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Aloft Sensing, Inc. Airborne X-band Radar Experiment

This document describes Aloft Sensing, Inc's (Aloft's) X-band stratospheric-based radar experiments, which are the subject of this FCC Special Temporary Authorization Application File #1693-EX-ST-2026.

Testing Overview:

Aloft is currently flying an experimental X-band radar system on a long-endurance stratospheric platform as part of a U.S. Government R&D project and is seeking a STA to facilitate emergent testing along our return path. The test sites are coordinated on short notice as part of ongoing science investigations to provide additional information about vegetation growth.

The experiments would begin in early September 2026 and continue through end-September 2026.

The requested area of operation is defined as 55-75 kft MSL above a 100-km radius centered on 37°12'44.8"N, 119°12'11.9"W as shown in Figure 1.

The associated tests will evaluate the synthetic aperture radar (SAR) imagery, interferometric synthetic aperture radar (InSAR) mapping, and moving target indication (MTI) capabilities from the stratosphere. Aloft Sensing, Inc. will not be commercially selling the imagery or data generated under this STA. The STA is not for generating revenue or providing an operational service; it is only to advance the research and mature the technology for the U.S. Government.

During the experiment, the radar antenna can be programmed to steer away from certain areas. An Aloft operator will also be able to disable the radar at any time. Transmission of the radar can be stopped by contacting Patrick Rennich at 734-821-3050.

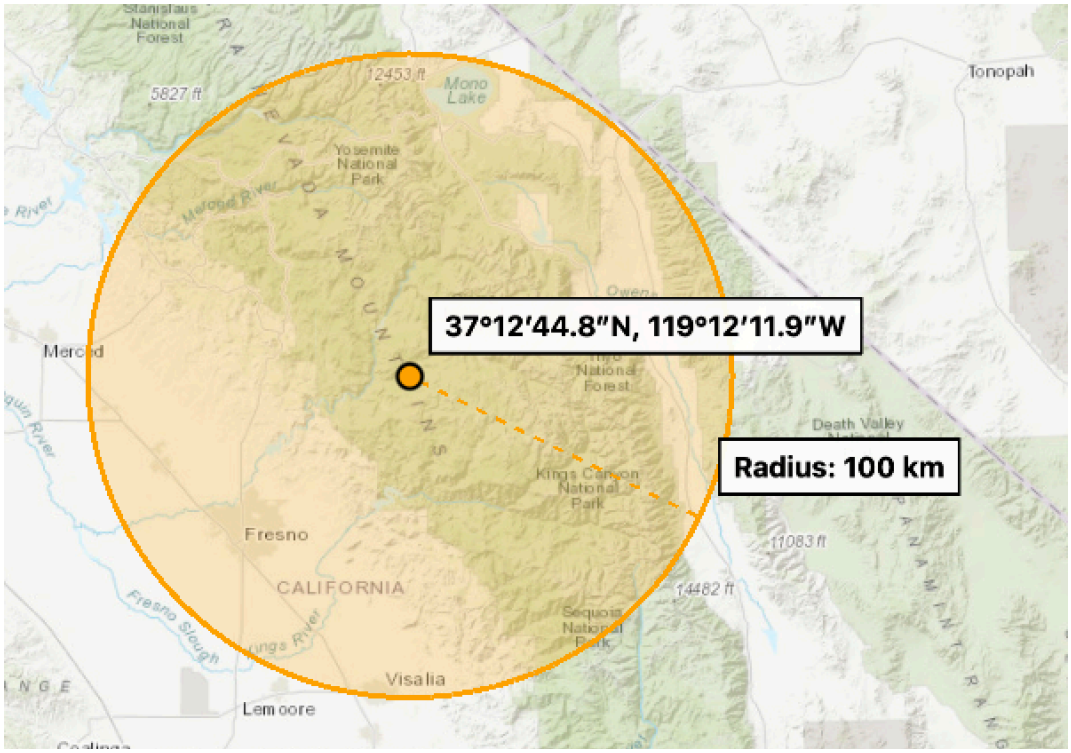

Figure 1. Requested area of operation, 100-km radius centered on 37°12′44.8″N, 119°12′11.9″W.

Radar System Description:

Aloft has integrated the radar system from a custom-built phased array antenna built by EMAG Technologies, Inc. and a custom-built software-defined radar transceiver by Aloft Sensing, Inc.

DIRECTIONAL ANTENNA INFORMATION: During testing, the radar will be mounted on a stratospheric vehicle. The phased array antennas will be mounted at a 45-degree angle in elevation. The antenna's beam will be steered electronically in elevation and azimuth to be roughly broadside to the vehicle's direction of travel. The beam location is computed and commanded either automatically by the onboard computer or by a remote operator. The beam can be steered to avoid specific locations and coordinates. The antenna polarization is nominally configured to be horizontal, but in some cases could be modified to be vertical. The antenna beamwidth is 8° × 8°, with a 26 dBi main beam gain. The maximum beam footprint on the ground is 8.1 km × 2.8 km when pointed 70° off nadir and 2.9 km × 2.8 km when pointed at 15° off nadir. The beam will generally be broadside to the vehicle's velocity direction but can be squinted forward or aftward by 40°.

MODULATING SIGNAL DESCRIPTION: The custom-built software-defined radar (SDRr) uses an arbitrary waveform generator (AWG) with flexibility to control key aspects of the waveform, including pulse width, occupied bandwidth, min and max frequency, and spectral notches. For this experiment, Aloft has configured the SDRr to transmit a pulsed linear FM chirp waveform over a variable bandwidth up to 798 MHz wide at a maximum pulse rate of 10 kHz and pulse

widths ranging from 2-58 μs. The worst-case duty cycle is 20%. The center frequency can be shifted around 9600 MHz, as needed, in software-defined, user-selectable tuning increments.

NECESSARY BANDWIDTH DESCRIPTION: The 3-dB emission maximum bandwidth was calculated to be 798 MHz and verified with lab measurements. The emitted power attenuates sharply outside this band, with a 818 MHz bandwidth at the -20 dB point, 844 MHz bandwidth at the -40 dB point, and 868 MHz bandwidth at the -60 dB point.

RADIATION HAZARD ANALYSIS: The minimal safe operating distance of the radar transmitter is calculated to be 32m using a safe power density of 1mW/cm^2 and the highest, worst-case value for average power of 12.8W. All key values are given in the following table. The average transmit power is controlled by the SDRr, and in most operational cases the average power will be lower by 10x at a value of 1.28W.

RADAR PAYLOAD TRANSMITTER SUMMARY:

- Frequency Range: 9201 MHz to 9999 MHz
- Center Frequency: Adjustable around 9600 MHz in software-defined increments
- Bandwidth: Variable up to 798 MHz
- Emission Designation: 798MQ3N
- Waveform Type: Pulsed Linear FM Chirp
- Transmit Power: 25.6 W (avg worst case), 128 W (peak)
- Transmit system losses: 0.5 dB
- Transmit Antenna Gain: 26 dBi
- Transmit Antenna height AGL: >55,000 ft.
- ERP (peak): 31kW
- Transmitter Equipment: custom-built software-defined radar transceiver by Aloft Sensing, Inc.
- Antenna Equipment: Gen-4 phased-array antenna custom by EMAG Technologies, Inc.