FCC Form 442
File No. 1059-EX-CN-2020
AST&Science LLC

Radiation Hazard Study

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Radiation Hazard Analysis for Midland, Texas Site

Introduction

This analysis predicts the radiation hazard levels in the Midland site where two antennas might operate simultaneously and will be collocated, mounted on the same rotator. One is a Comtech 2.4m X/Y antenna operating in V-Band and the other is a Sirio Antenna WY 400-10N yagi antenna operating in the 437 to 438 MHz range.

General Information

This report analyzes the non-ionizing radiation levels for a site with a 2.4-meter and a 400 MHz earth stations. The analysis and calculations performed in this report comply with the methods described in the current version of the FCC's Office of Engineering and Technology Bulletin, No. 65.

Comtech 2.4m X/Y antenna specifications

Antenna type	Cassegrain reflector
Antenna Diameter	2.4m
Dish center height over ground	1.4m
Antenna on-axis isotropic gain	59dBi
Antenna Efficiency (η)	50%
Minimum operational elevation angle	10°
Operating Frequency	47.2-50.2 and 50.4-51.4 GHz
Maximum transmit power (at the flange)	2.5W
Near Field region	< 240m
Far Field region	> 576m

Sirio Antenne WY 400-10N specifications

Antenna type	Yagi
Number of elements	10
Height over ground	1.4m
Antenna on-axis isotropic gain	14dBi
Antenna Efficiency (η)	80%
Minimum operational elevation angle	10°
Operating Frequency	437 to 438MHz
Maximum transmit power (at the port)	2W

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Calculations

Comtech 2.4m X/Y antenna

Power Density at the reflector surface

$S_{surface} = 4P/A = 4 * 2.5W / 4.5m^2 = 0.22mW/cm^2$

Near-Field Region

Less than 240m away from the antenna, on-axis power density:

$S_{nf} = 16\eta P / (\pi D^2) = 0.11mW/cm^2$

For a 10° minimum elevation angle, the distance at which one diameter away from the axis is at 2m height (head of a person) is 17m from the antenna. At such distance, the power density is at least 20dB less than the on-axis value calculated above (as per OET Bulletin 65). Beyond this point, no person or objects can lie within the on-axis cone/region by system design.

Off-axis power density at 17m < $0.001mW/ cm^2$

Sirio Antenne WY 400-10N

Minimum ox-axis allowed distance to antenna

The signal power S at a given distance R in the far-field region from the antenna is defined by the equation:

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

Hence, the minimum distance at which the power density is $0.2mW/cm^2$ will be:

$R = PG / 4\pi S^2 = 2W * 25.1 / (4\pi * 0.2mW/cm^2) = 10m$

And for $1.0mW/cm^2$ it results in:

$R = PG / 4\pi S^2 = 2W * 25.1 / (4\pi * 1.0mW/cm^2) = 2m$

Conclusions

As per Bulletin 65 Appendix A, Table 1 and Figure 1, the maximum power density allowed for the general population for operations between 1.5 GHz and 100 GHz is $1.0mW/cm^2$, and it is $5.0mW/cm^2$ for occupational/controlled exposure. For 437 to 438 MHz range, this requirement is $0.2mW/cm^2$ and $1.0mW/cm^2$ respectively.

Taking the worst case of $0.2mW/cm^2$ and $1.0mW/cm^2$ for the general population and occupations/controlled exposure, and considering when both antennas will operate simultaneously and will be collocated on the same rotator, the maximum power densities will be $0.21mW/cm^2$ at a 10m distance and $1.11mW/cm^2$ at a 2m distance.

Hence, to meet the FCC's exposure requirements, no personnel can work closer than 5m to the antennas at any moment unless the antennas are properly powered down for that purpose. The general population must always be kept farther than 20m away from the antenna.

AST has installed proper fencing to avoid the general population getting closer than 20m to the antennas and has also placed the appropriate warning signs for occupational/controlled exposure.

AST agrees to abide by the conditions specified in Condition 5208 provided below:

Condition 5208 - The licensee shall take all necessary measures to ensure that the antenna does not create potential exposure of humans to radiofrequency radiation in excess of the FCC exposure limits defined in 47 CFR 1.1307(b) and 1.1310 wherever such exposures might occur. Measures must be taken to ensure compliance with limits for both occupational/controlled exposure and for general population/uncontrolled exposure, as defined in these rule sections. Compliance can be accomplished in most cases by appropriate restrictions such as fencing. Requirements for restrictions can be determined by predictions based on calculations, modeling or by field measurements. The FCC's OET Bulletin 65 (available on-line at www.fcc.gov/oet/rfsafety) provides information on predicting exposure levels and on methods for ensuring compliance, including the use of warning and alerting signs and protective equipment for worker.

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Radiation Hazard Analysis for Kapolei, Hawaii Site

Introduction

This analysis predicts the radiation hazard levels of a single Comtech 2.4m X/Y antenna operating as an earth station at the Kapolei, Hawaii location requested by Applicant.

General Information

This report analyzes the non-ionizing radiation levels for a 2.4-meter earth station. The analysis and calculations performed in this report comply with the methods described in the current version of the FCC's Office of Engineering and Technology Bulletin, No. 65.

Comtech 2.4m X/Y antenna specifications

Antenna type	Cassegrain reflector
Antenna Diameter	2.4m
Dish center height over ground	1.4m
Antenna on-axis isotropic gain	59dBi
Antenna Efficiency (η)	50%
Minimum operational elevation angle	10°
Operating Frequency	47.2-50.2 and 50.4-51.4 GHz
Maximum transmit power (at the flange)	2.5W
Near Field region	< 240m
Far Field region	> 576m

Calculations

Power Density at the reflector surface

$S_{surface} = 4P/A = 4 * 2.5W / 4.5m^2 = 0.22mW/cm^2$

Near-Field Region

Less than 240m away from the antenna, on-axis power density:

$S_{nf} = 16\eta P / (\pi D^2) = 0.11mW/cm^2$

For a 10° minimum elevation angle, the distance at which one diameter away from the axis is at 2m height (head of a person) is 17m from the antenna. At such distance, the power density is at least 20dB less than the on-axis value calculated above (as per OET Bulletin 65). Beyond this point, no person or objects can lie within the on-axis cone/region by system design.

Off-axis power density at 17m < $0.001mW/ cm^2$

Conclusions

As per Bulletin 65 Appendix A, Table 1 and Figure 1, the maximum power density allowed for the general population for operations between 1.5 GHz and 100 GHz is 1.0mW/cm^2, and it is 5.0mW/cm^2 for occupational/controlled exposure.

Since the transmitted power is within the allowable limits, there is no risk for exposure at any area around the antenna. However, AST has installed proper fencing to avoid the general population getting closer than 20m to the antenna and has also placed the appropriate warning signs for occupational/controlled exposure.

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I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE RADIATION HAZARD REPORT, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

BY:_____

Mariano Boragno
Ground Stations Systems Engineer
ASTSpaceMobile

May 13, 2021