

Raytheon Missile Systems  
Application for Experimental License  
Application Number: 0198-EX-PL-2010

**Explanation of Need for Experimental License:**

In January 2010, Raytheon Missile Systems (Raytheon) filed a request for Special Temporary Authorization to operate Freewave Radios during airborne radar tests. That application, 0035-EX-ST-2010, was granted and testing commenced on March 1, 2010. The tests being conducted were requested by Raytheon's customers at the Department of Defense, to parallel testing being conducted by DOD on some of Raytheon's products.

Since the beginning of March 2010, those tests have been ongoing. These flights are very intermittent. They do not happen every day, but only when necessary. While it was originally thought that this testing would be complete in only 6 months, the program has determined that the radio experiment will need to extend beyond that six month period. Raytheon is now filing this request for an experimental license to continue testing the Freewave radios.

This license request is for the use of 1.35 to 1.39 GHz on an aircraft. As Raytheon previously agreed when the STA was granted, airborne operations will be limited to use of the frequencies 1.37 to 1.39 GHz.

**Explanation of Experiment:**

As stated previously, Raytheon's proposed experiment will implement the use of Freewave radios on an aircraft. The Freewave radios are installed on a Raytheon-operated aircraft that is being tracked by a second Raytheon-operated aircraft. One radio will transmit the precise position of the aircraft on which it is installed to the other aircraft. The second aircraft operates radar to track the flight of the first aircraft. The transmission of precise location information will be used to verify the accuracy and effectiveness of the radar operations on the second aircraft, a verification process that has not been possible previously.

Verification of the accuracy of the in-flight radar tracking is essential to advance the use of radar for national defense purposes. Prior to the formulation of this experiment, Raytheon used radar from one aircraft to the other for mapping and tracking purposes. However, because of the speed of the flights and the complexity of tracking from one aircraft to the other, it was impossible to verify that the information being received and processed by the tracking radar was accurate. By transmitting the position information from the tracked aircraft to the tracking aircraft, it is possible to verify that the position information determined by the radar is in sync with the actual position of the tracked aircraft. This proves the effectiveness of the radar. In the unlikely event that there is a position discrepancy, this experiment will provide the Raytheon researchers with

information which will allow them to reengineer to improve the performance of the radar tracking systems.

Both aircraft will be flying within a 100 km radius of Raytheon's facilities in Tucson, Arizona during these tests. The flights will be concentrated in the 50 km to the east of Raytheon's facilities. The aircraft lack pressurized cabins, so all flight operations will take place at an altitude below 10,000 feet.

#### **Technical Requirements of the Experimentation:**

The radios used here have been selected because they operate with characteristics that are ideal for the proposed application. The power level proposed is enough to span distances between the aircraft, without losing connection between the radios. The aircraft do not fly in parallel, but each engages in maneuvers which would preclude a line-of-sight radio transmission. The distances between the aircraft can range up to 200 km, although the likely spacing is more like 50 km at any given time. Still, the radar testing is done to help develop technologies that can detect incoming threats at ever-greater distances. These radios are able to maintain a connection and to transmit sufficient data rapidly to be able to verify the radar's accuracy in real-time. Other radio systems do not have enough data capacity to allow for the real-time verification of the radar systems.

#### **Coordination:**

After filing the request for special temporary authorization, Raytheon contacted radio astronomy researchers operating at Kitt Peak Observatory to coordinate use of the spectrum. The radio astronomy researchers had been concerned about the proposed operations. Raytheon agreed that it would limit flights to the east of Tucson, and avoid flying over Kitt Peak. That geographic solution addressed the questions raised, and no objections remained. In filing this request for an experimental license, Raytheon proposes to continue using the license only for testing done to the east of Tucson, away from the radio observatory at Kitt Peak. This limitation is being made to avoid any prospect of harmful interference to the radio astronomy operations taking place there.

#### **Conclusion:**

The initial tests have proven useful, but it will not be possible to gather enough of the required information for Raytheon's customers during a six-month period. For that reason, Raytheon is filing this request for an experimental license authorization.

Any questions about this application should be directed to Thomas J. Fagan, Spectrum Manager, Raytheon Missile Systems, 520-794-0227 [tjfagan@raytheon.com](mailto:tjfagan@raytheon.com) or to Anne Linton, 301-980-2335 [alc@wfsllc.biz](mailto:alc@wfsllc.biz).