Raytheon Missile Systems
Low Frequency Antenna Test Range
Renewal Application for WF2XNP
File No: 0223-EX-CR-2020

Explanation of Experiment and Need for License Renewal

Overview:

Raytheon Missile Systems has been testing antennas at an outdoor antenna test range at its Tucson facility since 1993. Much of the testing was previously conducted under a federal Frequency Assignment granted by the DoD Area Frequency Coordinator Arizona. Since May 2011, Raytheon has held experimental license WF2XNP to conduct antenna testing. Renewal of this experimental license is required to allow the ongoing testing required at this range.

The purpose of this experimentation is to test and develop technologically advanced low frequency antennas. The new technologies are tested to determine the antenna characteristics. Depending on what is learned, the antenna may be re-engineered or modified to optimize performance. After any re-engineering, the antenna is re-tested to see if the modifications achieved the goals set for improvement of the technology.

Key Elements of Experimentation

- Frequencies: 80-200 MHz
- Time of use: less than 3 minutes per year for total spectrum use; less than 10 sec per frequency
- Power level: 32 mW, with 6 dB gain, highly directional antenna
- Location: on Raytheon facility, backed by buildings pointing toward the desert

Description of operations:

Summary: An area outside of Raytheon's building 849 will be used to test low frequency antennas. The tests will use a log periodic antenna powered by a vector network analyzer at very low power levels. The transmit antenna is set low to the ground (about a meter above the ground) with building 849 behind the transmit antenna to provide protection from spurious emissions in the backlobe of the transmitting antenna. The transmitter operates on a narrow beamwidth of approximately 60 degrees. The transmitter is set to transmit facing south-southwest, from approximately 180 degrees to 235 degrees. To the south, there is more of the Raytheon facility. To the southwest, the transmission is directed toward an unpopulated section of the San Xavier Indian Reservation.

The log periodic transmit antenna is powered by a vector network analyzer that steps across the frequency band, 80 to 200 MHz, at 10 MHz steps. The vector network analyzer operates by pulsing a signal at one of the steps, and because of its internal

synchronization, it is able to receive and process the return pulse and analyze the characteristics of the Antenna under Test (AUT). The vector network analyzer gives information on both the amplitude and phase of the AUT.

Time of use: The transmitter steps through all the frequencies in less than four (4) seconds. The time of spectrum use expected over the course of a year is merely 120 seconds. This time of use based upon three (3) antennas being tested per year. Each antenna is tested approximately ten (10) times during the development process. This testing equipment can be expected to be in use about 30 times per year, at approximately four (4) seconds per test, leading to a total time of spectrum use of 120 seconds, or two (2) minutes. Each frequency step is in use, at most, about 10 seconds per year.

Use of Antennas: The antenna is used to conduct tests to determine three-dimensional (3D) far-field radiation patterns with full scale mockups. The log periodic antenna transmits to the AUT. Due to the principle of reciprocity, the radiation pattern obtained with the AUT receiving will be identical to that of the AUT when transmitting.

The operations proposed here continue to be at a secure facility (campus) with restricted access and even more tightly controlled access to the transmit area.

Interference testing showed no interference: Tests conducted by the spectrum management staff at Raytheon have shown that there is no interference experienced at the secure facility, not even near the secured area where the antenna tests are being conducted. This minimizes the chances of any entity experiencing harmful interference adjacent to the secured campus. Operational testing has been coordinated with nearby facilities such as the Air National Guard, Davis-Monthan Air Force Base, Tucson International Airport, Kitt Peak Observatory, and the University of Arizona. Additionally, the original experimental license application was successfully coordinated with the FAA's Western Regional Office. No interference issues have arisen from past and ongoing operations. The operations proposed in this experimental license renewal application are identical to the currently authorized operations, and so there is no anticipated new interference.

Previous operations under the federal frequency assignment did not cause any interference to any airport operations or to any activities at Davis Monthan Air Force Base. Further, there have been no reports of any interference to FM radio reception, including when FM radios were tested for interference on the range when the range was operating under the DOD frequency assignment.

Area of operation: The picture below, Figure 1, shows the area where Raytheon Low Frequency Antenna Test Range had been operating. The proposed operations will take place near the row of white containers at the base of building 849, with the building behind the transmitter. (See Figure 1, on the right hand side of the picture.) Most of the FM radio transmitters in the Tucson area are located atop Mt. Lemmon, which is approximately 25 miles to the northeast of the Raytheon facility. Most of Tucson's business and residential areas are also to the northeast of the Raytheon facility.

Power level: The testing uses a 32 milliwatt transmitter with a 6 db gain antenna.

Stop Buzzer Point of Contact: To stop operations immediately in the unlikely event of harmful interference, please call:

Jim Ortega, Spectrum Manager
Raytheon Missile Systems
520-794-0227 (office)
James.e.ortega@raytheon.com

Conclusion: If there are any questions, please contact Anne Linton Cortez, 520-360-0925, alc@conspecinternational.com.

The antenna is installed by the white containers at the lower right corner of the building in the photo above. The antenna is highly directional with a very narrow beam and the transmitter points out over the sparsely populated desert.

Figure 1. Low Frequency Antenna Test Range