Compliance With the RF Exposure Limitations

Peak Power = 1MW
Pulse Width = 2 microseconds
Pulse Repetition Frequency = 250 Hz
Average Power (P) = 1KW
Wavelength (λ) = 5.36 cm (C-Band Wavelength)
Reflector Diameter (D) = 3.7 meters
Reflector Surface Area (A) = 10.8 sq meters
Reflector Isotropic Gain = 44.7dBi

Given that the above parameters are fixed, the power density is a function of range and location with regard to the axis of the main beam. The power density is greatest along the main beam axis, so all calculations will be made for this condition.

Three different methods are used to estimate power density, depending on whether the point of interest is in the near-field region, the transition region, or the far-field region. For λ = 5.36 cm, the near field region extends to 63.8 meters (209.3 ft), the transition region extends to 153.2 meters (502.6 ft), and the far-field region extends from this point.

$R_{nf} = D^2/4\lambda$ 63.8 meters
$R_{ff} = 0.6\ D^2/\lambda$ 153.2 meters

Within the near-field region the power density can reach a maximum of 37.3274mw/cm².

The power density decreases inversely with distance from the antenna within the transition region. At the start of the transition region the power density is 37.33mw/cm². Near the end, (1550 ft) the power density is 6.47mw/cm².

Beyond 153.2 meters (502.6 ft) the power density can be calculated using the following:

$S = PG/(4\pi R^2)$

Where S is power density, P is power, G is antenna gain and R is distance from antenna.

Utilizing this equation we can solve for the distance at which the power density is below the FCC controlled exposure limit of 5mw/cm². This distance is 174.2 meters (571.6 ft). We can also solve for the distance at which the power density is below the FCC uncontrolled exposure limit of 1mw/cm². This distance is 389.6 meters (1278.1 ft).

If the point of interest is beyond 1278 ft, then the power density is such that it is below the uncontrolled exposure limit. **This is even if the point of interest remains on-axis at all times because the antenna is not rotating.**

If the point of interest is at least one antenna diameter (3.7m) off-axis within the near-field or transition region, the power density is at least a factor of 100 less than the values calculated above. The tower height should be such that the main beam is over 10m above ground level at 200m distance when the main beam is pointing 1 degree below the horizon. Therefore the tower should be at minimum:

10m+3.5m+3.7m = 17m (55.7ft)

At this height all points along the ground (near-field included) will have a power density below the FCC controlled limit of $5mw/cm^2$.

One item not considered is that exposure limits may be time averaged (6 minutes for controlled access and 30 for uncontrolled access). The fact that the antenna is rotating and a fixed point of interest is on-axis for only a brief period of time (factor of 0.0027) greatly reduces the average power density. Thus, **all** points of interest not on the antenna surface are below both exposure limits while the antenna is rotating.

Example: 30 minute exposure within 1278ft (Uncontrolled Access limit) factored by 0.0027 = 0.081 minutes (4.86 seconds) exposure time.

In conclusion, a radar system with the above characteristics can be within compliance with FCC exposure limit guidelines by mounting the antenna 60ft or higher above any occupied areas within 200 ft of the antenna.

Tx Average Power (dBm)	60	**dBm**	**Antenna Gain**	44.7	**dBi**	**RADAR #**	1000C	
Transmission Loss (dB)	1.9	**dB**	**Start Range**	140	**yards**	**EIRP**	19.05	**Gigawatts**
Power @ Antenna	58.1	**dBm**	**Plot Every**	2	**Yards**	**Rad Hazard Minimum Distance**		
OET 65, Supplement B (Edition 97-01)			**Controlled Access** - 6 minute average exposure			**5mW/cm^2**	571.6	**feet**
Pulsed Radar Calculations			**Uncontrolled Access** - 30 minute average exposure			**1mW/cm^2**	1278.1	**feet**