

Interference Analysis Report

**An Assessment of the Impact of Radiolocation Systems Operating in 3.1-3.7 GHz Band on
Fixed Satellite Services Earth Station Receiver**

Prepared for

SES Americom, Inc.

TRANSMIT-RECEIVE EARTH STATION (9.3 METER)

Site Name: Bristow, Virginia

(Call Sign: E980076)

Prepared By



August 2, 2013

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1.0 Introduction

Interference calculations were performed to determine the potential for in-band and out-of-band interference from Radiolocation Systems operating in the 3.1 to 3.7 GHz band¹. The geographical positions and operating parameters of these systems was derived from NTIA Document TR-99-361².

2.0 Radiolocation Systems in the 3.1 – 3.7 GHz Band

High powered mobile and fixed radar systems operated by the Federal Government operate in the 3.1 – 3.7 GHz band. These radars are used to search for and track near-surface and high-altitude airborne projectiles, sea surveillance, and airborne objects. The NTIA report referenced above has identified the locations for two types of systems: land-based and shipboard based. Also included in the report are the operating characteristics of these radars. There are two prevalent types of shipboard radars, denoted as type A and Type B, and one type of ground-based radar. An Airborne System radar is also specified. This analysis will concern itself with interference from the ground based and shipboard based radars based upon the relative operating positions and parameters specified in the NTIA report.

A summary of the operating parameters for the shipboard and ground based radar systems is shown below:

Table 1 – Technical Characteristics of 3.1-3.7 GHz Radiolocation Systems

Characteristic	Shipboard System A	Shipboard System B	Ground Based System
Modulation	P0N	Q7N	P0N
Tuning Range (GHz)	3.5-3.7	3.1-3.5	3.1-3.4
Peak transmit Power (MW)	1	4	0.12
Pulse Width (µsec.)	1.0	3.5-51.2	10.75
Pulse Repetition Rate (kHz)	1.125	0.152-6.0	2793.3-5050.51
Duty Cycle (%)	0.001	0.8-2.0	0.041
Transmit 3-dB Bandwidth (MHz)	4,16.6	4	1,10
Antenna Type	Reflector	Phased Array	Phase Scan Array
Antenna Mainbeam Gain (dBi)	32	42	36
Antenna Centerline (m)	46	20	46

¹ This report is being provided as required under Footnote US 245.

² National Telecommunications and Information Administration, U.S. DEPARTMENT OF COMMERCE, NTIA Report TR 99-361, *TECHNICAL CHARACTERISTICS OF RADIOLOCATION SYSTEMS OPERATING IN THE 3.1-3.7 GHz BAND AND PROCEDURES FOR ASSESSING EMC WITH FIXED EARTH STATION RECEIVERS*, (December 1999).

3.0 Earth Station System Parameters

The Fixed Satellite Service Earth Station's operational parameters are shown in the Tables 2 and 3 below:

TABLE 2 - SATELLITE EARTH STATION PARAMETERS AND COORDINATION DATA

Administrative Information					
Status	ENGINEER PROPOSAL				
Call Sign	E980076				
Licensee Code	P3210				
Licensee Name	SES Americom, Inc.				
Site Information			BRISTOW, VIRGINIA		
Venue Name					
Latitude (NAD 83)	38° 47' 1.0" N				
Longitude (NAD 83)	77° 34' 23.0" W				
Climate Zone	A				
Rain Zone	2				
Ground Elevation (AMSL)	85.34 m / 280.0 ft				
Link Information					
Satellite Type	Geostationary				
Mode	TR - Transmit-Receive				
Modulation	Analog and Digital				
Satellite Arc	10° W to 139° West Longitude				
Azimuth Range	104.5° to 251.2°				
Corresponding Elevation Angles	8.7° / 13.4°				
Antenna Centerline (AGL)	5.49 m / 18.0 ft				
Antenna Information		Receive		Transmit	
Manufacturer	Vertex Corporation		Vertex Corporation		
Model	9.3 Meter KPC		9.3 Meter KPC		
Gain / Diameter	50.5 dBi / 9.3 m		53.8 dBi / 9.3 m		
3-dB / 15-dB Beamwidth	0.50° / 1.00°		0.36° / 0.72°		
Max Available RF Power	(dBW/4 kHz)			SEE ATTACHMENT 1	
	(dBW/MHz)			SEE ATTACHMENT 1	
Maximum EIRP	(dBW/4 kHz)			SEE ATTACHMENT 1	
	(dBW/MHz)			SEE ATTACHMENT 1	
	(dBW)			SEE ATTACHMENT 1	
Interference Objectives:	Long Term	-156.0 dBW/MHz	20%	-154.0 dBW/4 kHz	20%
	Short Term	-146.0 dBW/MHz	0.01%	-131.0 dBW/4 kHz	0.0025%
Frequency Information		Receive 4.0 GHz		Transmit 6.1 GHz	
Emission / Frequency Range (MHz)	SEE ATTACHMENT 1		SEE ATTACHMENT 1		
Max Great Circle Coordination Distance	463.9 km / 288.2 mi		274.1 km / 170.3 mi		
Precipitation Scatter Contour Radius	555.5 km / 345.1 mi		153.6 km / 95.5 mi		

Vertex Corporation:
Model: 9.3 Meter KPC
Call Sign: E980076

4 GHz Gain: 50.5 dBi
6 GHz Gain: 53.8 dBi

Satellite Arc: 10.0 to 60.0 West Longitude

Receive Band: 3625.0 to 3700.0 MHz

Emissions

N0N
43K8G7D – 4M80G7D
43K8G7W – 72M0G7W

Satellite Arc: 10.0 to 139.0 West Longitude

Receive Band: 3700.0 to 4200.0 MHz

Emissions

N0N
43K8G7D – 4M80G7D
43K8G7W – 72M0G7W

Satellite Arc: 10.0 to 60 West Longitude

Transmit Band: 5850.0 to 5925.0 MHz

<u>Emission</u>	<u>RF Power Density</u> <u>(dBW/4 kHz)</u>	<u>EIRP/Carrier</u> <u>(dBW)</u>	<u>EIRP Density</u> <u>(dBW/ 4 kHz)</u>
N0N	-0.5	53.3	53.3
900KF1D	-2.7	74.6	51.1
43K8G7D to 4M80G7D	-10.5	53.7	43.3
43K8G7W to 72M0G7W	-10.5	74.1	43.3
	-2.7	61.5	51.1
	-15.5	80.8	38.3

Satellite Arc: 10.0 to 139.0 West Longitude

Transmit Band: 5925.0 to 6425.0 MHz

<u>Emission</u>	<u>RF Power Density (dBW/4 kHz)</u>	<u>EIRP/Carrier (dBW)</u>	<u>EIRP Density (dBW/ 4 kHz)</u>
N0N	-0.5	53.3	53.3
900KF1D	-2.7	74.6	51.1
43K8G7D to 4M80G7D	-10.5	53.7	43.3
43K8G7W to 72M0G7W	-10.5	74.1	43.3
	-2.7	61.5	51.1
	-15.5	80.8	38.3

Satellite Arc: 10.0 to 60.0 West Longitude

Transmit Band: 6491.0 to 6650.0 MHz

<u>Emission</u>	<u>RF Power Density (dBW/4 kHz)</u>	<u>EIRP/Carrier (dBW)</u>	<u>EIRP Density (dBW/ 4 kHz)</u>
N0N	-0.5	53.3	53.3
900KF1D	-2.7	74.6	51.1
43K8G7D to 4M80G7D	-10.5	53.7	43.3
43K8G7W to 72M0G7W	-10.5	74.1	43.3
	-2.7	61.5	51.1
	-15.5	80.8	38.3

Coordination Values**BRISTOW, VA**

Licensee Name SES Americom, Inc.
 Latitude (NAD 83) 38° 47' 1.0" N
 Longitude (NAD 83) 77° 34' 23.0" W
 Ground Elevation (AMSL) 85.34 m / 280.0 ft
 Antenna Centerline (AGL) 5.49 m / 18.0 ft
 Antenna Model Vertex Corporation 9.3 Meter KPC
 Antenna Mode Receive 4.0 GHz Transmit 6.1 GHz
 Interference Objectives: Long Term -156.0 dBW/MHz 20% -154.0 dBW/4 kHz 20%
 Short Term -146.0 dBW/MHz 0.01% -131.0 dBW/4 kHz 0.0025%
 Max Available RF Power -0.5 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 4.0 GHz		Transmit 6.1 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.83	104.36	-10.00	229.79	-10.00	131.95
5	0.91	99.41	-10.00	225.27	-10.00	128.34
10	0.90	94.46	-10.00	225.85	-10.00	128.81
15	0.81	89.50	-10.00	230.49	-10.00	132.50
20	0.83	84.55	-10.00	229.57	-10.00	131.77
25	0.76	79.60	-10.00	233.83	-10.00	133.86
30	0.60	74.66	-10.00	243.13	-10.00	141.28
35	0.40	69.72	-10.00	260.69	-10.00	155.99
40	0.57	64.77	-10.00	245.32	-10.00	143.08
45	0.56	59.84	-10.00	245.68	-10.00	143.37
50	0.43	54.92	-10.00	257.09	-10.00	152.87
55	0.00	50.06	-10.00	285.28	-10.00	179.20
60	0.00	45.16	-9.37	289.32	-9.37	181.63
65	0.00	40.29	-8.13	297.45	-8.13	186.41
70	0.00	35.45	-6.74	306.87	-6.74	191.76
75	0.00	30.64	-5.16	318.56	-5.16	197.82
80	0.00	25.91	-3.34	331.67	-3.34	204.77
85	0.00	21.28	-1.20	347.49	-1.20	211.45
90	0.00	16.86	1.33	366.87	1.33	221.98
95	0.00	12.85	4.27	389.72	4.27	235.21
100	0.30	9.53	7.53	404.28	7.53	240.75
105	0.45	8.27	9.07	463.90	9.07	274.12
110	0.71	9.69	7.34	361.64	7.34	208.39
115	0.95	12.97	4.17	318.36	4.17	184.10
120	1.00	16.59	1.50	293.02	1.50	168.99
125	1.05	20.13	-0.59	275.59	-0.59	155.94
130	1.10	23.54	-2.29	261.89	-2.29	147.06
135	1.15	26.82	-3.71	250.87	-3.71	140.05
140	1.22	29.90	-4.89	240.98	-4.89	133.88
145	1.31	32.78	-5.89	232.29	-5.89	129.54
150	1.39	35.40	-6.73	225.12	-6.73	124.68
155	1.33	37.84	-7.45	222.97	-7.45	123.61
160	0.76	40.40	-8.16	244.25	-8.16	139.82
165	0.73	42.11	-8.61	243.53	-8.61	139.83
170	0.49	43.57	-8.98	256.96	-8.98	151.32
175	0.46	44.37	-9.18	258.97	-9.18	153.31
180	0.50	44.59	-9.23	254.87	-9.23	149.90
185	0.00	44.83	-9.29	289.85	-9.29	181.95

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 Short Term -146.0 dBW/MHz 0.01% -131.0 dBW/4 kHz 0.0025%
 Max Available RF Power -0.5 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 4.0 GHz		Transmit 6.1 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	44.04	-9.10	291.09	-9.10	182.69
195	0.00	42.77	-8.78	293.16	-8.78	183.91
200	0.00	41.06	-8.34	296.08	-8.34	185.62
205	0.27	38.74	-7.70	291.61	-7.70	180.99
210	0.00	36.52	-7.06	304.65	-7.06	190.52
215	0.22	33.62	-6.17	308.77	-6.17	192.37
220	0.25	30.63	-5.15	311.73	-5.15	193.13
225	0.26	27.46	-3.97	318.72	-3.97	196.18
230	0.28	24.12	-2.56	327.02	-2.56	200.27
235	0.29	20.64	-0.87	337.52	-0.87	205.42
240	0.39	17.10	1.17	340.87	1.17	204.91
245	0.43	14.37	3.07	350.85	3.07	207.54
250	0.43	13.05	4.11	358.86	4.11	211.65
255	0.41	13.57	3.69	358.44	3.69	212.01
260	0.43	15.68	2.12	343.27	2.12	205.28
265	0.55	18.82	0.14	314.80	0.14	187.42
270	0.55	22.69	-1.89	299.02	-1.89	178.54
275	0.55	26.92	-3.75	286.32	-3.75	170.74
280	0.52	31.37	-5.41	277.21	-5.41	163.69
285	0.54	35.94	-6.89	266.26	-6.89	156.33
290	0.53	40.60	-8.21	258.49	-8.21	151.52
295	0.54	45.32	-9.41	250.52	-9.41	146.49
300	0.54	50.09	-10.00	247.15	-10.00	144.58
305	0.52	54.89	-10.00	248.18	-10.00	145.44
310	0.54	59.71	-10.00	247.12	-10.00	144.56
315	0.62	64.54	-10.00	242.00	-10.00	140.36
320	0.76	69.38	-10.00	233.44	-10.00	133.55
325	0.65	74.25	-10.00	240.37	-10.00	139.04
330	0.63	79.12	-10.00	241.49	-10.00	139.94
335	0.68	83.99	-10.00	238.18	-10.00	137.28
340	0.74	88.87	-10.00	235.11	-10.00	134.85
345	0.70	93.74	-10.00	237.52	-10.00	136.76
350	0.72	98.62	-10.00	236.29	-10.00	135.79
355	0.68	103.49	-10.00	238.15	-10.00	137.26

4.0 Interference Calculations

The interference was calculated into the earth station receive system for both in-band and out-of-band interference. The interference power level was calculated using the formula below:

$$P_r = P_t + G_t - \text{FSL} - \text{OHLOSS} + G_{es} - \text{LL}_t - \text{LL}_{es}$$

Where:

- P_r : Interference power level received at victim earth station, in dBW
- P_t : Transmitter power of Radiolocation system, in dBW
- G_t : Gain of Radiolocation transmit system, in dBi
- FSL: Free Space Loss between radiolocation system and earth station, in dB
- OHLOSS: Over-the-Horizon losses between radiolocation system and earth station, in dB
- G_{es} : Horizon gain of the earth station toward radiolocation transmitter, in dBi
- LL_t : Line losses of the radiolocation system, in dB (assume 2dB per NTIA report)
- LL_{es} : Line losses of the earth station system, in dB (assume 0 dB unless known)

This interference power level was then compared to in-band and out-of-band interference criteria. The in-band criteria was developed using ITU and FCC recommendations³. The out-of-band interference criteria was developed using the following:

The earth station's low noise amplifier front-end overload criteria of was determined using the following calculations:

$$T = C - G$$

Where:

- T = input threshold at which front-end overload occurs, dBW
- C = output 1 dB gain compression point of the LNA, typical -20 dBW
- G = Gain of the LNA, dB

For the purposes of this report it was assumed that the low-noise amplifier would not provide any out-of-band frequency rejection, thus no Frequency Dependent Rejection values based upon any RF selectivity, such as pre-LNA filtering or inherent LNA filtering, have been assumed. The maximum level of interference includes the input saturation threshold value minus a 10 dB output backoff value to consider in operation levels

The maximum interference power receive, P_r , allowable then becomes:

$$\text{Max } P_r \geq T - \text{IPBO}$$

For a 65 dB gain LNA this value is -95 dBW. In the absence of manufacturer LNA/LNB specifications the following typical values have been used:

- T = -95 dBW
- C = -20 dBW
- G = 65 dB

The propagation model to determine the over-the-horizon loss is the NSMA OH-Loss model⁴. When the propagation link is very lengthy, over 250 miles, an estimated OH-loss using a rounded earth modeling value has been used.

³ FCC Rules 47CFR25.251 by reference ITU Radio Regulations Appendix S7.

⁴ National Spectrum Managers Association has developed an industry accepted version which incorporates NBS Tech Note 101.

5.0 Summary of Results

The summary calculations are shown for all shipboard based and land based systems in Tables 4 through 8 below. Whenever Radar A and B are possibly in use, the interference calculations have assumed the higher powered systems (Radar B). The antenna elevation for the Ground Based systems was assumed to be 46 m even though it was not specified in the NTIA report.

Table 4 Shipboard Radar A Land-Based Test and Training Sites													
Radar Location	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?	
Pensacola, FL	302128	0871626	226.4	802.0	NO	-165.9	-81.7	N/A	-247.6	-190.2	NO	NO	
Pascagoula, MS	302200	0882900	230.1	850.6	NO	-166.4	-82.8	N/A	-249.2	-191.7	NO	NO	
St.Inigoes, MD	381000	0762300	123.0	77.3	YES	-145.6	-54.2	-54.2	-199.8	-138.3	YES	NO	
Table 5 Shipboard Radar B Land-Based Test and Training Sites													
Radar Location	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?	
Moorestown, NJ	395849	0745630	58.8	163.3	YES	-152.1	-58.1	-58.1	-210.2	-143.5	YES	NO	
Wallops Island, VA	375600	0752800	116.5	128.6	YES	-150.0	-57.1	-57.1	-207.1	-129.6	YES	NO	
Table 6 Shipboard Radars A and B Home Ports													
Radar Location	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?	
Bath, ME	435425	0694848	46.2	536.5	NO	-162.4	-74.8	N/A	-237.2	-171.1	NO	NO	
Bremerton, WA	473324	1223811	300.3	2356.1	NO	-175.3	-100.5	N/A	-275.7	-209.7	NO	NO	
Everett, WA	475858	1221354	301.1	2336.6	NO	-175.2	-100.3	N/A	-275.5	-209.5	NO	NO	
Mayport, FL	302334	0812427	201.8	618.3	NO	-163.6	-77.2	N/A	-240.9	-173.2	NO	NO	
Norfolk, VA	365200	0762100	152.8	148.2	YES	-151.2	-57.4	-57.4	-208.6	-139.3	YES	NO	
Pascagoula, MS	302253	0882933	230.2	850.3	NO	-166.4	-82.8	N/A	-249.2	-175.7	NO	NO	
Pearl Harbor, HI	212000	1580000	276.1	4966.8	NO	-181.7	-113.4	N/A	-295.2	-224.5	NO	NO	
Portland, ME	434100	0701800	45.9	507.8	NO	-161.9	-73.8	N/A	-235.7	-169.7	NO	NO	
San Diego, CA	324105	1170800	270.8	2263.2	NO	-174.9	-99.8	-73.3	-274.7	-200.5	NO	NO	

Table 7 Naval At-Sea Operational Areas												
Operational Area	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
AFWTF (North Range)												
AFWTF (NR)1	183000	0670000	152.8	1537.4	NO	-171.6	-93.0	N/A	-264.6	-195.3	NO	NO
AFWTF (NR)2	200000	0670000	151.2	1442.3	NO	-171.0	-91.9	N/A	-262.9	-193.6	NO	NO
AFWTF (NR)3	221000	0654800	145.5	1343.0	NO	-170.4	-90.7	N/A	-261.1	-191.8	NO	NO
AFWTF (NR)4	221000	0652000	144.4	1357.8	NO	-170.5	-90.9	N/A	-261.4	-190.2	NO	NO
AFWTF (NR)5	185000	0620000	141.7	1667.3	NO	-172.3	-94.4	N/A	-266.7	-195.6	NO	NO
AFWTF (NR)6	185000	0620000	141.7	1667.3	NO	-172.3	-94.4	N/A	-266.7	-195.6	NO	NO
AFWTF (NR)7	182500	0643000	147.3	1612.0	NO	-172.0	-93.9	N/A	-265.8	-196.5	NO	NO
AFWTF (NR)8	183000	0644500	147.8	1599.4	NO	-171.9	-93.7	N/A	-265.6	-196.3	NO	NO
AFWTF (NR)9	183000	0663800	151.9	1546.9	NO	-171.6	-93.1	N/A	-264.8	-195.5	NO	NO
AFWTF (South Range)												
AFWTF (SR)1	180500	0675500	155.3	1541.9	NO	-171.6	-93.1	N/A	-264.7	-196.8	NO	NO
AFWTF (SR)2	180500	0652700	149.7	1605.2	NO	-171.9	-93.8	N/A	-265.7	-196.4	NO	NO
AFWTF (SR)3	181500	0651000	149.0	1602.8	NO	-171.9	-93.8	N/A	-265.7	-196.4	NO	NO
AFWTF (SR)4	181500	0641000	146.8	1632.3	NO	-172.1	-94.1	N/A	-266.2	-196.9	NO	NO
AFWTF (SR)5	170000	0641000	148.2	1709.6	NO	-172.5	-94.9	N/A	-267.4	-198.1	NO	NO
AFWTF (SR)6	165800	0642800	148.8	1702.9	NO	-172.4	-94.8	N/A	-267.3	-198.0	NO	NO
AFWTF (SR)7	153300	0660600	153.5	1748.7	NO	-172.7	-95.3	N/A	-268.0	-198.7	NO	NO
AFWTF (SR)8	153900	0662300	154.1	1735.3	NO	-172.6	-95.1	N/A	-267.8	-198.5	NO	NO
AFWTF (SR)9	163000	0662300	153.3	1680.7	NO	-172.3	-94.6	N/A	-266.9	-197.6	NO	NO
AFWTF (SR)10	163000	0675500	156.7	1644.6	NO	-172.1	-94.2	N/A	-266.4	-198.5	NO	NO

Table 7 Naval At-Sea Operational Areas (continued)

Operational Area	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
AUTEC												
AUTEC1	252000	0780500	182.0	927.2	NO	-167.2	-84.3	N/A	-251.4	-184.6	NO	NO
AUTEC2	252000	0774500	180.7	926.8	NO	-167.2	-84.2	N/A	-251.4	-184.6	NO	NO
AUTEC3	232500	0762000	175.7	1061.2	NO	-168.3	-86.6	N/A	-254.9	-188.1	NO	NO
AUTEC4	232500	0771500	178.9	1058.8	NO	-168.3	-86.6	N/A	-254.9	-188.1	NO	NO
FORACS, Hawaii												
FORACS, Hawaii1	212530	1581100	276.3	4973.8	NO	-181.8	-113.4	N/A	-295.2	-224.6	NO	NO
FORACS, Hawaii2	212100	1581500	276.3	4980.7	NO	-181.8	-113.5	N/A	-295.2	-224.6	NO	NO
FORACS, Hawaii3	211500	1580800	276.1	4977.9	NO	-181.8	-113.5	N/A	-295.2	-224.6	NO	NO
FORACS, Hawaii4	211500	1580700	276.1	4976.9	NO	-181.8	-113.4	N/A	-295.2	-224.6	NO	NO
Gulf of Mexico OPAREA												
GoM1	293601	0800130	193.2	648.3	NO	-164.1	-78.0	N/A	-242.1	-175.2	NO	NO
GoM2	292521	0864800	221.9	834.4	NO	-166.2	-82.4	N/A	-248.7	-177.8	NO	NO
GoM3	284101	0864800	219.9	875.7	NO	-166.7	-83.3	N/A	-249.9	-179.1	NO	NO
GoM4	285231	0874400	223.4	898.8	NO	-166.9	-83.7	N/A	-250.6	-179.7	NO	NO
Pacific Missile Range Facility (PMRF)												
PMRF1	220000	1594500	277.5	5041.8	NO	-181.9	-113.7	N/A	-295.5	-224.9	NO	NO
PMRF2	220800	1620000	278.6	5167.3	NO	-182.1	-114.1	N/A	-296.2	-225.6	NO	NO
PMRF3	224500	1614000	279.1	5123.1	NO	-182.0	-114.0	N/A	-296.0	-225.3	NO	NO
PMRF4	260000	1581500	281.0	4798.4	NO	-181.4	-112.8	N/A	-294.3	-223.6	NO	NO
Pearl Harbor South OPAREA												
PHS1	190800	1591500	274.5	5129.0	NO	-182.0	-114.0	N/A	-296.0	-221.9	NO	NO
PHS2	210000	1580800	275.9	4987.9	NO	-181.8	-113.5	N/A	-295.3	-224.7	NO	NO
PHS3	210000	1573600	275.6	4956.9	NO	-181.7	-113.4	N/A	-295.1	-224.5	NO	NO
PHS4	191800	1562000	273.4	4952.0	NO	-181.7	-113.4	N/A	-295.1	-220.9	NO	NO
PHS5	184900	1574500	273.5	5054.4	NO	-181.9	-113.7	N/A	-295.6	-221.5	NO	NO

Table 7 Naval At-Sea Operational Areas (continued)												
Operational Area	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Southern California (SOCAL)												
SOCAL1	385200	1255200	285.3	2606.0	NO	-176.1	-102.2	N/A	-278.3	-210.5	NO	NO
SOCAL2	390000	1240000	284.9	2502.9	NO	-175.8	-101.5	N/A	-277.3	-206.7	NO	NO
SOCAL3	311500	1163000	267.9	2267.9	NO	-174.9	-99.8	-72.8	-274.7	-200.6	NO	NO
SOCAL4	300000	1203000	268.3	2526.5	NO	-175.9	-101.7	N/A	-277.5	-203.4	NO	NO
Virginia Capes OPAREA												
VC1	384500	0750000	90.2	139.0	YES	-150.7	-55.9	-55.9	-206.6	-129.2	YES	NO
VC2	384500	0743000	89.8	166.0	YES	-152.2	-59.7	-59.7	-211.9	-134.6	YES	NO
VC3	374500	0724000	103.4	276.2	NO	-156.6	-85.4	-85.4	-242.0	-158.5	NO	NO
VC4	350600	0724000	131.6	371.9	NO	-159.2	-68.4	N/A	-227.6	-152.9	YES	NO
VC5	320000	0771200	177.3	468.1	NO	-161.2	-72.4	N/A	-233.6	-166.8	NO	NO
VC6	342400	0773000	179.2	302.3	NO	-157.4	-64.8	N/A	-222.2	-155.4	YES	NO
VC7	354000	0752500	150.4	245.6	YES	-155.6	-79.6	-71.5	-227.1	-157.8	NO	NO
VC8	370000	0755000	141.8	155.5	YES	-151.7	-61.2	-61.2	-212.9	-141.7	YES	NO

Table 8 Land-Based Radar Test and Training Sites													
Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Fort Lewis	WA	470525	1223510	299.4	2354.0	NO	-175.3	-100.4	N/A	-275.7	-209.7	NO	NO
Yakima Firing	WA	464018	1202135	298.6	2244.5	NO	-174.8	-99.6	N/A	-274.5	-208.4	NO	NO
Fort Carson	CO	383810	1044750	278.1	1471.4	NO	-171.2	-92.3	N/A	-263.5	-192.8	NO	NO
Fort Riley	KS	385813	0965139	276.8	1040.1	NO	-168.2	-86.3	N/A	-254.4	-183.8	NO	NO
Fort Shafter	HI	211800	1574900	276.0	4957.5	NO	-181.7	-113.4	N/A	-295.1	-224.5	NO	NO
Hunter AAF	GA	320100	0810800	204.3	507.9	NO	-161.9	-73.8	N/A	-235.7	-168.1	NO	NO
Fort Gillem	GA	333600	0841900	228.5	519.4	NO	-162.1	-74.2	N/A	-236.3	-162.9	NO	NO
Fort Benning	GA	322130	0845815	225.4	608.2	NO	-163.5	-76.9	N/A	-240.4	-167.0	NO	NO
Fort Stewart	GA	315145	0813655	206.7	529.0	NO	-162.3	-74.5	N/A	-236.8	-167.8	NO	NO
Fort Rucker	AL	311947	0854255	224.3	690.7	NO	-164.6	-79.1	N/A	-243.7	-172.9	NO	NO
Yuma Proving	AZ	330114	1141855	269.9	2099.0	NO	-174.3	-98.4	-72.8	-272.7	-198.6	NO	NO
Fort Hood	TX	310830	0974550	251.1	1261.1	NO	-169.8	-89.6	N/A	-259.4	-179.3	NO	NO
Fort Knox	KY	375350	0855655	264.9	459.1	NO	-161.1	-98.3	-98.3	-259.4	-181.2	NO	NO
Fort Bragg	NC	350805	0790035	198.0	263.9	NO	-156.2	-81.3	-81.3	-237.5	-169.9	NO	NO
Fort Campbell	KY	363950	0872820	257.9	561.7	NO	-162.8	-108.6	N/A	-271.4	-193.3	NO	NO
Fort Polk	LA	310343	0931226	243.5	1035.0	NO	-168.1	-86.2	N/A	-254.3	-177.1	NO	NO
Fort Leonard	MO	374430	0920737	269.3	794.7	NO	-165.8	-81.6	N/A	-247.4	-173.3	NO	NO
Fort Irwin	CA	351536	1164102	275.4	2176.2	NO	-174.6	-99.1	-68.1	-273.7	-203.0	NO	NO
Fort Sill	OK	344024	0982352	262.5	1190.1	NO	-169.3	-88.6	N/A	-257.9	-179.8	NO	NO
Fort Bliss	TX	314850	1062533	261.9	1700.0	NO	-172.4	-94.8	N/A	-267.2	-204.1	NO	NO
Fort Leavenworth	KS	392115	0945500	277.9	933.5	NO	-167.2	-84.4	N/A	-251.6	-181.0	NO	NO
Fort Drum	NY	440115	0754844	13.6	372.8	NO	-159.2	-68.4	N/A	-227.7	-161.7	NO	NO
Fort Gordon	GA	332510	0820910	216.1	449.9	NO	-160.9	-71.7	N/A	-232.6	-161.7	NO	NO
Fort McCoy	WI	440636	0904127	302.7	774.0	NO	-165.6	-81.1	N/A	-246.7	-180.7	NO	NO
Fort Dix	NJ	400025	0743713	61.0	179.2	YES	-152.9	-60.7	-60.7	-213.6	-146.9	YES	NO
Parks Reserve	CA	374254	1214218	281.9	2401.6	NO	-175.4	-100.8	N/A	-276.2	-205.6	NO	NO
Aberdeen Proving	MD	392825	0760655	58.3	91.7	YES	-147.1	-49.2	-49.2	-196.3	-129.6	YES	NO
Fort Huachuca	AZ	313500	1102000	264.5	1919.5	NO	-173.5	-96.9	N/A	-270.4	-207.2	NO	NO
Fort Monmouth	NJ	401900	0740215	59.6	216.4	YES	-154.5	-73.4	-73.4	-227.9	-161.3	NO	NO
Picatinny Arsenal	NJ	405600	0743400	46.2	218.1	YES	-154.6	-74.5	-74.5	-229.1	-163.1	NO	NO

Table 8 Land-Based Radar Test and Training Sites (continued)													
Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Redstone Arsenal	AL	343630	0863610	242.8	578.2	NO	-163.1	-76.1	N/A	-239.1	-161.9	NO	NO
White Sands	NM	322246	1062813	263.2	1686.3	NO	-172.4	-94.6	N/A	-267.0	-203.9	NO	NO
Army Research	MD	390000	0765800	65.3	35.9	YES	-138.9	-33.4	-33.4	-172.3	-103.0	YES	NO
Fort Hunter	CA	355756	1211404	278.6	2410.9	NO	-175.5	-100.9	N/A	-276.3	-220.7	NO	NO
Kelly Support	PA	402357	0800925	309.8	177.3	YES	-152.8	-67.7	-66.9	-219.7	-153.7	YES	NO

Table Headings

- Radar Location : The site name of the radar system
- Lat (N) : Radar latitude
- Lon (w) : Radar Longitude
- Bearing (deg.) : Azimuth from earth station toward radar.
- Distance (mi) : Distance from earth station to radar
- Profile (Is path under 250 miles?) : If path is over 250 miles no OH-loss profile is generated
- FSL (dB) : Free Space Loss
- Estimated OH-Loss (dB) : Using a rounded-earth model an estimated OH-loss is calculated for long paths
- Profiled OH-Loss (dB) : Using the NSMA Tropo Loss actual OH-loss calculations are performed for shorter paths
- Total Path Loss (dB) : Total of Free Space Loss plus Over-the-Horizon loss
- Interfering Power Level (dBW/MHz) : Level of RF interference at the earth station's LNA input
- In-Band Interference? : If the Radar is operating in-band is the max. permissible interference criteria being met?
- Out-of Band Overload? : If the Radar is operating in out-of-band spectrum is the LNA overload threshold being met?

6.0 Conclusions

Calculations were performed to assess the electromagnetic compatibility (EMC) between the radars listed below and adjacent-band FSS earth station receiver at Bristow, Virginia. Interference assessment for Earth Stations Operating at 3625 - 3700 MHz at the Bristow, VA site identified 13 cases of In-band potential interference. The applicant is aware of this potential for interference and will work with the Government Users to mitigate the problem.

Results

Total Number of Paths 13 sites		Lat (N)	Lon (W)	Out-of-Band Overload?	In-Band Interference?
St. Inigoes,	MD	381000	0762300	No	Yes
Moorestown,	NJ	395849	0745630	No	Yes
Wallops Island,	VA	375600	0752800	No	Yes
Norfolk,	VA	365200	0762100	No	Yes
VC 1 OPEREA		384500	0750000	No	Yes
VC 2 OPEREA		384500	0743000	No	Yes
VC 4 OPEREA		350600	0724000	No	Yes
VC 6 OPEREA		342400	0773000	No	Yes
VC 8 OPEREA		370000	0755000	No	Yes
Fort Dix	NJ	400025	0743713	No	Yes
Aberdeen Proving	MD	392825	0760655	No	Yes
Army Research	MD	390000	0765800	No	Yes
Kelly Support	PA	402357	0800925	No	Yes