

INFORMATION ON OVER THE HORIZON RADAR, PART I

(UNCLASSIFIED TITLE)

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RADAR DIVISION

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CONTENT

This report contains the mission and siting information of FPS-95.

PROBLEM STATUS

This is an interim report on one phase of the problem; work is continuing.

AUTHORIZATION

USAF MIPR (30-602) 64-3412 to the Naval Research Laboratory
dated 26 March 1964
NRL Problem 53R02-42

SECRET

MISSION OF AND SITING INFORMATION ON FPS-95

MISSION

The mission of the proposed HF radar is to detect moving targets, under certain operating limitations, in the following modes:

- (a) Aircraft population counting. Initially the data rate is envisioned as approximately a one-hour count period every four to six hours, but the design must anticipate the addition of system components and operator aids for continuous surveillance. In this mode, any missile launchings or atomic events occurring in an illuminated sector could be observed.
- (b) Missile launch watching. In this mode it is envisioned that (a) above may be interrupted or restricted, in order to concentrate on searchlighting a designated sector, or a limited number of adjacent sectors, as directed.
- (c) Tracking of some aircraft of special interest. In this mode it is envisioned that certain aircraft flights within designated range-azimuth sectors would be under surveillance and that time-range records suggestive of type and route would be generated as directed.
- (d) Atomic events, both ground and air bursts. These events would be detected by modes (a), (b) and (c) during illumination. Search for such events may follow the pattern of (b) or (c) modes and as directed.
- (e) Operating limitations. Successful unrestricted operation would require a fairly normal ionosphere, a condition which does not always obtain. During normal operation the limitations would include the minimum 75 to 100 knots equivalent doppler separable from the natural doppler of ground backscatter return, and the thus delimited natural biconical zone of silence associated with single station operation.

SITE INFORMATION

- (a) Location. The HF radar of interest is to be located some 22 nautical miles westward of DIYARBAKIR, Turkey, being westward of TUSLOG DET 8 and its communications center which are both westward of Diyarbakir.
- (b) Terrain. The terrain is old volcanic in nature, semi-arid, with strewn stones visible on the surface in some places. Appendix A is a report on a nearby area by Lt. R. Paull on the general geology, dated 1954.
- (c) Topography. The expected location is on land which slopes gently toward the north in the ^{30°} direction of the desired azimuth angle coverage with a typical slope of say ^{30°} 150 meters per kilometer being representative. The azimuth angle of interest is bearing 290° through true north to bearing 70°.

[REDACTED]

(d) Transportation. There is a standard gauge railroad, not up to U.S. standards, from a deep water Mediterranean port to the town of Diyarbakir. A hard surface road runs from this town generally westward past the site of TUS-LOG DET 8 and its communication center and to the south of the site of interest on its way to the town of SIVEREK.

In addition to the above there are some other hard surface roads from seaports to the town of Diyarbakir which are all used for travel, trucking and tank truck oil runs. Finally, by arrangement with the host government, air and air freight transportation is available to the Diyarbakir airfield.

The details described above are all visible on maps NJ37-7 and NJ37-~~8~~¹¹, Series K502 of the Army Map Service. Appendix B is an excerpt from an RADC document, dated 1954, which contains additional details.

(e) Weather Data. Weather data pertinent to construction, structure design and structure survival are as follows:

- (1) Maximum temperature (12 yr. period)-- +46.2°C
- (2) Mean max. temperature (12 yr. period)-- +22.5°C
- (3) Minimum temperature (12 yr. period)-- -24.2°C
- (4) Mean min. temperature (12 yr. period)-- +3.5°C
- (5) Mean rel. humidity (12 yr. period)

0700 (12 yr. period)-- 64%
1400 (12 yr. period)-- 40%
2100 (12 yr. period)-- 54%

- (6) Greatest daily precipitation (12 yr. period)-- 65.8 mm
- (7) Mean monthly precipitation (12 yr. period)-- 487.6 mm
- (8) No. of days precipitation = 0.1 mm (12 yr. period)-- 87.4 yearly
- (9) No. of days precipitation = 10 mm (12 yr. period)-- 15 yearly
- (10) No. of snowy days (12 yr. period)-- 5.8 yearly
- (11) No. of days snow on ground (12 yr. period)-- 13.1 yearly
- (12) Greatest snow (3 yrs. of 12 yrs.) (12 yr. period)-- 40 cm
- (13) No. of foggy days (12 yr. period)-- 13 total
- (14) Greatest wind speed and direction (12 yr. period)-- S 33.8 meters/sec
- (15) Mean wind speed at

0700 (12 yr. period)-- 2 meters/sec
1400 (12 yr. period)-- 3.2 meters/sec
2100 (12 yr. period)-- 2.3 meters/sec

- (16) Mean earth temperature (12 yr. period)-- 19.3°C
- (17) Lowest earth temperature (12 yr. period)-- -11.6°C

Appendix C, an interview by Mr. B. P. Brown in 1954, contains the experiences and opinions of a local weatherman.

(f) Earthquake Data. Each year there are ten (10) major, one hundred (100) destructive shocks, (10^4) minor strong shocks and (10^5) shocks of all kinds throughout the world.

In the gross vicinity of the proposed site the following data are presented. (Note the six asterisks for the country of interest).

<u>Date</u>	<u>Place</u>
Aug. 18, 1958	Molozar and Nohorand Iran
Sept. 1, 1962	Hozarim to Hamodon to Savek to Kozarin Iran
Aug. 21, 1962	Naples Italy
Jan. 7-11, 1962	Mokorska Yugoslavia
June 11, 1962	Sorajevo
Aug. 28, 1962	Greece, Sicily, Crete, Malta, Yugoslavia
Mar. 8, 1957	Valos Island - Lorissa Greece
Apr. 23, 1957	Iran
*Apr. 25-28, 1957	Western Turkey and Island of Rhodes
*May 26, 1957	Bolon Turkey
July 2, 1957	Iran, Caspian Sea area
Dec. 13-15, 1957	Kermonshor and Kozamor Iran
*Feb. 20, 1956	Ankara Turkey
Nov. 4-6, 1956	Fars Province, Iran
*Apr. 25, 1959	Mugla Province, SW Turkey
*Oct. 25, 1959	Erzurum Turkey
Apr. 24, 1960	Gerosh and Lar Iran
*May 23, 1961	Southwestern Turkey
Jan. 11, 1961	Lar Iran

Ankara is in zone 3 while the area of interest is in zone 2 of the Corps of Engineers' designation. Other information indicates that no earthquakes of significance have occurred in the specific area under consideration for the past five hundred years. Appendix D contains seismology information by Dr. E. Marchesin, Esso Standard of Turkey, dated 1954. This document also contains water source information at a nearby site. Appendix E contains excerpts from a 1954 interview of Natives of Pirincli (Kirgali) by Mr. B.P. Brown on weather and earthquake conditions.

(g) Access. There is no freedom of entry and exit for contractors' personnel as we in America understand the terms. There are special rules of entry and exit for personnel, equipments, systems and tools of all nature which make one lean heavily on local contractors and their facilities. Additionally, there are rules for employment of a local labor force, and some nationalities are not welcome.

[REDACTED]

(h) Logistic Support. Logistic support from TUSLOG DET 8 can be assumed for the site to supply lodging, machine shop facilities, public works functions, main warehousing, local transportation, fuel, external communications and general military support. RADC should be consulted in this area and their report entitled "Site Survey Data" of 3 May '63, RADCP-400-1 will be found helpful.

MODE PRIORITIES

Mode (a) and to some extent mode (c) are to be considered the routine functions of the facility, but the growth potential of the design must be such that mode (b) could have equal importance with mode (a).

APPENDIX A
GENERAL GEOLOGY
NOTES BY LT. R. PAULL
1954

The site area is on the flanks of an extinct fissure type volcano called Karaca Dag. The lava is basalt in pillow and columnar structure. Much of the lava is vesicular. At the site, there is approximately 650' of basalt.

The surface of the ground is gently sloping and rolling. A 0-6' soil zone has been developed. A test pit in the site area showed 4' to bedrock. This soil is a fine red impervious clay. Many large and small boulders have been thrust to the surface through weathering and frost heaving.

Drainage is all surface due to the very impervious nature of the red clay. The first 1' of the clay will absorb moisture and become extremely gummy.

An approximate geologic column in the area follows:

650'	- several quaternary basaltic flows	
50'	- fine clay	
150'	- alluvial gravels and clay	
10'??	- white pumice ash	Probably
100'	- alluvial clays and sand	Miocene in age

This column is based on observations in the Tigris River Valley and may not hold in the site area. However, the 650' of basalt is based on a structural geology analysis and not on the 21' of basalt found at the Tigris River.

General dip of underlying sediments is to the south. Chances of artesian water are excellent. Aquify will probably be in the miocene sand beds.

For specific information on local geology, the following were contacted:

- (a) Mr. Topkaya, Chief Geologic Section of MTA (Mining and Technical Research Institute).
Paper No. 2056 on file in MTA's library is on Diyarbakir area, but is incomplete.
- (b) Dr. E. Marchesim, Esso Standard of Turkey, Inc., Ozdemir Cad, Bilir Sokak No. 1, Tele. 29891, Kauaklidere, Ankara.
Has a good knowledge of geology in general area.

APPENDIX B
TRANSPORTATION DATA, TUSAG JAMAT

ROADS: Reference is made to the Turkish highway map, Inc. #1. *

To date, information on highways is not available from any one source. Word of mouth information gathered from personnel who have driven the various routes provide the most accurate and current data, which is subject to bias. Under optimum conditions, it is a nine hour drive from Ankara to Adana under ideal conditions in the summer months. This is a distance of 525 kilometers or 328 miles on a major highway. In mountainous regions, roadways are sometimes closed for days at a time, since there is not a sufficient amount of snow removal equipment available in all areas.

RAILROADS: Information was taken from "The Source Handbook on Turkish Railways" (Sec). Specific info on the railways from Iskenderun to Adana to Fevzipasa to Diyarbakir was gathered. Iskenderun to Adana to Fevzipasa: Express train 8 hrs. Average good train (Cargo) 12 hrs. Dist. 295 kms.

Max. gradient per mile	25 degrees per mile
Min. radius of curves	300 meters
Max. permissible axle load	19 tons

FEVZIPASA TO DIYARBAKIR	CARGO TRAIN	PSGR. TRAIN	DIST.
Fev. to Malatya	10 hrs.	9 hrs.	250.5 kms
Mal. to Diyar.	11 hrs.	9 hrs.	253.5 kms
Max. gradient	25 degrees per mile		
Min. radius of curves	250 meters	frequent curves	
Max. permissible axle load	20 tons		

All tracks are single track, standard gauge 4 ft. 8-1/2 inch. 1.435 meters.

No firm schedules are available, however, indications are that sufficient wagons are available. Capacities of train wagons are 15, 35, and 50 tons. April 54 estimates indicate that 900 engines and 11,000 to 14,000 wagons are available. Estimates include all rolling stock, in commission, out of commission, irreparable, etc. There are also approx. 1200 passenger coaches available. Average floor space in box cars is 209.5 sq. ft. Open wagons are 8'6" to 9'1" in width and from 15'7-1/2" to 25'11" in length. The -----* project will have no item that will exceed 5' x 8' x 16' in size with max. gross weight of 5 tons.

PORTS: Nearest port is Iskenderun. There are no channels or breakwater. It is 365 miles by railroad to Diyarbakir and 340 miles by road. Anchorage is from end of pier. Approx. 1/4 miles to 2 miles out into the harbor. There

APPENDIX B - (cont'd)

were formerly 3 warehouses available to the military (Turkish). However, only one is now available since commercial interests have taken the other two. New metal fencing now extends around two sides of the military warehouse. Military shipping is accorded low priority from all indications. Col. Goodley, JAMMAT Trans. Section, advised that the TGS (Turkish General Staff) exercises command over the port facilities. The AF can be accommodated after necessary agreements have been reached. However, this is contingent upon total volume and it is mandatory that we specify tonnage and cubes as well as shipping arrival schedules when we request port facilities. Request should be submitted to Trans. Sect. JAMMAT. Further, we should never have over 2 ships in the port at one time to preclude disruption of commercial schedules. MDAP ships are considered Mil. Support ships, etc. The number of stevedores and types and quantity of handling equipment impose further limitations. At the present time, shipments for USAF projects in South Central Turkey have been shipped in under the guise of MDAP material, pending the signing of Turkish-US agreements. On occasions, large vehicles have been received with large USAF letters painted on the equipment. Such marking should be obliterated in all instances until agreements have been consummated.

WATERWAYS: There are no inland waterways that can support project -----*. An interesting note, however, is that the Bosporsis was frozen last winter for the first time in 80 years.

PIPELINES: No pipeline facilities are available to directly support this project. One pipeline from Mersin to Adana might be of assistance.

AIRFIELDS: Diyarbakir has an 8000 ft. concrete x 150' runway with 500' asphalt overruns (each end). Estimated wheel load is 30,000 lbs. Elev. is 2171 ft. Loaded Navy C-54 aircraft have landed there in the summer time.

Batman airfield, east of Diyar at 37 25' north and 41 07' east is of concrete and asphalt construction. 9000 ft. in length. This could be used as an alternate airfield in support of -----*. A fairly reliable homing beacon is available at Diyar.

APPENDIX C

INTERVIEW WITH THE WEATHERMAN AT THE DIYARBAKIR AIR BASE

The weather station located at the Diyarbakir Air Base is the simplest type of weather station and, at the present time, has no recording instruments. The weather data is recorded roughly once each hour by visual observation of the anemometers, thermometers, etc., although in unusual conditions

APPENDIX C - (cont'd)

weather data may be recorded more frequently. During the conversation with this weatherman, the following notes were recorded:

The maximum wind velocity observed this year, which occurred during the first week of September, was 38 knots. Information on freezing rains was very sketchy and it was indicated that the quantity of freezing rains was very small. The weatherman, who had been there some two years, stated that the maximum ice build-up due to freezing rain would be of the order of 1/2". Very light hoarfrost (frost feathers), caused by clouds drifting over metallic objects, may build up to a length of 2 centimeters. This condition may last about one to two hours in the sunshine. These people experienced no general dust storms; only small whirlwinds approximately 2 meters in diameter which may kick up local gusts of dust. In the summer time, winds of the order of 15 knots may pick up some very fine dust from the roads. The dust is not particularly abrasive and no special air filters are used in the vehicles in the area. The ground becomes very dry about the end of April and this is when the hot season starts.

When asked as to the percentage of open time on the air strip, the weatherman had the following statement to make:

Last winter (which was an especially bad winter), the strip was closed for one 20-day period because of bad weather. Usually the field may be expected to be closed down for periods of from two to six days, interspaced with about the same periods of good weather. The indication was that the strip was closed down approximately 50% of the time. The highest barrack temperature recorded last year was 115°F in the shade.

The relative humidity runs below 20%. Human comfort is fair at this humidity; although if the relative humidity happens to rise to the order of 30% to 40%, as it does in other areas of the country, human comfort disappears. There have been Arizona personnel previously stationed at this site; and, in talking to these people, the weatherman has obtained the impression that the general climate in this area is very similar to Arizona. During July and August, the temperature is usually above 40°C from 11:00 a.m. to 4:00 p.m. during the day. Usually, laborers only work from 6:00 a.m. to 1:00 p.m. in the heat of the summer. The rainfall in the spring, summer and fall usually takes the form of small thunderstorms, whereas the rains in the winter time are continuous for a one to two day period. The precipitation and snow fall is usually of the order of 5 to 10 centimeters, but last year there was a period when the snow was up to their knees. It is stressed again that last year was a particularly heavy winter. The minimum temperature last year recorded was -18°C, but this was also termed as unusual. They had around 10 days of last winter when the temperature was below 0°C. The weatherman said

APPENDIX C - (cont'd)

there had been no earthquakes in the area in the last 15 years.

The records from this weather station are transferred to a central office in Ankara on a yearly basis, and are held there in permanent file. The records for the past 20 years may be obtained there and the agency where this information can be obtained is as follows:

The Turkish Meteoroloji Central Office

The chief of this central office is Fuat Adali.

Upon leaving Turkey, we had requested that a correlation be made of the icing conditions and peak wind velocities for the past 20 years. This information is to be sent to Lt. Col. Adkins in Washington, a few days after the first of December.

APPENDIX D
FROM DR. E. MARCHESIN
ESSO STANDARD OF TURKEY 1954

I. Seismology

Dr. Erwan Lahn
Earthquake Section of Ministry of Public Works

1. Earthquake maps of Turkey shows D as negative area. Possible, but unlikely and of small magnitude.
2. Observation of buildings, airstrip and 500+ year old wall show no earthquake induced damage.
3. Buildings (stone) in Mardin, 95 kilo. south, are in perfect shape.
4. Personal contacts --Bert has information on Gendarme and old man -- no quakes.

Major Bryant, Meterologist, JAMMAT, brought back following information:

A quake of intensity 4 on the Marcalli scale was experienced in the D area, probably 5 years ago.

Direction of shock waves was 157° , 225° and 180° in the vicinity of the site.

Acceleration was on the order of $50 - 75 \text{ mm/sec}^2$.

APPENDIX D - (cont'd)

20-30 miles to the south of the site, direction of shocks are 45° - 75° and acceleration is 50-75 mm/sec. The epicenter of this quake was probably URFA.

All earthquakes come from the north or southeast. No epicenter have been reported in the site area.

II. H_2O

1. Surface Water -- Surface streams occur in the area. Streams are clean and run over bed rock.

- (a) 8 miles west, small, clean stream with many 6" fish.
- (b) 6 miles west, similar small stream with small (2") fish.
- (c) 2-1/2 miles west, similar small stream with 2" fish. A sample of this well was taken. This stream is 30 feet lower than the road.

2. Shallow Wells -- Shallow wells and springs are common all through the flank areas of Karaca Dag.

- (a) At the village of Pirincli, a spring has been tapped and flows out at a spring house. Two -2" pipes flow about 10 gallons/minute, or about 14,400 gallons/day. However, this water is used by villagers for drinking, washing and irrigation. This spring is a free flowing artesian and flows all year round. Evidently, a dry spell slowed flow down 3 years ago, but this appears to be quite unusual. A sample was taken.

Another well was studied across from the village. The well is through solid basalt. It is 12 feet to water and there is 17 feet of water.

There is a large amount of water associated with the basalt, however, wherever water appears a village is located and it would be difficult to procure water from village sources. Furthermore, the local supplies are below desired magnitude.

3. Deep Wells-- Walter Wissinger and William Nann, well drillers for Point "4" (FOA), were contacted.

Presently, there are 3 Frank's drills in the D area. These drills are good for 1000 feet of hole. The equipment is new, but evidently of inferior quality. All of the units have given trouble, but are operative.

APPENDIX D - (cont'd)

The Turks have a good core drill at Isparda. The Ministry of Public Works (Bakanliklare), the Department of Reclamation, Basic Development - Ankara, Mr. Dickson or Mr. Stelle, control the work location of the 3 FOA drills. Any desire to utilize this equipment would go through them.

There are two wells presently at the Base. They are 120 feet deep (base of the basalt). The well presently being drilled is now down 870' with no water.

The first 8 meters was basalt, then 2 meters of coarse gravel (alluvial), 20 meters more of basalt and 5 more meters of broken basalt, and the remainder has been sand, gravel and clay, all unconsolidated.

The basalt was drilled with a Hughes rock bit, costing about \$325 each. It takes a bit for every 35 feet of basalt. 10' a day in a 24 hour day is his drilling rate.

There is no drilling mud in the area, but Wissinger has made a good substitute using clay and volcanic ash.

It appears probable that a deep well will be required. This well will extend through the basalt which is approximately 650' thick. A water zone may be encountered in a fissure, a buried gravel zone or a porous zone in the basalt. A constant check should be kept while drilling through the basalt.

It is further suggested that the lowest point in the topography (north) near the site be investigated. This might lead to an artesian system in a fissure in the basalt. Furthermore, the basalt will be thinner at this point and it may indicate a pre-basalt low point.

The nearby stream could be used as an interim measure. Water is prevalent in the area and should not prove to be an extreme problem. Dry holes may be experienced, however, even at 1000'.

APPENDIX E
INTERVIEW WITH NATIVES AT PIRINCLIK (KIRGALI)
By B.P. Brown-1954

This village is a normal native village composed of 20 to 30 native families and a gendarme squad post. The gendarme commander is Corporal Calal Akbel. He has been on this post for some three and a half years. A very congenial gentleman, he offered to help on obtaining native labor for

APPENDIX E - (cont'd)

construction. When asked about the general weather conditions, he had these comments:

Last year, which was a particularly bad year as far as weather was concerned, there were two feet of snow on the ground at this time of the year. He mentioned that the maximum build-up of ice on the telephone wires has been about 1/2 centimeter radius, with normal wind velocities of the order of 30 mph. He stated that the local telegraph poles, which were sunk some four feet into the ground, had not been known to blow over.

We had a pleasant visit with this gentleman. He served coffee (which was sweeter than the rest of the Turkish coffee) and we enjoyed it very much. The gendarme people in Turkey are regarded somewhat in the same category as the Canadian Mounties, in that they are very well-educated government personnel and command a great deal of respect from the local country people.

We also interviewed the chief (and land-owner) of the village who had lived in this village all of his life. When asked of earthquake conditions, he mentioned only one that he could remember, which had occurred five years ago. This tremor lasted for approximately two seconds and he could hardly feel it. His father (a man around 50 to 60 years old) also concurred. In other words, this was the only earthquake that he could remember in his existence in the area, and he had been there all his life.