

## **NARRATIVE STATEMENT**

By this application, pursuant to the Section 5.3 (b), (d) and (h), Mirage Systems, Inc. ("Mirage") respectfully seeks a 2 year license beginning August 1, 2012 to test and further develop new applications of its airborne synthetic aperture ground penetrating radar, the FALCON GPSAR 906-AU-001 across the bands 400-900 MHz and 1200-2000 MHz.

The following information supports our request:

**A. Need for a 2 year License:**

Mirage seeks a 2 year license that will allow its development team adequate time to collect data, evaluate the data, make adjustments to optimize the performance for particular geophysical challenges and re-take data. This period is requested to allow adequate time to plan and execute an underground data collection program.

**B. Purpose of Operation:**

Mirage has invested 20 years of development into their GPSAR technology. For over 10 years, the Department of Defense has funded Mirage Systems in developing a radar that can image buried targets (landmines, IED's, UXO, etc.) from an airborne platform. Mirage is now considering utilizing this technology for gas and water pipeline mapping. The technology is an enhancement to a standard Synthetic Aperture Radar, utilizing low frequencies in the UHF and L Bands, which can both penetrate the ground and still have enough resolution to eliminate false alarms and correlate surface features. This technology is patent protected and called GPSAR (Ground Penetrating Synthetic Aperture Radar). The system can transmit from 300-3000 MHz and the system has the ability to notch out frequencies to avoid interference with other RF systems.

The objective of this test is to verify the minimum amount of bandwidth required to maintain performance of the sensor (i.e. still able to resolve buried targets). Mirage does not seek authority to conduct market studies or provide subsurface surveillance under the requested experimental authority, nor does it propose to market, sell, or lease prototype equipment to end users in conjunction with these tests. The participants in the test will be advised that: (1) the test is being conducted under an experimental authority issued to Mirage, (2) Mirage is the party responsible for the operations, (3) all operations must be conducted on a non-interference basis, and (4) after the test is completed, Mirage will retrieve and recover all devices that do not comply with FCC regulations. Mirage understands that the FCC may specify these as well as other conditions on its authorization.

**Technical Specifications and Physical Description:**

**1. GPSAR 906-AU-001 System:**

Frequency:	300-3000 MHz
Waveform Modulation:	FMCW
Peak Envelop Power:	100W
Avg Power:	33 W
Peak EIRP:	224 W
Avg EIRP:	74 W
Weight:	46 lbs
Aircraft:	Robinson R44 Helicopter
Standoff Range:	750 ft
Altitude:	500 ft
Notching/blanking:	Key bands can be physically notched by sensor > 30 dB
Antenna Beamwidth:	
Horizontal:	120 deg HH Pol; 80 deg VV Pol
Vertical:	80 deg HH Pol; 120 deg VV Pol

The system has the capability to prevent radiation at specific frequencies or frequency bands within its operating band. In particular, the system can readily operate satisfactorily with lockouts of appropriate bandwidths within the FAA "SAFETY OF LIFE" band 960-1215 MHz as well as the GPS 24 MHz protection band at 1575.42 MHz. In order to adequately assess the system's capability for JIEDDO and Army applications it is necessary to operate as a minimum in two sub-bands: 500 to 900 MHz and 1300 to 2000 MHz.

**2. Antenna Information:**

A TDK PLP3003 Log periodic antenna will be used in this application. The antenna will be mounted on a Robinson R44 helicopter (FAA approved mount via Supplemental Type Certificate) and operated at altitudes of ~500 feet above ground level (AGL). The antenna is directed at a 45 deg. angle of inclination to the horizon for improved clutter rejection and can be positioned for HH or VV polarization

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Size	80 cm × 81 cm × 3 cm (length × width × height)
Weight	1.25 kg
Construction	Aluminum with gold chromate finish
RF connector	N-type female
Frequency range	300 to 3000 MHz
Gain	6 dBi
VSWR	2:1 average
Power handling	500W CW
Polarization	Linear
Feedpoint impedance	50 ohms nominal

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**3. Proposed Locations:**

Mirage seeks authority to conduct its experimental operations with limited tests in the Southwestern region of the United States, primarily in isolated sectors outside of Naval Air Weapons Station China Lake, CA. The intent of the selected locations is the presence of buried and surface pipelines and the absence of residential, business, and air traffic, along with the consequential absence of high radio spectrum activity, thereby avoiding interference from and to spectrum users.

3NS x 5EW	UTM		LAT			LON		
<u>PL East</u>	Northing	Easting	deg	min	sec	deg	min	sec
Center	3945747.000	458451.000	35	39	16.8956	-117	27	32.4273
NW Corner	3947258.066	455958.938	35	40	5.5528	-117	29	11.8325
NE Corner	3947233.313	460956.984	35	40	5.5072	-117	25	53.0250
SE Corner	3944234.484	460943.823	35	38	28.1683	-117	25	53.0250
SW Corner	3944256.414	455945.765	35	38	28.1228	-117	29	11.7654

4.5NS x 3EW	UTM		LAT			LON		
<u>PL West</u>	Northing	Easting	deg	min	sec	deg	min	sec
Center	3931079.000	448884.000	35	31	19.1839	-117	33	49.5570
NW Corner	3933336.711	447397.437	35	32	32.1854	-117	34	49.1059
NE Corner	3933319.055	450396.281	35	32	32.1691	-117	32	50.0082
SE Corner	3928820.788	450371.318	35	30	6.1576	-117	32	50.0082
SW Corner	3928837.422	447372.468	35	30	6.1413	-117	34	49.0460

3NS x 1.5EW	UTM		LAT			LON		
<u>LA Aqueduct</u>	Northing	Easting	deg	min	sec	deg	min	sec
Center	3947997.000	419757.000	35	40	21.3246	-117	53	11.9919
NW Corner	3949503.225	419020.805	35	41	9.9928	-117	53	41.8197
NE Corner	3949489.562	420520.262	35	41	9.9887	-117	52	42.1641
SE Corner	3946490.647	420493.450	35	39	32.6501	-117	52	42.1641
SW Corner	3946504.049	418993.992	35	39	32.6460	-117	53	41.7995

Mirage has operated at China Lake for the Defense Department, and these locations are near Ridgecrest, CA and pose as a good test site for our sensor flights due to the conductivity of the soil and the distance from RF and human activities.

**4. Equipment to Be Used:**

One GPSAR 906-AU-001 sensor, a TDK PLP-3003 log periodic antenna and a Novatel SPAN-SE GPS Receiver commercial GPS will be installed on a Robinson R44, FAA certified under a Supplemental Type Certificate.

**C. Restrictions in Operation:**

Mirage recognizes that the operation of any unapproved or unlicensed device under experimentation must not cause harmful interference to authorized facilities. Mirage will monitor use of the relevant frequencies before commencing transmission, and will not operate if the frequencies are in use.

The helicopter will only fly flight patterns to direct energy within the locations noted above. Radar operation will be controlled on-board by experienced Mirage staffers who, given the low altitude optical advantage, can recognize ground activity changes and power-off the system if the ground activity changes. Two data collection apertures will be flown, Strip mode and Circle SAR mode. In strip mode, the vehicle will fly parallel to the center points of the target location offset by altitude. In Circle SAR mode, the vehicle will fly a circle with a radius equal to the altitude.

Mirage does not propose to sell this data, but use it only as information for research and development of their GPSAR sensor. Mirage understands that the FCC may permit the operation of equipment for, among other things, compliance testing, demonstration at trade shows and other exhibitions with appropriate notices displayed, and evaluation of product performance at the Mirage facility. (Ref Marketing Rules §2.803 Part 15). Notwithstanding the general rules, the FCC requires parties to seek authorization to use devices that normally require a license to operate or that will be operated near residential locations. Such authority may be granted under FCC's experimental rules set forth in Part 5 of the Code of Federal Regulations, 47 C.F.R. Part 5 (2010). Accordingly Mirage seeks an experimental license to conduct experimental operations permitted under Part 5 of the Commission's rules. Those rules permit such operation provided that: (1) participants are advised that the service or device is granted under experimental authority and is strictly temporary; and (2) the devices are owned by the licensee.

**D. Public Interest:**

Outside of the Defense and Homeland Security applications, the projected technology has unparalleled potential to detect and characterize phenomena beneath the ground surface from airborne altitudes. The advantage of pushing the state of the art can eventually introduce subsurface surveillance capability beyond ordnance and pipelines, including GPSAR imaging of waterways levees for breach avoidance, location of buried geophysical features, location of aquifers, disaster first-responders such as after an earthquake or tunnel collapse and archaeological studies.

**E. Contact Information:**

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