Engineering Statement
RADIOFREQUENCY EXPOSURE CALCULATIONS
prepared for
Gray Television Licensee, Inc.

Gray Television Licensee, Inc. ("Gray") is applying for a license to operate a transportable "KU Band" satellite uplink. The uplink transmit antenna would be located on a vehicle roof and operated at various locations throughout the United States. The instant study was completed to evaluate the potential for human exposure to radiofrequency electromagnetic field in accordance with the guidelines established by the Federal Communications Commission ("FCC"). In particular, the study determined whether exposure to radiofrequency ("RF") electromagnetic field from this antenna would exceed FCC maximum permissible exposure limits to the general public and to occupational workers, at locations in the vicinity of the uplink antenna, based on data provided by the applicant and representatives of the equipment manufacturers.

Human Exposure to Radiofrequency Electromagnetic Field

The *Gray* proposed operation was evaluated using the procedures outlined in FCC OET Bulletin No. 65 ("OET 65"). OET 65 describes a means of determining whether a proposed facility exceeds the *RF* exposure guidelines specified in §1.1310 of the Rules. Under present Commission policy, a facility may be presumed to comply with the limits in §1.1310 if it satisfies the exposure criteria set forth in OET 65. Based upon that methodology, and as demonstrated in the following, the transmitting system under study will comply with the cited adopted guidelines at publicly accessible locations when procedures described herein are followed.

Public Exposure

According to *Gray*, the uplink antenna will be operated from a truck roof with a center of radiation height of approximately 3.5 meters above the ground. The mechanical design of the mounting equipment is optimized to orient the antenna toward satellites which operate well above the horizon. With the elevation of the antenna and considering the look angle range, the nearest location to the antenna at two meters above ground is greater than one dish diameter from the main beam.

Prevention of public exposure by predicted *RF* electromagnetic field in excess of the general population/uncontrolled limit[1] depends on adherence to the following operational guidelines by the *Gray* technicians. To assure that no publicly accessible area is within the "main beam" of the uplink antenna, sites and satellites will be selected such that the elevation angle of the antenna will always exceed five degrees (and at least one dish diameter) above the horizon, nearby buildings, and places accessible by the public.

Because the instant antenna is of a transportable design, permanently installed fences and gates are impractical. Therefore, the use of crowd control stanchions, cones, and conspicuous *RF* exposure warning signs will be used to prevent public access in areas near the uplink antenna that are known to exceed the FCC's general population / uncontrolled MPE limit. These areas will be defined either by measurements made by qualified, on-site, personnel or by the calculations described herein.

Based on data provided by the applicant, the following parameters were used in the study:

Antenna Manufacturer	AVL
Antenna Model	AVL-12MUSA
Center Frequency	14.250 GHz
Wavelength at Center Frequency	0.02103807 meters
Max Average Antenna Input Power	79.6 Watts
Antenna Diameter	1.2 meter
Antenna Gain	43.5 dBi
Antenna Gain Ratio	22387.2
Aperture Efficiency	0.697

[1] The general population/uncontrolled maximum permissible exposure ("MPE") limit of 1 mW/cm² for 14,250 MHz is specified in §1.1310 of the Rules.

The area in the immediate vicinity of the antenna is known as the "near field region." In this region (17.1 meters in the case at hand), the antenna directional characteristics of have not fully formed. Therefore, antenna manufacturer "off-axis" discrimination specifications cannot be utilized for the purpose of determining potential *RF* exposure. OET 65 provides a methodology (Equation 13) for calculating an absolute "worst case" exposure figure within this region. Additionally, OET 65 specifies that the "worst case" power density would be reduced by 20 dB at locations at least one antenna diameter (1.2 meters) off-axis from the "main beam" of the antenna. In this instance, the predicted off-axis, near field is 0.197 mW/cm², or 19.7 percent of the general population/uncontrolled limit. Off-axis predicted fields reduce commensurately at greater distances from the antenna in the antenna transition region.

In the "far field" region of the antenna (in this case, starting at a distance of 41.07 meters from the antenna[2]), the antenna directional characteristics have formed, and the off-axis "far field" power density can be readily calculated using "off-axis" antenna discrimination specifications. At locations greater than four degrees off-axis from the "main beam," the manufacturer of the proposed antenna specifies a minimum side-lobe attenuation of 36 dB. Again using the methodology detailed in OET65, this "off-axis" attenuation is predicted to result in a power density of 0.0049 mW/cm², or 0.49 percent of the general population/uncontrolled limit.

As shown above, the "compliant area" is defined by any location more than four degrees and 1.2 meters away from the satellite antenna "main beam." Appropriate crowd control devices (described earlier) would be deployed 2-3 meters from the uplink truck (to prevent unauthorized access) and at sufficient distances in the direction of the antenna "main beam" to assure that publicly accessible locations do not result in "head heights" approaching the five-degree and 1.5 meter non-compliant area.

[2]The transition region between the near field and far field would lie between 17.1 and 41.07 meters.

Controlled Access Area Exposure

Access to the vicinity of the antenna will be limited and restricted to authorized, trained personnel. Using data provided by the applicant, the potential for RF exposure to occupational workers was evaluated. As described previously, the maximum predicted off-axis, "near field" power density is 0.197 mW/cm², or 3.94% of the controlled limit. As the operator will generally be posted at locations either behind the parabolic reflector or in the truck itself, it is anticipated that actual exposure will be substantially less than the above "worst case" prediction.

With respect to worker safety, it is believed that based on the preceding analysis, excessive exposure would not occur provided that adequate physical separation is established. As mentioned previously, detailed operator policy will be employed protecting workers from excessive exposure when work must be performed where high RF levels may be present. Such protective measures may include, but will not be limited to, restriction of access to areas where levels in excess of the guidelines may be expected, or the complete shutdown of facilities when work or inspections must be performed in areas where the exposure guidelines would otherwise be exceeded. On-site RF exposure measurements may also be undertaken to establish the bounds of safe working areas. The applicant will coordinate exposure procedures with all pertinent facilities.

Conclusion

As demonstrated herein, excessive levels of RF energy will not be caused at publicly accessible areas by strictly following the policy detailed herein. Consequently, neither members of the general public nor occupational staff will be exposed to RF levels in excess of the Commission's guidelines. Access to the vicinity of the uplink antenna will be restricted and controlled through the use of crowd control stanchions, cones, and conspicuous RFR warning signs as part of an overall RF safety program. The above study presumes that the subject antenna is the sole source of RF energy at the uplink site. In the case of multiple emitters, further analysis or measurement is necessary to assure compliance.

Certification

The undersigned hereby certifies that the foregoing statement was prepared by him or under his direction, and that it is true and correct to the best of his knowledge and belief. Mr. Clinton is a staff engineer in the firm of Cavell, Mertz & Davis, Inc.

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