Exposure of humans to RF fields

As per FCC KDB 447498 D01 and Section 2.1091 radio frequency transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels.

Calculations have been made using the General Public/Uncontrolled Exposure limits that are defined in Section 1.1310.

Minimum safe distances have been calculated below.

Power density, $mW/cm^2 = E^2/3770$

Limits for General Population / Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/ cm²)**	**Averaging Time |E|²,|H|² or S (minutes)**
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density Note 2: For the applicable limit, see FCC 1.1310				

- General Population / Uncontrolled exposure is (f/1500) mW/cm^2

As this radio can operate over the range of 421.0 to 480.0 MHz the lowest frequency of operation in the USA, which will give the worst case result, would be 421.0 MHz.

The power density at 421.0 MHz comes out to be 0.281 mW/cm^2.

For Uncontrolled Environment

Power Density = 0.281 $mW/cm^2 = E^2/3770$

$E = \sqrt{0.281*3770}$

E = 32.5 V/m

The rated maximum transmitter power = 4 watts (+36 dBm).

The client has stated that the unit is rated for 100% duty cycle for first 2 minutes, then 80% continuously.

A worst case scenario duty cycle of 100% has been used for the calculations.

The client has declared that this transmitter can be operated using quarter wave whip or dipole antennas which typically have a gain of 2.15 dBi or a numeric gain of 1.64.

The minimum distance from the antenna at which the MPE is met is calculated from the following

Field strength in V/m (FS),
Transmit power in watts (P)
Transmit antenna gain (G)
Transmitter duty cycle (DC)
Separation distance in metres (D)

The calculation is as follows:

FS = (√ (30 * P * G * DC)) / D

Therefore

D = (√ (30 * P * G * DC)) / FS

D = (√ (30 * 4 * 1.64 * 1)) / 32.5

d=0.43 m or 43 cm

Result: Complies if the safe distances defined for this environment is applied.