Part 5 Application

Question 7

Exhibit Detailing Program of Research for Part 5 Application
a. The complete program of research and experimentation proposed including description of equipment and theory of operation.
This is a program of research and experimentation of radio at the 600m wavelength. This program is expected to run for a 5 year period. Research into the propagation of radio at 600m, suitability of this band for one- and two-way automatic (computer controlled) and aural communication, and the effects of the solar sunspot cycle, weather, season, time of day, radiated power and antenna height upon this communication. Modern narrowband signaling methods will be tested and optimized for suitability at MF. This communication will be through a radio beacon operated between 505 and 510 kHz and between 510 and 515 kHz using on/off keying (cw Morse code) for aural reception, slow Morse code for automatic reception (QRSS), low baud rate phase shift keying and MSK (minimum shift keying) for automatic reception as well as narrowband voice transmissions in the single-sideband suppressed carrier mode. Both one- and two-way communication (two-way with other Part-5 license holders and foreign amateur radio operators who are authorized to use the 600 meter band) will be attempted.

The transmitters and other equipment used for this experiment are and will be built by owner/operators Warren H. Ziegler(Wayland, MA), John Andrews(Holden,MA), Jay Rusgrove(Burlington,CT), Robert J. Raide (Penn Yan,NY) and William Ashlock (Andover,MA and Ellsworth,NH). The applicants for this license are the owners/operators of the experimental stations. The applicants individually and collectively have many years experience in long wave and medium wave engineering and experimentation, including experience in medium wave broadcast engineering. The transmitters frequency will be determined by a quartz crystal and operated at LF through division of the crystal frequency or direct digital synthesis. The transmitters are class-D designs using power MOSFETs, and linear designs capable of reproducing amplitude/phase modulation with low distortion. Operation will be either automatic (computer controlled) or hand keying for cw Morse code and computer generated low speed Morse and frequency/phase shift keying as well as narrow-band voice transmissions. The antennas will be an electrically short, top loaded monopole and electrically small transmitting loop variety (see attached diagrams).

b. The specific objectives sought to be accomplished.
Objectives to be accomplished are:
• Study and proof of effective communication in this band using stated techniques.
• Optimization of modern narrowband signaling techniques for long distance medium frequency propagation.
• Study of propagation and suitability of this band for one- and two-way communication particularly with regard to coherent techniques as applied to Minimum Shift Keying (MSK).
• Study of effects of solar cycle, weather, season, time of day, radiated power, and antenna height upon this communication.

c. How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along line not already investigated. The lower end of the Medium Frequency range (300-3000 kHz) is characterized by stable ground wave paths with low to moderate path attenuation. This opens up the possibility of reliable communication on a scale of tens to a couple hundred kilometers independent of ionospheric propagation disturbances. Modern narrowband signaling techniques have not been studied in depth for application to the lower medium frequency range. This program will test both aural and automatic signaling techniques, and detail their effectiveness and how these techniques are influenced by sunspot cycle, weather, season, time of day, radiated

power, and antenna height. Of particular interest is the study of the stability of ground wave paths with respect to amplitude and phase variations. Minimum shift keying (MSK), a form of modulation where the phase changes are undertaken at the zero crossing points. By adopting the MSK technique the sidebands and hence the bandwidth required is reduced. It also enables coherent techniques to be used to gain a 3 dB advantage.

The results of this program will be made available to the public (for free) and to the FCC in hopes that the data may be used to further understand operation in this band and might perhaps be used by the FCC in any future consideration of uses for this band.