COMSEARCH

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Interference Evaluation of Earth Station Transmitter at Kapolei, HI to RADAR at Fort Shafter, HI

Purpose: The purpose of this document is to describe the calculations and analysis used to evaluate the potential interference levels from the LORAL 13-meter Earth Station operating in the 5850 – 5925 MHz Band at Kaploei, HI into a military RADAR operated at Fort Shafter, HI.

System Parameters: The operating and physical parameters used in the calculations and analysis for the earth station are in Table 1 and for the RADAR in Table 2.

Table 1 Operational Parameters of 13-meter Earth Station

Frequency Range	5850 - 5925 MHz
MAX Transmit Power	!23.5 dBW/MHz
Transponder Power	!9.7 dBW/MHz
MAX EIRP	79.8 dBW/MHz
Antenna Gain	56.3 dB
Antenna Size	13 meters
Antenna Side Lobe Gain	!32 – 25*Log(θ), ≥ -10 dB
Antenna Center Line	!49.5 feet
Site Ground Elevation	!157 feet

Table 2 Operational Parameters of the Military RADAR

Frequency Range	5400 - 5900 MHz
Transmit Power	250 kW Peak Power
	250 Watts Average Power
Output Tube	Magnetron
Pulse Width	Variable, !1.0, μseconds
Pules Recurring Frequency (PRF)	Variable, !1000 pulses per second
Receiver sensitivity	!-130 dBW/MHz
Antenna Gain (main beam)	!32 dB, 1584
(side lobe)	- 10 dB, 0.1
Antenna Motion	!360 Fixed Rotation
Antenna Height	!150 feet
Ground Elevation of Site	!78.7 feet

Note: ! shows the parameters used in the creation of the profile and values in the calculation

Calculations: Two procedures were carried out for the determination of the interference condition created by the earth station operation. The first procedure was to look at the profile between the earth station antenna and the RADAR antenna. The terrain profile for the path is shown in Figure 1 of this memorandum. The profile shows that there is a line-of-sight condition between the two antennas. The next procedure calculated the interference level coupled from the earth station to the RADAR system. To determine the level the following formula was used.

$$P_i = (P_{m(t)}*G_e*G_r*\lambda^2)/((4\Pi)*R)^{\mathbf{2}}$$

P_i = Power spectral density at the RADAR antenna terminals, Watts/MHz
P_m= Power spectral density transmitted by the earth station, MAX 23.5 dBW/MHz
P_{mt}= Power spectral density transmitted by earth station to single transponder, 9.7 dBW/MHz
R = Distance between the earth station and RADAR antennas, 17.7 miles or 28,492.7 meters
G_e = Gain of the earth station antenna in the direction of RADAR antenna, -10 dB or 0.1
G_r= Gain of the RADAR antenna in the direction of earth station antenna, main beam 32 dB or 1584.9, side lobe -10 dB or 0.1
λ = Wavelength of frequency at the center of the earth station band, 0.0508 meter

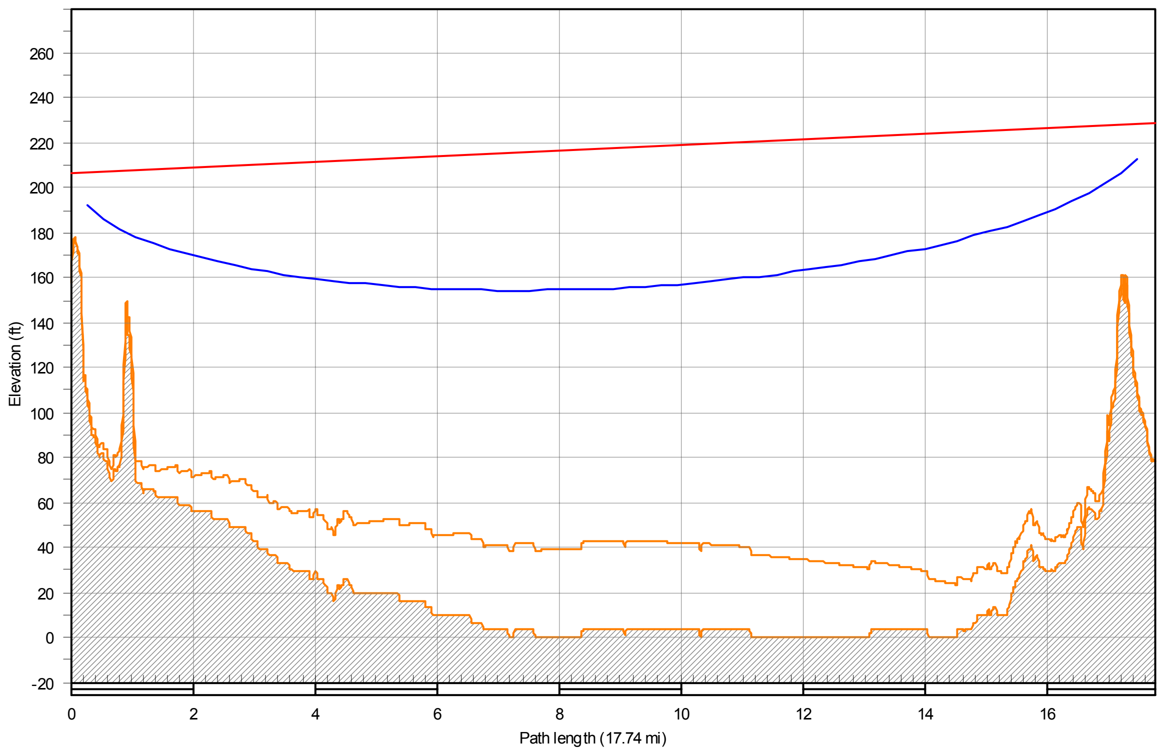
Calculation Results: The calculation was performed for the RADAR main beam and side lobe antenna position toward the earth station antenna. The calculation was made for the earth station maximum transmit power and the transmit power to a single satellite trasnsponder. The results are shown in Table 3.

Table 3 RADAR Main Beam and Side Lobe Interference Levels from Earth Station

RADAR Antenna Position	Interference Level dBWatts/MHz	Margin vs RADAR SENS dB
Main Beam-to-earth station	-91.4	-38.6 Max Tx Power
Main Beam-to-earth station	-105.2	-24.6 Single Transp
Side Lobe-to-earth station	-133.4	+3.4 Max Tx Power
Side Lobe-to-earth station	-147.2	+17.2 Single Transp

From the calculated results it can be seen that there will be interference to the RADAR when the main beam is directed toward the earth station antenna. There will be no interference when the RADAR main beam is pointed away from the earth station.

Conclusions: For the present position of the earth station and RADAR there will be interference to the RADAR every time its antenna sweeps past the area where the earth station is located. The profile indicates line-of-sight conditions for the two antennas. The calculations show that anywhere there can be RADAR antenna main beam coupling toward the earth station antenna interference will occur.



Site 1	
Latitude	21 20 12.60 N
Longitude	158 05 21.10 W
Azimuth	98.16°
Elevation	157 ft ASL
Antenna CL	49.5 ft AGL

Frequency (MHz) = 5900.0
K = 1.33
%F1 = 100.00

Site 2	
Latitude	21 18 00.00 N
Longitude	157 49 00.00 W
Azimuth	278.26°
Elevation	79 ft ASL
Antenna CL	150.0 ft AGL

Figure 1 Path Profile Kapolei - RADAR	Apr 28 05	

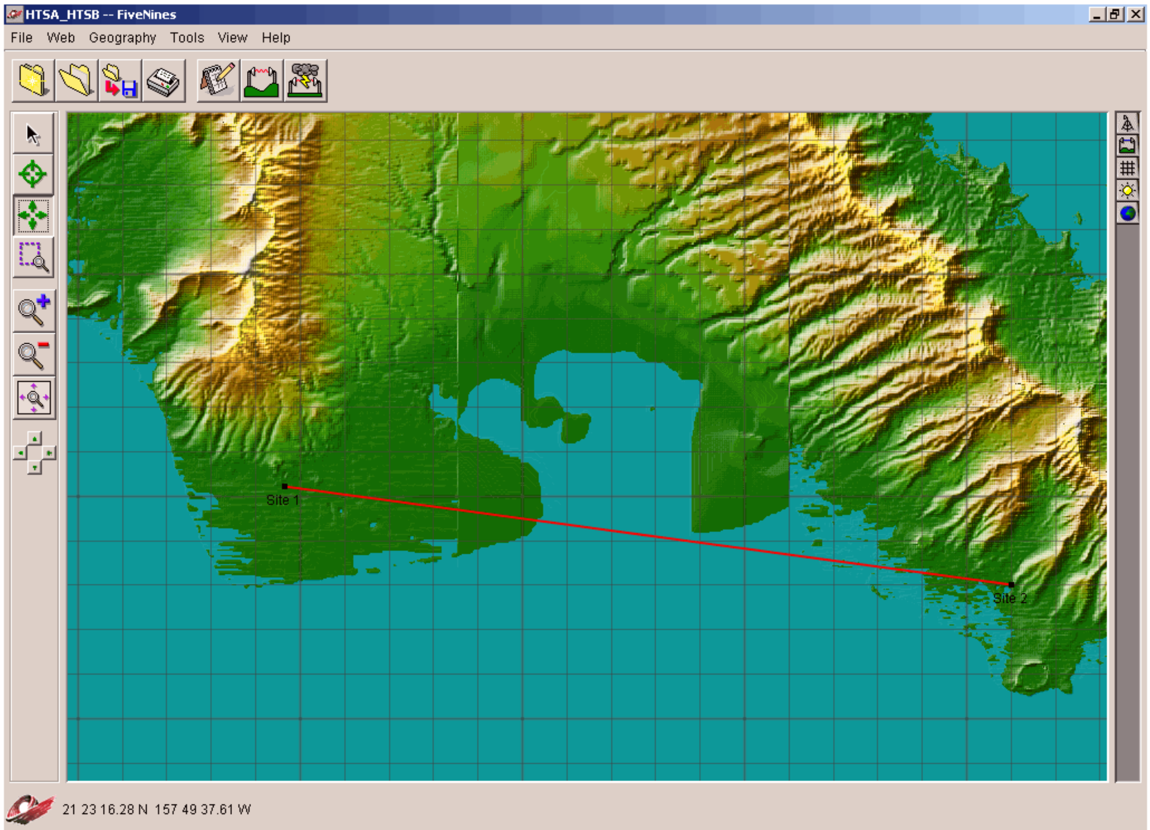


Figure 2 Map Over-Lay of Interference Path