Raytheon Missile Systems
Experimental License Renewal Application
Call Sign: WH2XYD
File Number: 0457-EX-CR-2019

Explanation of Experiment

Overview:

Raytheon Missile Systems (Raytheon) designs and builds missiles for the US Department of Defense and other agencies of the federal government. Raytheon is continuing work on advanced radar systems used to detect incoming weapons threats. This program has been working on development of the radar systems at the Raytheon facilities in Tucson, AZ. Raytheon has advanced the development of this technology through work in the laboratory at its facilities in Tucson, and it has been implementing some of the technology into its missile systems in McKinney, Texas.

In early 2015, to further advance the development of the technology, Raytheon was granted an STA, WI9XGC, to allow the radar to be tested in a dynamic environment. Then, it continued the work under WH2XYD, the license that Raytheon is seeking to renew now. These operations allow the airborne mobile testing to advance development of the radar seeker technology and determine how to advance performance of the system when it is operating in a dynamic setting.

Synopsis:

- Spectrum needed: 16.235-17.3 GHz
- Signal level: 100 Watts, with 19.5 kW ERP
- Locations: Tucson, AZ, Point Loma, CA, San Nicolas Island, CA, San Clemente Island, CA, Mojave Airfield California, Lake Meade, Lake Powell, and Patagonia, AZ
- Azimuth of transmissions: Transmissions will be limited to sectors on the diagrams below.
- All targets are ground-based, so all transmissions will be aimed down to the ground
- Time of Use and Duty Cycle: two flights per week, of 3 hours per flight, duty cycle: 10%

Nature of the Experimentation:

Raytheon is continuing work on the advanced development of its Radar Seekers. Using the semi-active radar system, the test equipment will use a low power transmitter to send a signal to the seeker's radar receiver. Then, the results will be evaluated to fine tune the receiver performance. This will lead to advancements in the performance of the Seeker.

The active radar system, operated from an airborne platform, uses its own signal reflected off a simulated target at the center of the radius of operations at each of the test sites. The seeker's radar receiver uses the reflected signal and advanced processing to accomplish the performance goals required by Raytheon's DOD customers and then to undertake additional independent research and development to further enhance the capabilities of the radar systems.

The Seeker radar systems are used for detection of incoming mortars, artillery, rockets, and other threats. The radar system scans for threats, and once a threat is detected it stays focused on the threat and provides the missile system with details on the movement of the threat, allowing the missile system to respond properly to neutralize it.

Locations for this testing:

Raytheon's program has selected eight sites in conjunction with its customer needs:

- Point Loma, California
- San Nicolas Island, off the coast of California
- San Clemente Island, off the coast of California
- Mojave Air and Space Port, California
- Lake Meade, on the border of Arizona and Nevada
- Lake Powell, on the border of Arizona and Utah
- Tucson, Arizona
- Patagonia, Arizona

Below are the specific descriptions of the sites and the proposed operations at each site. In the figures below, the red circle represents a 50 km or greater radius around the center point selected for the testing.

Point Loma, California: The testing at Point Loma, California was requested by Raytheon's Navy customers. They are interested in exploring how the Radar Seeker will be able to work in a marine environment, seeking out threats that are on the surface or coming from the sea. The site selected for testing is currently a Navy test facility at Point Loma. The airborne mobile operations are directed toward US Navy open ocean testing area Whiskey 291. Thus, all transmissions are directed between azimuth 180° and azimuth 290°. Figure 1 below shows the 63-km radius area of operations and clarifies the directionality of the transmissions. The colored area of the circle in Figure 2 below shows the area where flights are allowed. No flights are conducted outside of US airspace.

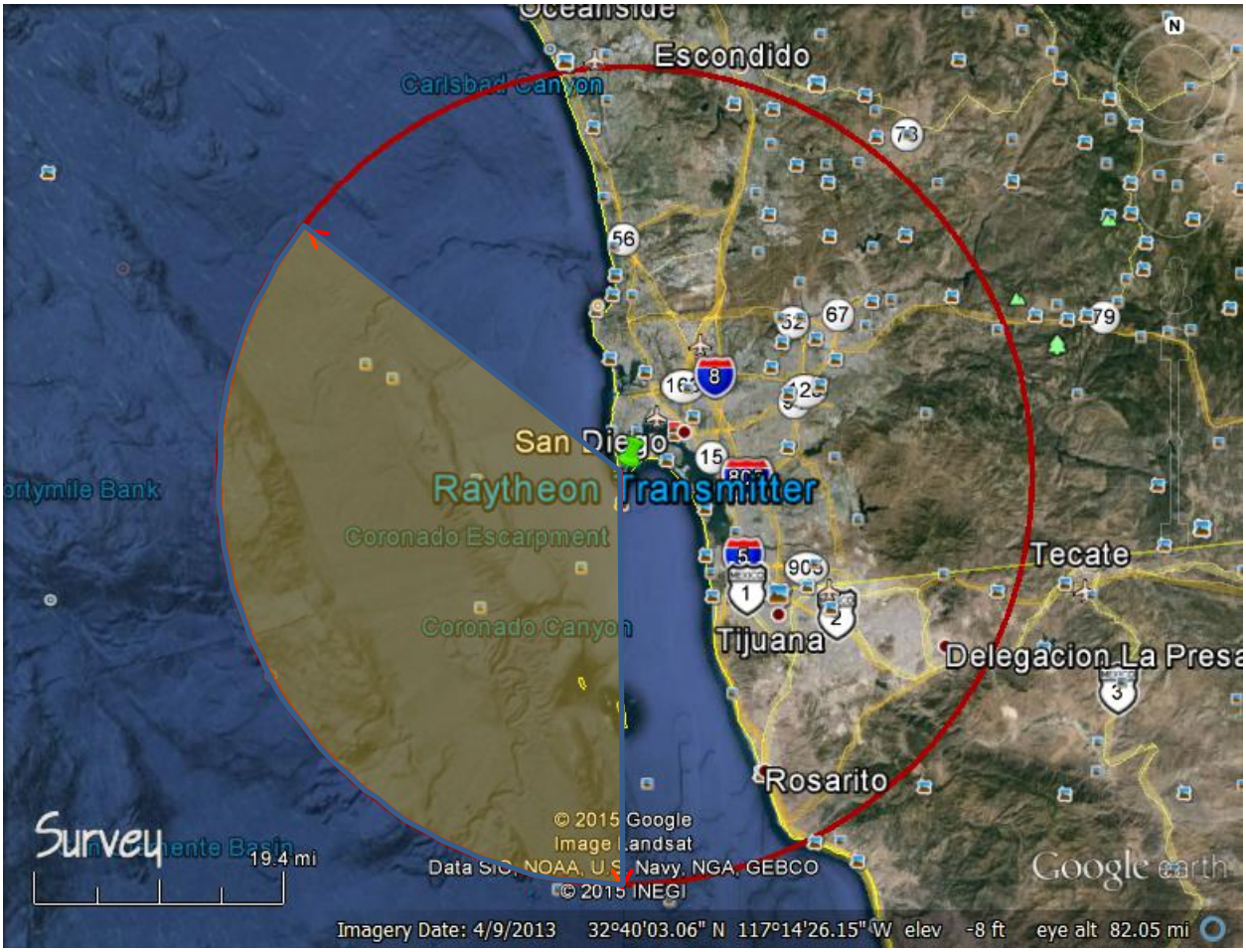

Figure 1. Point Loma Test Site

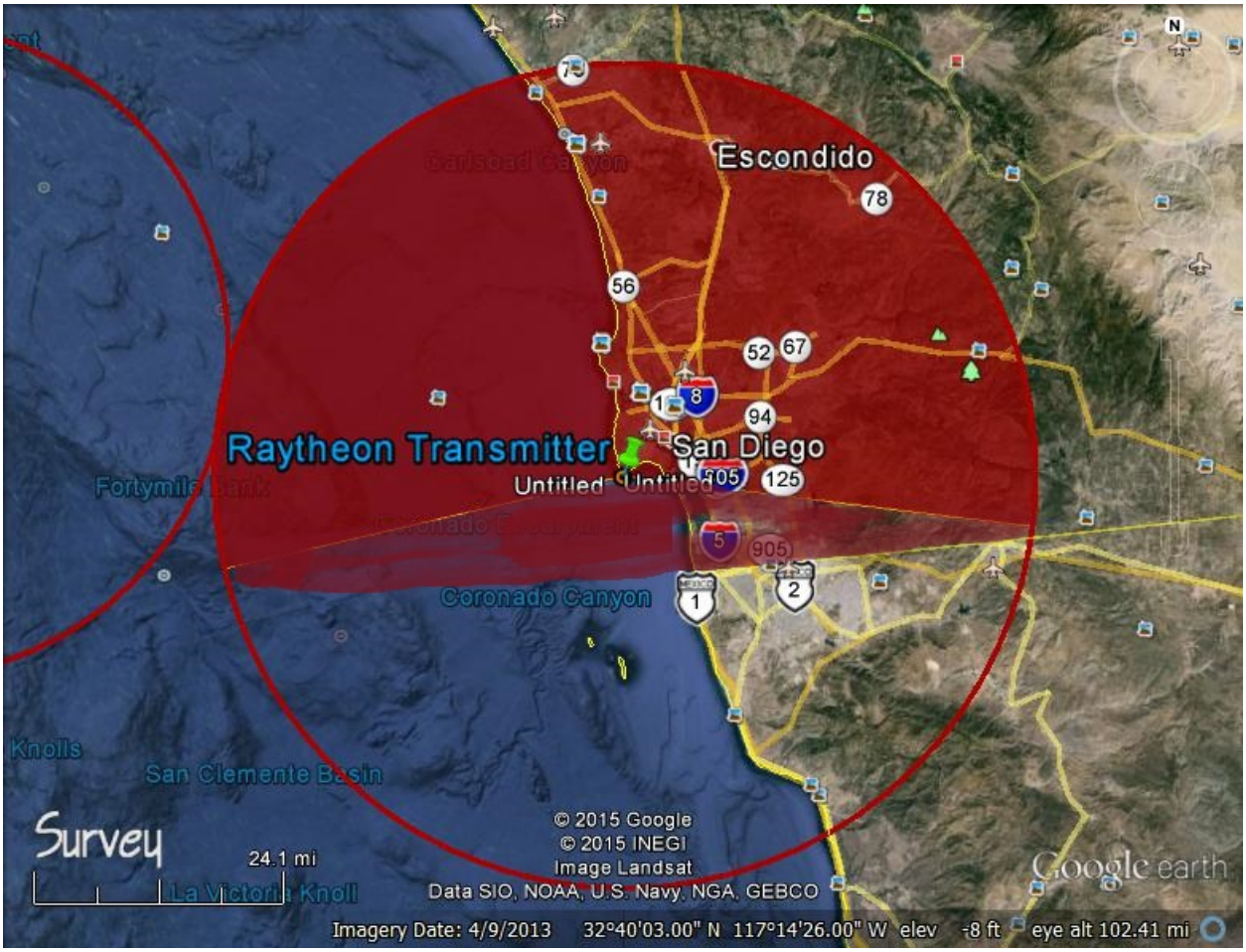

Figure 2. Point Loma Area of Operations, flights will all be in US airspace

San Clemente Island, California: The testing around San Clemente Island is combined with the Point Loma and San Nicolas Island testing, allowing the flights to follow moving targets on the ocean. This testing is aiding rapid advancements in the marine application of the radar seeker technology. The Navy is cooperating with this testing because the technology development is of great interest to them. They are allowing Raytheon to track from its aircraft some of the naval vessels coming out of bases in San Diego as those aircraft fly in the Point Loma, San Clemente, and San Nicolas areas of operation. As noted above, all flights will be limited to US airspace. The ships will be in Navy open ocean testing area Whiskey 291. Figure 3 below shows the 50 km radius of operations around San Clemente Island. Figure 4 below shows the overlapping flight areas covering Point Loma, San Clemente Island and San Nicolas Island. The radius of operations for Point Loma and for San Nicolas Island were set at 63 km, while the radius of operations for San Clemente Island is 50 km. This was done so that there would be no operations over Santa Catalina Island, but it would still be possible for the aircraft to have tests conducted while Navy vessels are making their way across the area covered by the three areas shown in Figure 4 below.

Figure 3. San Clemente Island Area of Operations

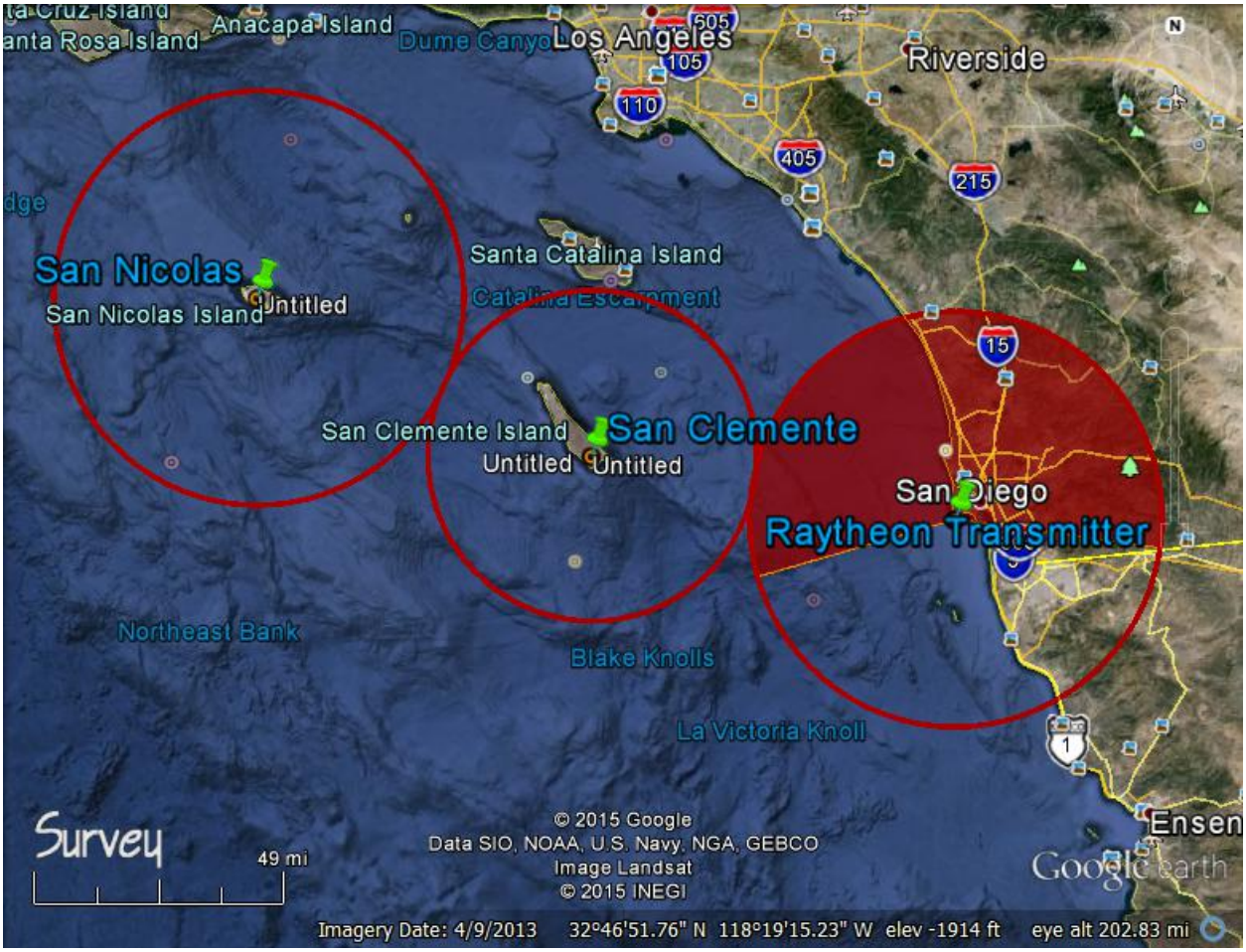

Figure 4. Point Loma, San Clemente Island, San Nicolas Island overlapping areas of operation

San Nicolas Island, California: As described above, the area of operations is airborne, tracking moving targets on the ocean below in the 63-km radius around San Nicolas Island, San Clemente Island, and on to the bases near Point Loma.

Mojave Air and Space Port, California: The testing at Mojave Air and Space Port is focused on land-based threat detection and response. The flight testing is aimed at a center point located at the air and space port to improve the performance the radar seeker system. Figure 5 shows the area of proposed operations. While in flight, the radar seeker is always directed toward the Mojave Port, so even though the 50-kilometer radius of operations covers a great deal of territory, the directional signals will not be widespread.

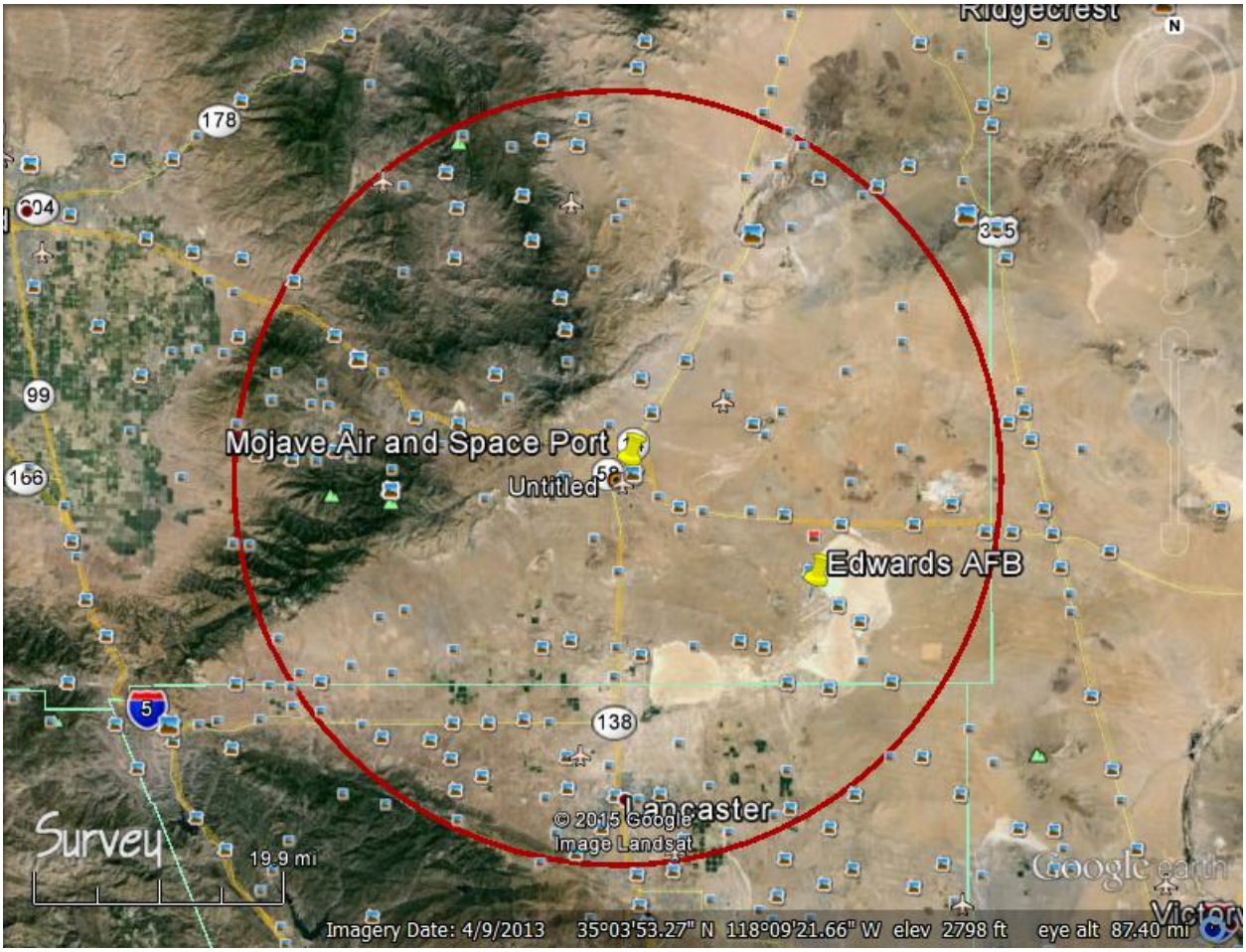

Figure 5. Mojave Air and Space Port Test Site

Lake Meade, Arizona and Nevada: The testing at Lake Meade is intended to further the development of the marine threat detection. The testing uses simulated threats placed on the lake and tests the ability of the radar seeker to detect and respond to those threats. While in flight, the radar seeker is always directed toward the threats in Lake Meade, so even though the 50-kilometer radius of operations covers a great deal of territory, the directional signals are not widespread. Figure 6 shows the area of proposed operations.

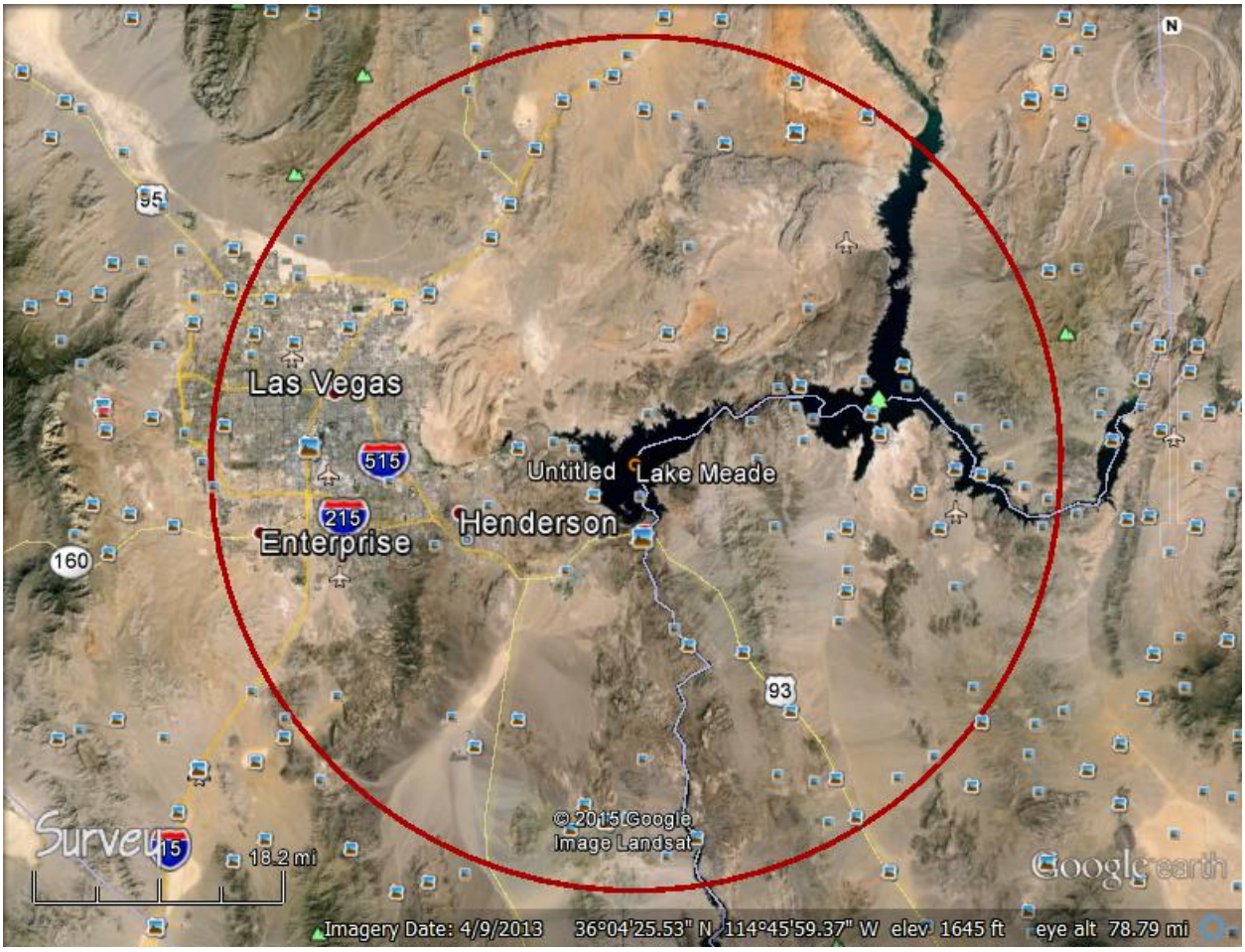

Figure 6. Lake Meade Test Site

Lake Powell, Arizona and Utah: The testing at Lake Powell is intended to further the development of the marine threat detection. The proposed testing uses simulated threats placed on the lake and test the ability of the radar seeker to detect and respond to those threats. While in flight, the radar seeker is always directed toward the Lake Powell targets, so even though the 50-kilometer radius of operations covers a great deal of territory, the directional signals are not widespread. Figure 7 shows the area of operations.

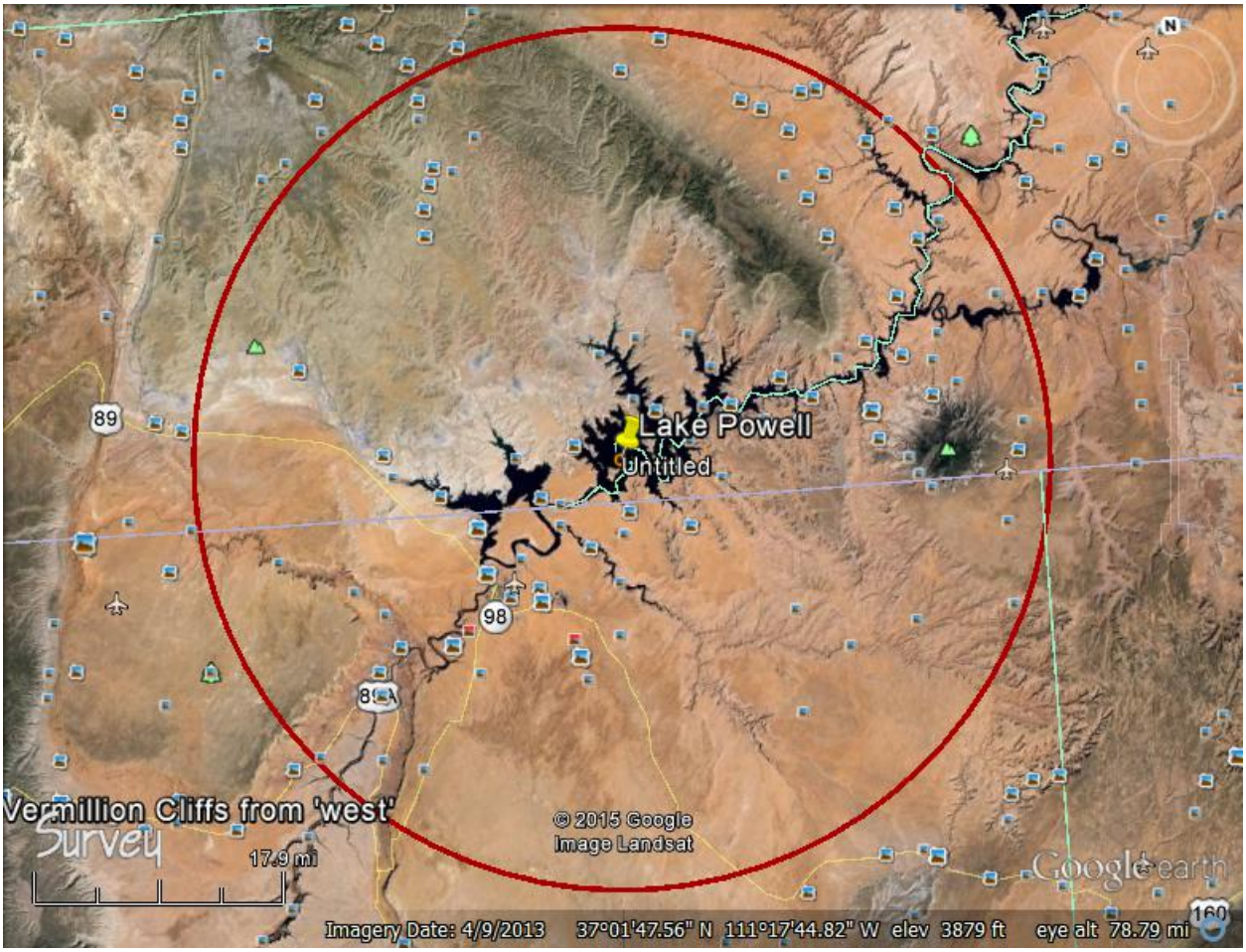

Figure 7. Lake Powell Test Site

Tucson, Arizona: The testing at Tucson, Arizona will focus on advanced, rapid system testing and development. Because the main test laboratory is located in Tucson, flight testing from the same location allows rapid development of the technology using test results on the spot to make corrections and test potential system enhancements. While in flight, the radar seeker is always directed toward the RMS Tucson facility, so even though the 50-kilometer radius of operations covers a large area, the directional signals are not widespread. Figure 8 shows the area of proposed operations and the directionality of the transmissions.

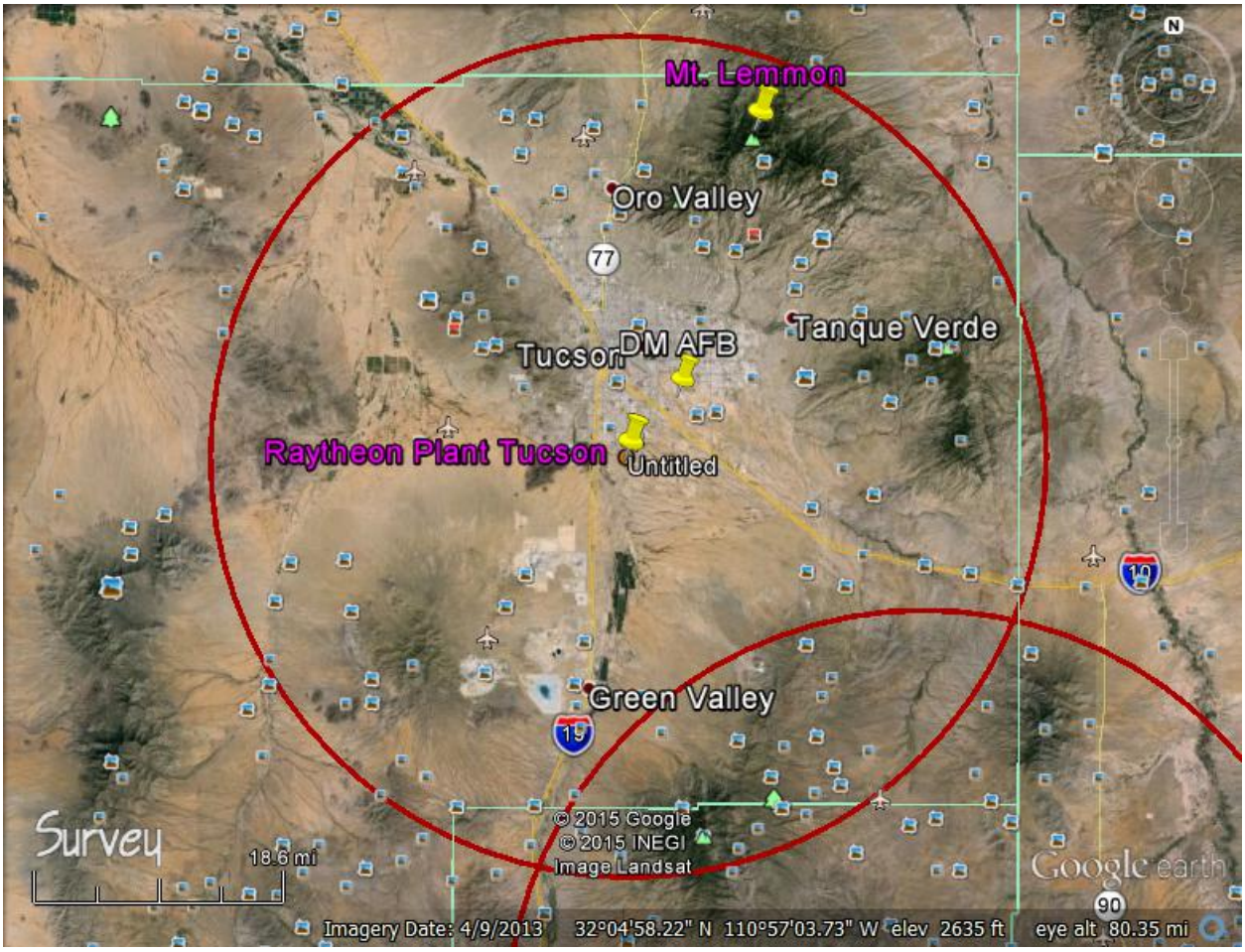

Figure 8. Tucson Test Site

Patagonia, Arizona: The testing near Patagonia focuses on system testing in a rugged environment. The area selected is sparsely populated desert/ranch land, and its remoteness helps the program to improve the radar seeker performance in hostile environments that are not heavily populated. Figure 9 shows the area of operations proposed. Flights

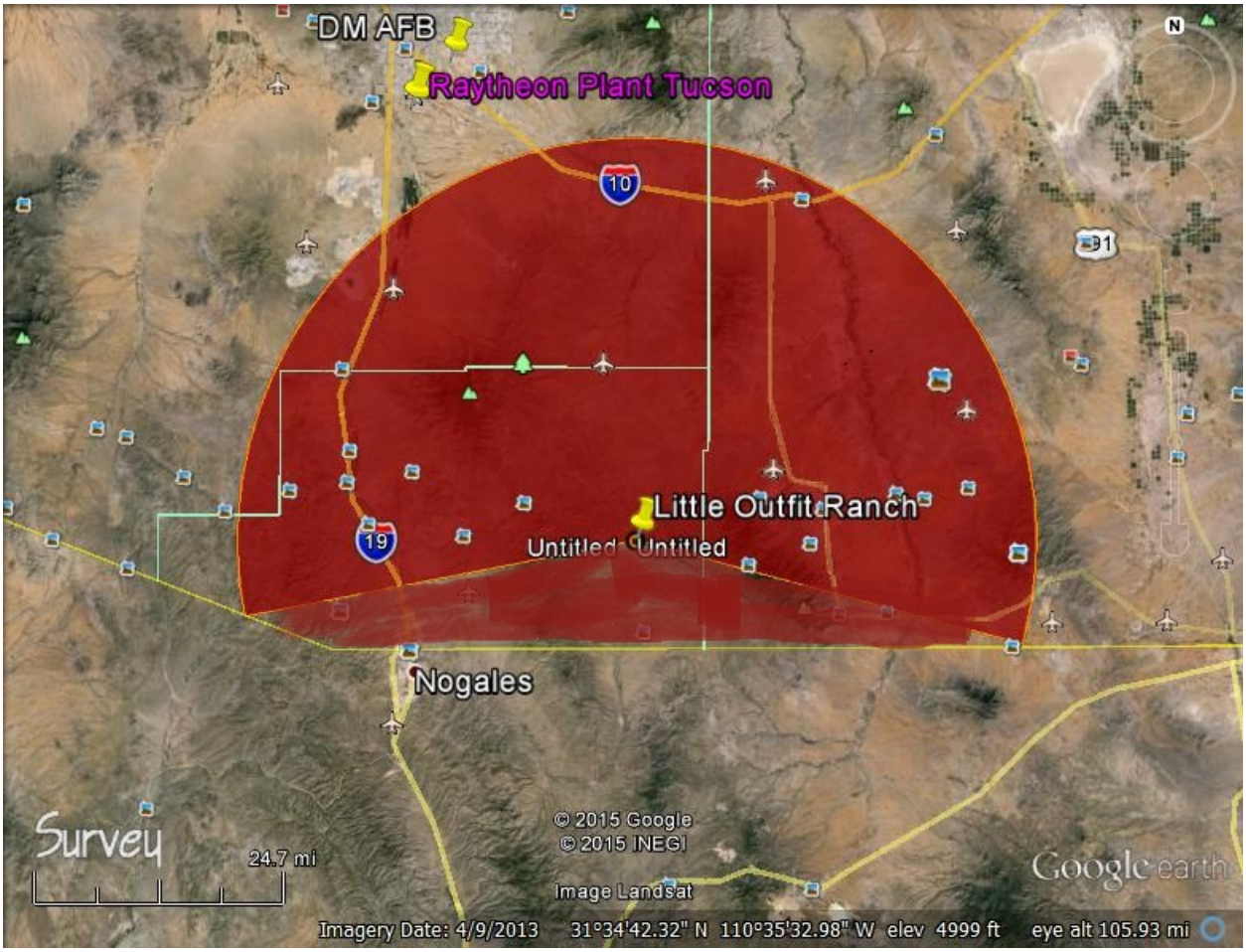

Figure 9. Patagonia Test Site, flights will all be in US airspace

Time of Use:

In the synopsis, Raytheon explained briefly that the system is in use for just two three-hour flights each week. The duty cycle of the radio system when the system is in use is merely 10%. It is important to explain that only one site will be in use at any time. The selected sites were chosen for different aspects of testing and technology development, but the program can only support testing at one site at a time.

Frequency Use:

The operations use pulsed radar signals. The spectrum band from 16.235 – 17.3 GHz will be stepped through in pseudo-random sequences.

Testing will use the requested frequencies to optimize radar system operations.

The radar pulse is approximately 30 MHz wide. The pulse may use any portion of the licensed spectrum. The duty cycle of the active radar system ranges up to 10%.

No likelihood of harmful interference to other users:

The radar seeker is mounted on an aircraft that flies at an altitude of 10,000 feet or below. The radar seeker is always be directed toward the ground or water, never directed out level or up into the sky. The signals are absorbed, scattered, and dispersed by the ground or water when they reach the target. This will attenuate any remaining signal so the chance of signals creating interference to the surrounding area is extremely low. The radar return bounces directly back to the seeker on the aircraft. The seeker is steerable from the aircraft, so that the seeker can be focused on the chosen targets.

The radar system uses a highly directional antenna that has 23.8 dBi of gain. The half power beamwidth is limited to 12.8°. Such a concentrated beam is unlikely to create any interference to areas that are not directly in the path of the seeker beam.

Because the flight altitude is relatively low and the highly directed beam is pointed to the ground, the operations of the radar seeker are unlikely to create harmful interference. The radar pulses are short, and the testing is infrequent at any location. Further, Raytheon will undertake frequency coordination with other entities, as required by the FCC.

Stop Buzzer Point of Contact:

To ensure that no instances of harmful inference occur, Raytheon's Stop Buzzer point of contact is:

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

Conclusion:

Raytheon is seeking to renew an experimental license to continue testing to work on advancements to its Seeker missile technology. The program has been moving quickly to deliver technology advancement in the radar systems.

Raytheon's work will advance the performance of the missile Seeker assembly improving its responsiveness and its precision. The time of use for these frequencies will be limited. The proposed power levels are as low as possible to achieve the goals of the system.

If there are any questions about this application or if any additional information is needed, please contact Anne L. Cortez, Washington Federal Strategies, 520-360-0925 or alc@conspecinternational.com.