5.1.5 Compliance with RF Exposure Limitations

The following summary explains the compliance with RF exposure limitations for the KHDD-1000S/HF radar as listed in FCC OET bulletin 56, Table 1-A and 1-B, Q&A regarding Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields and FCC OET bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

Peak Power = 1MW (10 E+9 mW)

Pulse Width = 4.5 us

Pulse Repetition Frequency = 333 Hz

Average Power (P) = 1498 W (1492000 mW)

Wavelength (λ) = 8.52 cm (High Frequency S-Band Wavelength)

Reflector Diameter (D) = 6 m (6000 mm)

Reflector Aperture Area (A) = 10.63 m^2 (1063 cm^2)

Reflector Isotropic Gain = 44.7 dBi

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

The power density can be calculated as follows.

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

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

Utilizing this equation, we can solve for the distance at which the power density is below the FCC controlled exposure limit of 5 mW/cm^2. This distance is 195 m (641 ft) for the reflector diameter listed. We can also solve for the distance at which the power density is below the FCC uncontrolled exposure limit of 1 mW/cm^2. This distance is 437 m (1434 ft).

If the point of interest is beyond 1434 ft, then the power density is such that it is below the uncontrolled exposure limit of $1mW/cm^2$. **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 (6m) 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 10m above ground level at 200m distance when the main beam is pointing 1 degree below the horizon. Therefore, the tower should be at a minimum:

10m + 3.5m + 6m = 19m (62.3 ft)

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

One item not considered is that exposure limits may be averaged (6 minutes for controlled access and 30 for uncontrolled access.) The fact that the antenna is rotating and a fix point of interest is on-axis for only a brief period of time (factor of .0027), greatly reduces the average power density. Safety interlocks are built into the KHDD-1000S/HF radar set that disable the radiation should the antenna positioner stop responding, the antenna remains in a fixed location for a predetermined duration, or should the system be commanded to point radiate whether locally or remotely. Certain radiation safety interlocks may not be bypassed and are hard wired into the radar. These three safety checks prevent the radar set from being commanded to radiate below a safe elevation at unsafe azimuth angles. It is because of these build in safety interlocks that point radiation is not a major concern with this radar set.

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 areas within 1434 ft of the antenna. If there are no potential radiated points within 1434 ft, the minimum mounting height would be 42 ft in order to achieve the minimum safe distance from the radiation source at ground level with the antenna at 0 degrees elevation.