16-Nov-2023

Conventional Experimental License File Technical Exhibit

Purpose Note

SRI is submitting this conventional experimental license request to continue support testing of an experimental marine radar system. This is a follow-on application from Experimental License File number 0211-EX-CM-2021, call sign WL2XKD. The antenna and transmitter are updated from the Experimental License grant. Testing will continue over a two-year period at the following locations:

- Menlo Park, CA (37.45 N, 122.18° W), operational radius of 80 km
- Boulder, CO (40.02° N,105.27° W), operational radius of 80 km
- Ann Arbor, MI (42.28° N, 83.74° W), operational radius of 80 km
- Fort Story, VA (36.92° N, 76.02° W), operational radius of 80 km
- Gulfport, MS (30.35° N, 89.09° W), operational radius of 80 km
- San Diego, CA (32.70° N, 117.08° W), operational radius of 80 km
- Monterey, CA (36.60° N, 121.88° W), operational radius of 80 km

SRI requests the window of operations to start January 1, 2024 and continue until December 31, 2025. Expected usage during this period is 8 hours a day approximately for up to 10 days per month. SRI International is a non-profit scientific research institute, more information about SRI may be found at https://www.sri.com/about-us/.

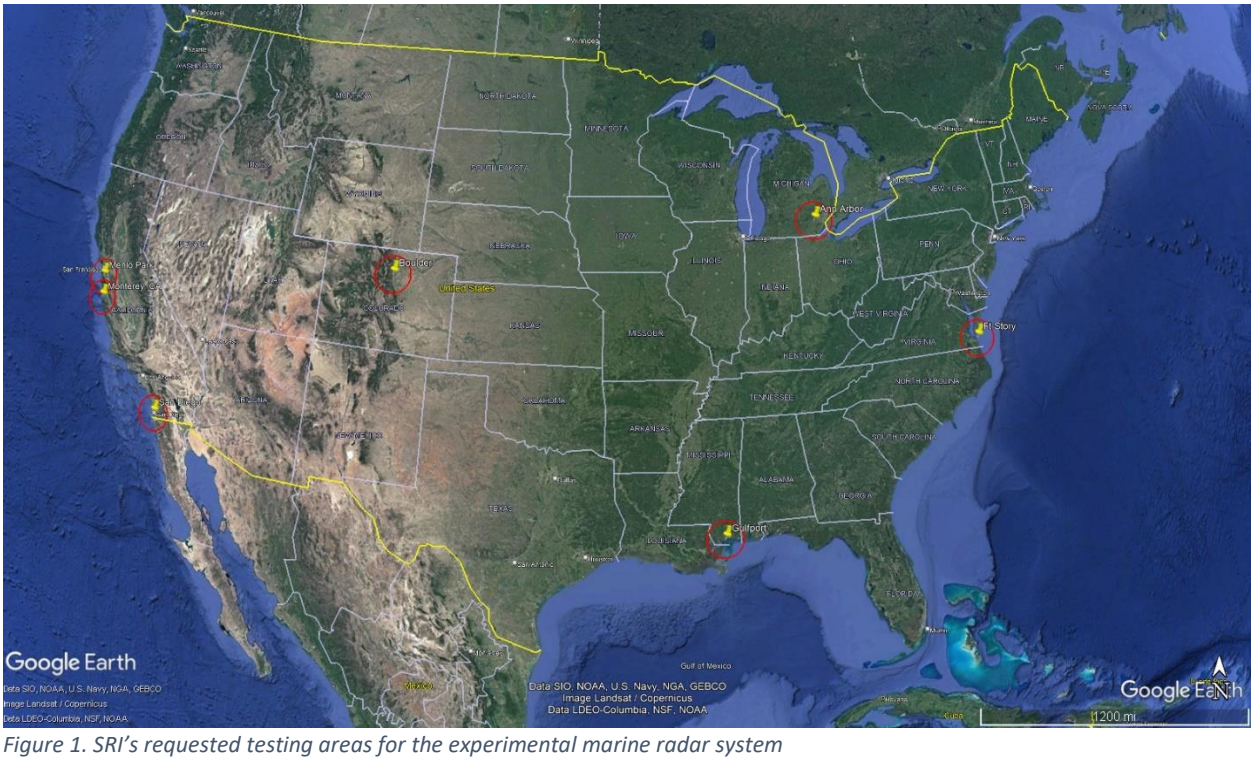

Figure 1. SRI's requested testing areas for the experimental marine radar system

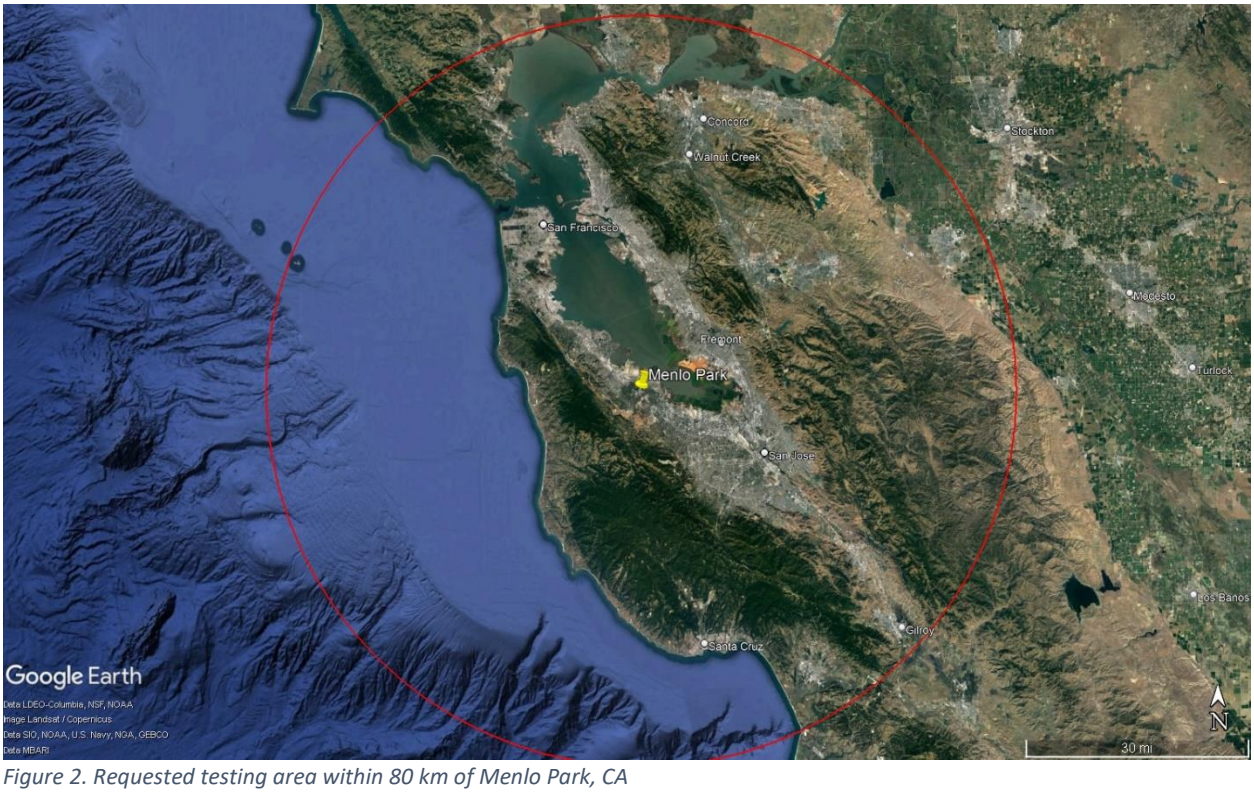

Figure 2. Requested testing area within 80 km of Menlo Park, CA

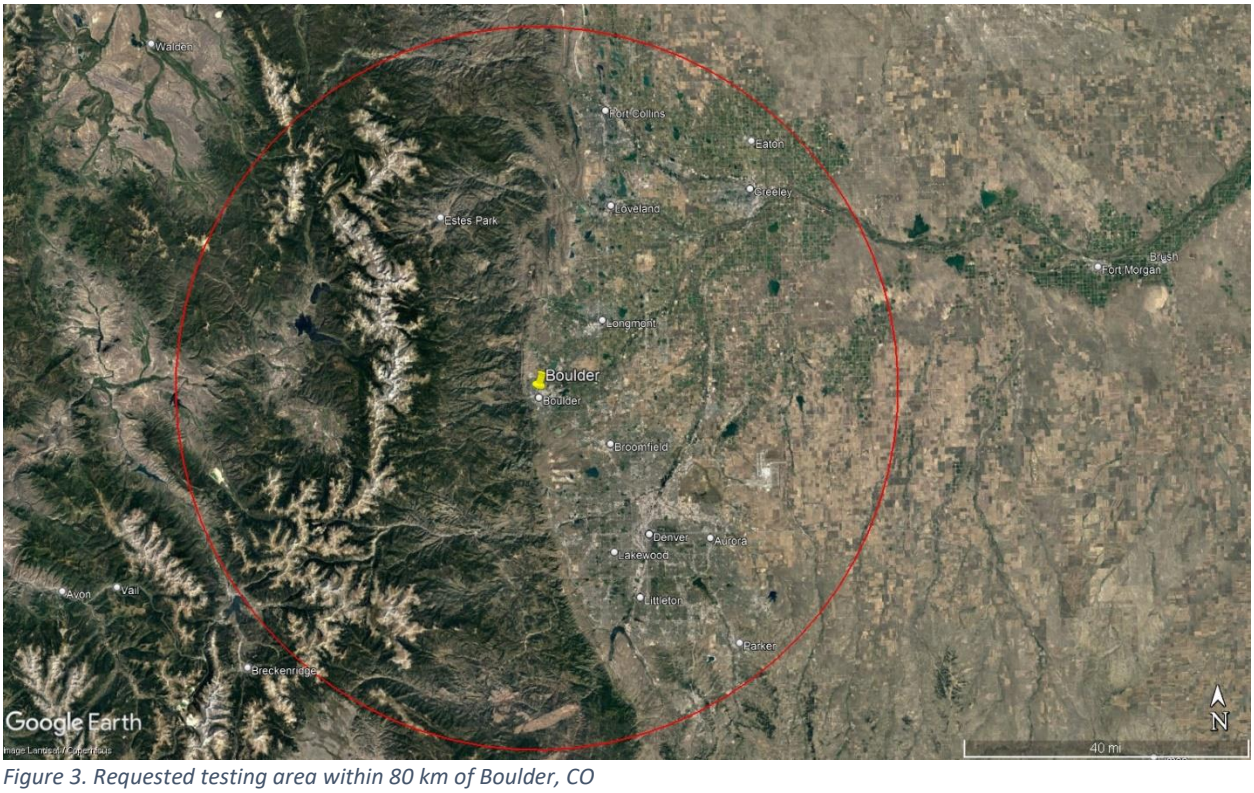

Figure 3. Requested testing area within 80 km of Boulder, CO

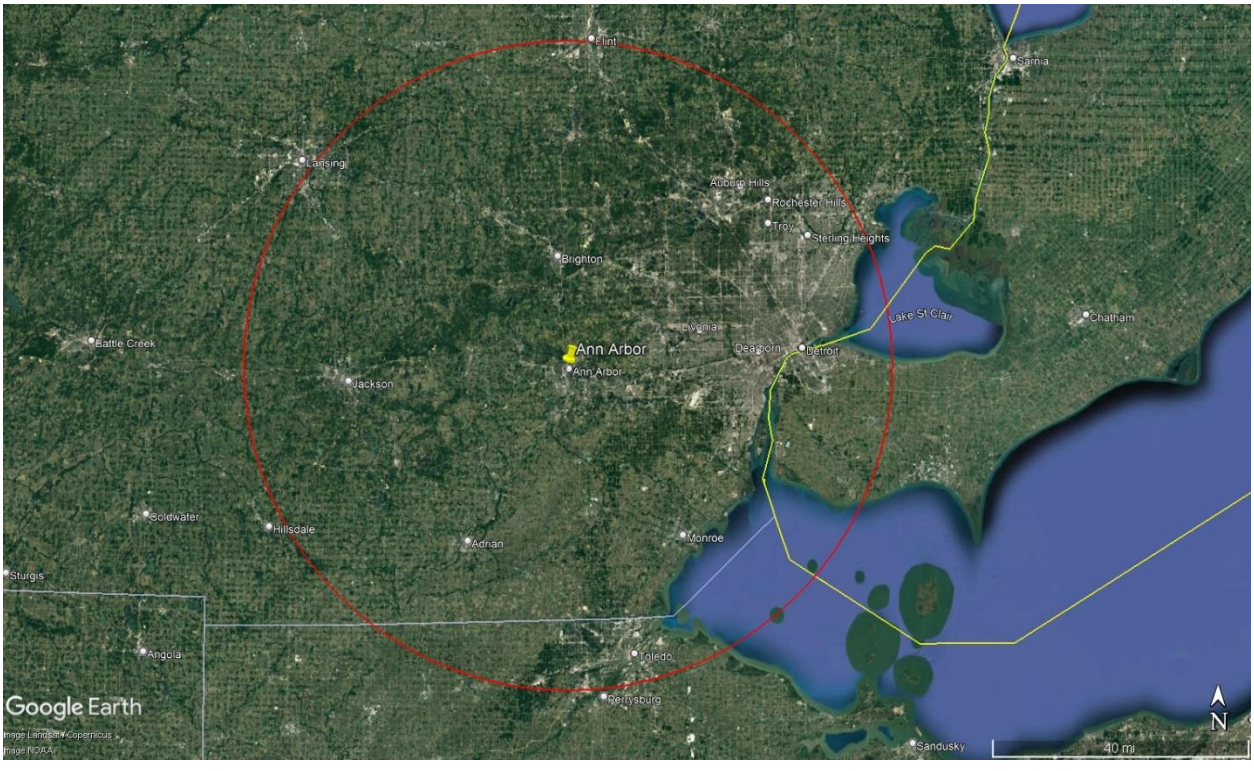

Figure 4. Requested testing area within 80 km of Ann Arbor, MI

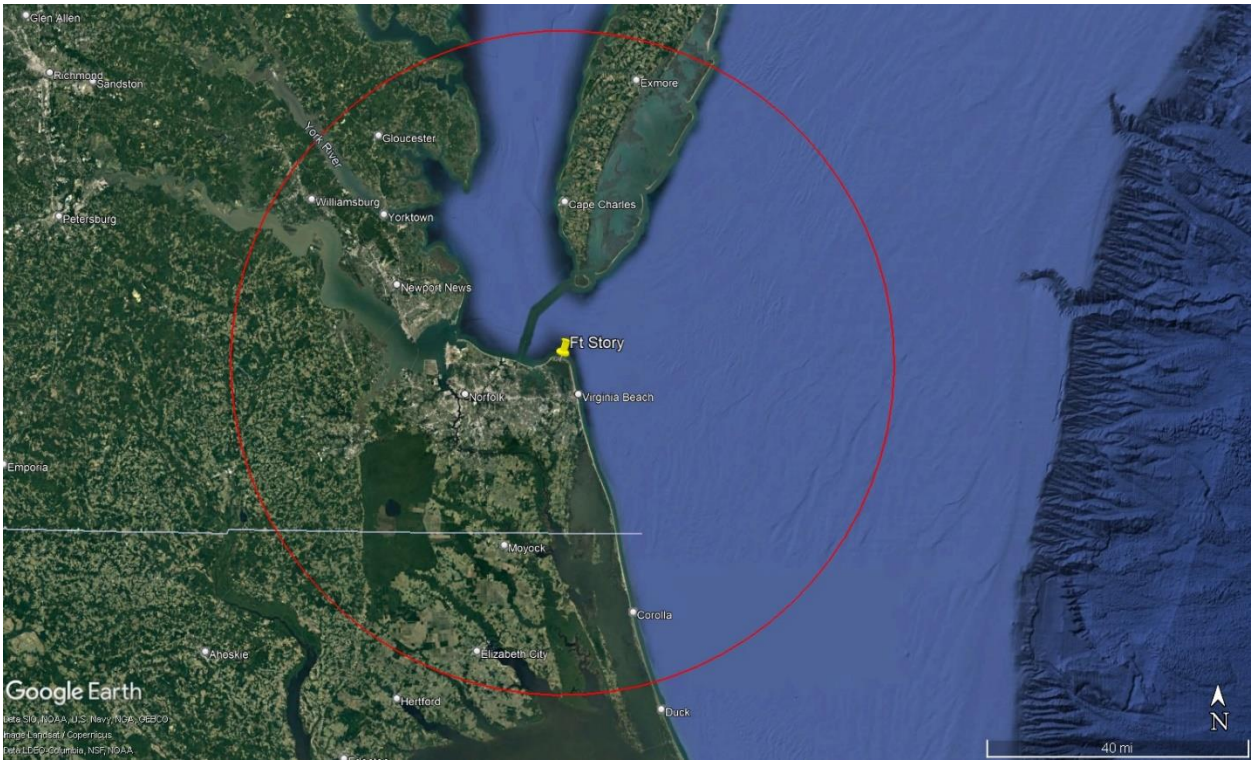

Figure 5. Requested testing area within 80 km of Ft Story, VA

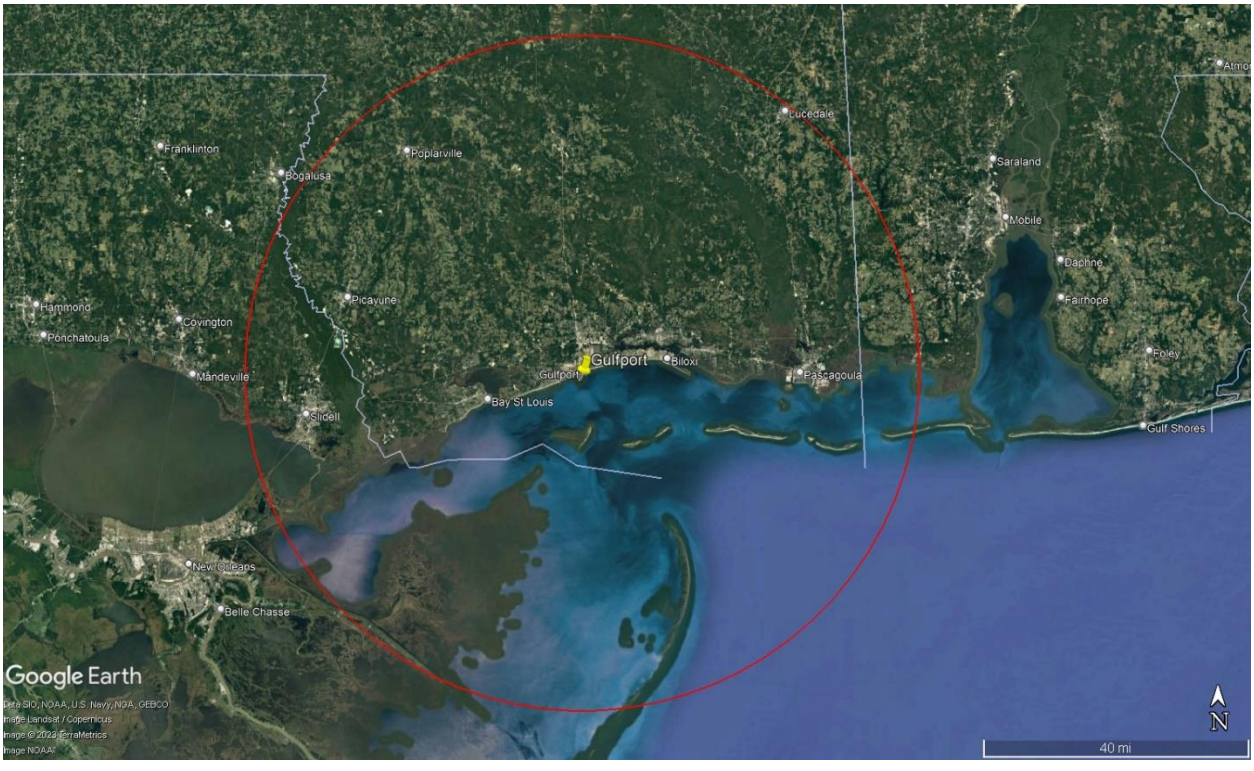

Figure 6. Requested testing area within 80 km of Gulfport, MS

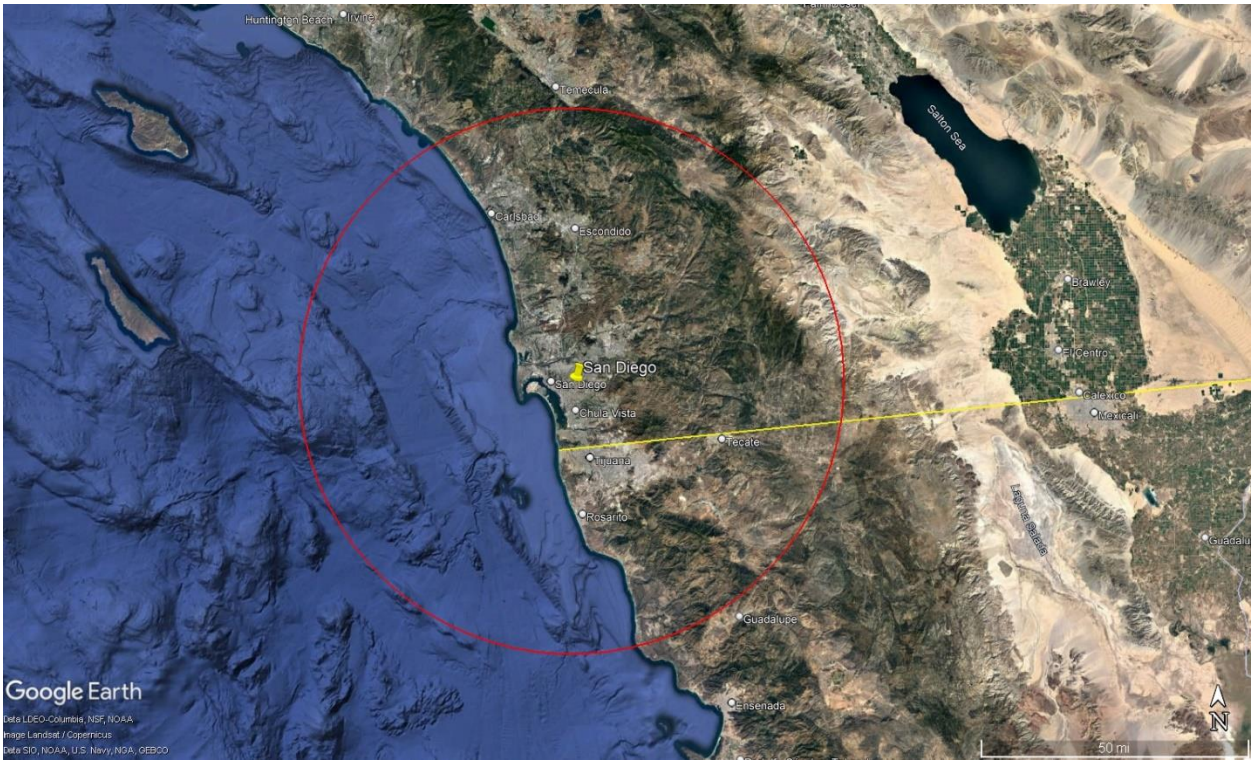

Figure 7. Requested testing area within 80 km of San Diego, CA

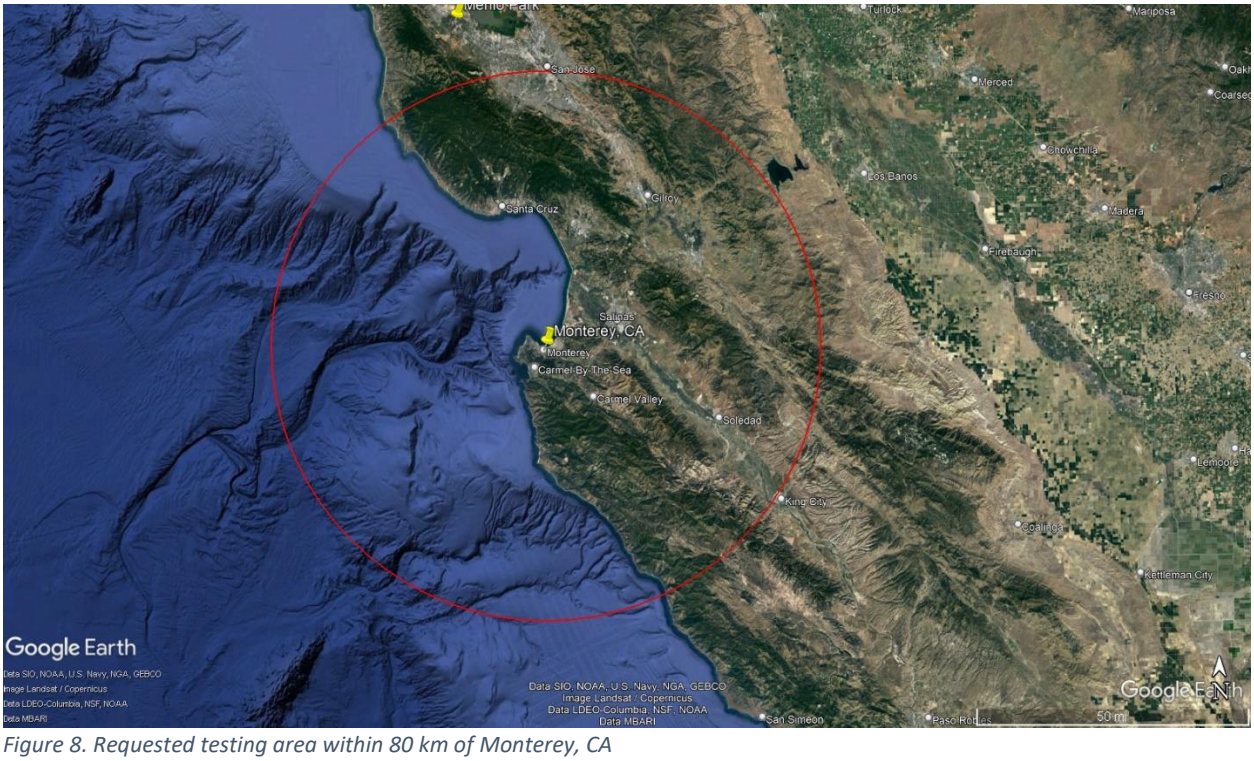

Figure 8. Requested testing area within 80 km of Monterey, CA

During testing, SRI engineers will be directly operating the radar and will have the ability to immediately turn off the radar should the need arise:

Persons of Contact:

- Justin Landrum: 415-519-2979
- Ryan Peterson: 734-255-3151

Marine Radar Description

The radar is a custom system developed by SRI International intended for marine navigation. It is comprised of four software defined radios, followed by an Intermediate Frequency (IF) to Radio Frequency (RF) frequency converter for each radio, followed by four active, electronically steered phased array (AESA). The AESAs are arranged in a square configuration, which each antenna covering a 90-degree sector of the horizon. The AESA is custom hardware manufactured by EMAG Technologies. The system will be tested on land using a tripod less than 2 m tall or on a small marine vessel where the antenna will be mounted less than 5 m above the water line. The transmit beam is steerable elevation and azimuth directions. In elevation, the beam will be directed between -30 and +60 degrees of the horizon, with a half-power, full-width of 13 degrees. The transmitter may be pointed in any azimuth direction, and the azimuth beamwidth is 4.2 degrees. The transmitter output power envelope will be pulsed with a duty factor not to exceed 30%, and pulse duration will not exceed 100 µs. The mean ERP will not exceed 18 kW, and the peak ERP will not exceed 60 kW.

Signal Descriptions

Emissions will be confined to the 8,500 – 9000 MHz and 9200 – 9500 MHz bands at all testing locations. While operating at the Fort Story, VA location emissions will be further confined to 8521 – 9000 MHz and 9200 – 9326 MHz. SRI can control where the signal emission falls within these two bands and associated sub-bands. This allows SRI's transmitter system to be used in allowed frequency bands

without interfering with nearby transmitters and receivers that may also operate in those bands. Instantaneous bandwidth will not exceed 200 MHz or 126 MHz, depending on area of operation and frequency band of operation. Overall pulse amplitude will be Tukey window shaped with sharpness varying between rectangular and raised-cosine. Within the windowed pulse, un-modulated, frequency modulated, and phase modulated emissions will be generated at different times. Since our system's waveform generator is a software defined radio, we can modify some parameters, including notching frequencies in some modes, if required. Below are further details on each emission defined in the application.

When operating between 8500-9000 MHz, 8521-9000 MHz, or 9200-9500 MHz:

100KP1N, on/off modulation
• The signal within the pulse envelope will be CW. The bandwidth is stated as 100 kHz due to spreading from the not-to-exceed 50 kHz pulse rate.

200M0Q1N, pulsed linear FM
• The signal within the pulse envelope will be a linear FM sweep, with a bandwidth of up to 200 MHz.

200M0Q1N, pulsed frequency hop
• The signal within the pulse envelope will frequency hop in an unspecified order over a bandwidth of up to 200 MHz

200M0Q1N, pulsed pseudo-random BPSK
• The signal within the pulse envelope will be a BPSK signal, modulated by pseudo-random bits at a chipping rate of up to 200 M chip/sec, and filtered to limit bandwidth to 200 MHz.

When operating between 9200-9326 MHz:

100KP1N, on/off modulation
• The signal within the pulse envelope will be CW. The bandwidth is stated as 100 kHz due to spreading from the not-to-exceed 50 kHz pulse rate.

126M0Q1N, pulsed linear FM
• The signal within the pulse envelope will be a linear FM sweep, with a bandwidth of up to 126 MHz.

126M0Q1N, pulsed frequency hop
• The signal within the pulse envelope will frequency hop in an unspecified order over a bandwidth of up to 126 MHz

126M0Q1N, pulsed pseudo-random BPSK
• The signal within the pulse envelope will be a BPSK signal, modulated by pseudo-random bits at a chipping rate of up to 126 M chip/sec, and filtered to limit bandwidth to 126 MHz.

Request for Detailed Problem Description if Conventional Experimental License cannot be approved

If the FCC cannot approve this Conventional Experimental License, SRI requests a description of the issues involved, so that we can efficiently modify the Conventional Experimental License to make it acceptable. If operating bands, bandwidth, or power is unacceptable, we request feedback on parameters that would make these acceptable. Since SRI's system's waveform generator is a software

defined radio, we can modify these parameters, including notching specific narrow frequency bands, if required.