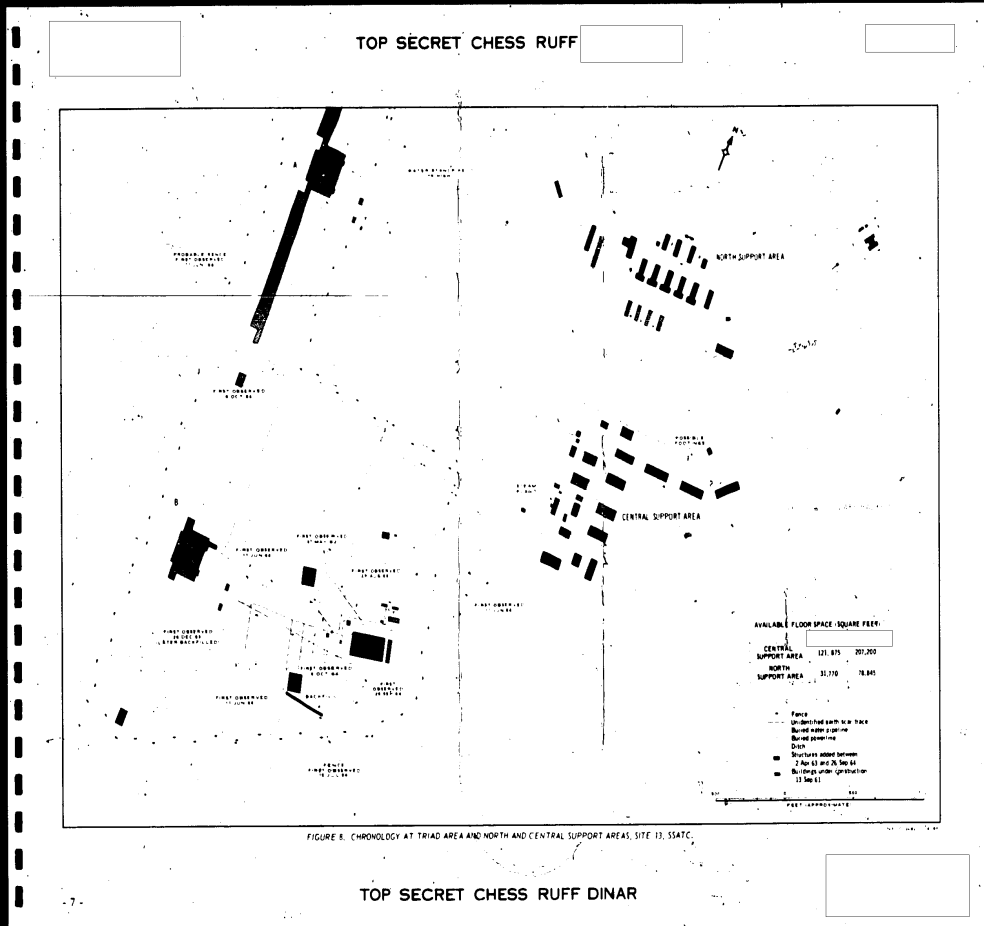
Figure 8 reveals prominent and possibly significant earth scars seen in the triad area plus a color code indicating the dates when the earth scars were first detected, including scars seen in this graphic shows that new trenching activity in the area of the triad coincided with the construction activity on the Dual HEN HOUSE installations and continued.

Available floorspace in support areas more than doubled from 185,520 square feet to 416,160 square feet. It should be noted that the total available floorspace at Sary-shagan Site I (support areas is now approximately similar to that which will be available at the Angarak Dual HEN HOUSE site. Note Figures 8 and 9.

Analysis of the larger-scale KH-7 photography reveals that the dark objects just west of Dual HEN HOUSE A probably are vehicles. On this date the area contained 94 probable vehicles and an unknown number of smaller suspect vehicles. The number of suspect and probable vehicles increased when this group was first seen at this location.

Figure 10 depicts the chronology of this increase. The rear walls of HEN HOUSE structures at installation A are in alignment with each other, with the rear of their suspect transmitter and terminal buses and with the rear of both sets of transmitter and terminal buses at Dual HEN HOUSE B. The rears of both piano-key channels at Installation B appear to be in alignment with each other and with the rear of their respective suspect transmitter and terminal houses. The front sides of HEN HOUSE structures at installation A are parallel to the front rows of footings for HEN HOUSE structures at

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installation B. However, the front footings at Installation B are approximately 30 feet to the rear of the front sides of HEN HOUSEs at installation A. Rear footings of the radar structures at Dual HEN HOUSE B are 65 feet behind the "piano key" channel at radar structure B-1 and 40 feet at radar structure B-2 (See Figure 5).

The square, dark tone surrounding the triad installation, visible on earliest and most subsequent photography of Site 13 suggests the possibility that a security fence (possibly temporary) at one time protected the construction activity at the triad.

**OLENEGORSK ELECTRONICS SITE**

Most recent of the Dual HEN HOUSE facilities to be discovered is located on the Kola Peninsula 68-09-00N

013-54-30E, approximately 11 nm east-northeast of Olenegorsk Airfield and 55 nm south-southeast of Murmansk (Figure 11). This facility was negated on August 1962 photography and first signs of construction activity were observed in the support area in June 1963.

As seen in Figure 11, the Dual HEN HOUSE facility at Olenegorsk differs from the others in that the individual HEN HOUSE experiments are not in alignment. The probable bearing azimuths (perpendiculars to the long side of each structure) are 296 and 326 degrees, and form an angle of 30 degrees.

These azimuths constitute a correction of azimuths previously reported and result from a refinement of ephemeral data for Mission 10021 (June 1964), subsequent to the publication of NFR R-855-64. Accomplishment of better quality photography may result in further adjustment of azi-

muths, provided all critical ephemeral parameters are available.

**ANGARSK DUAL HEN HOUSE RADAR SITE**

Late in December 1963, an unusual unidentified facility was discovered under construction near the banks of the Belaya River, approximately 35 nm northwest of Angarsk and 17 nm south-southeast of Uchrenkovo, at 52°55N 104°55E. Correlation of this activity with instrumentation site 13, SSATC, was immediately established.

Analysis of previous photography of the area revealed that December 1962 coverage probably negated the facility. However, partial cloud cover of what is now Support Area 2 precludes positive negation on that date. Poor quality of earlier photographic coverage also prevents positive negation. Probably the first indication of construction activity was photographed [redacted]. The photo quality was poor, however, initial clearing and suspect early construction activity in Support Area 2 could be detected.

The first positive confirmation of construction activity resulted from good-quality KLYHOE coverage [redacted]. This photography revealed that construction of Dual HEN HOUSE installation A had progressed to probable early stages of superstructure erection by the control building,

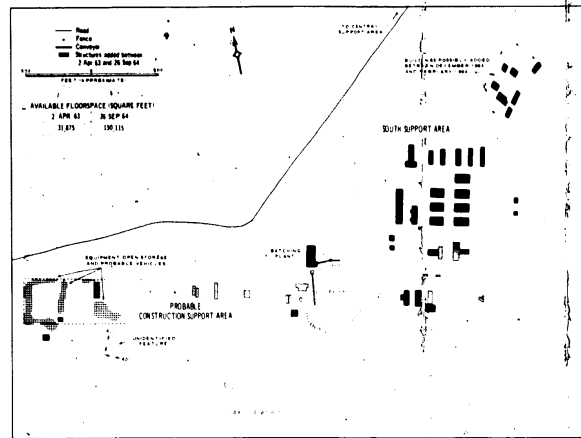


FIGURE 9. SOUTH SUPPORT AREA AT SITE 13, SSATC

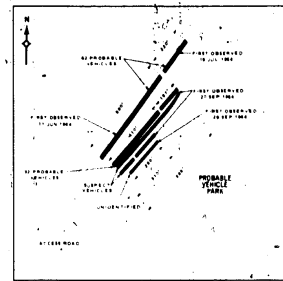
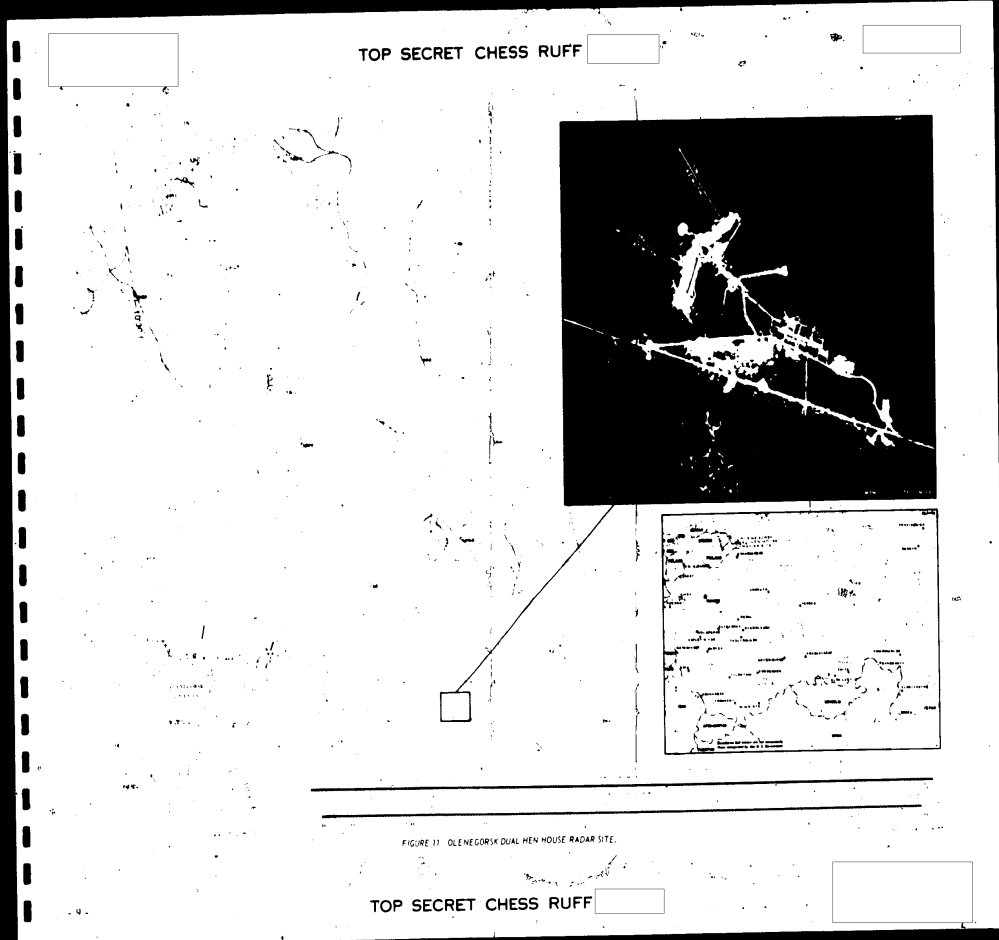


FIGURE 10. CHRONOLOGY OF VEHICLES NEAR DUAL HEN HOUSE A SITE 13, SSATC.

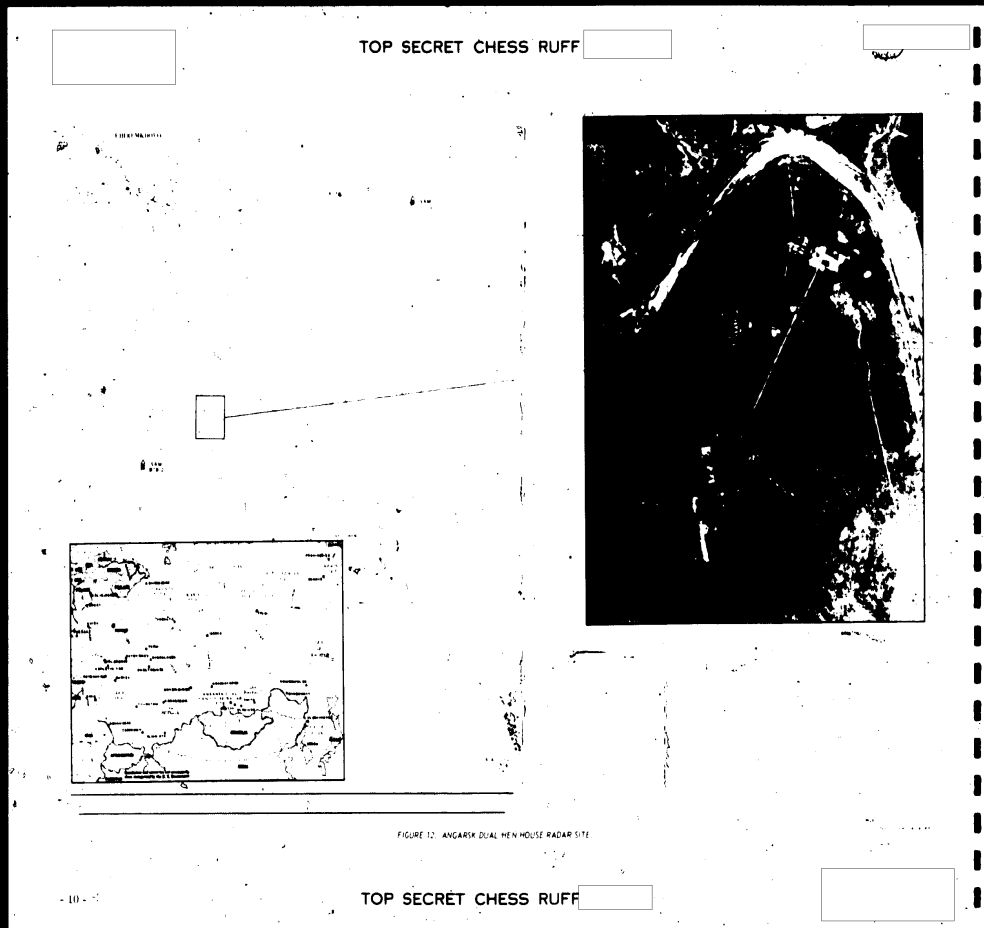
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and foundation excavations along the entire length of both antenna structures. At this time there was no evidence of construction or clearing activity for Dual HLN HORSI Installations B, C, or D.

The progress of construction [redacted] is documented by previously published reports. [redacted] as accomplished with the KH-7 system, resulting in relatively large-scale photography (Figure 12). Though light conditions during the satellite pass over Angarsk were less than optimum, the larger photo scale has permitted a far more detailed analysis than was previously possible. To provide for consistent annotations should additional facilities be constructed, the area designation system used in previous reports is changed to permit alphabetical designation of the Dual HLN HORSI installations and numerical designation of support areas, as shown in Figure 13. The sequence of designation will, where possible, follow the chronological development of facilities.

General. The Angarsk Dual HLN HORSI Radar Site occupies approximately 3,000 acres of flood plain in a bend of the Belaya River (Figure 12). It consists of a fenced operations area not containing 4 Dual HLN HORSI radar installations under construction, with 3 closely grouped support areas about 1 nm to the northeast (Figure 13). Photography of [redacted] revealed a 2,130- by 200-foot area had been cleared for the fourth Dual HLN HORSI installation.

The only cultural features visible at this site prior to commencement of construction activity were a few probable dwellings along the river and a series of straight earth scars. These scars, consisting mostly of suspect survey lines, form a grid pattern in an area covered with medium to sparse vegetation. The grid pattern is formed by parallel lines oriented north-south, spaced approximately 1,000 meters apart, and intersected by east-west oriented parallel lines approximately 2,000 meters apart. Three straight, non-parallel, unidentified earth scars cross the area southwest of the site. These more prominent lines are generally oriented northeast-southwest.

It is not possible to negate these earth scars, nor is it possible to establish any relationship to the Dual HLN HORSI facility, other than their geographic proximity and the orientation of the grid with reference to true north. The northwestern of the 3 more prominent scars runs

through the area now occupied by the operations area, and more specifically by the control building of Dual HLN HORSI A. The latter is possibly coincidental.

Communications. The facility is served by a possibly gravel-surfaced road which enters Support Area 3 and 2 from the south, then turns to the southwest toward the operations area. There was no other prominent access to the facility [redacted] from the site support area. The road leads south to a main road which connects Moshelovka on the west to Malta and Lavarka on the east. The latter two communities are served by hard-surfaced roads and a double-tracked railroad which connects Irkutsk, Angarsk, and Cherenkovo with points to the northwest and east. The airfield possibly serving this site would be Belaya Airfield, a medium bomber base, BT No. 0200160015 located approximately 10 nm to the east. (See Figure 12).

Defenses. The general area is defended by Cherenkovo SAM Site BHN-2, located approximately 6 nm southwest of the Dual HLN HORSI facility, by Cherenkovo SAM Site C10 2, located approximately 12 nm north-northeast of Belaya Airfield, and the northeastern SAM sites in the Irkutsk-Angarsk SAM defense complex.

Utilities. Two parallel earth scars, which enter the area from the west, are possible evidence of power and telephone lines serving the support areas during the early construction period. Sometime [redacted] construction work began on an electric power substation in an area approximately 360 by 220 feet located between the operations area and Support Area 2. During the same period, work began on a water treatment plant located between the power substation and Support Area 2. Concurrent with this activity, a trench was dug for a pipeline from the Belaya River to the water treatment plant.

During the period [redacted] vegetation was cleared from a 110-foot-wide strip, forming a power trace leading southward toward the electric power substation from an area north of Support Area 2. The power substation was still in very early stages of construction, with no evidence of structures visible. Initial construction on a probable sewage treatment plant was also initiated during this period.

Photography [redacted] revealed construction progress on all facilities. Initial electric power substation area, footings for possibly 250-kvaw, 3-phase, low-voltage transformers were under construction while a still-bearing construction on a 130- by 30-foot substation control house had reached the superstructure stage. [redacted]

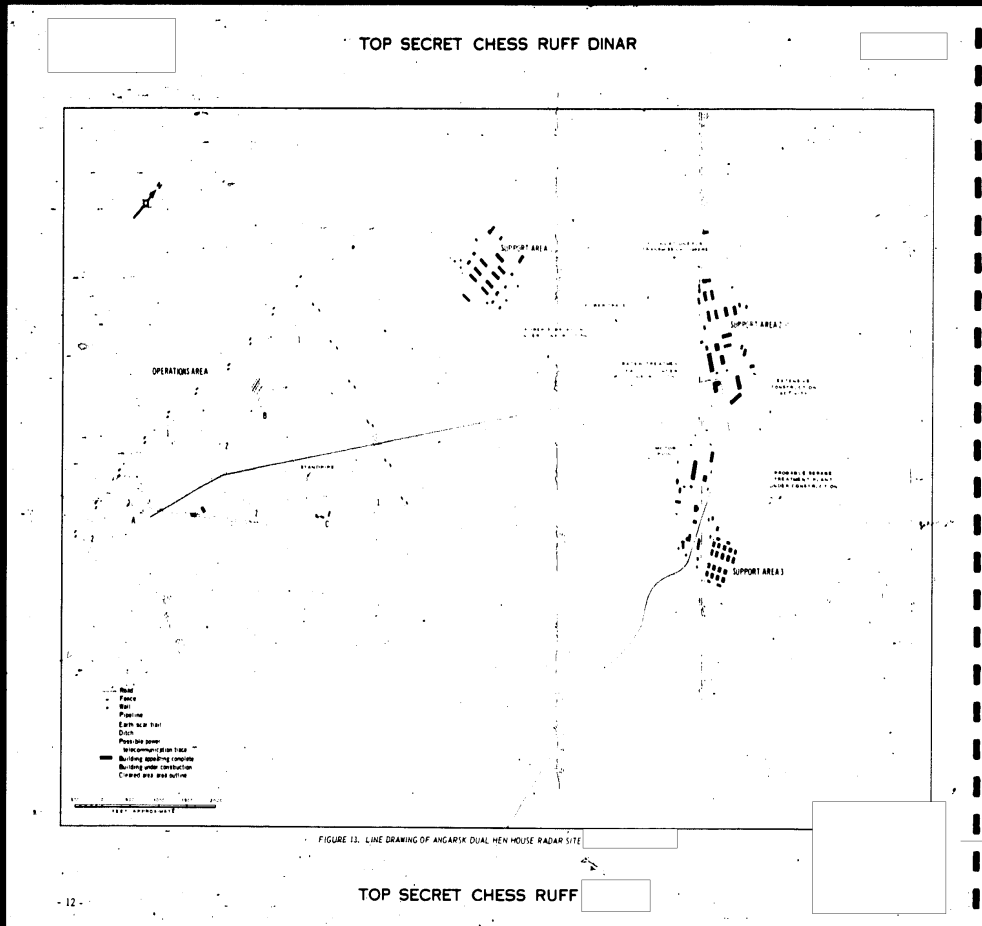
[redacted] the substation control house and on adjacent building measuring 78 by 45 feet to be completed on 27 April 1964 (probably stack of canvas-covered building material measuring 23 by 10 feet) was located approximately 200 feet northwest of the substation control house. This probable stack of material was not in evidence on 9 August 1964. Foundations for electric power transmission towers for 2 probable 110-kv powerlines with heavy, 4-phase conductors can be seen along the power trace extending north from the substation. Photography [redacted] revealed continuing work on the powerline, with power transmission tower footings newly identified northeast of the electrified railroad near the town of Mikhaylovka (Figure 12). The power trace is thus being extended toward the electrified railroad.

A probable sewage treatment plant is being constructed north of Support Area 3 and downstream from the water intake point. It consists of 2 earth-embanked, 18-foot diameter, probable digesters and a sewage treatment and pumping station under construction. [redacted] the sewer pipeline from the sewage treatment plant was extended to Support Area 2 and to the Belaya River. (See Figure 14).

The water treatment plant, consisting [redacted] four single-story, flat-roofed building and two 45-foot diameter semicircular premeditation basins, will be fed by a buried water pipeline from the Belaya River. Photography [redacted] Figure 14) reveals the circular basins have probably been covered. The intake end of the water pipeline ends at a slip-off slope north of Support Area 2. It is suspected that infiltration galleries are being constructed at that point.

From the water treatment plant, water pipeline trenches lead along the access road toward the operations area and toward Support Area 2. A number of trenches for water and sewer pipelines can be seen in Support Area 2. Probable pipe sections can be seen strung along the side of the access road between Support Area 2 and Support Area 3, probably preliminary to trench digging.

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**Motor Pool.** The motor pool area contains a 280-foot single-story probable shop-type garage and 4 smaller possible storage buildings. The possible storage buildings have a total of 12,440 square feet of floorpace.

The motor pool contained 8 possible tank semitrailers, 16 possible van semitrailers, 12 possible cargo trucks, 27 probable dump trucks, 40 probable vehicles, 10 possible vehicles, and 10 suspect vehicles for a total of 123 vehicles. The possible tank semitrailers and most of the possible van semitrailers were parked closely together in the western corner of the motor pool. Photography revealed an expansion of approximately 15 percent to the northern side of the motor pool area (Figure 14).

**The Operations Area.** The operations area occupies approximately a 400-acre triangular area 1 nm southwest of Support Area 3. Photography revealed the area was bounded on the north, west, and possibly the east, by a double security fence. Photography confirmed the presence of a security fence around the entire operations area. Clearance between the western side of Dual HEN HOUSE installations A and B, and the security fence to the west varies between 300 and 900 feet. A possibly gravel surfaced road connects the operations area with the support areas to the northeast.

Located within the operations area were 3 Dual HEN HOUSE radar antenna structures in various stages of construction (Figure 15). Dual HEN HOUSE A was the most complete of the 3, while installation C was least advanced. Dual HEN HOUSE A occupies the southernmost corner of the triangular area, with the long axis of the structure oriented 350 and 170 degrees. Dual HEN HOUSE B, at an earlier stage of construction, is located north of Dual HEN HOUSE A, with their control buildings approximately 2,400 feet apart. The long axes of Dual HEN HOUSE installations A and B are parallel and separated by 320 feet. Their control buildings are similarly oriented. Dual HEN HOUSE C control building is located approximately 1,800 feet east of Dual HEN HOUSE B control building, and approximately 3,100 feet north-northeast of the Dual HEN HOUSE A control building.

A clearing for a probable fourth Dual HEN HOUSE installation, parallel to Dual HEN HOUSE C, was revealed by photography accomplished (Figures 14 and 16).



FIGURE 14. ANGARSK DUAL HEN HOUSE RADAR SITE

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Photography [redacted] Figure 17) revealed continued progress in the operations area (note the drawing, Figure 18), with excavation activity visible in the space for installation D.

Dual HLN HOUSE A. This installation consists of 2 HLN HOUSE-type radar structures under construction, 1 on each side of a massive control building. The 2 HLN HOUSE antenna structures are being constructed along the same longitudinal axis, with the mass of the control building located east of the line. [redacted] Dual HLN HOUSE A measured 2,295 feet from end to end. Photography [redacted] revealed the probable addition of a small structure to the north end of HLN HOUSE A-1. If the dimensions of this addition are similar (\*) to those of the structure off the south end of HLN HOUSE A-2, the total length of the Dual HLN HOUSE will be approximately 2,340 feet.

Photography [redacted] confirmed that suspect transmitter and terminal houses are attached to each HLN HOUSE structure at Dual HLN HOUSE A. The rear sides of these small houses probably are aligned with the rear of the attached HLN HOUSE antenna structures.

The flat-roofed control building probably is constructed of reinforced concrete (Figures 15, 19, and 20). It consists of a 25-foot-high central section measuring [redacted] wings on the north, south, and west, and 2 probable 10-foot-high wings on the east. The north and south wings measure 140 by 40 feet, the west wing [redacted] and each of the 2 probable wings on the east measure 25 by 20 feet. The entire control building is located east of a line connecting the western sides of the 2 HLN HOUSE antenna structures.

The control building, which has approximately 44,000 square feet of roof area, did not appear complete. [redacted] Finishing work on the roof appeared to be in progress with a suspect asphalt plant in operation on the east side of the building. Building material, pipe sections and 5 probable vehicles could be seen in the area [redacted] Photography [redacted] does not permit confirmation of construction status, though the building appears complete.

Photography [redacted] revealed no changes in the control building, however the trench from the control

\* If the dimensions are approximately similar in size, the ground resolution of KH-4 Mission 10902 does not permit a meaningful comparison.

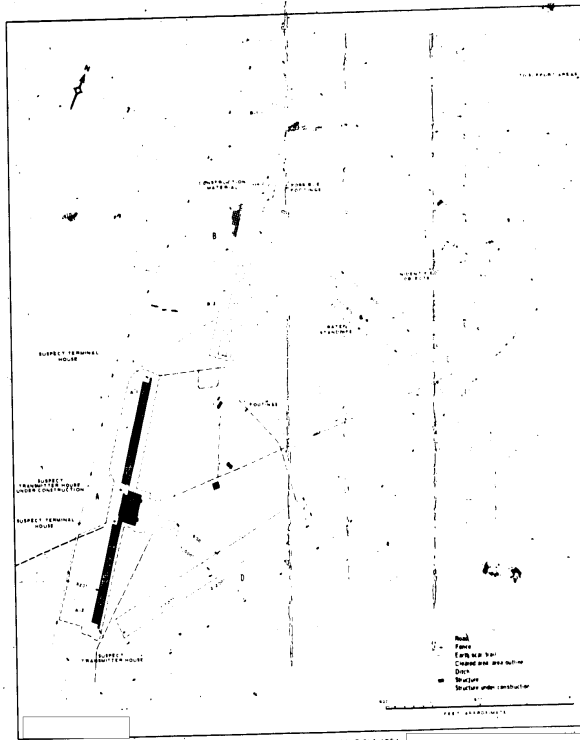


FIGURE 18. ANGARSK DUAL MEN HOUSE RADAR SITE OPERATIONS AREA

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building had been extended to the cleared area for Dual HLN HOU S1 D (Note Figure 17).

HLN HOU S1 Radar Antenna Structure A-1, a 915- by structure, located north of the control building, has its long sides parallel to the eastern and western sides of the control building. Its southern end was separated from the main control building section by 85 feet (Figure 19). Photography reveals the possible addition of a small structure (suspect transmitter house) between the HLN HOU S1 antenna structure and the control building. The western side of the HLN HOU S1 antenna structure is approximately 40 feet forward of the control building.

It is suspected that the structure on the left side of a HLN HOU S1 radar antenna structure is a transmitter house, while the structure on the right side is a terminal house.

Photogrammetric analysis has confirmed that the pitch of the trusses is not similar with the greatest angle of pitch being on the side facing west. Mensuration indicates that the slant height of the western side of each truss is and the slant height of the eastern side is . Possible margins of error on these calculations are: up to a maximum of plus 15 feet for the western slope, and down to a maximum of minus 15 feet for the eastern slope. Should the maximum possible error be applied to each side, the ridgeline would still be located west

of the central longitudinal axis of this structure. Photo quality and available information did not permit comparison of the structure height or the angles of elevation of the pitched roof. However, the ridgeline appears to be over a line located approximately two-thirds the distance of the building width, and west of the central longitudinal axis of the structure (Figure 21).

The ridge of the HLN HOU S1 structure appears to be approximately 25 times higher than the roof of the control building.

Photography revealed 44 trusses, spaced approximately 20 feet apart, erected over 860 feet of the structure's length, with probably 2 trusses still to be erected by the end of Figure 19. On 27 April 1964, roofing material covered approximately 9.5 structural bays east of the ridgeline, as shown in Figures 19 and 20. A dark straggler could be seen through the trusses, running most of the length of the structure and located parallel to and approximately 23 feet from the east side of the structure. Location of the straggler is shown in Figure 21. Photography reveals that the roof probably has been covered and that a small structure (suspect terminal house) probably has been added to the north end of the HLN HOU S1.

Photography revealed that the front vertical section of HLN HOU S1 A-1 probably is higher than the vertical front section of A-2, thus the bore-sight angle of elevation of the antenna face on HLN HOU S1 A-1 probably is greater than the bore-sight angle of elevation at HLN HOU S1 A-2. This correlates with the mensuration performed on Dual HEN HOUSE A at Naryshagan Site 13. Note Figure 6. Three different tones of gray could be seen in the vertical wall below the face at HLN HOU S1 A-1. Two tones of gray could be seen on the inclined face of HLN HOU S1 A-2 (See Figure 18). This tonal difference indicates that construction work probably continues at this installation.

The footings for HLN HOU S1 Radar Antenna Structure A-2, located south of the control building, indicated it would be similar in size to antenna structure A-1 to the north. Dimensions and locations of footing with reference to the control building are shown in the rectified line drawing in Figure 19. A 45-foot wall for a suspect transmitter house is located just off the south end of the footings at HLN HOU S1 A-2. It probably will be similar to structures

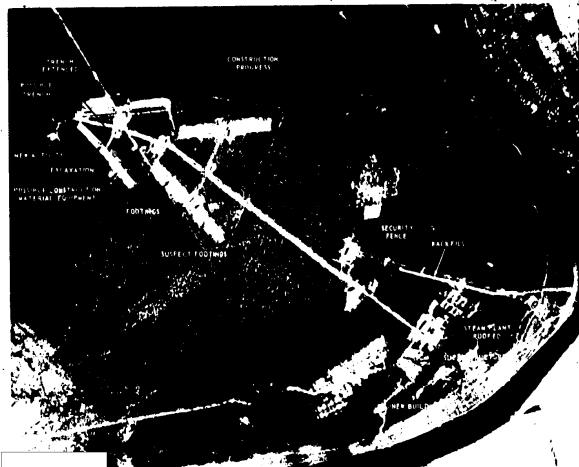


FIGURE 17. ANGARSK DUAL HEN HOUSE RADAR SITE, SHOWING CONSTRUCTION PROGRESS.

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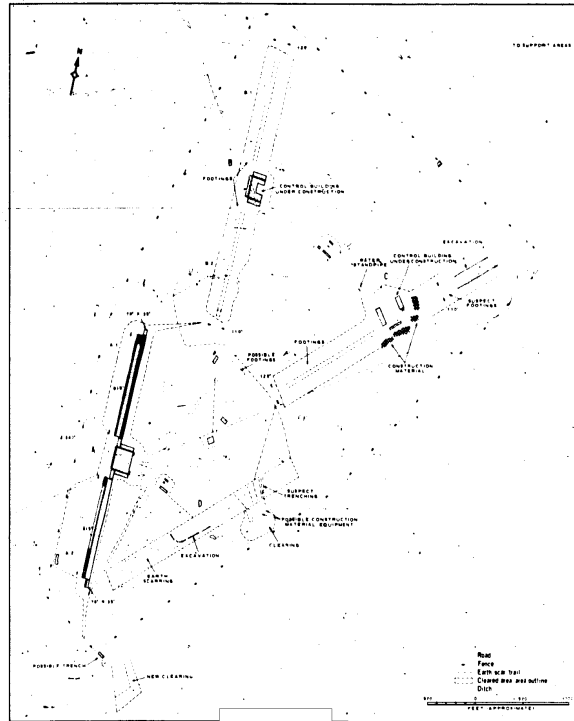


FIGURE 18. ANGARSK DUAL HEN HOUSE RADAR SITE OPERATIONS AREA.

which appear off each end of both HEN HOUSE structures at Dual HEN HOUSE A. At Sarv-sha in Site 13, three roughly circular possible excavations, with small concrete objects observed inside, were located between the antenna structure foundation and the control building on 27 April 1964. See Figures 19 and 20. The location of these features corresponds to the location of a suspected terminal house, which is located between the HEN HOUSE structure and the control building at Dual HEN HOUSE A, see also Site 13. Photographs [redacted] reveals the possible outline of a suspect terminal house between HEN HOUSE A-2 and the control building.

Within the outer row of column footings and parallel to them is a line of possible footings and footing holes, arranged in a straight line and spaced approximately 10 feet apart. The inner row of possible footings is not centered but is approximately [redacted] from the eastern rim of column footings.

Internal, suspect bed-associated structures, piano keys, roughly grid-shaped stonework and other scars, can be seen along the length of the structure. These are shown in the line drawing on Figure 19. Photographs of [redacted] revealed that the superstructure had been erected and that probably some early masonry was being applied.

Photographs [redacted] revealing approximately 30 percent of the HEN HOUSE A-2 face is black.

Dual HEN HOUSE B, Dual HEN HOUSE B, located north of Dual HEN HOUSE A, is in an earlier stage of construction. [redacted] It consists of a cleared area approximately 2,400 by 360 feet, in the center of which a control building was in early stage of construction. A large amount of construction material was stacked in the area west of the control building and in the cleared area to the south (Figure 15). Initial excavation activity had commenced in the southern end of the cleared area south of the control building. Photographs [redacted] reveals excavation and possible footings for both HEN HOUSE structures and construction progress on the control building.

Photographs [redacted] revealed further construction progress. Plans keys could not be detected inside the footings for HEN HOUSE B-2, and possible

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footings for "piano key channels" could be detected inside footings for HEN HOUSE B-1. Possible footings for a suspect transmitter house off the southern end of B-2 appeared in approximate alignment with the footings for the internal "piano key channel".

The control building at Dual HEN HOUSE B is oriented in a manner similar to that of the Dual HEN HOUSE A control building, and probably will have a similar configuration. The walls of the west and south wings were being erected and a small portion of the roof on the south wing was in place. The west wing appeared to be divided internally by 2 walls. Note Figure 22.

The extreme ends of the narrow west wing were either covered by a 5-foot wide strip of roofing, or the walls at this point are 5 feet thick. The south wing of the control building

section of its roof in place while a section, noticeably lower than the roof, protruded as shown in Figure 22.

Figure 22 shows the appearance of the control building at B of

Although photography does not resolve the small and narrow west wing, it reveals that superstructure and roof on the north and south wing have been erected and that construction on the large central section is progressing.

The area for both HEN HOUSE structures at B were cleared and initial excavation activity was visible south of the control building construction. Photography reveals excavation and possible footings at both HEN HOUSE B sites.

Dual HEN HOUSE C. This installation is least advanced

of the 3 Dual HEN HOUSE installations being constructed in the operations area. Concrete footings for the control building were in place and stacks of construction materials were lying on the ground in the vicinity. Figure 15. The pattern formed by the control building footings strongly suggests that the control building for Dual HEN HOUSE C will have the same dimensions and configuration as the control building at Dual HEN HOUSE A. This was partially confirmed by photography, which revealed the superstructure of the narrow, probably 100-foot wing and the other 2 wings being erected.

The cleared area on each side of the control building construction is sufficiently large to accommodate HEN HOUSE-type radar antenna structures. However, as there was no sign of excavation activity in the cleared area. Photography revealed that excavation for the HEN HOUSE foundations had begun.

Figure 22 reveals the appearance of the control building at Dual HEN HOUSE C.

The distance between footings for HEN HOUSE C-1 and C-2 and the location of possible footings for "piano key" channels at C-2, suggest that Dual HEN HOUSE C probably will be more nearly similar to Dual HEN HOUSE B than it will be to Dual HEN HOUSE A.

Dual HEN HOUSE D. The approximately 2,000-by-100-foot clearing for probable Dual HEN HOUSE D is located south of Dual HEN HOUSE C and east of Dual HEN HOUSE A. The long axis of this clearing is parallel to the long axis of Dual HEN HOUSE C. The appearance of this clearing gives the entire operations area a double Y or chevron configuration.

Other Structures and Activity in the Operations Area. A number of foundations containing footings for unidentified structures were located in the approximate center of the operations area (see annotations B through F, Figure 15). A standpipe with a capacity of approximately 353,000 U.S. gallons was seen just west of the control house construction at Dual HEN HOUSE C; however, there was no evidence of connecting pipelines.

Photography revealed earth scars connecting the 2 control buildings at Dual HEN HOUSE B

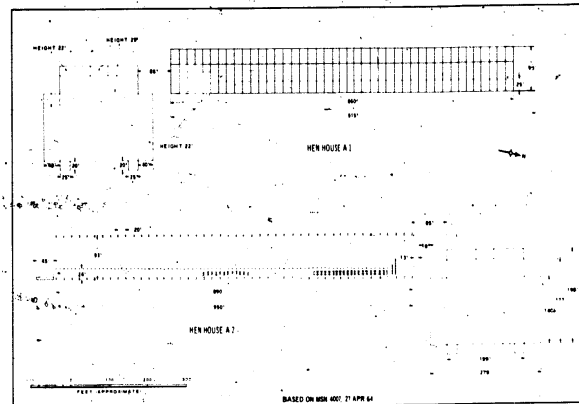


FIGURE 19. DUAL HEN HOUSE A, ANGARSK.

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and C and possibly the standpipe located just west of the Dual HEN HOUSE C control buildings. Earth scars also connect the control building at Dual HEN HOUSE A and construction activity located between the control house and the center of the cleared strip for Dual HEN HOUSE D.

This construction activity consists of a cleared area measuring approximately 190 by 150 feet and containing probable footings and some superstructure. Figure 23 shows the appearance of superstructure visible.

Approximately similar construction activity, also new, is located halfway between the control building of Dual HEN HOUSE B and Dual HEN HOUSE C, and adjacent to the connecting earth scar.

Photographs revealed that the probable trench from Dual HEN HOUSE A control building had been extended to the area of Dual HEN HOUSE D excavation activities (figures 17 and 18).

The approximate distance between the center of the control building at Dual HEN HOUSE A and the center of the cleared area for probable Dual HEN HOUSE D is 1,000 feet. The corresponding distance between the control buildings at Dual HEN HOUSE B and C is 1,800 feet.

The Support Areas. Figure 13 shows the relationship of support areas to the operating area and Figure 24 is a line drawing of all 3 support areas with information regarding floor space and construction progress.

The buildings in Support Area 1, Support Area 3,

and the western half of Support Area 2 appear to be wooden, temporary-type barracks and associated buildings. No effort has been made to construct a surface road to Support Area 1 or to the western half of Support Area 2. Though track activity indicates that access to these building areas has been primarily by foot, it also reveals that vehicles probably have been in these areas.

Intensive construction activity is visible in the central and southeastern end of Support Area 2. Two, and possibly three, tower-type construction cranes were positioned in the area. One was located at the beginning of the construction activity in the support area, the second, and a possible third were at work in the first-story building construction area. The four buildings shown on the drawings in Figures 13 and 24 represent buildings which were either complete or had walls and roof in place.

The structures outlined and not filled in represent buildings in earlier stages of construction, some with only footings in place. Most of the buildings in the central and southeastern half of Support Area 2 appear to be permanent-type buildings and construction

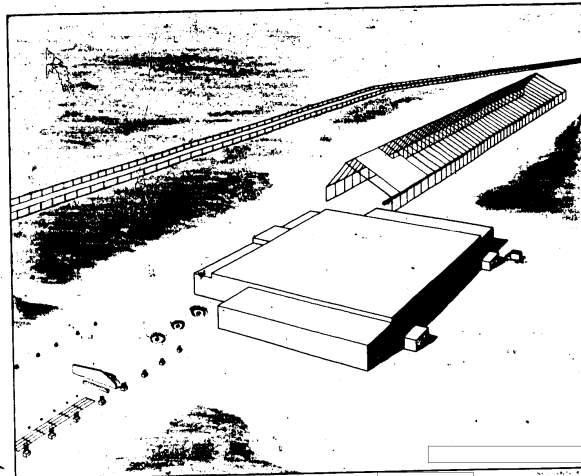


FIGURE 20. PERSPECTIVE OF DUAL HEN HOUSE A, ANGARSK.

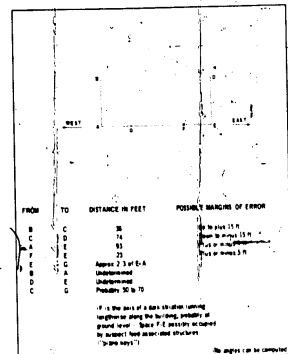
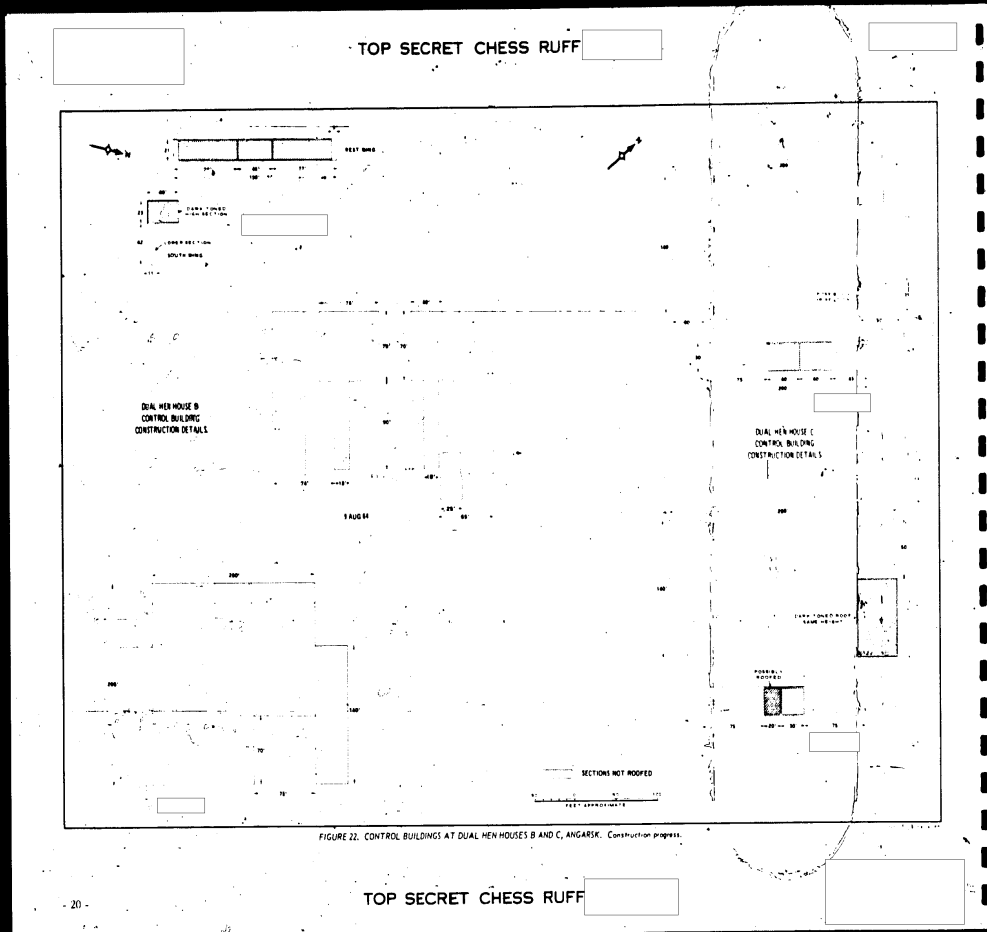


FIGURE 21. SIDE ELEVATION OF HEN HOUSE A1, ANGARSK.

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tion activity continues on and near most of them. Trenches, construction materials, and approximately 20 vehicles could be seen in the area. Photography reveals progress in Support Area 2. Superstructure is now visible on the steamplant, 2 adjacent structures and an additional multi-story permanent probable quarters in the southeastern end of Support Area 2. Photography revealed that approximately 6 buildings in Support Area 2, which were previously in early stage of construction, now appear externally complete. They include the steamplant and 1 of the multi-story probable quarters. Superstructure on the easternmost probable quarters is now being erected. Some of the trench for the water pipeline has been backfilled and a security fence can be detected around the electric power transformer substation.

The following figures reveal the probable personnel complement of the Angarsk Dual HEN HORSE Radar Site. It was assumed the uncompleted apartment-type buildings would have the same capacity as those completed:

| Type       | Floor Space | Accommodation          |                         |
|------------|-------------|------------------------|-------------------------|
|            |             | At 20 sq ft per person | At 100 sq ft per person |
| Barracks   | 56,000      | 1,250                  | 1,300                   |
| Apartments | 119,000     | 912                    |                         |
| Total      | 175,000     |                        |                         |

Probable minimum accommodation: 2,225 personnel  
 Probable maximum accommodation: 2,662 personnel

These figures need not necessarily represent a true picture of the total number of operational and support personnel at the site following its completion. It is possible that many of the barracks-type quarters were initially erected to house construction personnel, and may be dismantled or used for other purposes following completion of the project.

**Azimuths of Propagation**

Analysis of correlations between the configuration and size of Angarsk HEN HORSE A-1 (See Figures 19, 20, and 21) and the prototype HEN HORSE at Sary-Shagan Radar Site 1 permitted identification of the west side of Angarsk HEN HORSE A-1 as probably the antenna face side.

Initial analysis of the footings at Angarsk HEN HORSE A-2 resulted in a hypothesis that the internal footings might be located directly under the ridgeline of the HEN HORSE structure. This suggested that the antenna face on HEN HORSE A-2 might face to the east. Though this supposition seemed to be further supported by the linear non-alignment of excavations seen there were considerations which did not support this hypothesis.

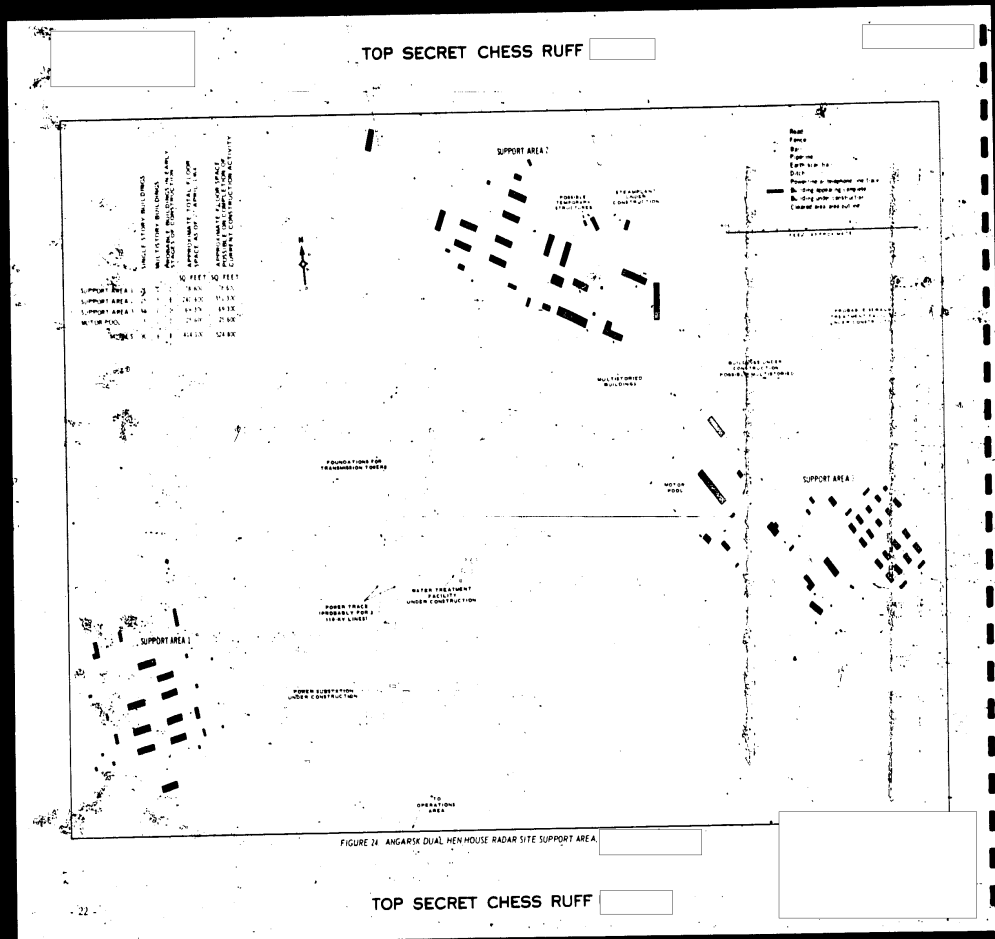
Further analysis of the Angarsk K117 coverage of revealed a dark striation along the length of and probably inside HEN HORSE A-1. It was located approximately the same distance from the east side of the structure as the distance separating the 2 easternmost rows of footings at HEN HORSE A-2. If this striation corresponds to the internal footings at A-2, it would follow that the internal footings at HEN HORSE A-2 need not necessarily fall under the ridgeline.

An important consideration is masking. If Angarsk HEN HORSE A-2 were to propagate in an easterly direction, Dual HEN HORSE C would cause interference. Furthermore, if similar construction at all other Dual HEN HORSE were to follow, it seems that serious masking problems would probably be experienced there as well.

If both antenna faces at Angarsk Dual HEN HORSE A were on the west side of their respective structures, there would be no masking problem. Assuming that this will indeed be the method of construction, other Angarsk installations were examined to determine possible correlations, assuming their construction pattern would be similar to installation A. This examination revealed that it would be reasonable to expect that both HEN HORSE antennas would be on the same side and have their boresight azimuths in parallel planes.

The face side of HEN HORSE structures probably can be predicted by noting the position of the control house with reference to a line joining the 2 HEN HORSE structures. Thus, if the face of each antenna at Angarsk Dual HEN HORSE A is on the west side, the entire control building would be to the rear of all propagating surfaces. If the same concept of construction is being followed at Sary-Shagan Site 13 (and it is at Dual HEN HORSE A, as revealed by photography) one can postulate that Dual HEN HORSEs at Angarsk will have their antenna faces on corresponding sides, having similar boresight azimuths in

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Dual HEN HOUSE installations, this map also shows the boresight azimuth from the prototype HEN HOUSE at Sary-Shagan Radar Site 1 and the possible azimuth from the Moscow DUG HOUSE possible phased-array radar, assuming that both faces of the DUG HOUSE will contain radar antennas.

Though these azimuths have been computed to an [redacted] most of them are only probable azimuths until photographic or other evidence can confirm the location of each antenna face. Consequently, for research purposes, a list of geographic coordinates along each conceivable azimuth from the HEN HOUSE structures is attached as Tables 1 through 12, pages 31 to 35. These geographic coordinates have been computer-determined at regular intervals along each of the listed azimuths, for a distance of approximately 5,000 nm from the given installation.

Geographic coordinates along both boresight azimuths from the DUG HOUSE also have been computer-determined and are included in Tables 14 and 15. The computer-produced coordinates were checked by solving reverse problems. Additional computer checks determined azimuths, given the previously computed coordinates.

A study of Figure 26 reveals that boresight azimuths (and some back azimuths) go near or through certain related installations. For example, the boresight azimuth from Angarak Dual HEN HOUSE A and B passes very close to Sary-Shagan and that from Sary-Shagan Dual HEN HOUSE C passes close to Angarak. Consequently, a second computer analysis was initiated to determine the exact distances and azimuths between possibly related points. Table 16 shows the result of this computer analysis.

A study of these azimuths shows that there is a high degree of probability that:

- 1) Angarak Dual HEN HOUSEs A and B are oriented to place their probable boresight azimuth through Sary-Shagan Site 13.
- 2) Sary-Shagan Dual HEN HOUSEs A and B are oriented to place their possible boresight azimuths through Iystratam Missile Test Center.
- 3) Sary-Shagan Dual HEN HOUSE C is oriented to place its possible boresight azimuth through the Angarak

Dual HEN HOUSE Radar Site.

- (4) Olenegorsk HEN HOUSE A-2 is oriented to place its possible back azimuth through Sary-Shagan Site 13.

If we hypothesize that the above probabilities are indeed fact, then one of the following conclusions could be accepted as correct:

- (1) The Soviets surveyed these installations accurately, to have the boresight azimuths line up as suggested in the previously stated probabilities and the azimuths computed for Figure 26 have a slightly higher margin of error than supposed.
- (2) The azimuths computed for Figure 26 are accurate and the Soviets did not survey these installations accurately (assuming an intent to have boresight azimuths line up as suggested above).
- (3) The azimuths computed for Figure 26 are accurate and the Soviets surveyed their installations accurately, and the proximity of boresight azimuths to the listed installations is simply coincidental (implying no intention to line up the boresight azimuths exactly with the given installations).
- (4) The azimuths compiled for Figure 26 are accurate and the Soviets surveyed the installations accurately, to have the boresight azimuths line up approximately as suggested in the above stated probabilities (implying no intention to have pinpointed accuracy).

Of the 4 possible conclusions listed, the first and the fourth appear to be the most reasonable.

### DISCUSSION

#### Type of Radar

It is generally believed that the HEN HOUSE structures house some type of phased-array radar. As the result of one hypothesis, it is suspected that 1 of the small structures attached to the end of a Dual HEN HOUSE serves as a transmitter house and the other as a terminal house. It is possible that such an arrangement would be compatible with a frequency-scanned phased-array radar.

Another hypothesis concludes that the bulk of the HEN HOUSE structure behind the face suggests the use of an array of lenses in the antenna face, with the feed elements

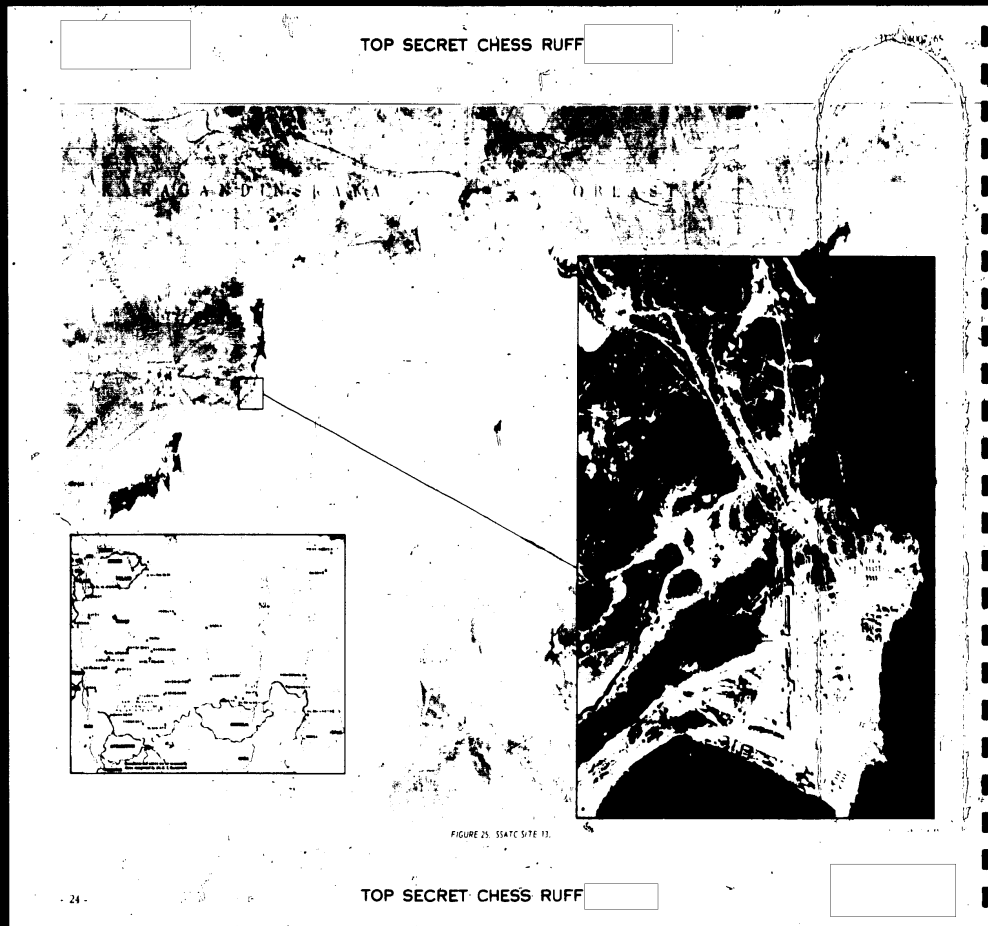
mounted internally a given distance behind each of the lens panels. The internal feedings and suspect internal feed-associated structures ( piano keys ) seen at the various HEN HOUSEs under construction must be studied carefully by antenna engineers. Figure 27 shows special care must be taken to note the correlation between the size, spacing and positions of the piano keys and the size and location of the relatively small buildings on each end of the HEN HOUSE structures. Further correlation to boresight angles and elevation will be most important.

The appearance of this internal construction of the various HEN HOUSEs somewhat resembles the appearance of suspect feed-associated structures which were revealed in front of the northern HEN HOUSE antenna structure at Radar Site Number 2; (b) TALENT photograph of [redacted] See Figure 28 which contains a photograph's impression of the piano key-type structure between the HEN HOUSE antenna and the ground clutter screen to the west. It is not possible to confirm whether these structures still are located in front of the HEN HOUSE antenna; however, some of the best and most recent KH-4 photos of HEN HOUSEs has not yet been covered by larger scale (1:100,000) photographs reveals a faint light-toned structure in front of the HEN HOUSE antenna, suggesting the possibility that some portion of these structures still remains (Figure 29).

TALENT photography of the HEN HOUSEs was used to compute the angles shown in Figure 28. Distances were measured on current, good-quality KH-4 photography.

The size of the original panels at Sary-Shagan's prototype HEN HOUSE was approximately 40 by 20 feet, according to analysis of TALENT photography of April 1960. Photographs [redacted] revealed that possibly larger panels were being installed (Figure 30). Because of the limitations imposed by relatively poor ground resolution the dimensions shown must be considered approximate only. The fact that a space can be detected between 6 separate panels would at first suggest that the distance between panels must be between 10 and 20 feet, the probable range of ground resolution for this coverage. However, linearity (considering a probable panel length of 40 feet) would make it possible to detect a smaller separation. The numerical coefficient in this relationship is not shown. Though the confidence in panel width measurements is relatively low, it is nevertheless interesting to note the

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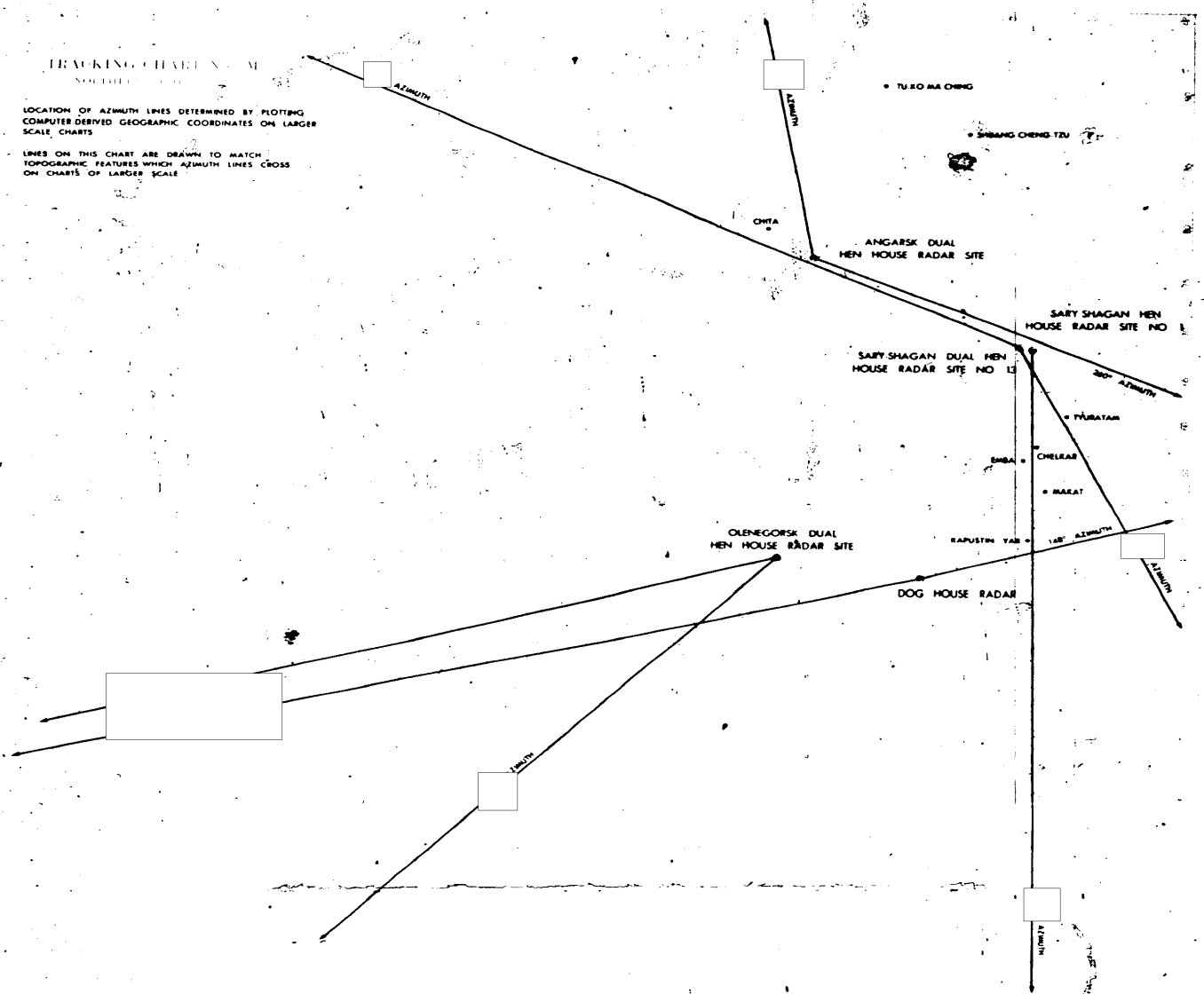


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TRACKING CHART  
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COMPUTER DERIVED GEOGRAPHIC COORDINATES ON LARGER  
SCALE CHARTS  
LINES ON THIS CHART ARE DRAWN TO MATCH  
TOPOGRAPHIC FEATURES WHICH AZMUTH LINES CROSS  
ON CHARTS OF LARGER SCALE



25X1

25X1

25X1

25X1

25X1

25X1

25X1

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TOP SECRET CHESS RUFF

metric system measurements derived. Later photography permitting more detailed analysis revealed the entire face as black, however, individual panels could not be detected. This suggests 1 of 3 possibilities:

- 1. Wider panels were installed, with distance between panels too small for photo resolution.
- 2. Wider panels were installed with no space between panels.
- 3. The entire face was covered by a continuous sheet of dark material.

### Size and Configuration of HEN HOUSE Structures

A study of line drawings and dimensions reveals that probably at least 2 different modifications of the Dual HEN HOUSE installations are being constructed, though the control house in each case appears similar in shape and size. These different modifications are possibly related to the requirements of propagating radar energy along different bore-sight angles of elevation. However, bore-sight angles of elevation at Sary-Shagan Dual HEN HOUSE A are different at each of the HEN HOUSE radar faces, despite the fact that the HEN HOUSE structures and probably their piano key channels are similar in size and placement.

For purposes of discussion the 2 modifications can be called "EAL-BOY" and "THIN-BOY." In the case of the THIN-BOY variety, both HEN HOUSE antenna structures are generally similar in size, both being approximately 100 feet in width, or less. In addition, THIN-BOY HEN HOUSEs have their internal suspect feed-associated structures (piano keys) against the rear wall of the HEN HOUSE structure. The piano key channels in both THIN-BOY HEN HOUSE structures are probably similar in width, though they are markedly smaller than the piano key features at EAL-BOY HEN HOUSEs. Suspect transmitter and terminal houses at THIN-BOY HEN HOUSEs are smaller than the corresponding structures attached to EAL-BOY HEN HOUSEs (Figure 27).

In the case of EAL-BOY HEN HOUSEs, the HEN HOUSE structure on each side of the control building differs in width, 1 being approximately 110 feet wide, the other approximately

135 feet wide. The width of the piano key channel possibly differs and the channels are positioned a markedly different distance from the rear of their respective HEN HOUSE enclosures. Therefore it is suspected that bore-sight angles of elevation on EAL-BOY HEN HOUSEs might be sufficiently elevated to permit the vertical beaver tail propagation pattern to extend beyond the zenith along the back azimuth. Dual HEN HOUSE A at Angarak and Sary-Shagan are of the THIN-BOY variety, with suspect transmitter and terminal houses lined up with the row of internal suspect feed-associated structures (piano keys) which are positioned against the inside rear wall of the HEN HOUSE structure.

The following Dual HEN HOUSE radars are of the EAL-BOY variety:

- Sary-Shagan Site 13 - Dual HEN HOUSE B
- Sary-Shagan Site 13 - Dual HEN HOUSE C
- Probably Angarak Dual HEN HOUSE B
- Probably Angarak Dual HEN HOUSE C

It is suspected that Dual HEN HOUSE D at Angarak and at Sary-Shagan Site 13 will be of the THIN-BOY variety in view of the pattern established to date.

Both HEN HOUSE structures at Olengorak are probably of the THIN-BOY variety, based on the width of the HEN HOUSE antenna structure, the alignment of suspect transmitter and terminal houses with the rear of the HEN HOUSE structure, and the possible placement of internal feed-associated structures against the rear wall of the HEN HOUSE.

### Function of the Dual HEN HOUSEs

The locations of the Dual HEN HOUSE sites at Angarak and at Sary-Shagan suggest that these installations are possibly part of a satellite radar fence. The prototype HEN HOUSE at Sary-Shagan Radar Site 1 was the research and development version; therefore, it is hardly likely that the extensive Dual HEN HOUSE installations at Sary-Shagan and northwest of Angarak would be for research and development purposes. Their location does not appear optimum for an early warning role against ballistic missiles. [redacted] from Sary-Shagan Site 13 passes through Launch Complex A at Tyuratam and the [redacted] azimuth passes within 250 and 275 nm of the centers of Soviet Pacific Impact Areas 1 and 2, respectively.

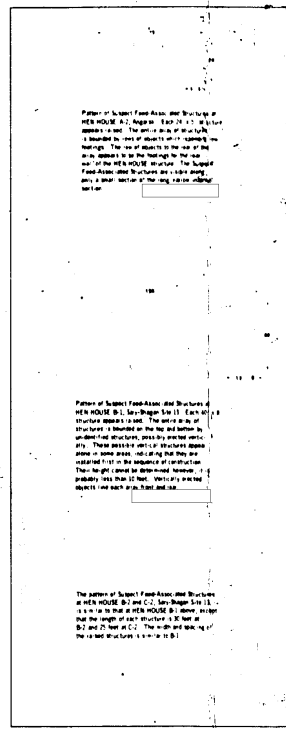


FIGURE 27. SUSPECT FEED-ASSOCIATED STRUCTURES, SARY-SHAGAN AND ANGARAK

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TOP SECRET CHESS RUFF

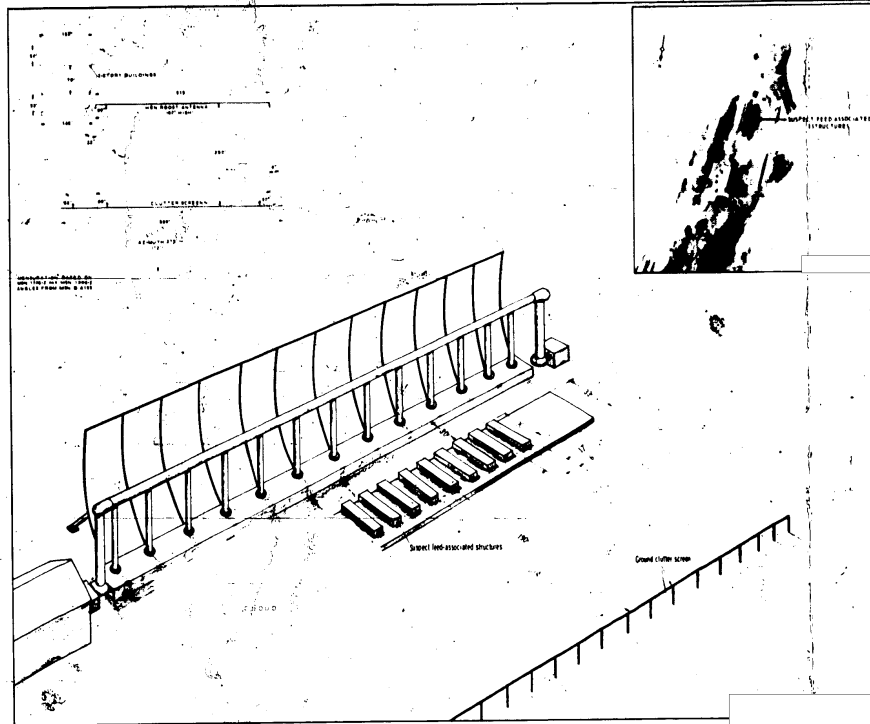


FIGURE 28: NEW MOBILE RADAR, SSATC.

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TOP SECRET CHESS RUFF

These impact areas are approximately 900 and 600 nm south-southeast of Johnston Island. These facts suggest a possibility that Sary-Shagan Site 13 Dual HEN HOUSE might also be employed in the Soviet space and ICBM test program.

The location of the Olenegorsk Dual HEN HOUSE facility, with its probable azimuths of propagation shown in Figures 11 and 26, suggests a dual role: ballistic missile early warning and anti-satellite radar fence.

As regards the possibility of the site at Olenegorsk being part of a ballistic missile early warning system, it is argued that, if true, we may find more installations of the same type going up simultaneously along the northern reaches of the Soviet Union. This is not necessarily true. Though we may reject the idea of a pre-emptive first strike against the Soviet Union, it is highly probable that Soviet political and military thinking equates possibility with capability and not with current Western political thinking. Consequently, the Soviets must develop the capability to launch their strategic weapons before they can be destroyed by a pre-emptive strike from the West. Therefore, a ballistic missile early warning system is mandatory if their strategic military power is to be credible as a deterrent force. The vulnerability of the Olenegorsk Dual HEN HOUSE radars to nuclear attack does not detract from their early warning effectiveness and the political gain from establishment of an operational system for even a limited number of important targets would be great. It is therefore possible that the Soviets would press forward to the early realization of such a system, even though its operational effectiveness initially might be rather limited.

**Relationship of the Dual HEN HOUSES and the Building Triad at Site 13, Sary-Shagan**

A functional relationship between the building triad at Sary-Shagan Site 13 and the nearby Dual HEN HOUSE installations is probable, but cannot be confirmed.

The collocation of the building triad and the Dual HEN HOUSE installations is probably not coincidental. With the appearance of construction activity at Dual HEN HOUSE in-

stallation B, [redacted] photography revealed a straight earth scar between the building triad area and the vicinity of construction on the control building of Dual HEN HOUSE B. See graphic chronology of earth scars in Figure 8. This earth scar will be very prominent [redacted]

[redacted] It appeared to run from an area adjacent to the south side of the large building in the triad toward the control building at Dual HEN HOUSE B. It is suspected that this scar is a buried conduit to the control house, passing under the road which runs behind the HEN HOUSE construction. [redacted] a straight earth scar could be seen leading toward the Dual HEN HOUSE B construction from the north side of the large building in the triad. Partial cloud cover did not permit observing its terminus. The same mission revealed a straight earth scar south of the entire triad, oriented approximately east-west and skirting the southern side of the southernmost small building of the triad. Photograph [redacted] confirmed the presence of the 2 scars seen [redacted]

The scar seen leaving the area adjacent to the south side of the large triad building in December 1963 and February 1964 could no longer be detected [redacted] The shorter of the 2 scars still visible has its terminus at points south of the large triad building and southeast of Dual HEN HOUSE B control building. It is possible these earth scars are simply signatures of buried water, steam or electric power lines. They could, however, signify some sort of functional interdependence. Enclosing the Dual HEN HOUSES and the triad facility behind the same double security fence, in itself, does not prove functional interdependence; however, it is important evidence to consider.

Perhaps the most critical evidence regarding the possible relationship of the building triad to the Dual HEN HOUSE at Sary-Shagan concerns chronology of electric powerline installations (Figure 30). Electric power transmission lines leading from the Balkhash area toward the Sary-Shagan Main Support Base and Gulshat were tapped and towers for overhead electric power transmission lines were installed in lines leading southward toward the Dual HEN HOUSE construction site. Transmission towers for a 35-kv line were first seen on 26 December and negated [redacted] Transmission towers for a 110-kv line were suspected in place [redacted]

[redacted] The latter data applies to the larger of the 2 electric power transformer substations located about 2 nm northwest of the central support area. Evidence of other overhead powerlines into Site 13 cannot be found, however evidence of power transmission or telecommunication poles can be detected leading into the water pumping station area from the town of Gulshat. Because of the extensive track activity between the pumping station and Sary-Shagan Site 13, and the limitation of available photography, an electric power transmission line cannot be negated between these 2 points. However, it is conceivable that electric power consumed at Sary-Shagan Site 13 prior to 1964 was produced on site by internal combustion power generators. If on site power generation would be inadequate for employment of the building triad, it can be concluded that the triad at Sary-Shagan Site 13 has not yet been operational. [redacted] It is the fact that the transmission towers carrying electric power from the vicinity of the Main Support Base to Radar Sites 1 and 2 down into Instrumentation Site 12, have a spacing and height which strongly suggest that 35-kv power lines are serving these installations. The same is true of transmission tower spacing for electric powerlines serving Launch Complex B and Instrumentation Site 10. At the same time it should be recalled that 110-kv powerlines are being installed into the Angarsk Dual HEN HOUSE Radar Site.

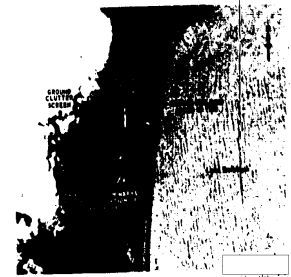
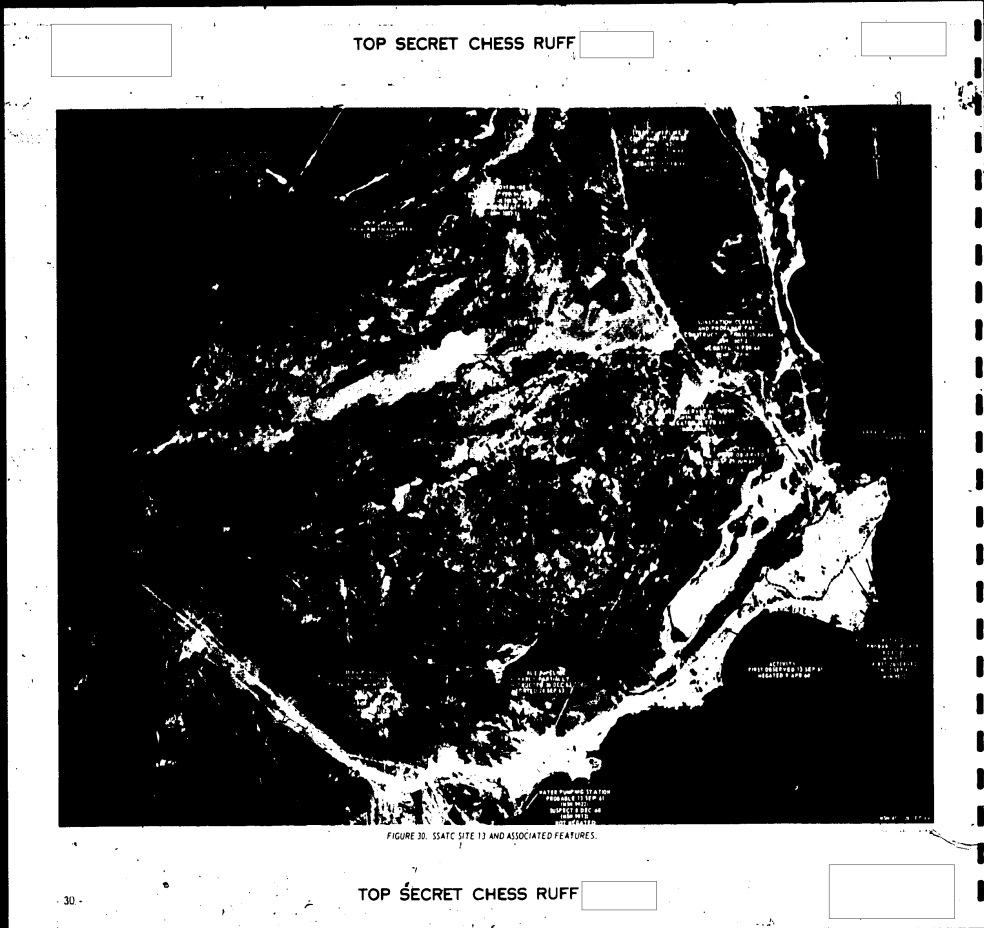


FIGURE 29. HEN HOUSE NORTH TRIAD

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Table 1. HVA HOUSE, Key Stage 1 (Continued), etc. 11  
Geographic Coordinates

Latitude Longitude

|        |        |
|--------|--------|
| 46.35N | 71.00E |
| 46.25N | 71.40E |
| 46.10N | 69.20E |
| 46.00N | 67.30E |
| 45.50N | 65.00E |
| 46.15N | 63.00E |
| 46.25N | 60.50E |
| 46.30N | 57.00E |
| 46.40N | 52.00E |
| 46.50N | 45.20E |
| 46.00N | 37.50E |
| 45.75N | 31.50E |
| 46.10N | 26.10E |
| 46.00N | 18.40E |
| 46.15N | 15.00E |
| 46.40N | 10.50E |
| 46.10N | 10.10E |
| 46.30N | 10.10E |
| 46.10N | 0.30E  |
| 46.00N | 0.40E  |
| 46.05N | 0.50E  |
| 46.00N | 0.60E  |
| 46.00N | 0.70E  |
| 46.00N | 0.80E  |
| 46.00N | 0.90E  |
| 46.00N | 1.00E  |
| 46.00N | 1.10E  |
| 46.00N | 1.20E  |
| 46.00N | 1.30E  |
| 46.00N | 1.40E  |
| 46.00N | 1.50E  |
| 46.00N | 1.60E  |
| 46.00N | 1.70E  |
| 46.00N | 1.80E  |
| 46.00N | 1.90E  |
| 46.00N | 2.00E  |
| 46.00N | 2.10E  |
| 46.00N | 2.20E  |
| 46.00N | 2.30E  |
| 46.00N | 2.40E  |
| 46.00N | 2.50E  |
| 46.00N | 2.60E  |
| 46.00N | 2.70E  |
| 46.00N | 2.80E  |
| 46.00N | 2.90E  |
| 46.00N | 3.00E  |
| 46.00N | 3.10E  |
| 46.00N | 3.20E  |
| 46.00N | 3.30E  |
| 46.00N | 3.40E  |
| 46.00N | 3.50E  |
| 46.00N | 3.60E  |
| 46.00N | 3.70E  |
| 46.00N | 3.80E  |
| 46.00N | 3.90E  |
| 46.00N | 4.00E  |
| 46.00N | 4.10E  |
| 46.00N | 4.20E  |
| 46.00N | 4.30E  |
| 46.00N | 4.40E  |
| 46.00N | 4.50E  |
| 46.00N | 4.60E  |
| 46.00N | 4.70E  |
| 46.00N | 4.80E  |
| 46.00N | 4.90E  |
| 46.00N | 5.00E  |
| 46.00N | 5.10E  |
| 46.00N | 5.20E  |
| 46.00N | 5.30E  |
| 46.00N | 5.40E  |
| 46.00N | 5.50E  |
| 46.00N | 5.60E  |
| 46.00N | 5.70E  |
| 46.00N | 5.80E  |
| 46.00N | 5.90E  |
| 46.00N | 6.00E  |
| 46.00N | 6.10E  |
| 46.00N | 6.20E  |
| 46.00N | 6.30E  |
| 46.00N | 6.40E  |
| 46.00N | 6.50E  |
| 46.00N | 6.60E  |
| 46.00N | 6.70E  |
| 46.00N | 6.80E  |
| 46.00N | 6.90E  |
| 46.00N | 7.00E  |
| 46.00N | 7.10E  |
| 46.00N | 7.20E  |
| 46.00N | 7.30E  |
| 46.00N | 7.40E  |
| 46.00N | 7.50E  |
| 46.00N | 7.60E  |
| 46.00N | 7.70E  |
| 46.00N | 7.80E  |
| 46.00N | 7.90E  |
| 46.00N | 8.00E  |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

Table 2. HVA HOUSE, Key Stage 2 (Continued), etc. 12  
Geographic Coordinates

Latitude Longitude

|        |        |
|--------|--------|
| 46.35N | 71.00E |
| 46.25N | 71.40E |
| 46.10N | 69.20E |
| 46.00N | 67.30E |
| 45.50N | 65.00E |
| 46.15N | 63.00E |
| 46.25N | 60.50E |
| 46.30N | 57.00E |
| 46.40N | 52.00E |
| 46.50N | 45.20E |
| 46.00N | 37.50E |
| 45.75N | 31.50E |
| 46.10N | 26.10E |
| 46.00N | 18.40E |
| 46.15N | 15.00E |
| 46.40N | 10.50E |
| 46.10N | 10.10E |
| 46.30N | 10.10E |
| 46.10N | 0.30E  |
| 46.00N | 0.40E  |
| 46.05N | 0.50E  |
| 46.00N | 0.60E  |
| 46.00N | 0.70E  |
| 46.00N | 0.80E  |
| 46.00N | 0.90E  |
| 46.00N | 1.00E  |
| 46.00N | 1.10E  |
| 46.00N | 1.20E  |
| 46.00N | 1.30E  |
| 46.00N | 1.40E  |
| 46.00N | 1.50E  |
| 46.00N | 1.60E  |
| 46.00N | 1.70E  |
| 46.00N | 1.80E  |
| 46.00N | 1.90E  |
| 46.00N | 2.00E  |
| 46.00N | 2.10E  |
| 46.00N | 2.20E  |
| 46.00N | 2.30E  |
| 46.00N | 2.40E  |
| 46.00N | 2.50E  |
| 46.00N | 2.60E  |
| 46.00N | 2.70E  |
| 46.00N | 2.80E  |
| 46.00N | 2.90E  |
| 46.00N | 3.00E  |
| 46.00N | 3.10E  |
| 46.00N | 3.20E  |
| 46.00N | 3.30E  |
| 46.00N | 3.40E  |
| 46.00N | 3.50E  |
| 46.00N | 3.60E  |
| 46.00N | 3.70E  |
| 46.00N | 3.80E  |
| 46.00N | 3.90E  |
| 46.00N | 4.00E  |
| 46.00N | 4.10E  |
| 46.00N | 4.20E  |
| 46.00N | 4.30E  |
| 46.00N | 4.40E  |
| 46.00N | 4.50E  |
| 46.00N | 4.60E  |
| 46.00N | 4.70E  |
| 46.00N | 4.80E  |
| 46.00N | 4.90E  |
| 46.00N | 5.00E  |
| 46.00N | 5.10E  |
| 46.00N | 5.20E  |
| 46.00N | 5.30E  |
| 46.00N | 5.40E  |
| 46.00N | 5.50E  |
| 46.00N | 5.60E  |
| 46.00N | 5.70E  |
| 46.00N | 5.80E  |
| 46.00N | 5.90E  |
| 46.00N | 6.00E  |
| 46.00N | 6.10E  |
| 46.00N | 6.20E  |
| 46.00N | 6.30E  |
| 46.00N | 6.40E  |
| 46.00N | 6.50E  |
| 46.00N | 6.60E  |
| 46.00N | 6.70E  |
| 46.00N | 6.80E  |
| 46.00N | 6.90E  |
| 46.00N | 7.00E  |
| 46.00N | 7.10E  |
| 46.00N | 7.20E  |
| 46.00N | 7.30E  |
| 46.00N | 7.40E  |
| 46.00N | 7.50E  |
| 46.00N | 7.60E  |
| 46.00N | 7.70E  |
| 46.00N | 7.80E  |
| 46.00N | 7.90E  |
| 46.00N | 8.00E  |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

Table 3. HVA HOUSE, Key Stage 3 (Continued), etc. 13  
Geographic Coordinates

Latitude Longitude

|        |        |
|--------|--------|
| 46.35N | 71.00E |
| 46.25N | 71.40E |
| 46.10N | 69.20E |
| 46.00N | 67.30E |
| 45.50N | 65.00E |
| 46.15N | 63.00E |
| 46.25N | 60.50E |
| 46.30N | 57.00E |
| 46.40N | 52.00E |
| 46.50N | 45.20E |
| 46.00N | 37.50E |
| 45.75N | 31.50E |
| 46.10N | 26.10E |
| 46.00N | 18.40E |
| 46.15N | 15.00E |
| 46.40N | 10.50E |
| 46.10N | 10.10E |
| 46.30N | 10.10E |
| 46.10N | 0.30E  |
| 46.00N | 0.40E  |
| 46.05N | 0.50E  |
| 46.00N | 0.60E  |
| 46.00N | 0.70E  |
| 46.00N | 0.80E  |
| 46.00N | 0.90E  |
| 46.00N | 1.00E  |
| 46.00N | 1.10E  |
| 46.00N | 1.20E  |
| 46.00N | 1.30E  |
| 46.00N | 1.40E  |
| 46.00N | 1.50E  |
| 46.00N | 1.60E  |
| 46.00N | 1.70E  |
| 46.00N | 1.80E  |
| 46.00N | 1.90E  |
| 46.00N | 2.00E  |
| 46.00N | 2.10E  |
| 46.00N | 2.20E  |
| 46.00N | 2.30E  |
| 46.00N | 2.40E  |
| 46.00N | 2.50E  |
| 46.00N | 2.60E  |
| 46.00N | 2.70E  |
| 46.00N | 2.80E  |
| 46.00N | 2.90E  |
| 46.00N | 3.00E  |
| 46.00N | 3.10E  |
| 46.00N | 3.20E  |
| 46.00N | 3.30E  |
| 46.00N | 3.40E  |
| 46.00N | 3.50E  |
| 46.00N | 3.60E  |
| 46.00N | 3.70E  |
| 46.00N | 3.80E  |
| 46.00N | 3.90E  |
| 46.00N | 4.00E  |
| 46.00N | 4.10E  |
| 46.00N | 4.20E  |
| 46.00N | 4.30E  |
| 46.00N | 4.40E  |
| 46.00N | 4.50E  |
| 46.00N | 4.60E  |
| 46.00N | 4.70E  |
| 46.00N | 4.80E  |
| 46.00N | 4.90E  |
| 46.00N | 5.00E  |
| 46.00N | 5.10E  |
| 46.00N | 5.20E  |
| 46.00N | 5.30E  |
| 46.00N | 5.40E  |
| 46.00N | 5.50E  |
| 46.00N | 5.60E  |
| 46.00N | 5.70E  |
| 46.00N | 5.80E  |
| 46.00N | 5.90E  |
| 46.00N | 6.00E  |
| 46.00N | 6.10E  |
| 46.00N | 6.20E  |
| 46.00N | 6.30E  |
| 46.00N | 6.40E  |
| 46.00N | 6.50E  |
| 46.00N | 6.60E  |
| 46.00N | 6.70E  |
| 46.00N | 6.80E  |
| 46.00N | 6.90E  |
| 46.00N | 7.00E  |
| 46.00N | 7.10E  |
| 46.00N | 7.20E  |
| 46.00N | 7.30E  |
| 46.00N | 7.40E  |
| 46.00N | 7.50E  |
| 46.00N | 7.60E  |
| 46.00N | 7.70E  |
| 46.00N | 7.80E  |
| 46.00N | 7.90E  |
| 46.00N | 8.00E  |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

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Table 6. BEN HOUSE, Oleznorsk, Geographic Coordinates

| Latitude | Longitude |
|----------|-----------|
| 08-12N   | 103-47E   |
| 11-11N   | 103-10E   |
| 12-08N   | 102-50E   |
| 13-08N   | 101-40E   |
| 15-11N   | 101-00E   |
| 16-15N   | 100-41E   |
| 17-03N   | 100-10E   |
| 17-54N   | 101-20W   |
| 17-56N   | 101-24W   |
| 17-58N   | 101-41W   |
| 17-54N   | 102-14W   |
| 17-02N   | 102-10W   |
| 16-13N   | 103-45W   |
| 15-11N   | 105-24W   |
| 13-59N   | 106-04W   |
| 12-59N   | 107-03W   |
| 11-15N   | 107-15W   |
| 09-42N   | 107-52W   |
| 08-02N   | 108-20W   |
| 06-29N   | 108-43W   |
| 04-49N   | 108-06W   |
| 03-02N   | 108-12W   |
| 01-25N   | 108-10W   |
| 38-32N   | 106-44W   |
| 37-51N   | 106-14W   |
| 36-04N   | 105-35W   |
| 34-15N   | 104-50W   |
| 32-05N   | 103-58W   |
| 30-37N   | 102-40W   |
| 18-47N   | 100-58W   |
| 16-57N   | 100-52W   |
| 15-03N   | 101-42W   |
| 13-14N   | 102-30W   |
| 11-22N   | 103-18W   |
| 10-10N   | 103-56W   |
| 07-34N   | 104-53W   |
| 05-46N   | 105-33W   |
| 03-54N   | 106-10W   |
| 02-03N   | 106-57W   |
| 30-06N   | 108-57W   |
| 28-15N   | 107-28W   |
| 25-08N   | 107-40W   |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

Table 7. BEN HOUSE, Oleznorsk, Geographic Coordinates

| Latitude | Longitude |
|----------|-----------|
| 06-29N   | 108-40E   |
| 04-49N   | 108-00E   |
| 03-08N   | 108-00E   |
| 01-25N   | 108-04E   |
| 38-37N   | 106-04E   |
| 37-55N   | 106-02E   |
| 36-08N   | 105-10E   |
| 34-15N   | 104-41E   |
| 32-04N   | 103-52E   |
| 30-36N   | 103-02E   |
| 28-44N   | 102-10E   |
| 26-56N   | 101-40E   |
| 25-05N   | 101-10E   |
| 23-12N   | 100-20E   |
| 21-24N   | 099-30E   |
| 19-36N   | 098-40E   |
| 17-48N   | 097-50E   |
| 15-58N   | 097-00E   |
| 14-08N   | 096-10E   |
| 12-18N   | 095-20E   |
| 10-28N   | 094-30E   |
| 08-38N   | 093-40E   |
| 06-48N   | 092-50E   |
| 04-58N   | 092-00E   |
| 03-08N   | 091-10E   |
| 01-18N   | 090-20E   |
| 39-28N   | 109-20E   |
| 37-38N   | 108-30E   |
| 35-48N   | 107-40E   |
| 33-58N   | 106-50E   |
| 32-08N   | 106-00E   |
| 30-18N   | 105-10E   |
| 28-28N   | 104-20E   |
| 26-38N   | 103-30E   |
| 24-48N   | 102-40E   |
| 22-58N   | 101-50E   |
| 21-08N   | 101-00E   |
| 19-18N   | 100-10E   |
| 17-28N   | 099-20E   |
| 15-38N   | 098-30E   |
| 13-48N   | 097-40E   |
| 11-58N   | 096-50E   |
| 10-08N   | 096-00E   |
| 08-18N   | 095-10E   |
| 06-28N   | 094-20E   |
| 04-38N   | 093-30E   |
| 02-48N   | 092-40E   |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

Table 8. BEN HOUSE, Oleznorsk, Geographic Coordinates

| Latitude | Longitude |
|----------|-----------|
| 07-12N   | 108-22E   |
| 06-30N   | 108-24E   |
| 05-05N   | 108-22E   |
| 03-49N   | 108-19E   |
| 02-24N   | 108-16E   |
| 17-05N   | 105-54E   |
| 16-44N   | 105-54E   |
| 16-05N   | 105-54E   |
| 15-24N   | 105-54E   |
| 14-43N   | 105-54E   |
| 14-02N   | 105-54E   |
| 13-21N   | 105-54E   |
| 12-40N   | 105-54E   |
| 12-00N   | 105-54E   |
| 11-19N   | 105-54E   |
| 10-38N   | 105-54E   |
| 09-57N   | 105-54E   |
| 09-16N   | 105-54E   |
| 08-35N   | 105-54E   |
| 07-54N   | 105-54E   |
| 07-13N   | 105-54E   |
| 06-32N   | 105-54E   |
| 05-51N   | 105-54E   |
| 05-10N   | 105-54E   |
| 04-29N   | 105-54E   |
| 03-48N   | 105-54E   |
| 03-07N   | 105-54E   |
| 02-26N   | 105-54E   |
| 01-45N   | 105-54E   |
| 01-04N   | 105-54E   |
| 00-23N   | 105-54E   |
| 39-42N   | 109-42E   |
| 37-52N   | 108-52E   |
| 36-02N   | 108-02E   |
| 34-12N   | 107-12E   |
| 32-22N   | 106-22E   |
| 30-32N   | 105-32E   |
| 28-42N   | 104-42E   |
| 26-52N   | 103-52E   |
| 25-02N   | 103-02E   |
| 23-12N   | 102-12E   |
| 21-22N   | 101-22E   |
| 19-32N   | 100-32E   |
| 17-42N   | 99-42E    |
| 15-52N   | 98-52E    |
| 14-02N   | 98-02E    |
| 12-12N   | 97-12E    |
| 10-22N   | 96-22E    |
| 08-32N   | 95-32E    |
| 06-42N   | 94-42E    |
| 04-52N   | 93-52E    |
| 03-02N   | 93-02E    |
| 01-12N   | 92-12E    |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

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Table 9. BEN HOUSE. Approx. Geographic Coordinates

| Latitude | Longitude |
|----------|-----------|
| 32-50N   | 103-43E   |
| 32-51N   | 106-32E   |
| 32-52N   | 108-21E   |
| 32-53N   | 110-10E   |
| 32-54N   | 111-59E   |
| 32-55N   | 113-48E   |
| 32-56N   | 115-37E   |
| 32-57N   | 117-26E   |
| 32-58N   | 119-15E   |
| 32-59N   | 121-04E   |
| 33-00N   | 122-53E   |
| 33-01N   | 124-42E   |
| 33-02N   | 126-31E   |
| 33-03N   | 128-20E   |
| 33-04N   | 130-09E   |
| 33-05N   | 131-98E   |
| 33-06N   | 133-87E   |
| 33-07N   | 135-76E   |
| 33-08N   | 137-65E   |
| 33-09N   | 139-54E   |
| 33-10N   | 141-43E   |
| 33-11N   | 143-32E   |
| 33-12N   | 145-21E   |
| 33-13N   | 147-10E   |
| 33-14N   | 148-99E   |
| 33-15N   | 150-88E   |
| 33-16N   | 152-77E   |
| 33-17N   | 154-66E   |
| 33-18N   | 156-55E   |
| 33-19N   | 158-44E   |
| 33-20N   | 160-33E   |
| 33-21N   | 162-22E   |
| 33-22N   | 164-11E   |
| 33-23N   | 166-00E   |
| 33-24N   | 167-89E   |
| 33-25N   | 169-78E   |
| 33-26N   | 171-67E   |
| 33-27N   | 173-56E   |
| 33-28N   | 175-45E   |
| 33-29N   | 177-34E   |
| 33-30N   | 179-23E   |
| 33-31N   | 181-12E   |
| 33-32N   | 183-01E   |
| 33-33N   | 184-90E   |
| 33-34N   | 186-79E   |
| 33-35N   | 188-68E   |
| 33-36N   | 190-57E   |
| 33-37N   | 192-46E   |
| 33-38N   | 194-35E   |
| 33-39N   | 196-24E   |
| 33-40N   | 198-13E   |
| 33-41N   | 200-02E   |
| 33-42N   | 201-51E   |
| 33-43N   | 203-40E   |
| 33-44N   | 205-29E   |
| 33-45N   | 207-18E   |
| 33-46N   | 209-07E   |
| 33-47N   | 210-96E   |
| 33-48N   | 212-85E   |
| 33-49N   | 214-74E   |
| 33-50N   | 216-63E   |
| 33-51N   | 218-52E   |
| 33-52N   | 220-41E   |
| 33-53N   | 222-30E   |
| 33-54N   | 224-19E   |
| 33-55N   | 226-08E   |
| 33-56N   | 227-97E   |
| 33-57N   | 229-86E   |
| 33-58N   | 231-75E   |
| 33-59N   | 233-64E   |
| 34-00N   | 235-53E   |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

Table 10. BEN HOUSE. Approx. Geographic Coordinates

| Latitude | Longitude |
|----------|-----------|
| 32-50N   | 105-13E   |
| 32-51N   | 108-02E   |
| 32-52N   | 110-91E   |
| 32-53N   | 113-80E   |
| 32-54N   | 116-69E   |
| 32-55N   | 119-58E   |
| 32-56N   | 122-47E   |
| 32-57N   | 125-36E   |
| 32-58N   | 128-25E   |
| 32-59N   | 131-14E   |
| 33-00N   | 134-03E   |
| 33-01N   | 136-92E   |
| 33-02N   | 139-81E   |
| 33-03N   | 142-70E   |
| 33-04N   | 145-59E   |
| 33-05N   | 148-48E   |
| 33-06N   | 151-37E   |
| 33-07N   | 154-26E   |
| 33-08N   | 157-15E   |
| 33-09N   | 160-04E   |
| 33-10N   | 162-93E   |
| 33-11N   | 165-82E   |
| 33-12N   | 168-71E   |
| 33-13N   | 171-60E   |
| 33-14N   | 174-49E   |
| 33-15N   | 177-38E   |
| 33-16N   | 180-27E   |
| 33-17N   | 183-16E   |
| 33-18N   | 186-05E   |
| 33-19N   | 188-94E   |
| 33-20N   | 191-83E   |
| 33-21N   | 194-72E   |
| 33-22N   | 197-61E   |
| 33-23N   | 200-50E   |
| 33-24N   | 203-39E   |
| 33-25N   | 206-28E   |
| 33-26N   | 209-17E   |
| 33-27N   | 212-06E   |
| 33-28N   | 214-95E   |
| 33-29N   | 217-84E   |
| 33-30N   | 220-73E   |
| 33-31N   | 223-62E   |
| 33-32N   | 226-51E   |
| 33-33N   | 229-40E   |
| 33-34N   | 232-29E   |
| 33-35N   | 235-18E   |
| 33-36N   | 238-07E   |
| 33-37N   | 240-96E   |
| 33-38N   | 243-85E   |
| 33-39N   | 246-74E   |
| 33-40N   | 249-63E   |
| 33-41N   | 252-52E   |
| 33-42N   | 255-41E   |
| 33-43N   | 258-30E   |
| 33-44N   | 261-19E   |
| 33-45N   | 264-08E   |
| 33-46N   | 266-97E   |
| 33-47N   | 269-86E   |
| 33-48N   | 272-75E   |
| 33-49N   | 275-64E   |
| 33-50N   | 278-53E   |
| 33-51N   | 281-42E   |
| 33-52N   | 284-31E   |
| 33-53N   | 287-20E   |
| 33-54N   | 290-09E   |
| 33-55N   | 292-98E   |
| 33-56N   | 295-87E   |
| 33-57N   | 298-76E   |
| 33-58N   | 301-65E   |
| 33-59N   | 304-54E   |
| 34-00N   | 307-43E   |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

Table 11. BEN HOUSE. Approx. Geographic Coordinates

| Latitude | Longitude |
|----------|-----------|
| 32-50N   | 106-53E   |
| 32-51N   | 109-42E   |
| 32-52N   | 112-31E   |
| 32-53N   | 115-20E   |
| 32-54N   | 118-09E   |
| 32-55N   | 120-98E   |
| 32-56N   | 123-87E   |
| 32-57N   | 126-76E   |
| 32-58N   | 129-65E   |
| 32-59N   | 132-54E   |
| 33-00N   | 135-43E   |
| 33-01N   | 138-32E   |
| 33-02N   | 141-21E   |
| 33-03N   | 144-10E   |
| 33-04N   | 146-99E   |
| 33-05N   | 149-88E   |
| 33-06N   | 152-77E   |
| 33-07N   | 155-66E   |
| 33-08N   | 158-55E   |
| 33-09N   | 161-44E   |
| 33-10N   | 164-33E   |
| 33-11N   | 167-22E   |
| 33-12N   | 170-11E   |
| 33-13N   | 173-00E   |
| 33-14N   | 175-89E   |
| 33-15N   | 178-78E   |
| 33-16N   | 181-67E   |
| 33-17N   | 184-56E   |
| 33-18N   | 187-45E   |
| 33-19N   | 190-34E   |
| 33-20N   | 193-23E   |
| 33-21N   | 196-12E   |
| 33-22N   | 199-01E   |
| 33-23N   | 201-90E   |
| 33-24N   | 204-79E   |
| 33-25N   | 207-68E   |
| 33-26N   | 210-57E   |
| 33-27N   | 213-46E   |
| 33-28N   | 216-35E   |
| 33-29N   | 219-24E   |
| 33-30N   | 222-13E   |
| 33-31N   | 225-02E   |
| 33-32N   | 227-91E   |
| 33-33N   | 230-80E   |
| 33-34N   | 233-69E   |
| 33-35N   | 236-58E   |
| 33-36N   | 239-47E   |
| 33-37N   | 242-36E   |
| 33-38N   | 245-25E   |
| 33-39N   | 248-14E   |
| 33-40N   | 251-03E   |
| 33-41N   | 253-92E   |
| 33-42N   | 256-81E   |
| 33-43N   | 259-70E   |
| 33-44N   | 262-59E   |
| 33-45N   | 265-48E   |
| 33-46N   | 268-37E   |
| 33-47N   | 271-26E   |
| 33-48N   | 274-15E   |
| 33-49N   | 277-04E   |
| 33-50N   | 279-93E   |

\*Coordinates at regular intervals from site to a distance of approximately 5,000 m.

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Table 12. BEN HOUSE, Legend, Geographic Coordinates

Table 13. Singshalet HP Base Site 1, Geographic

Table 14. BEN HOUSE, Legend, Geographic

| Latitude | Longitude | Latitude | Longitude | Latitude | Longitude |
|----------|-----------|----------|-----------|----------|-----------|
| 32°31N   | 101°15E   | 45°59N   | 125°00E   | 72°25N   | 104°41E   |
| 32°30N   | 101°14E   | 46°00N   | 125°01E   | 72°26N   | 104°42E   |
| 32°29N   | 101°13E   | 46°01N   | 125°02E   | 72°27N   | 104°43E   |
| 32°28N   | 101°12E   | 46°02N   | 125°03E   | 72°28N   | 104°44E   |
| 32°27N   | 101°11E   | 46°03N   | 125°04E   | 72°29N   | 104°45E   |
| 32°26N   | 101°10E   | 46°04N   | 125°05E   | 72°30N   | 104°46E   |
| 32°25N   | 101°09E   | 46°05N   | 125°06E   | 72°31N   | 104°47E   |
| 32°24N   | 101°08E   | 46°06N   | 125°07E   | 72°32N   | 104°48E   |
| 32°23N   | 101°07E   | 46°07N   | 125°08E   | 72°33N   | 104°49E   |
| 32°22N   | 101°06E   | 46°08N   | 125°09E   | 72°34N   | 104°50E   |
| 32°21N   | 101°05E   | 46°09N   | 125°10E   | 72°35N   | 104°51E   |
| 32°20N   | 101°04E   | 46°10N   | 125°11E   | 72°36N   | 104°52E   |
| 32°19N   | 101°03E   | 46°11N   | 125°12E   | 72°37N   | 104°53E   |
| 32°18N   | 101°02E   | 46°12N   | 125°13E   | 72°38N   | 104°54E   |
| 32°17N   | 101°01E   | 46°13N   | 125°14E   | 72°39N   | 104°55E   |
| 32°16N   | 101°00E   | 46°14N   | 125°15E   | 72°40N   | 104°56E   |
| 32°15N   | 100°59E   | 46°15N   | 125°16E   | 72°41N   | 104°57E   |
| 32°14N   | 100°58E   | 46°16N   | 125°17E   | 72°42N   | 104°58E   |
| 32°13N   | 100°57E   | 46°17N   | 125°18E   | 72°43N   | 104°59E   |
| 32°12N   | 100°56E   | 46°18N   | 125°19E   | 72°44N   | 105°00E   |
| 32°11N   | 100°55E   | 46°19N   | 125°20E   | 72°45N   | 105°01E   |
| 32°10N   | 100°54E   | 46°20N   | 125°21E   | 72°46N   | 105°02E   |
| 32°09N   | 100°53E   | 46°21N   | 125°22E   | 72°47N   | 105°03E   |
| 32°08N   | 100°52E   | 46°22N   | 125°23E   | 72°48N   | 105°04E   |
| 32°07N   | 100°51E   | 46°23N   | 125°24E   | 72°49N   | 105°05E   |
| 32°06N   | 100°50E   | 46°24N   | 125°25E   | 72°50N   | 105°06E   |
| 32°05N   | 100°49E   | 46°25N   | 125°26E   | 72°51N   | 105°07E   |
| 32°04N   | 100°48E   | 46°26N   | 125°27E   | 72°52N   | 105°08E   |
| 32°03N   | 100°47E   | 46°27N   | 125°28E   | 72°53N   | 105°09E   |
| 32°02N   | 100°46E   | 46°28N   | 125°29E   | 72°54N   | 105°10E   |
| 32°01N   | 100°45E   | 46°29N   | 125°30E   | 72°55N   | 105°11E   |
| 32°00N   | 100°44E   | 46°30N   | 125°31E   | 72°56N   | 105°12E   |
| 31°59N   | 100°43E   | 46°31N   | 125°32E   | 72°57N   | 105°13E   |
| 31°58N   | 100°42E   | 46°32N   | 125°33E   | 72°58N   | 105°14E   |
| 31°57N   | 100°41E   | 46°33N   | 125°34E   | 72°59N   | 105°15E   |
| 31°56N   | 100°40E   | 46°34N   | 125°35E   | 73°00N   | 105°16E   |
| 31°55N   | 100°39E   | 46°35N   | 125°36E   | 73°01N   | 105°17E   |
| 31°54N   | 100°38E   | 46°36N   | 125°37E   | 73°02N   | 105°18E   |
| 31°53N   | 100°37E   | 46°37N   | 125°38E   | 73°03N   | 105°19E   |
| 31°52N   | 100°36E   | 46°38N   | 125°39E   | 73°04N   | 105°20E   |
| 31°51N   | 100°35E   | 46°39N   | 125°40E   | 73°05N   | 105°21E   |
| 31°50N   | 100°34E   | 46°40N   | 125°41E   | 73°06N   | 105°22E   |
| 31°49N   | 100°33E   | 46°41N   | 125°42E   | 73°07N   | 105°23E   |
| 31°48N   | 100°32E   | 46°42N   | 125°43E   | 73°08N   | 105°24E   |
| 31°47N   | 100°31E   | 46°43N   | 125°44E   | 73°09N   | 105°25E   |
| 31°46N   | 100°30E   | 46°44N   | 125°45E   | 73°10N   | 105°26E   |
| 31°45N   | 100°29E   | 46°45N   | 125°46E   | 73°11N   | 105°27E   |
| 31°44N   | 100°28E   | 46°46N   | 125°47E   | 73°12N   | 105°28E   |
| 31°43N   | 100°27E   | 46°47N   | 125°48E   | 73°13N   | 105°29E   |
| 31°42N   | 100°26E   | 46°48N   | 125°49E   | 73°14N   | 105°30E   |
| 31°41N   | 100°25E   | 46°49N   | 125°50E   | 73°15N   | 105°31E   |
| 31°40N   | 100°24E   | 46°50N   | 125°51E   | 73°16N   | 105°32E   |
| 31°39N   | 100°23E   | 46°51N   | 125°52E   | 73°17N   | 105°33E   |
| 31°38N   | 100°22E   | 46°52N   | 125°53E   | 73°18N   | 105°34E   |
| 31°37N   | 100°21E   | 46°53N   | 125°54E   | 73°19N   | 105°35E   |
| 31°36N   | 100°20E   | 46°54N   | 125°55E   | 73°20N   | 105°36E   |
| 31°35N   | 100°19E   | 46°55N   | 125°56E   | 73°21N   | 105°37E   |
| 31°34N   | 100°18E   | 46°56N   | 125°57E   | 73°22N   | 105°38E   |
| 31°33N   | 100°17E   | 46°57N   | 125°58E   | 73°23N   | 105°39E   |
| 31°32N   | 100°16E   | 46°58N   | 125°59E   | 73°24N   | 105°40E   |
| 31°31N   | 100°15E   | 46°59N   | 126°00E   | 73°25N   | 105°41E   |
| 31°30N   | 100°14E   | 47°00N   | 126°01E   | 73°26N   | 105°42E   |
| 31°29N   | 100°13E   | 47°01N   | 126°02E   | 73°27N   | 105°43E   |
| 31°28N   | 100°12E   | 47°02N   | 126°03E   | 73°28N   | 105°44E   |
| 31°27N   | 100°11E   | 47°03N   | 126°04E   | 73°29N   | 105°45E   |
| 31°26N   | 100°10E   | 47°04N   | 126°05E   | 73°30N   | 105°46E   |
| 31°25N   | 100°09E   | 47°05N   | 126°06E   | 73°31N   | 105°47E   |
| 31°24N   | 100°08E   | 47°06N   | 126°07E   | 73°32N   | 105°48E   |
| 31°23N   | 100°07E   | 47°07N   | 126°08E   | 73°33N   | 105°49E   |
| 31°22N   | 100°06E   | 47°08N   | 126°09E   | 73°34N   | 105°50E   |
| 31°21N   | 100°05E   | 47°09N   | 126°10E   | 73°35N   | 105°51E   |
| 31°20N   | 100°04E   | 47°10N   | 126°11E   | 73°36N   | 105°52E   |
| 31°19N   | 100°03E   | 47°11N   | 126°12E   | 73°37N   | 105°53E   |
| 31°18N   | 100°02E   | 47°12N   | 126°13E   | 73°38N   | 105°54E   |
| 31°17N   | 100°01E   | 47°13N   | 126°14E   | 73°39N   | 105°55E   |
| 31°16N   | 100°00E   | 47°14N   | 126°15E   | 73°40N   | 105°56E   |
| 31°15N   | 99°59E    | 47°15N   | 126°16E   | 73°41N   | 105°57E   |
| 31°14N   | 99°58E    | 47°16N   | 126°17E   | 73°42N   | 105°58E   |
| 31°13N   | 99°57E    | 47°17N   | 126°18E   | 73°43N   | 105°59E   |
| 31°12N   | 99°56E    | 47°18N   | 126°19E   | 73°44N   | 106°00E   |
| 31°11N   | 99°55E    | 47°19N   | 126°20E   | 73°45N   | 106°01E   |
| 31°10N   | 99°54E    | 47°20N   | 126°21E   | 73°46N   | 106°02E   |
| 31°09N   | 99°53E    | 47°21N   | 126°22E   | 73°47N   | 106°03E   |
| 31°08N   | 99°52E    | 47°22N   | 126°23E   | 73°48N   | 106°04E   |
| 31°07N   | 99°51E    | 47°23N   | 126°24E   | 73°49N   | 106°05E   |
| 31°06N   | 99°50E    | 47°24N   | 126°25E   | 73°50N   | 106°06E   |
| 31°05N   | 99°49E    | 47°25N   | 126°26E   | 73°51N   | 106°07E   |
| 31°04N   | 99°48E    | 47°26N   | 126°27E   | 73°52N   | 106°08E   |
| 31°03N   | 99°47E    | 47°27N   | 126°28E   | 73°53N   | 106°09E   |
| 31°02N   | 99°46E    | 47°28N   | 126°29E   | 73°54N   | 106°10E   |
| 31°01N   | 99°45E    | 47°29N   | 126°30E   | 73°55N   | 106°11E   |
| 31°00N   | 99°44E    | 47°30N   | 126°31E   | 73°56N   | 106°12E   |

\*Coordinates at regular intervals from site to a distance of approximately 1,000 m.

\*Coordinates at regular intervals from site to a distance of approximately 1,000 m.

\*Coordinates at regular intervals from site to a distance of approximately 1,000 m.

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Table 15. DUG BOG SE, Moscow, Geographic Coordinates Only

Latitude Longitude

|        |        |
|--------|--------|
| 52-00N | 04-00E |
| 52-05N | 04-00E |
| 52-10N | 04-00E |
| 52-15N | 04-00E |
| 52-20N | 04-00E |
| 52-25N | 04-00E |
| 52-30N | 04-00E |
| 52-35N | 04-00E |
| 52-40N | 04-00E |
| 52-45N | 04-00E |
| 52-50N | 04-00E |
| 52-55N | 04-00E |
| 53-00N | 04-00E |
| 53-05N | 04-00E |
| 53-10N | 04-00E |
| 53-15N | 04-00E |
| 53-20N | 04-00E |
| 53-25N | 04-00E |
| 53-30N | 04-00E |
| 53-35N | 04-00E |
| 53-40N | 04-00E |
| 53-45N | 04-00E |
| 53-50N | 04-00E |
| 53-55N | 04-00E |
| 54-00N | 04-00E |
| 54-05N | 04-00E |
| 54-10N | 04-00E |
| 54-15N | 04-00E |
| 54-20N | 04-00E |
| 54-25N | 04-00E |
| 54-30N | 04-00E |
| 54-35N | 04-00E |
| 54-40N | 04-00E |
| 54-45N | 04-00E |
| 54-50N | 04-00E |
| 54-55N | 04-00E |
| 55-00N | 04-00E |
| 55-05N | 04-00E |
| 55-10N | 04-00E |
| 55-15N | 04-00E |
| 55-20N | 04-00E |
| 55-25N | 04-00E |
| 55-30N | 04-00E |
| 55-35N | 04-00E |
| 55-40N | 04-00E |
| 55-45N | 04-00E |
| 55-50N | 04-00E |
| 55-55N | 04-00E |
| 56-00N | 04-00E |

\*Coordinates at regular intervals; from site to a distance of approximately 5,000 m.

Table 16. DUG BOG SE, Moscow, Geographic Coordinates Only

From To Distance (km)

|               |               |     |
|---------------|---------------|-----|
| 52-00N 04-00E | 52-05N 04-00E | 5.0 |
| 52-05N 04-00E | 52-10N 04-00E | 5.0 |
| 52-10N 04-00E | 52-15N 04-00E | 5.0 |
| 52-15N 04-00E | 52-20N 04-00E | 5.0 |
| 52-20N 04-00E | 52-25N 04-00E | 5.0 |
| 52-25N 04-00E | 52-30N 04-00E | 5.0 |
| 52-30N 04-00E | 52-35N 04-00E | 5.0 |
| 52-35N 04-00E | 52-40N 04-00E | 5.0 |
| 52-40N 04-00E | 52-45N 04-00E | 5.0 |
| 52-45N 04-00E | 52-50N 04-00E | 5.0 |
| 52-50N 04-00E | 52-55N 04-00E | 5.0 |
| 52-55N 04-00E | 53-00N 04-00E | 5.0 |
| 53-00N 04-00E | 53-05N 04-00E | 5.0 |
| 53-05N 04-00E | 53-10N 04-00E | 5.0 |
| 53-10N 04-00E | 53-15N 04-00E | 5.0 |
| 53-15N 04-00E | 53-20N 04-00E | 5.0 |
| 53-20N 04-00E | 53-25N 04-00E | 5.0 |
| 53-25N 04-00E | 53-30N 04-00E | 5.0 |
| 53-30N 04-00E | 53-35N 04-00E | 5.0 |
| 53-35N 04-00E | 53-40N 04-00E | 5.0 |
| 53-40N 04-00E | 53-45N 04-00E | 5.0 |
| 53-45N 04-00E | 53-50N 04-00E | 5.0 |
| 53-50N 04-00E | 53-55N 04-00E | 5.0 |
| 53-55N 04-00E | 54-00N 04-00E | 5.0 |
| 54-00N 04-00E | 54-05N 04-00E | 5.0 |
| 54-05N 04-00E | 54-10N 04-00E | 5.0 |
| 54-10N 04-00E | 54-15N 04-00E | 5.0 |
| 54-15N 04-00E | 54-20N 04-00E | 5.0 |
| 54-20N 04-00E | 54-25N 04-00E | 5.0 |
| 54-25N 04-00E | 54-30N 04-00E | 5.0 |
| 54-30N 04-00E | 54-35N 04-00E | 5.0 |
| 54-35N 04-00E | 54-40N 04-00E | 5.0 |
| 54-40N 04-00E | 54-45N 04-00E | 5.0 |
| 54-45N 04-00E | 54-50N 04-00E | 5.0 |
| 54-50N 04-00E | 54-55N 04-00E | 5.0 |
| 54-55N 04-00E | 55-00N 04-00E | 5.0 |
| 55-00N 04-00E | 55-05N 04-00E | 5.0 |
| 55-05N 04-00E | 55-10N 04-00E | 5.0 |
| 55-10N 04-00E | 55-15N 04-00E | 5.0 |
| 55-15N 04-00E | 55-20N 04-00E | 5.0 |
| 55-20N 04-00E | 55-25N 04-00E | 5.0 |
| 55-25N 04-00E | 55-30N 04-00E | 5.0 |
| 55-30N 04-00E | 55-35N 04-00E | 5.0 |
| 55-35N 04-00E | 55-40N 04-00E | 5.0 |
| 55-40N 04-00E | 55-45N 04-00E | 5.0 |
| 55-45N 04-00E | 55-50N 04-00E | 5.0 |
| 55-50N 04-00E | 55-55N 04-00E | 5.0 |
| 55-55N 04-00E | 56-00N 04-00E | 5.0 |

(\*) Intersection "A" is the intersection of the lat of the Moscow DUG BOG SE and the 268-degree azimuth line of the Moscow DUG BOG SE.

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TOP SECRET CHESS RUFF

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**PROJECT**

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**TOP SECRET CHESS RUFF**

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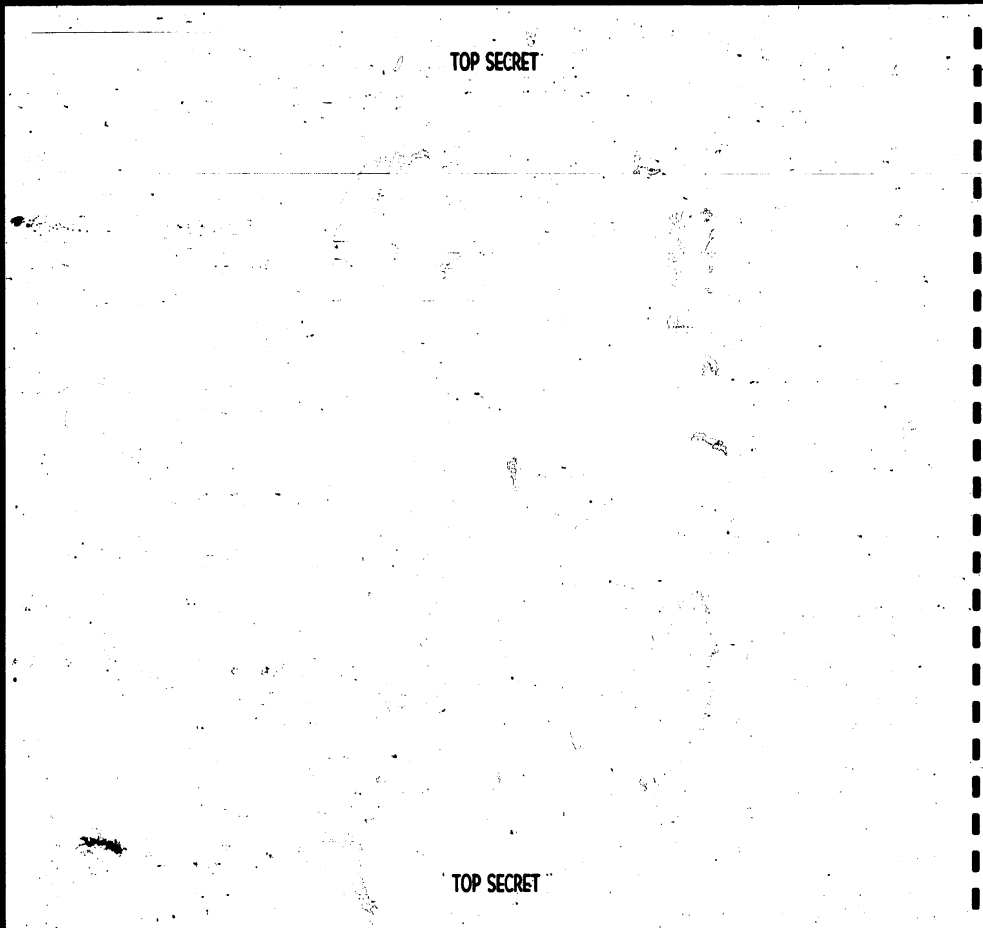
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