FCC Form 422 EXHIBIT Number 1

Sponsoring Government Agencies: Office of the Secretary of Defense (OSD), Special Operations Forces Command (SOCOM) Office of Science and Technology (OST)

Government Contracting Office: US Army Robert Morris Acquisition Center, APG Contracting Division, AA BR

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Government Program Narrative:

Achieving reliable, covert, high bandwidth communications in difficult terrain, and over extended distances, is a critical requirement for the United States Special Operations Command (USSOCOM) and other remotely located forces. Under previous research efforts, Multispectral Solutions, Inc. (MSSI) developed a non line-of-sight (non-LOS), high data rate, low probability of detection (LPD), communications system utilizing wideband pulse technology. The key to the operation of this communication system over extended ranges was the use of low operational frequencies in the Very High Frequency (VHF) band (30-50 MHz) where surface wave propagation effects could be used to advantage. Signal losses using surface wave are considerably less than those encountered with direct wave transmission; however, surface wave propagation is essentially a low frequency phenomenon which becomes increasingly unimportant above low VHF frequencies.

The purpose of this effort is to extend the range of previously developed MSSI surface wave wideband pulse transceivers by moving lower in frequency (i.e., 3 to 30 MHz) to the High Frequency (HF) band. In this band, surface wave effects are several orders of magnitude stronger, and ionospheric propagation of signals becomes increasingly important to yield achievable ranges of several hundred miles. In addition, a significant increase in peak power output to 1 kW will be developed to further extended communications range. The ultimate aim of the research is to achieve high data rate communications over extended ranges, and to study the performance of these types of broadband systems over frequency dispersive channels.

During this research and development program, MSSI designed and fabricated a wideband HF transceiver system to assess the ionosphere's response to HF wideband pulses. The ionosphere's reaction to continuous wave RF emissions is to form charged structures which create a plasma layer reflecting the signal. The HF wideband signal may or may not have sufficient time to constitute a plasma frequency resonance within the ionosphere to cause a frequency selective reflection of the wideband signal. As a result, with a HF wideband signal directed at the ionosphere with a vertical launch may not reflect back. If this is the circumstance, the ionosphere will not selective distort the wideband pulse waveform and the signals will refract in ionospheric propagation.

To test assess if the ionosphere will selectively distort wideband pulse frequencies, MSSI's wideband pulse generating transceiver will be used to perform ionospheric soundings at the

Alaskan HIPAS test range. The ionosphere's response to HF wideband pulsed waveforms will provide information necessary to model HF wideband pulse propagation in the ionosphere for long range HF wideband pulse skywave communications. The wideband propagation models will define the performance requirements for future LPD HF wideband pulse skywave transmitter and receiver development.

Waveform Characteristics

The time and frequency responses of the HF wideband pulse waveform time is shown in the figure below. It must be noted the signals below were recorded on RF test equipment with 60 dB of attenuation in the lines. These HF wideband waveforms do not reflect the nature of the Ultra WideBand (UWB) waveforms MSSI has developed for commercial applications under the FCC Part 15 Subpart F rules. For this experimental license, the waveform from the transmitter line out spans from 3 to 30 MHz with peak power approximately 1.0 kWatt.

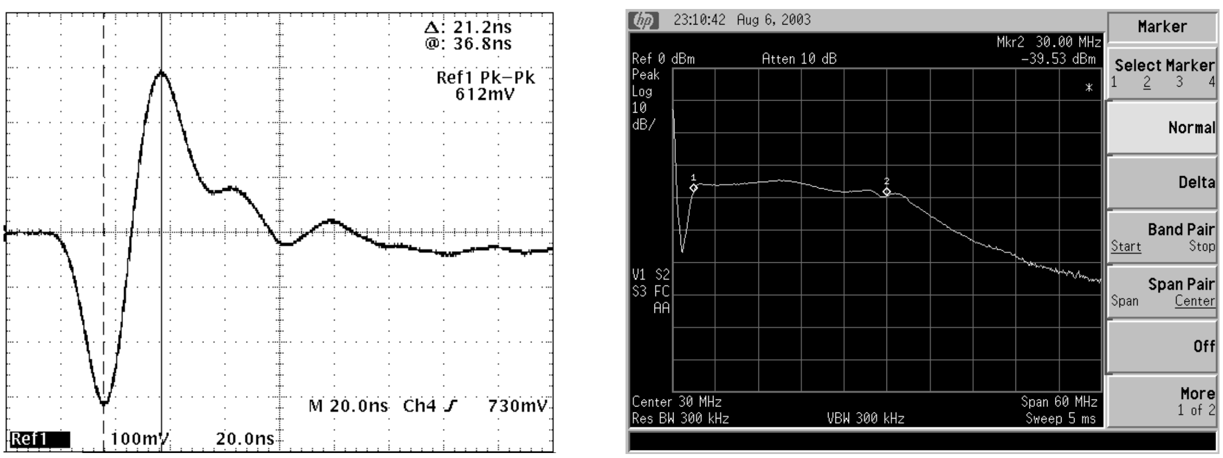

Figure: The HF Wideband Pulse Time and Frequency Responses

The average power of the signal depends upon the Pulse Repetition Frequency (PRF) of the signal. For the Alaskan test, the PRF will be 100 Hz. From a potential interference perspective, what matters is the peak and average power as a function of the resolution bandwidth with a victim intercept receiver. In the table below, the peak and average power is shown for multiple resolution bandwidths of the HF wideband signal.

Table: HF UWB Signal Power Specrtal Density

Resolution B/W (KHz)	Pulse Rep Freq (Hz)	Peak Power (mWatts/Hz)	Average Power (μWatts/Hz)
1	100	37.0	0.137
2	100	74.1	0.274
5	100	185.2	0.686
10	100	370.4	1.372
30	100	1111.1	4.115
100	100	3703.7	13.717
1000	100	37037.0	137.174

Interference Mitigation:

Since the spectrum energy is spread instantaneously over many MHz of bandwidth, the peak and average powers are very small on a resolution bandwidth basis as shown in the Table. Energy entering in the victim intercept receiver Radio Frequency (RF) front end will be very small.

For the ionospheric sounding tests, the PRF will be kept very low to allow for propagation time to receive any potential ionospheric signal reflections. The low PRF will minimize the RF energy transmitted and the possibility of interference with any potential victim receiver. UWB interference studies performed by the National Telecommunications and Information Administration (NTIA) have shown that a wideband pulse train will build up energy in the front end filter of a victim receiver proportional to the ratio PRF squared divided by the square of the victim receiver resolution bandwidth. In this case, the extremely low PRF (100 Hz) will mitigate any potential interference and the victim receiver backend signal processing will most likely not detect the presence of the UWB signal.

The test site for the HF wideband pulse transmissions is remote, outside of Fairbanks, Alaska where the signal will be directed skyward in a vertical launch into the ionosphere. Most of the energy transmitted will go directly into outer space with minimal lateral propagation. The polarization of the signal will be horizontal minimizing any potential surface wave propagation of the HF signal since surface wave propagation requires vertical polarization.