

# Raytheon Request for FCC Experimental License

Reference File No.: XXXXXX

Applicant Name (Company): Raytheon IDS

528 Boston Post Road

Sudbury, MA 01776

Date: 09-01-2010

## **Experimental License Explanation:**

*Raytheon has been operating the Prototype Demonstration System (PDS) Radar at Raytheon's Integrated Air Defense Center (IADC) in Andover, MA, since September 24, 2010 under Experimental License Call Sign WF2XNX, file number 0416-EX-PL-2010. Raytheon is now requesting an extension to this experimental license in order to continue to operate the radar for an additional year. Raytheon is requesting some additional operational capabilities under the extension and plans to continue to abide by the operational modes and conditions granted by the existing Experimental License (WF2XNX) during the requested experimental license period.*

## **Purpose of Operation:**

*Frequency authorization is being requested for the period of September 24, 2011 – September 24, 2012 in the 3.1 GHz to 3.4 GHz band in order to demonstrate the operation of a prototype radar system. Raytheon has been operating the prototype system in this band under since September 24, 2010 under Experimental License Call Sign WF2XNX, file number 0416-EX-PL-2010.*

*Continuation of radar demonstrations beyond the current Experimental License expiration date of September 24, 2011 is critical to Raytheon's winning a next phase proposal. Operation of the prototype radar is needed to demonstrate to our customer that key technologies designed and developed by Raytheon are mature and ready for inclusion in the proposed system. It is Raytheon's view that these technologies set Raytheon apart from our competitors so it is essential that performance is demonstrated in a radar environment similar to the proposed radar system. Raytheon has demonstrated the capabilities of these critical technologies under the existing Experimental License but incremental improvements in radar performance must be demonstrated over the next year in order for Raytheon to be competitive in the next phase proposal. These incremental improvements include additional transmit power and minor modifications to the radar operational modes. Raytheon's Enhanced Prototype Development System (EPDS) will be operated from September 24, 2011 to September 24, 2012.*

## **Test Summary:**

*An experimental license is requested to continue to demonstrate the performance of the prototype radar to our customer for an additional year beyond the current Experimental License (WF2XNX) expiration date of September 24, 2011. Formal demonstrations for the customer began August 2010 and will be continued through September 2012. The system will continue to transmit either pulsed Linear FM (LFM) 100 KHz, or pulsed unmodulated carriers in the 3.1 GHz – 3.4 GHz band. It is expected that the EPDS radar will be nominally operated for periods of up to ten hours per day with a maximum transmit duty factor of 30%.*

*Raytheon's RF safety group has been involved and will continue to be involved with these demonstrations to ensure that no personnel are subjected to RF power density levels exceeding the Maximum Permissible Exposure(MPE) limits of the Part 1.1310 of the FCC Rules and the guidelines in FCC's OET Bulletin Number 65. Raytheon has a Company Policy and Environmental, Health and Safety Standard which addresses electromagnetic energy exposure control. It is Raytheon's policy to ensure that our personnel, the general public and our customers are not exposed to RF levels which exceed applicable standards. To that end, we will have an RF Safety Plan in place for the testing. The RF Safety Plan defines the procedures and controls required to prevent personnel exposure to levels which exceed the MPE. To verify the safety of personnel, several RF surveys have already been performed. All measured levels, where personnel have access, are well below the MPE.*

*Raytheon has also evaluated the potential susceptibility of aircraft and Electro-Explosive Devices (EEDs) in or on aircraft during the operation of the prototype radar. The results show that there are no radiation hazards to personnel, aircraft, aircraft equipment or EEDs, during the proposed testing. These results are documented in a separate attachment.*

*Additional information is also provided in slides attached to this summary which cover: power levels, test site layout, and transmit scan coverage.*

**Raytheon Technical Point of Contact:**

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*FRN: 0003628344*

**Period of Use:**

*Start date: September 24, 2011*

*End date: September 24, 2012*

**Equipment Information:**

Indicate all equipment that will be involved in this operation.

**Transmitter info:**

Manufacturer: *Raytheon*

Model: *Enhanced Prototype Demonstration System (EPDS)*

Number of units: *1*

Experimental (Y/N): *Y*

**For each frequency band:**

RF output at the transmitter terminals:

144KW3N 20480 Watts peak, 6144 Watts average  
 5M31W3N 20480 Watts peak, 1638 Watts average  
 33K0P0N 200 Watts peak, 60 Watts average

**Effective radiated power from the antenna (if pulsed emission, specify peak power):**

124.8 MWatts peak, 37.5 MWatts average (average is based on 30% duty cycle.) . The slides at the end of this document provide the effective radiated power for each emission type.

**Frequency Tolerance:**

Less than 0.01 %.

**List each type of emission separately for each frequency (basically list the emission designators)**

The Enhanced Prototype Development System (EPDS) will operate from 3.1 GHz to 3.4 GHz. This Radar system will utilize three waveform types. The emissions designators and carrier center frequency maximum and minimum assignments are shown in the table below:

100 KHz LFM (144KW3N)		5 MHz LFM (5M31W3N)		Unmodulated Carrier (33K0P0N)	
Max Fc MHz	Min Fc MHz	Max Fc MHz	Min Fc MHz	Max Fc MHz	Min Fc MHz
3399.50	3100.50	3397.30	3102.70	3399.95	3100.05

The transmit waveform pulses are either, Single Tone Unmodulated Carrier or 100 KHz LFM chirps. The total transmit on time does not exceed 10 msec at a maximum duty factor of 30%. Operation will either be sequence of unmodulated carriers at low power (used to calibrate the system) or a sequence of 100 KHz modulated carriers. Operational modes are not mixed.

**List as appropriate for the type of modulation:**

Maximum speed of keying in bauds: *Not Applicable, not a communication device*  
 Maximum audio modulating frequency: *Not Applicable*  
 Frequency deviation of carrier: *Not Applicable*  
 Pulse duration and rep rate:

	5 MHz LFM (5M31W3N)	100 KHz (144KW3N)	Unmodulated Carrier Used for Calibraion (33K0P0N)
a. RATE (U)	100 pps	200 pps, 100 pps, 50 pps	1525 pps
b. WIDTH (U)	0.5 ms	1.25 ms & 1.75 ms, 0.5 ms	151 us
c. RISE TIME (U)	12 us	12 us	12 us
d. FALL TIME (U)	12 us	12 us	12 us
e. COMP RATIO (U)	2500	125, 175, 50	Not Applicable

For complex emissions, describe in detail: *Linear FM and pulsed CW*

**Necessary bandwidth. Explain how determined.**

*The necessary bandwidth was measured. It represents the 20 dB BW for each waveform type.*

**Location:**

*The Raytheon facility in Andover, MA, located at North 42°38'18.30", West 71°11'32.71". The street address is 350 Lowell Street, Andover, MA 01810.*

**Is a directional antenna (other than radar used)?**

*No.*

**If yes, give the following info:**

**Width of beam in degrees at the half-power point:**

*6.88° Azimuth, 1.82° Elevation*

**Orientation in horizontal plane:**

*+76 to - 50 degrees East - West*

**Orientation in vertical plane:**

*Max Elevation Scan: 84.98 degrees (relative to horizontal or aperture plane)*

*Min Elevation Scan: 74.33 degrees (relative to horizontal/or aperture plane)*

*(-15.8 degrees to -5 degrees from vertical relative to north)*

**Will the antenna extend more than 6 meters above ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be mounted on an existing structure other than a building?**

*No. The antenna array is rectangular facing skyward parallel to the horizontal plane. The antenna is mounted roughly 4.2 meters above grade.*

**If Yes,**

**Overall height above ground to tip of antenna in meters:**

*4.2 m*

**Elevation of ground at antenna site above mean sea level in meters:**

*40 m*

**Distance to nearest aircraft landing area in km:**

*Lawrence Municipal Airport – 8 km*

*Laurence G. Hanscom Field Airport – 23 km*

*Beverly Municipal Airport – 24 km*

*Manchester-Boston Regional Airport – 36 km*

*Logan International Airport – 36.5 km*

**List any natural formations of existing man-made structures (hills, trees, water tanks, etc) which in the opinion of the applicant would tend to shield the antenna from aircraft and thereby minimize the aeronautical hazard of the antenna:**

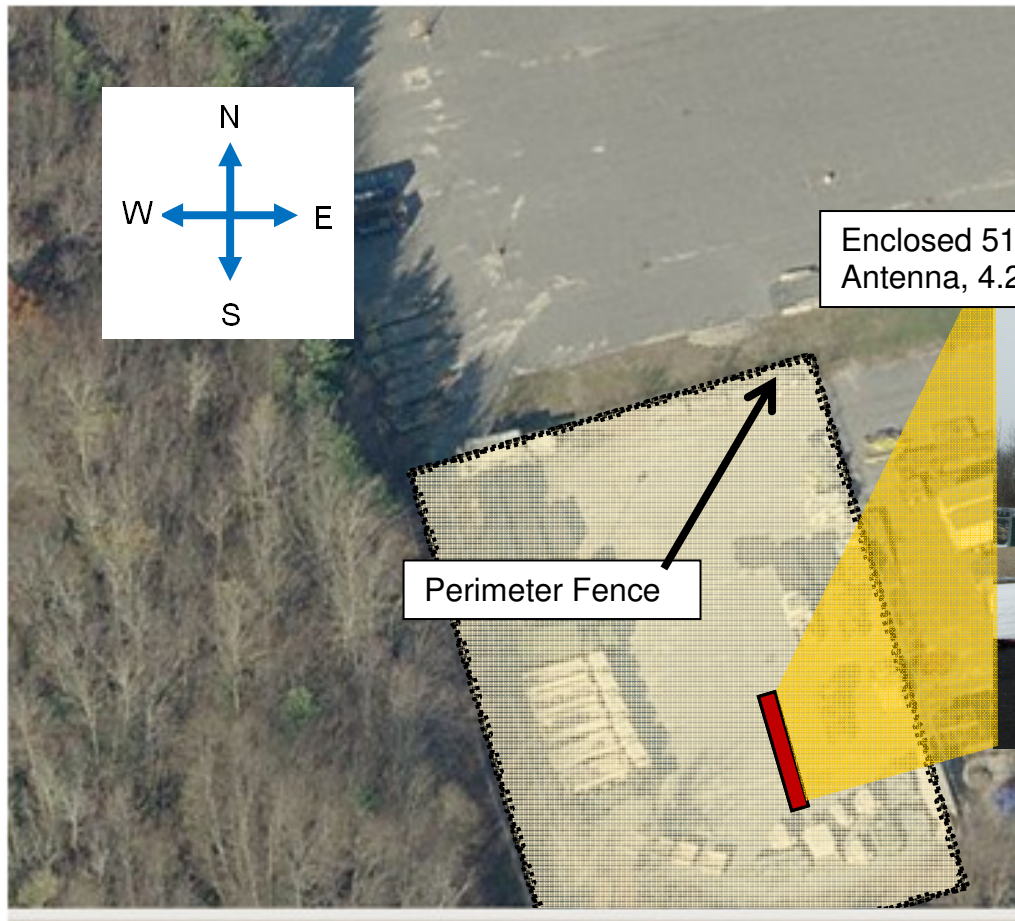
*None.*

*See the attached figures for a top view of the radar test site and transmit scan coverage. The prototype radar hardware resides in a customized isocontainer facility with a radome housing the antenna array on the top. The test area is cordoned off in an unused area on Raytheon property.*

# Transmit Configuration

## Raytheon IADC Facility, Andover, MA

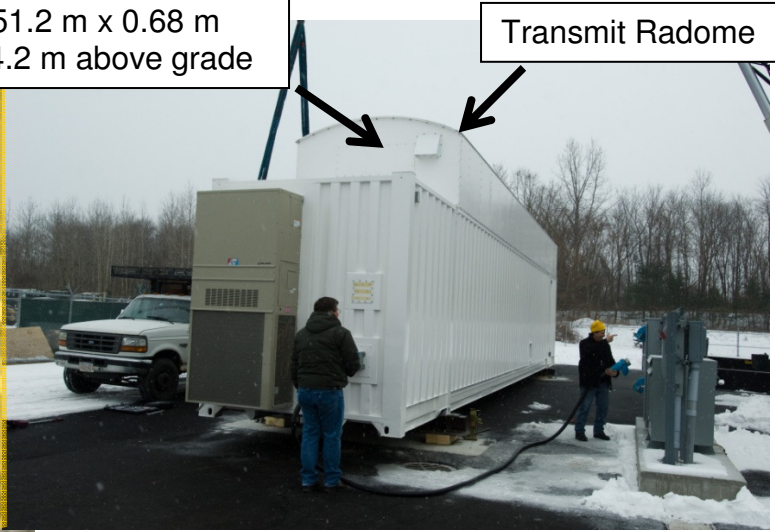
North  $42^{\circ}38'18.30''$  West  $71^{\circ}11'32.71''$   
40 meters above sea level



Flat antenna facing upwards,  
radiation looking skyward  
3dB BW 6.88 deg AZ, 1.82 deg  
EL  
+76 to -50 deg East – West  
-15.8 to -5 deg From Vertical  
and relative to North

Enclosed 51.2 m x 0.68 m  
Antenna, 4.2 m above grade

Transmit Radome





# Enhanced Prototype Demonstration System (EPDS) Transmit Scan Coverage (144KW3N, 5M31W3N Modes)

