

**SUPPORTING STATEMENT
FOR REQUEST FOR MODIFICATION OF EXPERIMENTAL AUTHORITY**

Pursuant to Section 5.3(c) and (e) of the Federal Communications Commission (“FCC”) rules, 47 C.F.R. §§ 5.3(c) and (e) (2016), Southwest Research Institute (“SwRI”) respectfully requests modification of its experimental authority issued under call sign WI2XEE to operate ionospheric sounder technology in selected high frequency (“HF”) bands below 16 MHz as part of its research to meet its obligations under a contract with the Air Force Research Laboratory, FA8650-16-C-9104, HFGeo Phase 2 and 3.

Specifically, the Air Force Research Laboratory has asked SwRI to supplement the testing conducted under SwRI’s current authorization utilizing a low-power sounder emissions by testing a conventional high-power ionosonde, the DPS4D Digisonde from Lowell Digisonde, International. Such supplemental testing will allow SwRI to evaluate and analyze the accuracy of the results of its initial tests.

In support of SwRI’s request, the following is shown:

1) Applicant’s Address, Background and FRN:

Southwest Research Institute is headquartered at 6220 Culebra Road, San Antonio, TX 78238-5166. It is an independent, not-for-profit, applied engineering and development organization devoted to technology development and transfer. It conducts business with the industry and government (U.S. and other friendly nations) on a worldwide basis. Approximately 50% of the SwRI’s business is for the U.S. Government. Its FCC Registration Number (“FRN”) is 0004074217.

2) Purpose and Description of Operation:

As noted above, SwRI seeks to supplement the experimental tests it has conducted to obtain real-world data samples of the characteristics of a low-power ionospheric sounder designed to improve the propagation fidelity of real-time ionospheric propagation models. These models will, in turn, be applied to HF emitter geolocation systems to enhance the geolocation accuracy performance of stand-alone and netted direction-finding (“DF”) sensors. If successful, this technology could be applied to civil HF geolocation networks, including the FCC’s HF DF system and other U.S. government systems.

A primary objective of this effort is to develop an ionospheric sounder solution that only radiates 1 milliwatt (“mW”) of effective radiated power (“ERP”). Accomplishing this objective will mitigate the interference issues currently created by other relatively high-power, pulsed and Frequency-Modulated Continuous-Wave (“FMCW”) sounder techniques and render this sounder difficult

to detect outside the very near vicinity of the sounder transmitter. In particular, such sounder will separately measure the following parameters on X and O modes (if present): virtual height, Doppler shift, and azimuth & elevation angle of the return signal.

While the low-power sounder emissions will be at approximately 1 mW ERP (less than 100 mW ERP), in order to test its accuracy, SwRI proposes to use a conventional high-power ionosonde, the DPS4D Digisonde from Lowell Digisonde, International. The DPS4D operates at a maximum of 300 Watts ("W") effective radiated power ("ERP").

3) Location(s) of Proposed Operations:

The proposed tests will be conducted within the campus of Southwest Research Institute, 6220 Culebra Road, San Antonio (Bexar County), Texas. Operations will be at temporary fixed locations within a 1.5 km radius of NL 29-26-29; WL 98-36-55 (NAD 83). SwRI's campus is comprised of approximately 1200 acres, and the location of the test transmitter antenna would be near the center of the campus. The nearest off-campus property is over 400 meters away.

4) Equipment to Be Used and FCC Codes:

SwRI proposes to operate a fixed base stations capable of operating in the requested bands. The FCC station class code for the proposed operations is "FX" for Fixed Base and the radio service code is "XR" for Experimental Research.

5) Frequencies Desired:

As stated in Section 2, SwRI seeks to obtain real-world data samples of the characteristics of a very low power ionospheric sounder designed to improve the fidelity of real-time ionospheric propagation models. Thus, it is critical to SwRI to conduct tests in several HF bands with a range of signal to noise ratios ("SNRs"). Specifically, SwRI proposes to operate in selected HF bands between 2 MHz and 16 MHz specified in Attachment A. The maximum signal bandwidth would be 100 kHz with a typical bandwidth of 79 kHz for the Digisonde ($\leq 300W$ ERP) and 15 kHz for the low-power sounder (≤ 100 mW ERP).

SwRI does not propose, however, to operate on the restricted bands set forth in Section 15.205 of the FCC's Rules, 47 C.F.R. § 15.205 (2016), or on channels deployed by licensees in the public safety (radio service code "PW"), aeronautical fixed ("AF") or public coast ("PC") radio services. In addition, company personnel will monitor the operations of other users before commencing transmissions to avoid interference to other users.

SwRI also recognizes that the use of certain frequencies will require coordination through the Interdepartment Radio Advisory Committee ("IRAC") and SwRI is amenable to deleting certain frequencies from the bands requested and coordinating with Federal government personnel prior to commencing any transmissions.

6) Power Level and Compliance with Human Exposure Limits:

SwRI will operate with the minimum necessary power to conduct its test. Transmitted power levels would be ≤ 300 W ERP. SwRI is requesting up to 300 W ERP to facilitate initial development and testing of the signal processing algorithms and waveforms.

SwRI certifies that it will operate under this experimental license in full compliance with the limits for exposure to radio frequency electromagnetic fields set forth in Section 1.1310 of the Commission's Rules. All personnel who will operate the equipment are knowledgeable as to the effects of RF energy and will have the ability to control their exposure.

7) Type of Emission, Modulation Technique, and Bandwidth Required:

As noted above, the maximum signal bandwidth would be 100 kHz with a typical bandwidth of 15 kHz for the low-power sounder (≤ 100 mW ERP). Waveforms would consist of PSK modulated signals or Gaussian distributed I/Q sample arbitrary waveforms. The primary emission designators for the low-power sounder's proposed operations are 15K0D3N, 15K0G1N, 50K0DXN, 50K0G1N, 100KD3N, and 100KG1N.

The 300-W ERP DPS4D digisonde's waveform is a spread spectrum (bi-phase modulation) waveform occupying a 79 kHz bandwidth. The typical pulse length in time is 33.33 microseconds, and multiple pulses are transmitted in succession for a total typical transmission time of 533 microseconds. The digisonde steps through a fixed set of frequencies at regular intervals, excepting frequencies in exclusion bands programmed by an operator, every 5 – 15 minutes (15 is typical). The emission designator for the digisonde is 79K0Q1N, as indicated on the accompanying FCC Form. The short duration of the spread spectrum signal at any given frequency severely limits the likelihood of harmful interference to normal communications systems and signals.

Other emission modes and modulation techniques may be utilized, but in no event will the emissions extend beyond the limits associated with the above-referenced emission. SWRI does not propose to supply station identification as set forth in Section 5.115 of the Commission's Rules.

8) Overall Height of Antenna(s) Above Ground:

SwRI will comply with all Federal Aviation Administration ("FAA") and FCC rules and regulations regarding the installation and operation of antennas and their support structures. Moreover, the antennas to be deployed under this authority, if mounted on an existing building or tower, will not extend more than fifteen meters above the building or above the FAA/FCC approved height for a tower or building.

9) Interference Protection/Stop Buzzer Contact Information:

SwRI understands that other stations may be licensed in the bands it has requested and that, if any interference occurs, it may be required to discontinue its operations immediately. It does not expect interference to occur, however, as its tests will be conducted only on a limited basis. Specifically, SwRI expects that the duration of any single transmission would be typically less than 5 seconds but a duration of up to 20 seconds is requested to facilitate research and development aspects of this effort. Channel occupancy would be 0.56% (fifty-six one-hundredths of one percent), based upon a uniform distribution of clear channels between 2 and 16 MHz and a waveform bandwidth of 79 kHz operating on a 24/7 basis. The duty cycle would be < 0.5% (half of one percent) on any given frequency.

Moreover, SwRI personnel will be monitoring the RF spectrum and will carefully select areas of the HF spectrum to minimize any interference with observable transmissions. A clear channel detector will be implemented and used to measure power at a given frequency band. If any received energy is observed, the system will not transmit at that frequency, but will look for another frequency until it finds a clear channel.

SwRI also advises the Commission that Jim Nixon, Director, SIGINT Solutions Department, Defense and Intelligence Solutions Division, is the technical contact overseeing these tests. He will be personally responsible for the operations and will serve as the “stop buzzer/kill switch” in the event that operations must be terminated because of any interference concerns. Mr. Nixon can be reached at (210) 522-2619, email: jim.nixon@swri.org.

10) Restrictions on Operation:

SwRI does not propose to market, sell, or lease unapproved equipment to end users or conduct a market study in conjunction with this test. After the completion of the tests, SwRI will recall and recover all devices that do not comply with FCC regulations. If any different treatment becomes necessary during the course of its experimentation, SwRI will seek separate and additional authority from the agency.

Last, SwRI understands that: (a) permission to operate the units has been granted under experimental authority issued by the Federal Communications Commission, is strictly temporary, and may be cancelled at any time and that (b) operation is subject to the condition that it not cause harmful interference.

11) Application Contact Information:

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ATTACHMENT A

Proposed Bands of Operation

Although frequency bands are specified below, SwRI proposes to operate on frequencies between 2 and 16 MHz with a 15 to 100 kHz bandwidth as described above in the supporting statement. SwRI would agree to special conditions on the face of the grant of authority that limit operations to certain frequencies or that restrict the use of certain frequencies or sub-bands. SwRI also recognizes that the use of certain frequencies will require coordination through the Interdepartment Radio Advisory Committee ("IRAC") and SwRI is amenable to deleting certain frequencies from the bands requested and coordinating with Federal government personnel prior to commencing any transmissions.

2.0000—2.1660
2.1980—2.4875
2.5125—4.1175
4.1355—4.1697
4.1853—4.1997
4.2153—4.9875
5.0125—6.2075
6.2255—6.2602
6.2758—6.3042
6.3198—8.2835
8.3015—8.3545
8.4223—9.9875
10.0125—12.2825
12.3005—12.5122
12.5278—12.5692
12.5848—13.3525
13.4175—14.9825
15.0175—16.0000