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Radiation Hazard Report – 3.7-meter Antenna

This report analyzes electro-magnetic non-ionizing radiation which would accompany the operation of the Black Sky 3.7-meter earth station antenna (manufactured by Orbit and known as model AL-1000-SX) which will be used to uplink S-Band signals to their two satellites. The antenna will be located at Tukwila, WA where the site elevation is 15.9m AMSL. The antenna will be transmitting at S-Band (2025-2110 MHz).

This report provides calculations which are used to determine the transmission power density in the “Far Field”, the “Near Field” and the “Transition Region”. Additional analysis determines the region between the “Main Reflector and the Subreflector”, the “Main Reflector Region” and the “Main Reflector and the Ground”.

Accordingly, we use the “Maximum Permissible Exposure” limits published by the FCC OET 65 Bulletin for the General Population/Uncontrolled Exposure and the limits for the Occupational/Controlled Exposure. The results of the calculations meet the FCC’s OET Bulletin, No. 65, with the exception of the “Main Reflector and the Subreflector”, where a Hazard Zone is located.

The Hazard Zone, the region between the “Main Reflector and the Subreflector”, is a dangerous location for workers to be in, doing tests, or replacing various equipment, or doing anything required their having a reason to be located there. All workers will be advised that being in the Hazard Zone while the antenna is transmitting is strictly forbidden. Black Sky will have specific rules placed on numerous highlighted signs for all employees and temporary workers to see. The signs will be available in the area of work and elsewhere around the antenna where it can be seen at any time. In addition, whenever the antenna is transmitting to the satellite, red lights will be illuminated alerting workers and visitors to be careful to stay away from the antenna and any other equipment which may be operating. Black Sky will maintain a 7-day-per-week hotline at its Mission Control Center. Make certain that no one is near the antenna during transmissions.

The results of the calculations performed are all within the FCC’s requirements except for the Hazard Zone.

Far Field Analysis

The calculation for the Far Field location includes the actual distance to where the far field begins, followed by a calculation of the power density at that location.

Near Field Analysis

The power flux density will be at its highest value the whole length of the Near Field area. We evaluate end of the Near Field, followed by the maximum power density in that area.

Transition Area

In the transition area between the Near and Far Fields, the power density decreases inversely with the square of the distance.

Main Reflector and Subreflector

The subreflector of the antenna transmits directly to the Main Reflector which reflects the transmissions to free space. The maximum amount of power density in this area will be calculated at the subreflector.

Main Reflector Area

Power density at the 3.7 meter dish is analyzed and the calculation provided.

Area from the Main Reflector to nearby Ground

The power density in this area will be determined by calculation of the nearby ground area.

Conclusions

The following page provides the details of each analyzed area. The results of the calculations demonstrate that the Black Sky 3.7-meter antenna will meet all required values of power density except for the area between the subreflector and the main reflector, where signage will be used to prevent any dangerous exposure to the public or working employees.

S-Band Power Density

Inputs		Units	Calculations	<u>S-Band Power Density</u>	Units
S-Band Diameter	3.7	m	Far Field distance	55.4445	m
S-Band Gain	33.5	dBi	On-Axis Power Density Far Field	0.579526358	W/m ²
S-Band Gain	2238.72114			0.057952636	mW/cm ²
S-band EIRP	41.65	dBW			
Power S-Band	8.15	dBW	Near Field Distance	23.101875	m
Freq (S-Band)	2025	MHz	Near Field Power Density	1.352869552	W/m ²
Wavelength S-Band	0.14814815	m		0.135286955	mW/cm ²
Antenna efficiency S-Band	0.36365475				
Power in Watts	10	W	Transition Distance	39.2731875	m
S-Band Subreflector Diameter	123.333333	cm	Transition Region Power Density	0.795805619	W/m ²
S-Band Subreflector Area	11946.7787	cm ²		0.079580562	mW/cm ²
S-Band Antenna Surface Area	10.7521009	m ²			
			Flange/Reflector	3.348182879	mW/cm ²
			Main Reflector Region	3.720203199	W/m ²
				0.37202032	mW/cm ²
			Antenna/Ground	0.9300508	W/m ²
				0.09300508	mw/cm ²