

Pioneer Engineers

Radio at its core is a technology. Therefore, anyone who has ever spoken into a microphone or sat before a radio receiver owes an immense debt of gratitude to the many technical innovators who made it possible. Guglielmo Marconi, a diminutive Italian with enormous genius, first used electromagnetic (radio) waves to send a message. Marconi made his historical transmission, and several others, in the last decade of the nineteenth century. Relying, at least in part, on the findings of two earlier scientists, James Clerk Maxwell and Heinrich Hertz, Marconi developed his wireless telegraph, thus revolutionizing the field of electronic communications.

Other wireless innovators made significant contributions to the refinement of Marconi's device. J. Ambrose Fleming developed the diode tube in 1904, and two years later Lee de Forest created the three-element triode tube called the Audion. Both innovations, along with many others, expanded the capability of the wireless.

In 1906, Reginald Fessenden demonstrated the transmission of voice over the wireless from his experimental station at Brant Rock, Massachusetts. Until that time, Marconi's invention had been used to send Morse code or coded messages. An earlier experiment in the transmission of voice via the electromagnetic spectrum also had been conducted. In 1892, on a small farm in Murray, Kentucky, Nathan B. Stubblefield managed to send voice across a field using the induction method of transmission, yet Fessenden's method of mounting sound impulses atop electrical oscillations and transmitting them from an antenna proved far more effective. Fessenden's wireless voice message was received hundreds of miles away.

Few pioneer broadcast technologists contributed as much as Edwin Armstrong. With his development of the regenerative and superheterodyne circuits associated with the process of amplitude modulation (AM), Armstrong vastly improved receiver efficiency. In the 1920s Armstrong worked at developing a static-free mode of broadcasting, and in 1933 he demonstrated the results of his labor—FM. Armstrong was a man ahead of his time. It would be decades before his innovation would fully be appreciated, and he would not live to witness the tremendous strides it would take.



FIGURE 10.1 - Assembling the technology (courtesy Library of Congress).

Had it not been for these men, and many others like them, there would be no radio medium. Today's broadcast engineers and technologists continue in the tradition of their forebears. Without their knowledge and expertise, there would be no broadcast industry because there would be no medium. Radio is first and foremost an engineer's medium. It is engineers who put the stations on the air and keep them there.

Radio Technology

Radio broadcasters utilize part of the electromagnetic spectrum to transmit their signals, and in return for receiving permission to operate, are obliged to pay regulatory fees to the FCC to offset administrative expense. In 2013, annual fees ranged from as little as \$775 for certain small market AM broadcasters to \$12,025 for certain major-market FM licensees for this privilege. A natural resource, the electromagnetic spectrum is composed of radio waves at the low-frequency end and cosmic rays at the high-frequency end. In the spectrum between are infrared rays, light rays, X rays, and gamma rays. Broadcasters, of course, use the radio wave portion of the spectrum for their purposes.

Electromagnetic waves carry broadcast transmissions (radio frequency) from station to receiver. It is the function of the transmitter to generate and shape the radio wave to conform to the frequency the station has been assigned by the FCC. Audio signals are conveyed by either wired or wireless studio-transmitter links (STLs) from the control room to the transmitter. The audio-signal current then modulates the carrier wave so that it may achieve its authorized frequency. A carrier wave that is undisturbed by audio current is called an unmodulated carrier.

The antenna radiates the radio frequency. Receivers are designed to pick up transmissions, convert the carrier's electrical energy into sound waves, and distribute them to the frequency tuned. Thus, in

order for a station assigned a frequency of 950 kHz (a kilohertz equals 1,000 hertz [Hz]) to reach a radio tuned to that position on the dial, it must alter its carrier wave 950,000 cycles (Hz) per second. The tuner counts the incoming radio frequency.

Smart Receivers

It is possible to get more than just audio from a radio receiver. HD sets and satellite radio receivers are programmable and provide visual screens offering copious data. In fact, consumers are able to format scan without actually having to listen to stations. These so-called smart receivers feature emergency alerting capabilities, traffic announcements, advertisements and promos, music-tagging options, and other informational services via a built-in LCD display panel. These features were proposed in the early 1990s by Radio Broadcast Data Systems but never were fully realized. Now, with the existence of digital and satellite radio, it has come to fruition.

Some programmers opposed the idea of “sightradio” (a throwback term used to describe television at its onset) because they felt that it was difficult to categorize a format given the existing options, especially with a limited number of alphanumeric character positions. The thought of a quasi-teletext component to radio inspires mixed emotions in many broadcasters. Will people be *watching* radio, and what exactly will that mean? In the main, however, “screen” radio is perceived as an important value-added feature for the medium, and something it must offer in the computer age.

Although it is difficult at this time to predict the future impact and role of these innovations, it is certain, with the conversion to digital, that eventually receivers will do more than simply tune frequencies.

One other plus offered by smart-receiver technology is that it will allow car radios to automatically retune a different station offering the same format when a vehicle leaves the coverage area of the first station.

The Engineer's Duties

The FCC requires that all stations designate someone as chief operator. This individual is responsible for a station's technical operations. Equipment repairs and adjustments, as well as weekly inspections and calibrations of the station transmitter, remote control equipment, and monitoring and metering systems, fall within the chief operator's area of responsibility.

Depending on the makeup and size of a station or cluster, either a full- or part-time engineer will be contracted. Many small outlets find they can get by with a weekly visit by a qualified engineer who also is available should a technical problem arise. Larger stations and cluster operations with more studios and operating equipment often employ an engineer on a full-time basis. It is a question of economics. The small station can little afford a day-to-day engineer, whereas the

larger station or cluster usually finds that it can ill afford to be without one.

Beasley Broadcast Group's McNamara considers protecting the station's license his number one priority: "A station is only as good as its license to operate. If it loses it, the show is over. No other area of a station is under such scrutiny by the FCC as is the technical. The dereg movement in recent years has affected programming much more than engineering. My job is to first keep the station honest, that is, in compliance with the commission's rules. This means, keep the station operating within the assigned operating parameters, i.e., power, antenna phase, modulation, and so on, and to take corrective action if needed."

According to former engineer Steve Church, maintenance and equipment repairs consume a large portion of an engineer's time: "General repairs keep you busy. One moment you may be adjusting a pot on a studio console and the next replacing a part on some remote equipment. A broadcast facility is an amalgam of equipment that requires care and attention. Problems must be detected early or they can snowball. The proper installation of new equipment eliminates the chance of certain problems later on. The station's chief must be adept at a whole lot."

Other duties of the chief engineer may include training a supporting staff of technicians, monitoring radiation levels, planning maintenance schedules, and handling a budget. Many stations hire outside engineering firms to conduct performance proofs, but it is ultimately the responsibility of the chief operator to ensure that the outlet meets its technical performance expectations. Proofs ascertain whether a station's audio equipment performance measurements fall within the prescribed parameters. A station's frequency response, harmonic distortion, FM noise level, AM noise level, stereo separation, crosstalk, and subcarrier suppression are gauged. If found adequate, the proof is passed. If not, the chief sees to it that necessary adjustments are made. Although the FCC no longer requires Proof of Performance checks, many stations continue to observe the practice as a fail-safe measure to ensure sonic quality in an ever-competitive listening environment.

The duties of a station engineer are wide ranging and demanding. It is a position that formerly required, first and foremost, a thorough grasp of electronics theory relative to the broadcast environment. Today, it is likely even more important for the CE to be conversant in information technology (IT), computers, and networking. Then, as is now, knowledge of FCC rules and regulations pertaining to station technical operations, and, especially in the case of the chief engineer, the ability to manage finances and people are high on the list of required knowledge and skills.

Station Log

In 1983, the FCC dispensed with its requirement that radio stations keep maintenance and operating logs. In their place the commission created a new and considerably modified document called the Station Log, which stations must maintain. The new log requires that information pertaining to tower light malfunctions, Emergency Alert System (EAS) tests, and AM directional antenna systems be entered. Station logs are kept on file for a period of two years.

Despite the fact that the FCC has eliminated the more involved logging procedures, some stations continue to employ the old system. "I like the accountability that maintenance and operating logs provide. We still use them here, and they are inspected daily. Despite the elimination of certain requirements, namely, the tech logs, a station is still required to meet the operating stipulations of their license. Actually, enforcement action has been on the rise at the FCC, perhaps in reaction to the deregs. The commission is really interested in station technical operations. Keeping daily logs ensures compliance," says McNamara.

§ 73.1820 Station Log

(a) Entries must be made in the station log either manually by a person designated by the licensee who is in actual charge of the transmitting apparatus, or by automatic devices meeting the requirements of paragraph (b) of this section. Indications of operating parameters that are required to be logged must be logged prior to any adjustment of the equipment. Where adjustments are made to restore parameters to their proper operating values, the corrected indications must be logged and accompanied, if any parameter deviation was beyond a prescribed tolerance, by a notation describing the nature of the corrective action. Indications of all parameters whose values are affected by the modulation of the carrier must be read without modulation. The actual time of observation must be included in each log entry. The following information must be entered:

(1) *All stations:* (i) Entries required by § 17.49 of this chapter concerning any observed or otherwise known extinguishment or improper functioning of a tower light:

(A) The nature of such extinguishment or improper functioning.

(B) The date and time the extinguishment or improper operation was observed or otherwise noted.

(C) The date, time and nature of adjustments, repairs or replacements made.

(ii) Any entries not specifically required in this section, but required by the instrument of authorization or elsewhere in this part.

(iii) An entry of each test and activation of the Emergency Alert System (EAS) pursuant to the requirement of part 11 of this chapter and the EAS Operating Handbook. Stations may keep EAS data in a special EAS log which shall be maintained at a convenient location; however, this log is considered a part of the station log.

(2) *Directional AM stations without an FCC-approved antenna sampling system* (see § 73.68):

(i) An entry at the beginning of operations in each mode of operation, and thereafter at intervals not exceeding 3 hours, of the following (actual readings observed prior to making any adjustments to the equipment and an indication of any corrections to restore parameters to normal operating values):

(A) Common point current.

(B) When the operating power is determined by the indirect method, the efficiency factor F and either the product of the final amplifier input voltage and current or the calculated antenna input power. See § 73.51(e).

(C) Antenna monitor phase or phase deviation indications.

(D) Antenna monitor sample currents, current ratios, or ratio deviation indications.

(ii) Entries required by § 73.61 performed in accordance with the schedule specified therein.

(iii) Entries of the results of calibration of automatic logging devices (see paragraph (b) of this section), extension meters (see § 73.1550) or indicating instruments (see § 73.67) whenever performed.

(b) Automatic devices accurately calibrated and with appropriate time, date and circuit functions may be utilized to record entries in the station log *Provided:*

(1) The recording devices do not affect the operation of circuits or accuracy of indicating instruments of the equipment being recorded;

(2) The recording devices have an accuracy equivalent to the accuracy of the indicating instruments;

(3) The calibration is checked against the original indicators as often as necessary to ensure recording accuracy;

(4) In the event of failure or malfunctioning of the automatic equipment, the person designated by the licensee as being responsible for the log shall make the required entries in the log manually at that time;

(5) The indicating equipment conforms to the requirements of § 73.1215 (Indicating instruments—specifications) except that the scales need not exceed 5 cm (2 inches) in length. Arbitrary scales may not be used.

(c) In preparing the station log, original data may be recorded in rough form and later transcribed into the log.

[43 FR 45854, Oct. 4, 1978, as amended at 44 FR 58735, Oct. 11, 1979; 47 FR 24580, June 7, 1982; 48 FR 38481, Aug. 24, 1983; 48 FR 44806, Sept. 30, 1983; 49 FR 33603, Aug. 23, 1984; 58 FR 44951, Aug. 25, 1993; 59 FR 67102, Dec. 28, 1994; 60 FR 55482, Nov. 1, 1995]

§ 73.1835 Special Technical Records

The FCC may require a broadcast station licensee to keep operating and maintenance records as necessary to resolve conditions of actual or potential interference, rule violations, or deficient technical operation. (48 FR 38482, Aug. 24, 1983)

§ 73.1840 Retention of Logs

(a) Any log required to be kept by station licensees shall be retained by them for a period of 2 years. However, logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the FCC and about which the licensee has been notified, shall be retained by the licensee until specifically authorized in writing by the FCC to destroy them. Logs incident to or involved in any claim or complaint of which the licensee has notice shall be retained by the licensee until such claim or complaint has been fully satisfied or until the same has been barred by statute limiting the time for filing of suits upon such claims.

(b) Logs may be retained on microfilm, microfiche, or other data-storage systems subject to the following conditions:

1. Suitable viewing-reading devices shall be available to permit FCC inspection of logs pursuant to § 73.1226, availability to FCC of station logs and records.

2. Reproduction of logs, stored on data-storage systems, to full-size copies, is required of licensees if requested by the FCC or the public as authorized by FCC rules. Such reproductions must be completed within two full work days of the time of the request.

3. Corrections to logs shall be made:
- (i) Prior to converting to a data storage system pursuant to the requirements of § 73.1800 (c) and (d) (§ 73.1800, General requirements relating to logs).
 - (ii) After converting to a data-storage system by separately making such corrections and then associating with the related-data-stored logs. Such corrections shall contain sufficient information to allow those reviewing the logs to identify where corrections have been made, and when and by whom the corrections were made.
4. Copies of any log required to be filed with any application; or placed in the station's local public inspection file as part of an application; or filed with reports to the FCC must be reproduced in full-size form when complying with these requirements. (45 FR 41151, June 18, 1980, as amended at 46 FR 13907, Feb. 24, 1981; 46 FR 18557, Mar. 25, 1981; 49 FR 33663, Aug. 24, 1984)

The FCC and Radio

Allen Myers



FIGURE 10.2 - Allen Myers.

In evaluating the service to the radio medium provided by the Federal Communications Commission, it is necessary to understand that the Commission was created by Congress in the Communications Act of 1934 and that the agency, therefore, carries out the wishes of that body. If the Commission wants to implement regulations for which it lacks the statutory authority, it must first obtain the approval of Congress.

The FCC's service to the radio medium is twofold. First, it sets the technical standards under which the medium operates. Second, it ensures an adequate and equitable distribution of radio services throughout the United States. The commission was created by Congress to specifically carry out these objectives. Prior to the existence of the FCC and its predecessor, the Federal Radio

Commission, radio broadcasting in this country was in a state of chaos. There was no spectrum planning. Operators put the stations on the air wherever they wanted. If a new station caused interference to a station already on the air, the operator of the older station often would just increase power—sort of an electronic shouting match. There were also no standards for radio receivers to prevent them from causing radiofrequency interference. So when Congress created the FCC, it charged it with making the radio medium “serve the public interest need and necessity.”

The FCC’s principal missions are accomplished with this objective in mind. Some of the agency’s rules set minimum and maximum power requirements for radio stations; others set interference and distance standards—all with the objective of making sure that when a listener tunes to a radio station, he or she will be able to hear it clearly. The commission’s role in setting technical standards also extends to the equipment used in the transmission of radio signals. Manufacturers of transmitters and receivers are required to receive FCC “type acceptance” approval before putting their products on the market. This insures that a clean signal is transmitted and received and that the equipment does not cause interference to other stations or electronic services. Other commission rules deal with spectrum planning and are intended to ensure an equitable distribution of radio stations throughout the country so that as many communities as possible will have a local radio station and possibly access to several different stations to provide a multitude of voices.

The FCC recognizes the different types of services that radio stations provide to listeners. To this end, it will often establish rules to foster the growth of a group of stations providing a unique service. For example, in 1945 the FCC reserved the first twenty channels in the FM band (88.1–91.9 MHz) for radio stations licensed to nonprofit, educational institutions and organizations to be operated as noncommercial, educational radio stations. The commission then established a set of rules for this type of station, including both technical standards and spectrum planning. Similarly, in 2000 the FCC accepted applications for the first Low Power FM (“LPFM”) stations to further enhance the public’s access to local, noncommercial FM radio stations.

Finally, in looking at the FCC’s service to the radio medium, one must realize that the Communications Act is a living document. It has been amended many times to allow for new technologies in the radio medium, and the FCC has implemented regulations to carry out these changes. There is no doubt that the Communications Act will continue to be amended to take into consideration future changes in radio service and the FCC will proscribe regulations implementing these changes.

The views expressed by the author are not necessarily those of the Federal Communications Commission.

Posting Licenses and Permits

The FCC requires that a station’s license and other official authorization notices be posted. What follows are the rules pertaining to this requirement as outlined in Subpart H, § 73.1230, of the

FCC's regulations.

§ 73.1230 Posting of station license.

(a) The station license and any other instrument of station authorization shall be posted in a conspicuous place and in such a manner that all terms are visible at the place the licensee considers to be the principal control point of the transmitter.

(b) Posting of the station license and any other instruments of authorization shall be done by affixing them to the wall at the [sic] posting location, or by enclosing them in a binder or folder which is retained at the posting location so that the documents will be readily available and easily accessible.

[60 FR 55480, Nov. 1, 1995]

APPENDIX: Federal Communications Commission

Fact Sheet: Hints on Filing Comments with the FCC

The FCC is interested in any experiences, knowledge, or insights that outside parties may have to shed light on issues and questions raised in the rule-making process. The public and industry have the opportunity to comment upon Petitions for Rule Makings, NOIs, NPRMs, Further NPRMs, Reports and Orders, and others' comments on the aforementioned documents. It is a common misconception that only a lawyer can file comments with the FCC, but all that is necessary is an interest in an issue and the ability to read and follow directions.

Prior to drafting comments it is crucial to read and understand fully the item on which you wish to comment. Usually, the NPRM, NOI, or other item will specify and invite comment upon the issue(s) that the Commission is interested in studying further. Examination of the issue(s) and relevant documents is the most important part of the comment process. Comments may take any form, but the following hints may assist you in writing them.

Format. There is no required format for informal comments, although if you plan to file formally, it is required that they be typed, double-spaced, and on 8.50" × 11" paper. Additional requirements for formal filings are set forth in Sections 1.49 and 1.419 of the FCC Rules. The Docket Number or Rule Making Number of the item at hand should be included on your comments and can be found on the front page of the commission document or public notice. You should also include your name and complete mailing address.

Content. Your comments should state who you are and what your specific interest is. (You do not need to represent yourself in an official capacity. You may, for example, express your opinion as a concerned consumer, concerned parent, etc., and sign your name.) State your position and the facts directly, as thoroughly but as briefly as possible. Explain your position as it relates to your experience and be explicit. Make clear if the details of a proposed rule or only one

of several provisions of the rule are objectionable. If the rule would be acceptable with certain safeguards, explain them and why they are necessary.

Support. Statements of agreement or dissent in comments should be supported to the best extent possible by factual (studies, statistics, etc.), logical, and/or legal information. Support should illustrate why your position is in the public interest. The more support made, the more persuasive the comments will be.

Length. Comments may be any length, although it is preferred that they be succinct and direct. If formal comments are longer than ten pages, a summary sheet is required.

Time frame. Your comments should be submitted well within the time frame designated on the original document or public notice. It is almost always included on the first page of an NPRM or NOI. However, if the deadline has passed, you can still submit your views informally in a permissible ex parte presentation.

Filing. Send your written comments to Secretary, Federal Communications Commission, 445 Twelfth Street, S.W., Washington, D.C. 20554. If you wish your comments to be received as an informal filing, submit the original and one copy. If you want your comments to be received as a formal filing, you should submit an original and four copies. For more specific filing information, please refer to the FCC Public Notice “Guidelines for Uniform Filings” available from the same address.

Reply comments. As the name implies, reply comments are used to respond to comments filed by other parties. You may file reply comments even if you did not submit comments initially. When drafting reply comments use the same guidelines expressed earlier regarding content and be careful not to raise additional or irrelevant issues.

Tracking your comments. After you have properly filed your comments with the FCC, they will be part of the official record. To track the progress of proceedings in which you have filed comments, you may check the *Daily Digest* or *Federal Register* for releases and notices. The *Daily Digest* can be obtained from the Office of Public Affairs, 445 Twelfth Street, S.W., Washington, D.C. 20554 or from a daily recorded listing of texts and releases at 202-418-2222.

For further information. For further information, you may contact the Secretary’s office at the FCC directly, at 202-418-0300. Explicit information about filings in rulemaking proceedings can be found in Sections 1.49 and 1.419 of the FCC Rules. Copies of any FCC documents can be obtained through the FCC’s duplicating contractor, Best Copy and Printing, Inc. www.bcpweb.com 1-800-378-3160 or from one of the private distributors of FCC releases. A list of distributors is available from the Public Service Division, 445 Twelfth Street, S.W., Washington, D.C. 20554, 202-418-0190.