Sec. 5.63 Supplementary statements required for granting special temporary authorization (STA).

(a) Each applicant for an authorization in the Experimental Radio Service must enclose with the application a narrative statement describing in detail the program of research and experimentation proposed, the specific objectives sought to be accomplished; and how the program of experimentation has a reasonable promise of contribution to the development, extension, or expansion, or utilization of the radio art, or is along lines not already investigated.

Background

I am project manager for The Marconi 2006 Project. In December, 2006, for only the second time since Marconi received the first transatlantic radio signal on December 12, 1901 will the same solar, climatic, and geomagnetic conditions be repeated (for further details, please visit http://marconi2006.com/Cycles%20compared.htm). A team of U.S. and Canadian amateur radio operators and shortwave enthusiasts plan to duplicate Marconi's feat by receiving European 800-820 KHz daytime broadcast transmissions from Cape Race, Newfoundland. Both land-based and kite-lifted antennas will be employed. Rather than modern equipment, unsophisticated receivers will be used in a way to (as best as modern conditions allow) access the validity of Marconi's claims - claims still seen as controversial (a list of relevant articles may be found at http://marconi2006.com/critiques.html). A significant part of this effort is to install a replica of the famous Marconi Italian Navy coherer in an attempt to receive European AM broadcasts through it.

The coherer was utilized in the early days of radio to specifically receive spark gap (dampened wave) excitations. This was the normal method of receiving radio signals in 1901. In its most usual form, the coherer consists of a mass of metal filings lying in a small air gap between two metal plugs fitted tightly into a glass tube. One plug is connected to the receiving antenna, the other to earth. An 1895 coherer is pictured below.

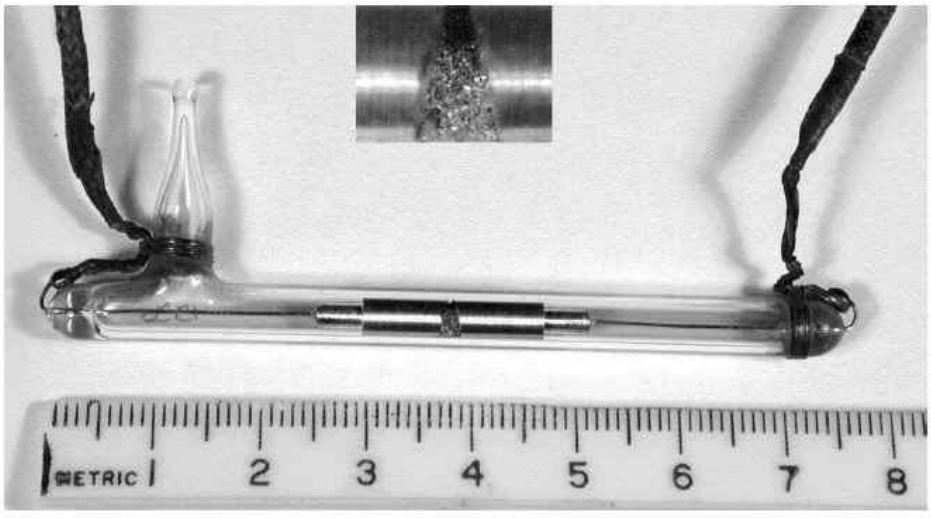


Figure 13 A Marconi coherer. Note the small gap in the metal plugs, containing metal filings, (enlarged in inset at top) and also that the tube is evacuated. (Courtesy of John Jenkins.)

On reception of an RF pulse, the filings coherer moves to a low resistance state. Marconi refined the filings coherer as a result of many careful experiments. The Italian Navy coherer is a further development involving adding a small drop of mercury or carbon particles to the metal filings and using one plug composed of carbon. The phenomenon involves the breakdown of the thin oxide layers on the surfaces of the metal to form a good metal-to-metal contact. In essence, the coherer is the first solid state rectifier. A good technical description of the electronic properties of the Italian Navy coherer is provide by V.J. Phillips (The "Italian Navy Coherer" Affair: A Turn-of-the-Century Scandal", PROCEEDINGS OF THE IEEE, VOL. 86, NO. 1, JANUARY 1998).

To design a sufficiently sensitive Italian Navy coherer it will be necessary to optimize the design and construction using 800-820 KHz RF radiation. In one series of bench tests, the sine wave output of an RF generator will be used in a closed circuit (no RF emissions from the circuit) to analyze the sensitivity of different metal/metal oxide compositions and grain sizes to medium frequency RF energy. Promising prototype coherers will be employed to receive nearby AM broadcast stations and judged for selectivity with various matching antennas configurations.

Little research has been done into coherer reception of AM radio signals. Some experiments were carried out in 1974 by G. L. Grisdale at the Marconi laboratories in the UK. However, these have never been completely documented. What is known (as reported by V.J. Phillips) is the Grisdale attempted to use the Italian Navy coherer as a diode envelope detector for the reception of AM signals and to compare its action with that of a germanium point contact diode. His conclusion was that it would indeed rectify, but very inefficiently. However, no recent research has been conducted that characterizes coherer reception of damped waves versus continuous waves, or of modern digital modes for communication.

Thus, one important aspect of any research program on the Italian Navy coherer must be to gain an understanding of the differences between its receptions of damped waves as opposed to continuous, modulated waves.

<u>Need for Part 5 Experimental Special Temporary Authorization</u>

It is this necessity to investigate both the sensitivity and the selectivity of promising coherer designs with pulsed, dampened RF waveforms that requires Part 5 temporary experimental licensing. In general, a spark gap transmitter is not authorized and is specifically prohibited for unlicensed operation under Title 47 CFR, Part 15:

"**§ 15.23 Home-built devices.**
Equipment authorization is not required for devices that are not marketed, are not

constructed from a kit, and are built in quantities of five or less for personal use.. It is recognized that the individual builder of home-built equipment may not possess the means to perform the measurements for determining compliance with the regulations. In this case, the builder is expected to employ good engineering practices to meet the specified technical standards to the greatest extent practicable. The provisions of § 15.5 apply...

§ 15.5 General conditions of operation
(d) Intentional radiators that produce Class B emissions (damped wave) are prohibited."

Proposed work under Part 5 Experimental Special Temporary Authorization

Under a grant of temporary experimental licensing, a spark gap transmitter (<1 watt ERP) with emission type X0N operating on 800 KHz will be utilized to optimize the design and construction of an Italian Navy coherer. A horizontal quarter-wave grounded antenna system, parallel to the earth, will act as the tuning circuit in a design known as a "plain antenna transmitter". Data resulting from these tests will afford correlation of coherer reception characteristics as outlined above. The spark gap transmitter will be constructed from a piezoelectric gas BBQ igniter or automotive spark coil and operate at less than 1 watt ERP at 800 KHz. The transmitter and coherer will be in close proximity to one another and will utilize parallel, quarter-wave grounded antennae in a plain antenna transmitter design (spark gap/coherer connected in series to a resonant antenna, the antenna acting as the tuning circuit).

This work will be done on an occasional basis (daytime on weekends) in the desert region of Eastern Washington, west of Kennewick, WA. In should be noted that in our remote locale, there are no broadcast stations on 800 KHz. The repetition rate of the proposed damped wave emission would be manually controlled and be no greater than 0.3 Hz (once every 3 seconds). Each test session would extend no longer than two hours during daytime on weekends. As a licensed general radiotelephone and amateur radio operator I have the understanding and equipment necessary to monitor and control these emissions, avoiding interference to other radio services. As a professional physical scientist employed by Pacific Northwest National Laboratory I have the training necessary to optimize these experiments, reduce resulting data, and document their analysis (my research expertise maybe viewed here http://emslbios.pnl.gov/id/beck_km).

Preliminary investigation of a BBQ igniter spark gap transmitter

The Amateur Radio Service authority to test a non-sequential, spark gap emission not modulated by a signal and containing no information (emission type X0N) is contained in Title 47 CFR, Part 97:

"**§97.305 Authorized emission types.**

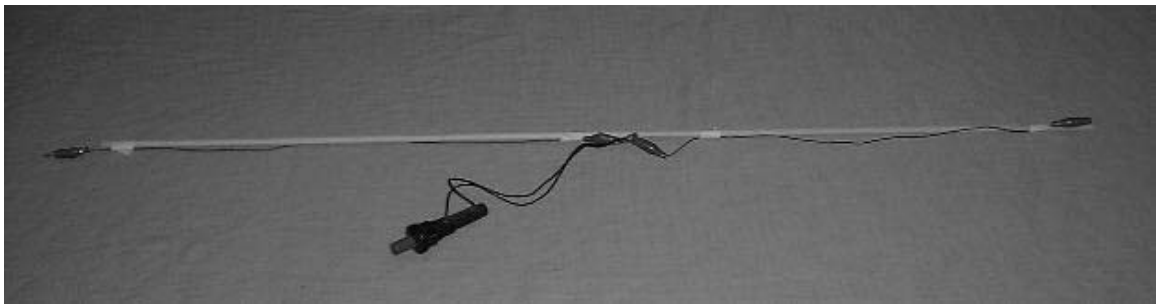
(b) A station may transmit a test emission on any frequency authorized to the control operator for brief periods for experimental purposes, except that no pulse modulation emission may be transmitted on any frequency where pulse is not specifically authorized and no SS modulation emission may be transmitted on any frequency where SS is not specifically authorized."

The amateur bands of 6 meters and higher frequency are designated for test emission, although pulse emission *with modulation* is only designated for 33 cm and above.

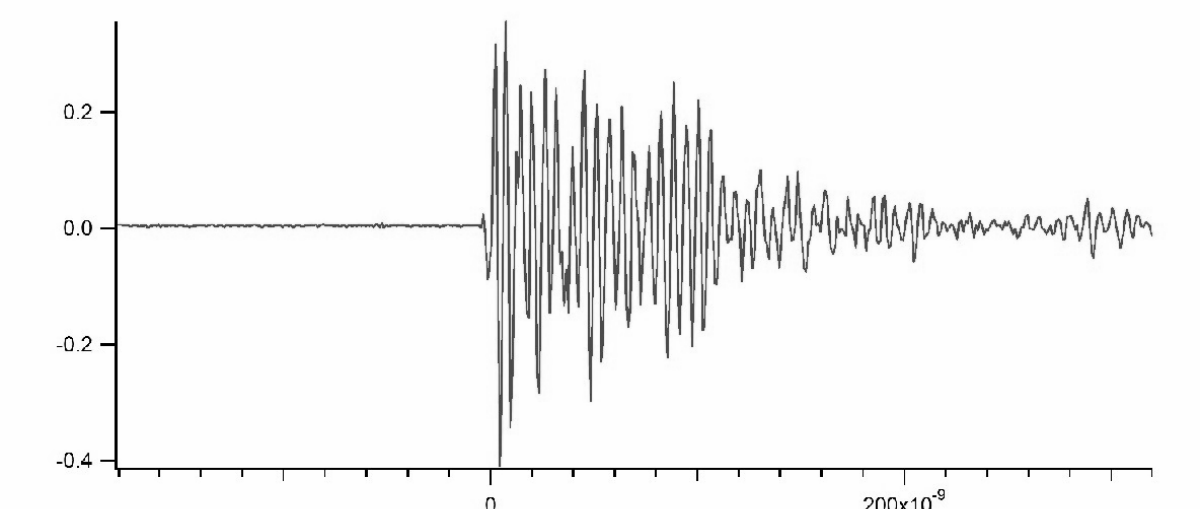
Thus, the following short test lasting 30 seconds was conducted:

A 2 meter dipole receiving antenna of #22 wire was terminated at 1 MW (10 pF capacitance) to a Tektronix TDS 724A 500 MHz (1GS/s) digital recording oscilloscope.

A 2 meter spark gap transmitter constructed from a *Weber Grill* (copyright) BBQ piezoelectric igniter attached in series with a two meter dipole antenna was placed parallel, at the same height, and 6.6 meters away from the receiving antenna. This transmitter has a 1/8" spark gap and is pictured below.



The transmissions of the spark gap transmitter triggered the 724A. Signals were average over 10 firings of the spark gap transmitter. Shown below is the recorded temporal profile with a50 nanoseconds/division acquisition timebase.



Two aspects are immediately apparent. First, that after 200 nanoseconds the damped wave pulse is essentially complete, although a longer term ringing at the -10dBV level continues. Second, that the fundamental frequency of oscillation is stable throughout 200 nanoseconds. This latter observation is confirmed by a Fourier transform of the acquired waveform showing a 146 MHz signal with a necessary bandwidth of 4 MHz (144-148 MHz). Linear extrapolation of this result to 800 KHz gives a necessary bandwidth as noted in the attached application.

(c) If the authorization is to be used for the sole purpose of developing equipment for exportation to be employed by stations under the jurisdiction of a foreign government, the applicant shall submit a narrative statement describing the project, any associated contract number, and the name of the foreign government concerned.

The primary purpose of this Part 5 Experimental temporary license would be to investigate the reception characteristics an Italian Navy coherer and optimize its use for AM reception at Cape Race, Newfoundland (Canada) for a period of two weeks in December, 2006. The Marconi 2006 Project has been granted exclusive access to the Marconi museum and use of VO1MCE, the Canadian amateur radio station at Cape Race. This facility is operated by the Society of Newfoundland Radio Amateurs (SONRA) who is solely authorized to manage the facility by Parks Canada. At the completion of the two weeks reception period, the Italian Navy coherer will return to the USA with me.