Exhibit B - Radiation Hazard Study

When applying for a license to construct and operate, modify, or renew an earth station, it is understood that the applicant must certify whether grant of the application will have significant environmental impact as defined in the Federal Communications Commission's (FCC) rules, 47 C.F.R. § 1.1307.

In this report Koch Pipeline Company LP ("Koch") analyzes the maximum radiofrequency (RF) levels emitted from the satellite communications antenna described below. The reference document for this study is OET Bulletin No.65, Edition 97-01, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields,* August 1997.

1. <u>Antenna Near-Field Power Density Calculation</u>

The extent of the near-field is defined by the following equation[1]:

$$R_{near} = (D_{antenna})^2 / (4\lambda\ )$$

where:

R_{near} = extent of the near-field (in meters)

$D_{antenna}$ = diameter of the antenna main reflector (in meters)

λ = wavelength of the RF transmit frequency (in meters)

The maximum on-axis power density within near-field is defined by the following equation[2]:

$$S_{near} = \{(16\eta\ P_{feed}) / [\pi\ (D_{antenna})^2]\} / 10$$

where:

S_{near} = maximum on-axis power density within the near-field (in milliwatts per square centimeter)

η = antenna aperture efficiency

P_{feed} = maximum power into antenna feed flange (in watts)

$D_{antenna}$ = diameter of the antenna main reflector (in meters)

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[1] See OET 65 page 27 formula (12).

[2] See OET 65 page 28 formula (13). The right side of the equation is divided by 10 so that the power spectral density units on the left side will be mW/cm^2.

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2. Antenna Far-Field Power Density Calculation

The distance to the beginning of the far-field region is defined by the following equation[3]:

$$R_{far} = [0.6(D_{antenna})^2] / \lambda$$

where: R_{far} = distance to beginning of far-field (in meters)

$D_{antenna}$ = diameter of the antenna main reflector (in meters)

λ = wavelength of the transmit frequency in (meters)

The maximum on-axis power density within the far-field is defined by the following equation[4]:

$$S_{far} = [(P_{feed}\, G_{antenna}) / 4\pi\, (R_{far})^2] / 10$$

where: S_{far} = maximum on-axis power density in the far-field (in milliwatts per square centimeter)

P_{feed} = maximum power into antenna feed flange (in watts)

$G_{antenna}$ = antenna main beam gain at AF transmit frequency (in numeric value)

R_{far} = distance to beginning of far-field (in meters)

The on-axis power densities calculated from the above formulas represent the maximum exposure levels that the system can produce. Off-axis power densities will be considerably less.

3. Antenna Transition Region Power Density Calculation

The on-axis power spectral density for the transition region is defined by the following formula[5]:

$$S_{tr} = S_{near}\, R_{near} / R$$

where: S_{tr} = maximum on-axis power density in the transition region (in milliwatts per square centimeter)

S_{near} = maximum on-axis power density in the near-field (in milliwatts per square centimeter)

R_{near} = is the distance that defines the end of the near field region.

R = is the distance within in the transition region between the near field and far field regions.

[3] See OET 65 page 29 formula (16).
[4] See OET 65 Section 2, page 19, formula (3) and page 29, formula (18). The right side of the equation is divided by 10 so that the power spectral density units on the left side will be mW/cm^2.
[5] See OET 65 page 34, formula (17).

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Since the distance within the transition region "R" will always be greater than the distance to the end of the near field region "R_{near}" then $S_{tr} \leq S_{near}$.

4. Antenna Feed-Flange Power Density Calculation

The maximum power density at the antenna feed-flange is defined by the following equation[6]:

$$S_{feed} = 1000\{[4(P_{feed})] / \{[\pi\ (D_{feed})^2] / 4\}\}$$

where: S_{feed} = maximum power density at the antenna feed-flange (in milliwatts per square centimeter)

P_{feed} = maximum power into antenna feed flange (in watts)

D_{feed} = diameter of the antenna feed-flange (in centimeters)

5. Antenna Main Reflector Power Density Calculation

The maximum power density in the main reflector region of the antenna is defined by the following equation[7]:

$$S_{antenna} = \{[4(P_{feed})] / \{[\pi\ \{(D_{antenna})^2] / 4\}\} / 10$$

where: $S_{antenna}$ = maximum power density in the antenna main reflector region (in milliwatts per square centimeter)

P_{feed} = maximum power into antenna feed flange (in watts)

$D_{antenna}$ = diameter of the antenna main reflector (in meters)

6. Power Density Calculation between the Antenna Main Reflector and the Ground

The maximum power density between the antenna main reflector and the ground is defined by the following equation:

$$S_{ground} = \{P_{feed} / \{[\pi\ \{(D_{antenna})^2] / 4\}\} / 10$$

where: S_{ground} = maximum power density between the antenna main reflector and the ground (in milliwatts per square centimeter)

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[6] The formula is multiplied by 1,000 on the right side of the equation to change the units from watts on the right side of the equation to milliwatts on the left side.

[7] See OET 65 equation (11) which is "S = 4 P / A", where "A" is the area of the reflector and for a circular reflector $A = \pi\ (D_{antenna})^2 / 4$. The formula is divided by 10 on the right side to change the units from meters and watts on the right side of the formula to cm and mW on the left side.

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P_{feed} = maximum power into antenna feed flange (in watts)

$D_{antenna}$ = diameter of the antenna main reflector (in meters)

7. Calculation of Radiation Levels and FCC Standards

Koch understands that a licensee must ensure that people are not exposed to harmful levels of radiation. Koch plans to use transmitters with power input to the antenna feed of up to 3-watts of output power. The preceding formulas were used to calculate the power densities shown on the following page.

The Commission's maximum permissible exposure (MPE) limits at the transmit frequency band for the earth stations included in this application are provided in the table set forth below.

Maximum Permissible Exposure (MPE) Limits at 14,000-14,500 MHz

Exposure Criteria	Power Density (mW/cm^2)	Averaging Time (minutes)	Reference
general population/uncontrolled exposure	1	6	OET 65 page 67 Appendix A Table 1 (A)
occupational/controlled exposure	5	30	OET 65 page 67 Appendix A Table 1 (B)

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Radiation Hazard Calculations

Antenna IDs	REMT1	1VSAT	REMT2
Antenna main reflector diameter	1.2 m	1.8 m	1.2 m
Feed flange diameter	14.63 cm	14.63 cm	14.63 cm
RF transmit frequency	14.250 GHz	14.250 GHz	14.250 GHz
Maximum power into antenna feed-flange	3.0 W	3.0 W	3.0 W
Main-beam gain of antenna	43.2 dBi	46.5 dBi	43.2 dBi
Antenna aperture efficiency	0.65	0.65	0.65
Antenna main reflector surface area	1.131 m^2	2.5447 m^2	1.131 m^2
Feed flange surface area	168.1 cm^2	168.1 cm^2	168.1 cm^2
Wavelength at RF transmit frequency	0.021 m	0.021 m	0.021 m
Distance to beginning of far-field region	40.3 m	90.7 m	40.3 m
Distance to extent of near-field region	16.8 m	37.8 m	16.8 m

Max. on-axis power density in far-field	0.29 mW/cm^2 Satisfies MPE Limits	0.12 mW/cm^2 Satisfies MPE Limits	0.29 mW/cm^2 Satisfies MPE Limits
Max. on-axis power density in near-field	0.69 mW/cm^2 Satisfies MPE Limits	0.28 mW/cm^2 Satisfies MPE Limits	0.69 mW/cm^2 Satisfies MPE Limits
Max. on-axis power density in transition region	0.69 mW/cm^2 Satisfies MPE Limits	0.28 mW/cm^2 Satisfies MPE Limits	0.69 mW/cm^2 Satisfies MPE Limits
Max. power density at feed-flange (see note 1)	**66.6 mW/cm^2** **Potential Hazard**	**66.6 mW/cm^2** **Potential Hazard**	**66.6 mW/cm^2** **Potential Hazard**
Max. power density at main reflector	0.99 mW/cm^2 Satisfies All MPE Limits	0.44 mW/cm^2 Satisfies All MPE Limits	0.99 mW/cm^2 Satisfies All MPE Limits
Max. power density between main reflector and ground	0.25 mW/cm^2 Satisfies All MPE Limits	0.11 mW/cm^2 Satisfies All MPE Limits	0.25 mW/cm^2 Satisfies All MPE Limits

Note 1: Feed flange power density exceeds both uncontrolled MPE limit of 1 mW/cm^2 and controlled MPE limit of 5 mW/cm^2

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8. Conclusion

The calculations provided in this exhibit indicate that antennas, which are the subject of this application, exceed the MPE limits for occupational/controlled and general population/uncontrolled exposure at the feed horn and in the area between the feed horn and reflector. All antennas will be installed such that the area where the MPE is exceeded will not be readily accessible. All transmissions will be terminated whenever the technical staff is required, for maintenance or other activities, to occupy the regions where potentially hazardous power density levels can exist. Additionally, the earth stations will have an automatic shut-off mechanism that will terminate transmissions if the receive signal is lost, which will occur if there is blockage of the area between the feed horn and reflector.

Exhibit C

In response to Item 37 of the Form 312, Koch Pipeline Company, L.P. ("Koch") provides the following information:

On September 19, 1980, Koch Industries, Inc., an entity that indirectly controls Koch Pipeline Company, LP, was sentenced to a $50,000 fine by the U.S. District Court for the District of Colorado. The sentence was the result of Koch Industries' plea agreement resolving charges that it and other defendants had manipulated a lottery administered by the Federal Bureau of Land Management by submitting more applications for oil and gas leases than the rules permitted. Although the incident in question occurred over 30 years ago, Koch Pipeline Company, LP is making this disclosure out of an abundance of caution.