SOLAS

All Stations—Distress

Radio communications from the time of the Titanic.

by Mr. Joe Hersey
Chief, U.S. Coast Guard
Spectrum Management and Telecommunications Policy Division

In 1912, the RMS *Titanic* carried the most modern radio system in existence. Its transmitter was a five-kilowatt rotary spark gap designed to provide the most transmit power possible in the days before electric oscillators. Designed with an operating range of 250 miles, communications could normally be maintained for a maximum of 400 miles during the day and 2,000 miles at night. However, only rudimentary transmitter tuning was possible, so when the *Titanic* was transmitting, other stations in its area often needed to wait until the ship finished before transmitting themselves.

The 1906 International Radiotelegraph Conference

Six years before the *Titanic* disaster, the first regulatory conference of its kind, the International Radiotelegraph Conference, met to sign the International Radiotelegraph Convention to regulate radio communications between coasts and ships at sea, and those exchanged between ships. The wavelengths 600m (frequency 500 kHz) and 300m (1 MHz) were allocated for maritime communications.

Coast stations were generally required to be operational 24 hours a day but ship stations were not. The radio distress signal "SOS" and general procedures for transmitting radio telegrams were established.

After 1906, the conference met in 1912 (three months after the *Titanic* casualty), 1927, 1932, 1938, and still meets roughly every four years, as the International Telecommunications Union World Radio Conference. It was renamed once radio use expanded beyond telegraphy. Conference decisions are still recognized as having treaty status.

The Marconi Company owned the ship's radio call sign "MGY." Radio operators John G. Phillips, chief operator, and Harold Bride, deputy, were both Marconi employees. The ship's radio handled 250 passenger telegrams from the time the ship left Southampton until her sinking, some 36 hours later. This is notable, as passenger telegrams financed the radio's operation.

It was well known that the *Titanic* received an ice report from the M/V *Mesaba* of the Atlantic Transport Line. At 7:50 p.m. on April 14, 1912, the *Mesaba* sent the following message to the *Titanic,* giving information regarding the ice pack the ship would soon encounter:

"In lat 42N to 41.25N long 49W to long 50.30W saw much heavy pack ice and great number of large icebergs also field ice. Weather good, clear."

Stanley Lord, the captain of the nearby vessel *Californian,* also instructed his radioman to inform the *Titanic* of the ice field.

So What Happened?

Navigational warnings telegrammed to ships included the prefix "MSG," which stood for Masters' Service Gram, requiring the operator to return with a personal acknowledgement receipt from the captain. While previous ice warnings sent to the *Titanic* used that prefix, the 7:50 p.m. warning from the *Mesaba* did not. Instead, the message prefix was simply "Ice Report."

As the *Titanic* came within range of the Cape Race coast station, the ship's radio operators needed to clear a huge backlog of passenger telegrams for the United States. The *Californian's* ice warning telegram also was not preceded by the MSG prefix, and since the content of the telegram was informal, *Titanic's* radio officer reportedly rejected the communications.

The Distress Calls

At 12:15 a.m. the *Titanic* transmitted its first distress call:

"CQD (all stations—distress) DE (this is) MGY position 41.44 N. 50.24 W."

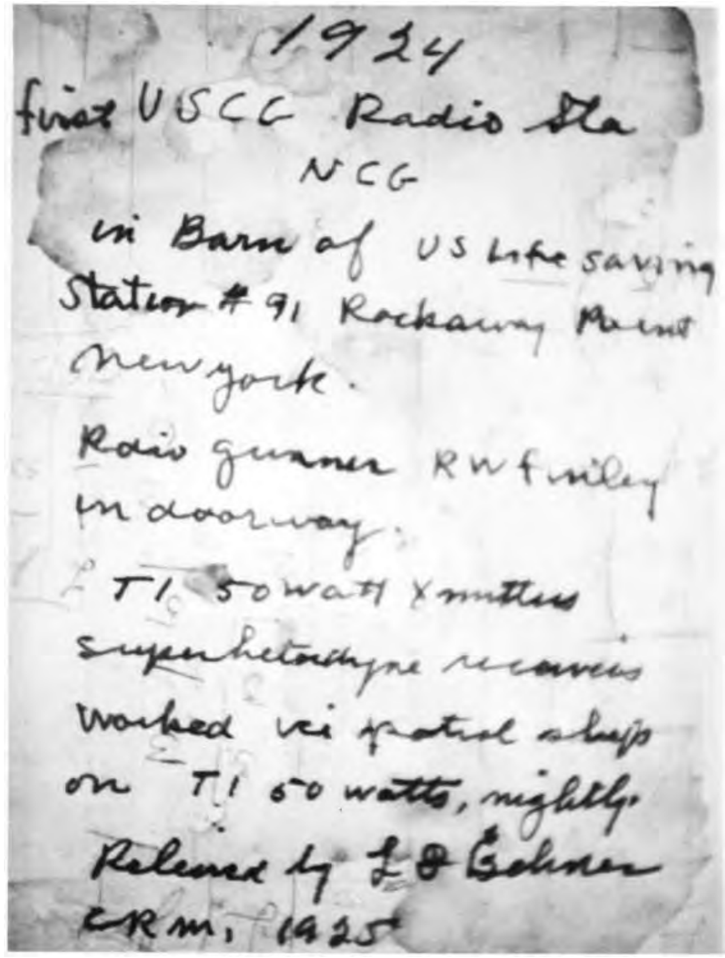
While Cape Race and various ships received the call, they were too far way to provide much assistance. It is reported that the *Californian* was quite near *Titanic,* but tragically, her radio operator had left his station for the night before the first distress call. The RMS *Carpathia,* a transatlantic passenger steamship, received the call at 12:25 a.m. The *Titanic* remained in communications with several ships that were rushing to its aid, until 2:17 a.m. when the steamship *Virginian* received the last message from the *Titanic:* "CQ." At that point, the *Titanic's* signal ended abruptly.

The ship foundered three minutes later. Both radio officers stayed at their stations until the end, despite being relieved by their captain. Harold Bride managed to survive, but Jack Phillips did not.

Changes as a Result

Radio communications procedural and technology changes addressing shortfalls from the *Titanic* casualty were gradually implemented. For example, a messaging priority was established that is still in use today, establishing warnings, including ice warnings, and precedence higher than general correspondence, including the stipulation that transmission be of no cost to ships. That regulation was also implemented in the U.S. as part of the Communications Act of 1934.

continued on page 57


1924
first USCG Radio Sta
NCG
in Barn of US Life saving
Station #91 Rockaway Point
New york.
Radio gunner R W finley
in doorway.
T1 50 watt Xmitter
superhetrodyne receiver
Worked ice patrol ships
on T1 50 watts, nightly.
Relieved by
CRM, 1925

Pictured is a log entry taken by the first U.S. Coast Guard radio station, call sign NCG, in Rockaway Point, NY. This station, established in 1924, in the barn of Lifesaving Station No. 91, was responsible for communicating with northeast coastal shipping and North Atlantic shipping vessels approaching the U.S. and documenting any distress alerts.

Titanic's Distress Signals Ignored

The SS *Californian* was only a few miles away, but, unfortunately, the *Californian's* only wireless operator had already secured the watch position for the night before *Titanic* called for aid. While those aboard saw the pyrotechnic signals from *Titanic,* they failed to recognize they were signals of distress and did not go to her rescue.

The *Titanic* had missed several ice warnings that night, including warnings coming from the *Californian.* However, the wireless operator aboard the *Titanic* dismissed those warnings.

The RMS *Carpathia* did answer the wireless distress signals, but arrived after the *Titanic* foundered. Captain Arthur Henry Rostron and his crew rescued more than 700 survivors in lifeboats.

Bibliography:

RADM George H. Rock, U.S. Navy, *The International Conference on Safety of Life at Sea, 1929, with Special Reference to Ship Construction*. New York, November 1929.

Titanic bibliography on Captain Stanley Lord of the *Californian,* at www.encyclopedia-titanica.org/titanic-biography/stanley-lord.html.

Titanic Inquiry Project, 1999 to 2007. Information available at www.titanicinquiry.org/.

Call sign NMQ

USCG Radio Station Long Beach, Calif., early 1950s.

At that time, each Coast Guard district had one primary station and frequently one secondary station that served their district commander, providing services including:

- **voice communications on 2 MHz to and from district units (the way the majority of stations and smaller cutters received their radio messages),**
- **voice weather broadcasts and notices to mariners intended for all vessels within district boundaries,**
- **voice distress radio guard on 2182 KHz.**

The stations also provided three Morse code services:

- **continuous watch on the international Morse code distress and calling frequency 500/8364 KHz (the same frequency used to make distress calls by the RMS *Titanic's* radio operator);**
- **a 2 MHz intra-district Morse code circuit utilized by the larger cutters for all ship/shore/ship radio traffic;**
- **a Morse code broadcast service that provided weather and notices to mariners for suitably equipped vessels on a designated working frequency after an initial announcement on 500 KHz.**

Generally, each radio station had two teletype circuits, referred to as teletype wire private lines (TWPLs). One circuit connected the individual radio station to its district communications center, while the other connected each radio station to a communications center within its area for distress and other high-priority messages as well as informal coordination.

Pictured (right) is a RM1 watch supervisor at USCG Radio Station Long Beach. It is not uncommon for those supervising to also serve as one of the operators.

"Position five" in the photo depicts: two variable receivers, two speakers, and a simple patch panel, which allows the receiver output be patched to various speakers. Photo suggests it is normally unmanned, indicating it was used to monitor specific frequencies.

The transmitter control panel, to the supervisor's right, permits operator position assignment and control of a particular transmitter. The receiver antenna patch panel permits assigning a specific antenna to a specific radio receiver. Receiver antennas are located on the station grounds, separated from the transmitting antenna.

The automatic keying machine, shown behind the supervisor, was used in conjunction with another device to make Morse Code broadcasts. The machine keyed an associated transmitter a specified speed, freeing an operator from the need to key by hand.

Immediately behind the supervisor are two receivers, a limited transmitter control device, a patch panel, and a remote receiver amplifier, which indicates that the station had a receiver in another location.

The operations room at USCG Radio Station Long Beach (left).

The radio operator monitors the international distress and calling frequency and operates the TWPL, which connected the station to the district headquarters. Through the glass is another radio operator monitoring another distress frequency and making all voice broadcasts.

Position four (the unmanned position) appears to be a combination voice/Morse position; two variable receivers, a patch panel, and speaker are visible.

The position in the background is most likely the guard position, where an operator monitors 500 KHz continuously for distress, while processing more traffic on a working frequency. The position in the foreground shows a transmitter control device (the panel with the toggle switches and dial telephone pad) used to control the mode and frequency of the selected transmitter, and a device called a "whetstone machine," used with the automatic keying machine.

Those same regulations also require that there be no charge for any distress-related communications.

The Safety of Life at Sea (SOLAS) Convention, first adopted in 1914 as a consequence of the *Titanic* casualty and now sponsored by the International Maritime Organization (IMO), complemented the International Radiotelegraph Convention and its International Telecommunications Union (ITU) radio regulation successors. SOLAS focused on mandating radio watchkeeping and defining carriage requirements for ships, while ITU radio regulations addressed distress radio frequency allocations radio procedures and personnel licensing, and radio equipment technical standards.

Lessons learned from this casualty affected regulations and procedures for shipboard distress and safety radiocommunications equipment still in existence today. Such technological innovations as radiotelephone, amplitude modulation, single sideband on 2182 kHz and later yet, very high frequency modulation on 156.8 MHz, were adopted in these conventions, as were automatic watchkeeping receivers and electronics based first on electron tubes, then transistors, and finally integrated circuit devices.

Nevertheless, Morse telegraphy distress watchkeeping on 500 kHz, first established by regulation on the 1906 International Radiotelegraph Convention and used by the *Titanic,* remained the primary international maritime distress system until the end of the 20th century.

COMSAT, INMARSAT

On August 27, 1962, President John F. Kennedy signed the Communications Satellite Act, establishing the Commutations Satellite Corporation (COMSAT) to create a commercial satellite network. With the support of the U.S. Navy, COMSAT began operating MARISAT, the first maritime mobile satellite system in 1976 when three geostationary satellites were successfully launched over the Atlantic, Pacific, and Indian Oceans.

In 1966, the Inter-governmental Maritime Consultative Organization (predecessor to International Maritime Organization) appointed a panel of experts to investigate the possibilities of creating a maritime satellite system to improve maritime communications. In 1973, it hosted the first of a series of conferences to establish an international organization to operate such a system; and, from 1975 to 1976, a new intergovernmental organization named the International Maritime Satellite Organization (INMARSAT) worked to improve maritime, aeronautical, and land mobile communications. COMSAT became the U.S. representative to Inmarsat; and, in early 1982, Inmarsat commenced operations using leased MARISAT maritime satellites.

Upon Inmarsat's successful start, the Intergovernmental Maritime Consultative Organization's radiocommunications subcommittee began developing a maritime distress and safety system. ITU convened world administrative radio conferences in 1983 and 1987 in support of this effort. IMO adopted the Global Maritime Distress and Safety System (GMDSS) in 1988, as an amendment to the SOLAS Convention. This new system replaced the Morse radiotelegraphy system in place at the time of the *Titanic* casualty. GMDSS itself started to come into force on an incremental basis in 1993. It came into full effect on February 1, 1999.

The Global Maritime Distress and Safety System

GMDSS is a system of systems, comprised of Inmarsat satellite earth stations, satellite emergency position indicating radio beacons (EPIRBs) maintained by the COSPAS-SARSAT system, VHF, and MF/HF radio equipped with digital selective calling, search and rescue radar transponders, and maritime safety information receivers.

This technology eliminated the need for the radio officer position on ships and 500 kHz watchstanding positions ashore, and helped to fund GMDSS implementation. The International Hydrographic Organization, World Meteorological Organization, and IMO cooperatively established a worldwide system of navigational and meteorological areas by which GMDSS-equipped ships traveling anywhere on the globe could be assured of receiving relevant and timely navigational warnings, meteorological forecasts and warnings, search and rescue alerts, and ice warnings prepared by the International Ice patrol.

Under the SOLAS Convention, equipment carriage on ships was based upon the establishing four areas of radio coverage:

- Sea Area A1 within VHF coverage of shore (~20 nm),
- Sea Area A2 based upon medium frequency coverage from shore (~70 nm),
- Sea Area A3 based upon Inmarsat's satellite footprint,
- Sea Area A4 for polar regions outside of Inmarsat's footprint.

With the later closing of most coast stations, Sea Area A3 became the default for most installations. In the U.S., Sea Area A2 was planned but never implemented and Sea Area A1 is being delayed until the end of 2012. While Sea Area A4's HF operations are still supported, the Coast Guard has no HF stations near the Arctic and GMDSS coverage there remains poor.

While GMDSS provided a clear and demonstrable improvement in maritime communications and in maritime safety, it wasn't an unqualified success. Digital selective calling, for example, assumed the existence of a public coast marine operator network, an assumption that proved wrong, such coast stations began disappearing as GMDSS came into force. Additionally, a high false-alert rate induced more than one ship to shut off the digital selective calling-equipped radios.

Continuing Improvement

Presently, new technology to replace elements of the Global Maritime Distress and Safety System is being developed. One example is the Automatic Identification System, a shipborne autonomous broadcast system that acts like a transponder and is already used on ships for navigation, vessel traffic management, and maritime domain awareness. IMO has already adopted the Automatic Identification System search and rescue transmitter as an element of the GMDSS, and IMO and ITU are investigating using AIS for distress communications as well. A scoping exercise on GMDSS modernization is nearing completion; and, if successful, full-scale planning may proceed.

Except possibly for such specialized equipment as the satellite EPIRB, the next generation GMDSS will likely not consist of specialized shipborne equipment at all, but instead may become embedded within the ship's communications and software systems, with capabilities provided to the mariner as part of an existing integrated navigation system display. Maritime safety broadcasts and distress messages will likely be graphically displayed, with communications largely by short message service or chat, backed by broadband communications systems.

Bibliography:

The RMS Titanic *Radio Page* at www.hf.ro/.

Johnson, Dwight A. KI5WI, *The Radio Legacy of the R.M.S.* Titanic, March 1998; revised December 28, 1998. Website: www.avsia.com/djohnson/titanic.html.

International Telecommunication Union's History Portal. Website: www.itu.int/en/history/Pages/default.aspx.

The International Radiotelegraph Convention of Berlin: 1906, and propositions for the International radio telegraph conference of London (1912). Website: www.archive.org/details/internationalrad00interich.

Huurdeman, Anton A. *The worldwide history of telecommunications*, John Wiley & Sons/IEEE Press, 2003.

History of International Maritime Organization. Website: www.imo.org/About/HistoryOfIMO/Pages/Default.aspx.

COMSAT Corporation's Company History. Website: www.fundinguniverse.com/company-histories/Comsat-Corporation-Company-History.html.

Inter-governmental Maritime Consultative Organization (IMCO) International Conference on the Establishment of an International Maritime Satellite System, 1975-1976, Final Act of the Conference, Convention and Operating Agreement on the International Maritime satellite Organization (INMARSAT), London, 1976.

Dalgleish, D.I. *An introduction to satellite communications*, Institution of Engineering and Technology (IET), May 1989.

About the author:

Mr. Joe Hersey is chief of the U.S. Coast Guard Spectrum Management and Telecommunications Policy Division. He is also agency vice chair of the U.S. Interdepartment Radio Advisory Committee. He is a professional engineer and holds a bachelor's and master's degree in engineering from Brown University.