



**Application for Experimental Authorization  
Over-the-Air Ground Station and Nightingale 1 Testing  
Radiation Hazard Analysis**

Rev. A

**CesiumAstro, Inc.**  
13215 Bee Cave Parkway Suite A-300  
Austin, Texas 78738

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## 1 PURPOSE

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Per CFR 47, Section 1.1307.b(1), all applications for experimental operations require evaluation for compliance with human exposure limits defined in Section 1.1310.

## 2 RADIO ANALYSES

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Each transmitter within the application is listed here with its relevant specifications for calculations. These calculations provide validation for the results listed. For analyses involving power density calculations, the following equation is used:

$$P = \frac{p_t g_t}{4\pi r^2}$$

$P$  is the power density of the antenna ( $W/m^2$ ) at a given distance  $r$  (m),  $p_t$  is the output power of the antenna (W), and  $g_t$  is the gain of the antenna. The distance  $r$  is the minimum safe distance from the antenna to the target area, and this equation is inverted to solve for  $r$ .

The below calculations define the minimum safe working distance for both Occupational and General Public, which are based on the maximum permissible exposure limits of  $5 \text{ mW/cm}^2$  and  $1 \text{ mW/cm}^2$  respectively.

### 2.1 NIGHTINGALE 1

The Cesium Nightingale 1 (NG1) is an experimental Ka-band active phased antenna system. The antenna will be operated in a controlled area. Only persons authorized to work with this antenna will be allowed access to the area of operation. In addition, the transmitter will be secured prior to and following operation, and the area will be monitored during operation to ensure that personnel and the general public are clear of any radiation hazard area. Operation of the antenna will not be conducted in directions that would expose the general public or personnel to harmful radiation. The values listed below are for emissions with the highest power and gain. Emissions of lower power are enveloped by these keepout distances.

Transmitter Power (dBW):	4.15
Transmitter Power (W):	2.6
Maximum Antenna Gain (dBi):	27
Non-dimensional Antenna Gain:	501.19
ERP (dBW):	27.85
ERP (W):	609.54

	<u>Minimum Safe Distance</u>	
	Occupational	General Public
Meters:	1.45	3.23
Feet:	4.76	10.6

### 2.2 CESIUM GROUND STATION

The Cesium ground station is an experimental Ka-band parabolic antenna system. The antenna will be operated in a controlled area. Only persons authorized to work with this antenna will be allowed access to the area of operation. In addition, the transmitter will be secured prior to and following operation, and the area will be monitored during operation to ensure that personnel and the general public are clear of any radiation hazard area. Operation of the antenna will not be conducted in directions that would expose the general public or personnel to harmful radiation. The values listed below are for emissions with the highest power and gain. Emissions of lower power are enveloped by these keepout distances.

Transmitter Power (dBW): -10  
 Transmitter Power (W): 0.1  
 Maximum Antenna Gain (dBi): 55.5  
 Non-dimensional Antenna Gain: 354813.39  
 ERP (dBW): 33.4  
 ERP (W): 2188

<b><u>Minimum Safe Distance</u></b>		
	Occupational	General Public
Meters:	7.52	16.81
Feet:	24.67	55.15