

TECHNICAL NOTE

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Subject: **RF Safety Analysis for Service Personnel Working Adjacent to the VRC and IAG Antennas.**

Reference: IEEE C95.1-1991 requirements for RF safety.

There are two parameters required by IEEE C95.1 standards related to RF safety for personnel working adjacent to RF transmission source: 1) power density and 2) specific absorption rate (SAR).

1. Power Density

Power density at distance r from a radiated source is given by:

$$P_d = P_t / (4\pi r^2)$$

where P_t is the Equivalent Isotropic Radiation Power (EIRP) of the radiated signal.

2. Specific Absorption Rate (SAR)

Rate of absorption of RF radiated energy by a body tissue

$$SAR = \sigma E^2 / (2\rho)$$

where σ : conductivity of body tissue, typical 1100-1200 mS/m

E : electric field

ρ : tissue density, typical 1.25 g/cm³.

For MARK IV –IVHS Readers equipped with VRC and/or IAG antenna power density and SAR levels are shown in Figure 1 and 2. Calculation is based on the 4-W EIRP setup level at the antenna with TDMA time frame of 10 ms and RF pulse duty cycle of 25%.

RF safety limit in Figure 1 and 2 is extracted from the IEEE C95.1 (1991) requirements for non-controlled environment since it reflects the worst case scenerio. In these figures, data is not applicable in the front and on the side of antenna at distance less than 10 cm due to 10-cm (4") long of the antenna radom. For the backside of the antenna, this distance is approximately 5 cm.

Analysis results show that no risk is anticipated if personnel working in the back of antennas; i.e. on the gantry's catwalk. Both power density and SAR levels are well below safety limits.

For personnel working on the side of antennas, the risk level is low if the human body is within 30 cm (1 ft) or greater distance from the antennas.

For personnel working in front of the antennas, the risk level is high if the distance between human body to antennas is less than 45 cm (1.5 ft). Specific absorption rate will become more harmful if body exposure exceeds 30 minutes.

Recommendations:

1. When VRC antenna or IAG antenna is active, no service should take place which involves personnel working in front or on the side of the antenna at distance less than 2 ft. Otherwise, the antennas transmission must be turned off.
2. No risk is anticipated if personnel working in the back of antennas; i.e. on the gantry's catwalk. There is no need to turn off RF transmission due to low radiated power in the antenna backlobe.

Figure 3. Recommended Limit for Personnel Working Adjacent to Antenna

