Sonic Boom
Ground Recording System
(GRS)

Request for Information (RFI) based upon a summary of the requirements

ABSTRACT

NASA-AFRC is looking for companies capable and willing to obtain for NASA's use; either through purchase or lease of an existing commercial system or through the design and manufacture of a specialized system, an audio recording system capable of recording high resolution audio of low amplitude sonic booms at ground level.

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1. THIS IS A REQUEST FOR INFORMATION (RFI) ONLY

This RFI is issued solely for information / planning purposes and is intended to solicit responses from potential manufacturers. It does not constitute a Request for Quote (RFQ) or a promise to issue an RFQ in the future. The responses to this RFI will be used for planning purposes and for the possible generation of a detailed solicitation. NASA-AFRC is not requesting proposals at this time. All information gathered as a part of this request will be used for Market Research purposes only at this time. The issuance of this RFI does not commit NASA/AFRC to pay any proposal preparation costs or obligate NASA/AFRC to procure or contract for these services or supplies, nor should it be construed as authorization to proceed with, or be paid for any charges incurred by, performing any of the work described herein. Not responding to this RFI does not preclude participation in any future RFQ, should any be issued.

2. Introduction

The National Aeronautics and Space Administration (NASA) – Armstrong Flight Research Center (AFRC) is interested in gathering information to identify vendors capable and willing to work closely with our team of engineers to obtain an audio recording system capable of capturing high resolution acoustic data from sonic booms or waveforms with characteristics similar to sonic boom except with significantly lower amplitudes. NASA – AFRC would like to either purchase or lease a commercial system or purchase the design and manufacture of specialized systems. Multiple units of this Ground Recording System (Referred to as GRS in the remainder of this document) will primarily be deployed outdoors and unattended at different test sites throughout the USA in support of NASA's Low Boom Flight Demonstration (LBFD) Mission. There may be occasions where a unit or two may be deployed outside the USA. Deployment environments will range from hot and dry (e.g. the Mojave Desert in California) to hot and humid (e.g. southern Florida) to cold and dry or humid (e.g. the northern Midwest or Northeast). The GRS units will be set up and left in these environments for days or weeks at a time.

Details of the concepts and requirements for the GRS units (**GRS-Design-Requirements.pdf**) are in direct support of two phases of the LBFD Mission that will depend on rapidly and efficiently acquiring ground signature data from supersonic overflight of existing supersonic military aircraft and the X-59 Quiet Supersonic Technology (QueSST) aircraft.

3. Background

3.1 NASA's Low Boom Flight Demonstrator (LBFD)

NASA's LBFD Mission has two main goals. The first is proving technology can reduce the sound of supersonic overflight from what is known as a sonic boom to a much quieter sound known as a sonic thump. The second and critical goal is to gather data on community response to the sonic thump that will be provided to national and international rulemaking organizations in support of establishing standards and regulations for acceptable supersonic flight overland.

The LBFD Mission consists of three phases. The first phase, currently in progress, focuses on the design, fabrication and initial flight testing of the X-59 research aircraft. The second phase will focus on validating the supersonic acoustic characteristics of the X-59. The third phase will consist of a series of community test campaigns in different locations in the US and potentially internationally. Phases 2 and 3 will employ the GRS.

3.2 Supersonic Ground Acoustic Signatures

An aircraft flying at supersonic speeds generates a pattern of shock waves that travel away from the aircraft in all directions. The intersection with the ground of the shock pattern generated at a specific instant is hyperbolic in shape (figure1). As time elapses, this intersection travels along the ground behind the supersonic aircraft making a two-dimensional effected region known as the carpet. Atmospheric factors and flight conditions affect size and position of the carpet relative to the flight path of the aircraft. Typically, the carpet can be up to 50 miles wide and is centered along the full length of the supersonic flight path.

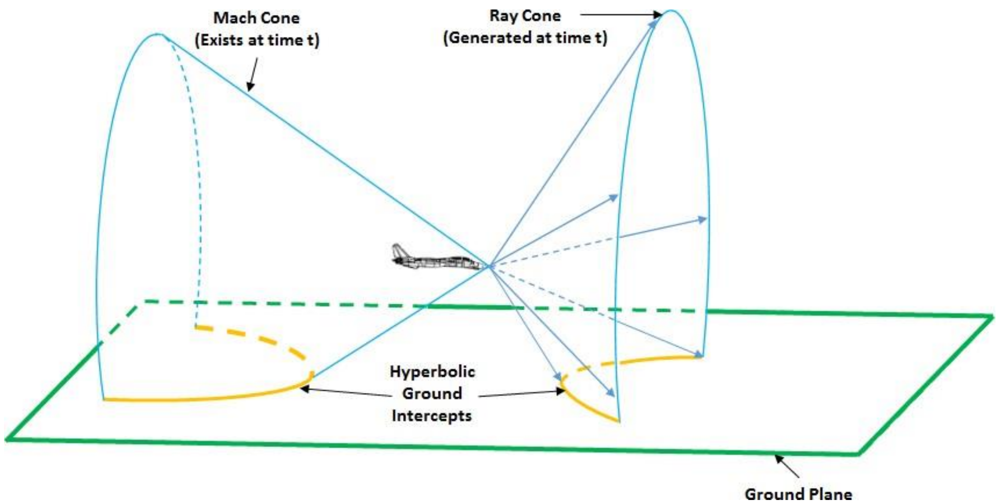

Figure 1: Mach Cone

The ground overpressure signature for current supersonic aircraft in cruise is called an N-wave because the shape of the pressure wave is similar to the capital "N" letter. All the shock waves coalesce into two pressure jumps separated by an expansion before reaching the ground. A U-wave shape, generally louder, is produced during the acceleration and maneuvers. When either wave form propagates through turbulence in the atmosphere noise is added to the wave forms sometimes rounding the sharp edges making them quieter and sometimes spiking them louder. Aircraft shaped to lessen the intensity of the pressure wave produce more of a sine waveform with a much lower amplitude (see figure 2). It is intended that the GRS will record all of these variations in waveforms.

3.3 Test Approach

For LBFD Phase 2 the intent is to use GRS units to capture detailed acoustic data from the full width of the carpet of the X-59 aircraft. Phase 2 will deploy multiple GRS units in a 30-mile linear array in the Mojave Desert, perpendicular to the aircraft's flight path. Additional GRS units will be deployed parallel to the flight path to capture variation in the ground signature due to atmospheric turbulence. The acoustic signal will reach each GRS in the array at a different time requiring a different recording initiation time or sufficient recording duration to capture the entire waveform and ambient noise before and after the event. It is anticipated that up to 80 GRS units will be deployed for the LBFD phase 2 ground measurements.

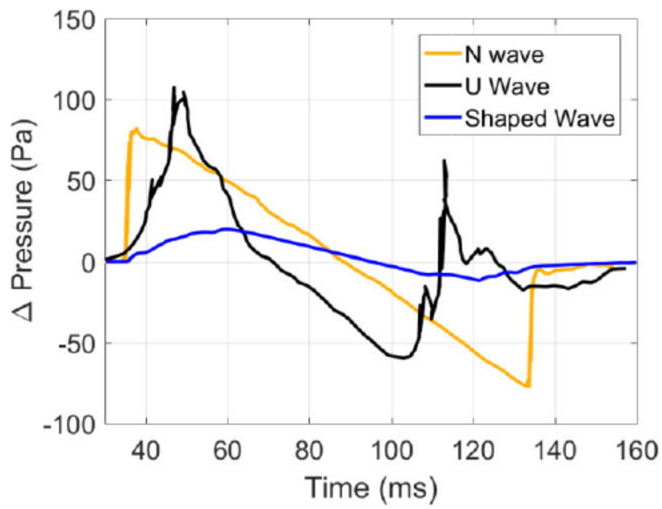

Figure 2: Sonic Boom Pressure Wave

Prior to LBFD Phase 2 NASA plans two developmental test campaigns for the GRS system. These tests will also take place in the Mojave Desert and will use an existing supersonic aircraft to generate the acoustic signals.

LBFD Phase 3 will acquire data on public perception of the sound of quiet supersonic flight over land. Numerous test campaigns over representative populations of the contiguous 48 US States are planned. International tests are also under consideration. The GRS units will be deployed in an area approximately 30 x 50 nm in size and are anticipated to be operated by a small team. Such operations will require remote triggering to initiate recording; remote communication for status, health monitoring, and subsampled quick-look data. (Full duplex communications).

A summary of the tests as currently envisioned is shown in the following table:

Test Name	Planned date	Location	# of GRS	GRS deployment	Purpos e
Development Test 1	Q2 FY21	Mojave Desert	5	~15 days	GRS prototype evaluation
Development Test 2	Q1 FY22	Mojave Desert	80	~15 days	LBFD phase 2 dry run: Array populated with all GRS available
LBFD Phase 2 – Acoustic Validation	Q2 FY22-Q4 FY22	Mojave Desert	80	~ 1 month (possibly multiple times)	Detailed X-59 acoustic validation
LBFD Phase 3 – Community Tests	Q2 FY23-Q1 FY26	CONUS Communities	150	~1-2 months per test (4 – 6 tests)	Community response

Table 1: Targeted Mission Dates

4. GRS Information & Configuration

Refer to document **GRS-Design-Requirements.pdf** for the GRS specifications presented as; Goals, Objectives and Requirements for the Ground Recorder System. Respondents are asked to note if any requirements present significant challenges which could drive cost or development schedule of the GRS.

Stated requirements are for a manually operated basic system, with the intent that the GRS has the ability to incorporate updates / modifications and/or plug-n-play expansion systems such as; remote triggering, remote operation, automated data upload/download, being powered by a solar panel array and network interconnectivity.

5. Responses

5.1 How to Respond

White papers may be in Microsoft Word compatible format (preferred) or in PDF format. Responses have no limit the amount of pages. Each email transmittal cannot exceed 10MB. Proprietary information, if any, should be minimized and MUST BE CLEARLY MARKED. To aid the Government, please separate proprietary information. Please be advised that all submissions become Government property and will not be returned.

The beginning of the white paper shall provide administrative information, and shall include the following as a minimum:

a. Company name
b. Mailing address
c. Overnight delivery address (if different from mailing address)
d. Company phone number
e. Company fax number (if available)
f. Point of Contact (POC): Name, e-mail & phone number

5.2 Industry Discussions

NASA-AFRC representatives may or may not choose to meet with potential offerors. Such discussions would only be intended to get further clarification of potential capability to meet the requirements, especially any development and certification risk.