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Sent: Friday, September 09, 2005 11:15 AM
To: matthew.burchfield@faa.gov
Cc: John Kennedy; Wells, Claude
Subject: FAA Coordination for GPS Re-radiation experimental license

Jim,

Per my voicemail this morning, the FCC currently requires applicants to send responses to the questions below to the appropriate FAA regional office in order to coordinate GPS re-radiation device applications. This coordination is necessary because GPS L1? signal transmits between 1215 - 1390 MHz. Lockheed Martin is renewing FCC experimental license WD2XMZ, a GPS re-radiation experimental license used inside our Orlando, FL facility. A description of our experimental program is attached.

Unless FAA Headquarters notifies the FCC otherwise, it is my understanding the FAA regional office must be notified and coordinated with regarding GPS re-radiation applications. The FCC provided me the questions below and Lockheed Martin's responses are provided in Red.

If you have any questions, please feel free to contact me.

Best regards,

Joe

Please submit the following parameters to the FAA Southern Regional Office for the frequency 1227.6 MHz and confirm in your response to this e-mail when that submission has been completed:

- peak envelope power (PEP) - 12 PicoWatts Max.
- type of antenna - 2x2 inch Flat Plate.
- transmit antenna gain - 0 dBi.
- elevation above sea level of the antenna site - ~90 feet ASL.
- height above ground of the focal point of the antenna - ~20 feet AGL. Use is indoors and fixed.
- antenna polarization - Omnidirectional.
- the azimuth that the antenna is pointed or appropriate designator to indicate whether the antenna is rotating, non-directional, etc. - Omnidirectional with reference plane above radiating element (Pointing Down).
- pulse repetition rate (PRR) that the equipment is capable of operating on to include PRR stagger sequences if appropriate, whether the PRR is adjustable and what PRR's the equipment can accept, and any other information that would be helpful in understanding the pulse characteristics of the equipment - Not applicable.
- pulse width - No Modulation - system is Block Amplifier, or Not Applicable.
- equipment nomenclatures - Not Applicable or not available.
- whether the equipment is capable of blanking transmissions in certain azimuths and any limitations with respect to blanking - Not applicable.
- radius of operations if appropriate - 100 ft.
- detailed description of the proposed operation to include any technical parameters that will be altered during operations - GPS Re-radiation experiment internal to Lockheed Martin Facility on Lake Underhill Road Orlando Florida. See Description of Experiment attached below.

<<LM Exhibit 1 - WD2XMZ Renewal.doc>>

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FCC FORM 442 – EXHIBIT 1

GPS Re-Radiation System Testing to Determine Accuracy of US Army Training Equipment

Lockheed Martin would like to renew its current FCC STA, WD2XMZ, to a 2-year full experimental license. WD2XMZ allows Lockheed Martin to re-radiate GPS signals in order to provide such signals into a laboratory used to verify GPS receiver functionality in support of the following US Army contracts:

Contracting Agency: PEO-STRI (Orlando Florida)

Programs: PEO-STRI Combat Training Centers Objective Instrumentation System (CTC OIS)
PEO-STRI Common Training Instrumentation Architecture (CTIA) Program
PEO-STRI Multiple Integrated Laser Engagement System MILES XXI.
N61339-00-D-0707 STRICOM Omnibus Contract (STOC)
Delivery Orders under STOC:
-0005 MILES XXI
-0012 CTIA
-0017 NTC-OIS

All programs support live training equipment and systems development to assist in training the US Army for force on force and force on target engagements. The re-radiation system allows the GPS signal to be received inside the Lockheed Martin laboratory testing facility. The signals are used to verify GPS receiver performance and develop tracking systems.

The GPS re-radiation system is designed to work as follows:

A GPS antenna is positioned on the roof of the Lockheed Martin building in order to receive GPS signals. The GPS signal travels through a coax cable inside the building to a lab where it is connected to a series of attenuators and then to eight GPS antennas. These GPS antennas radiate the original GPS signal into the lab space. The signal level inside the lab space is designed to be equivalent to the GPS signal received on the roof of the building. The antennas in the labs are omni-directional. Due to low re-radiated power, distance between antennas and Lockheed Martin property boundaries, and attenuation of the GPS signal by building construction materials, no GPS signals can be received outside of Lockheed Martin controlled areas.

The frequencies to be re-radiated are: GPS L1/L2 (1575.42 MHz/1227.6 MHz)
The Emission at both frequencies: 24M0G1D
Power at antenna is 12 pW

On May 3, 2005, the NTIA issued an information letter to the IRAC Executive Secretary stating that a new section, 8.3.28, will be included in the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management. This section provides the criteria federal agencies must follow in order to operate devices that re-radiate signals from the Global Position System. Although not directly applicable, below are responses to the criteria.

1. Individual authorization is necessary for each device at a site-specific location.

Eight re-radiation antennas are located in one room at the following coordinates:

North Latitude: 28-32-17

West Longitude: 81-12-48

This coordinate is the same as the location in FCC STA Wd2XMZ

2. Applications for frequency assignment should be applied for as an XT station with a note indicating the device is to be used as "Experimental RNSS Test Equipment for the purpose of testing GPS receivers".

WD2XMZ, as well as this renewal application will be used to test RNSS receiver functionality.

3. Approved applications for frequency assignment will be entered in the GMF.

Lockheed Martin will work with the FCC and NTIA to satisfy this requirement.

4. The maximum length of the assignment will be two years, with possible renewal.

Lockheed Martin requests an experimental license for 2 years.

5. The operation must be at specified fixed location and mobile operation is not authorized.

The operation is fixed at the location described above. Mobile operation is not requested.

6. The area of potential interference to GPS reception has to be under the control of the user.

The laboratory where the GPS re-radiation occurs is an interior room of the Lockheed Martin facility. Access to the building and its surrounding area is secured and controlled by Lockheed Martin personnel.

7. The maximum equivalent isotropically radiated power must be such that the calculated emissions are no greater than -140 dBm/24 MHz at a distance of 100 feet (30 meters) from the building where the test is being conducted. The calculations showing compliance with this requirement must be provided with the application for frequency assignment and should be based on free space propagation with no allowance for building attenuation.

The Authorized Power for WD2XMZ is 12 pW (ERP). Lockheed Martin requests this same power level for this license. Equations showing 12 pW (ERP) as complying with this requirement are provided below.

The attenuation of the GPS signal while traveling through free space is calculated with the following formula:

$$\text{Free space loss or PL} = 32.4 + 20 \times \log F(\text{MHz}) + 20 \times \log R(\text{km})$$

Where:

F = the frequency in MHz; and

R = the distance in kilometers (km). At 100 ft or 33 meters, R = 0.033 km.

The GPS Re-radiation device transmits at two frequencies:
1227.6 MHz and 1575.42 MHz

Therefore, the Free Space Path Loss (PL) equals:

- For 1227.6 MHz: $PL = 32.45 + 20 \times \log(1227) + 20 \times \log(0.033) =$

$$PL = 32.45 + 61.78 - 29.62$$

$$PL = 64.6 \text{ dB}$$

- For 1575.42 MHz: $PL = 32.45 + 20 \times \log(1575) + 20 \times \log(0.033) =$

$$PL = 32.45 + 63.95 - 29.63$$

$$PL = 66.76 \text{ dB}$$

Therefore, the EIRP at 100 ft from the transmitting antenna will equal:

Transmitted Power = 12 picowatts EIRP.

$$10 \times \log(12 \times 10^{-12} \text{ W} / 1 \text{ mW}) = -79.2 \text{ dBm} = 12 \text{ picowatts}$$

- For 1227.6 MHz, the EIRP at 100 feet = $-79.2 \text{ dBm} - 64.6 \text{ dB} = \mathbf{-143.8 \text{ dBm}}$
- For 1575.42 MHz, the EIRP at 100 feet = $-79.2 \text{ dBm} - 66.76 \text{ dB} = \mathbf{-145.9 \text{ dBm}}$

8. GPS users in the area of potential interference to GPS reception must be notified that GPS information may be impacted for periods of time.

Lockheed Martin has and will continue to notify staff and visitors in the area that GPS information may be impacted. This requirement is currently being followed under FCC license WD2XMZ.

9. The use is limited to activity for the purpose of testing RNSS equipment/systems.

WD2XMZ, as well as this renewal application will be used to test RNSS receiver functionality.

10. A “Stop Buzzer” point of contact for the authorized device must be identified and available at all times during GPS re-radiation operation of the device under any condition.

The Stop Buzzer point of contact is Mr. Harold Prosser at (407) 306-2221.