Regulatory History

The licensing of radio operators has always been controversial. Early Congressional arguments compared radio operators to train engineers, who did not need licensing. It was up to the railroad (or the station licensee) to evaluate the qualifications of its employees. As it became evident that radio would play an important part in marine safety, it was decided that radio stations and operators should be licensed. Through the years, the required qualifications for a broadcast transmitter operator have varied. During World War II, there was a shortage of operators holding the First Class Radiotelephone license. So, routine operation by a lesser grade operator was permitted. The lesser grade operators were supervised by a chief operator.

Starting in the 1950's, the FCC began considering the possibilities of remote control of transmitters, thus allowing transmitter duty operators to be employed for other functions. In the 1970's, the FCC considered the possibility of automating transmitter operation. In the 1990's, Congress amended the Communications Act of 1934 to allow the Commission to waive the licensed operator requirement for broadcast stations. Besides allowing for unlicensed operators, it allowed for no operator at all! Here's how we got from there to here. Note, most of the history reviewed was obtained from the *Federal Register* (FR) and the *FCC Record* (FCC). Citations are provided to allow readers to review the source documents.

Operator Requirements

1910 - In The Beginning

Public Law 262, passed June 24, 1910, required the Commerce Department to license radio operators. The Radio Division of the Commerce Department was established July 1, 1911. Public Law 632, the Radio Act of 1927, established the Federal Radio Commission (FRC) which took over the regulation of broadcasting. Other radio services remained with the Commerce Department. The Communications Act of 1934 created the Federal Communications Commission (FCC), which took over the regulation of all radio services from the FRC and the Commerce

Department. It also took over regulation of telephone and telegraph services from the United States Post Office. Many of the existing FRC rules were adopted by the FCC.

1934 - Section 318

Section 318 of the Communications Act of 1934 states, "The actual operation of all transmitting apparatus in any radio station for which a station license is required by this Act shall be carried on only by a person holding an operator's license issued hereunder... ." The FCC is authorized to waive this requirement under various conditions. Until 1992, these requirements could not be waived for broadcast stations, except those primarily engaged in rebroadcasting other broadcast signals. The allowance of unattended operation or operation by a non-licensed operator for broadcast stations, "primarily rebroadcasting other broadcast signals" was introduced in 1960 (for television translators) and in 1976 (for radio or television translators or boosters).

1942 - Duty Operator Requirements Reduced During WWII

During World War II, the FCC reduced the operator requirements for the routine operation of broadcast transmitters due to a shortage of first class operators. Routine operation and minor adjustments could made by any qualified holder of any class of commercial license. Restricted radiotelephone permit holders were required to take an exam to demonstrate an understanding of radiotelephone theory [8 FCC 56].

On January 19, 1943, the FCC decided to endorse restricted radiotelephone permits to allow the operation of broadcast transmitters of 100 watts or less, if a first class operator in charge of the station certified that the permittee was able to satisfactorily operate that particular station [9 FCC 83]. This marked the start of operator requirement relaxation and the increase in the responsibility of the chief operator, who now had to certify the qualifications of lesser grade operators.

1947 - War Ends, First Phone Required

With the end of World War II, the FCC rescinded the allowance for the use of restricted radiotelephone permit holders to operate broadcast transmitters. This was due to the ready availability of first class operators, since many radio operators were returning from the war [12 FCC 53].

In 1951, the FCC proposed authorizing AM and FM stations to operate with less than a first class operator on duty, provided that additional first class operators were not available, and a first class operator would be on call to handle emergencies. The chief operator (holding a first class license) was to notify the FCC district Engineer In Charge (EIC) that the operator had been properly trained in the operation of the station. This authorization was good for 120 days, and could be renewed as necessary. [43 FCC 643, 16 FR 3309, 16 FR 7263].

1953 - Restricted Permit OK For Most Stations

In response to a petition from the National Association of Radio & Television Broadcasters (NARTB), the FCC reduced operator requirements for the routine operation of non-directional AM and FM stations (with powers of 10 KW or less), to restricted radiotelephone permit. (This is the same exam free permit that was required to operate a broadcast station until recently.) Stations employing lesser grade operators had to have one or more first class operators as full-time employees. These operators were responsible for making non-routine adjustments and repairs and instructing the other operators [18 FR 726, 18 FR 1615, 18 FR 1920].

1963 - Broadcast Endorsed Third

By 1963, the FCC had found an excessive number of violations at broadcast stations that might have been due to unqualified operators. The FCC increased the routine operator license requirement from restricted third class radiotelephone to broadcast endorsed third class radiotelephone. These requirements applied to non-directional AM stations (up to 10 KW) and FM stations (up to 25 KW). Stations using any operators (other than first class operators) for

routine operation were required to have a first class operator employed full-time or employed part-time with a written contract. Although not specifically stated, this was the beginning of the chief operator requirement. If a station used lesser grade operators for routine operation, a fully qualified chief operator was required to supervise the operation [28 FR 7382, 28 FR 7674, 28 FR 8116, 28 FR 11270].

1968 - Provisional Certificate

In 1968, the FCC authorized issuing a provisional certificate for a broadcast endorsed third phone. The provisional certificate was valid for one year. It was expected that during that period the operator would travel to an FCC field office to take the exam for the broadcast endorsed third. A first phone license holder, who was responsible for the technical operation of the station (the chief operator), had to certify that the operator had been properly trained in the operation of the station [32 FR 13821, 33 FR 913].

1970 - Endorsed Third Operates Almost Any Radio Station if...

In 1970, the FCC proposed authorizing the operation of high power radio transmitters and AM Directional Antenna (DA) stations by operators holding a broadcast endorsed third class license [24 FCC 2d 642]. The inquiry examined the type of training required to operate and maintain a directional antenna. Consideration was given to the possibility of establishing another endorsement on the first phone. This endorsement was required to be the chief operator of a directional station. An exam on directional array theory and operation was required for the endorsement. The inquiry also examined the reduction in required operator oversight due to possible automation of transmitter control and logging. The FCC considered requiring automatic logging if a third class operator was used. Enforcement action against the chief operator of non-compliant stations was also considered.

In 1972, the FCC adopted rules authorizing the operation of high power radio transmitters and non-critical directional arrays by holders of broadcast endorsed third class license holders *if* the station employed at least one first class licensee. (A critical directional array is one with

tolerances specified on station license as tighter than those in Rules.) [35 FCC 2d 290]. These stations were required to designate a chief operator in writing. The FCC EIC was to receive a copy of the designation within three days. The chief operator was to inspect the DA system within two hours after the start of DA operation. Further, DA stations using lesser grade operators were required to make a partial proof of the DA performance each year. The chief operator of an AM DA station and non-directional high power (more than 10 KW) AM or (more than 25 KW) FM stations had to be a full-time employee of the station. One person could not be the chief operator of more than one station in a single service (for example, two AM stations). The rules adopted at this time also required operators to be fully trained in the operation of the station and required that printed step-by-step instructions and parameter limit charts be posted. The rules also required a directional antenna system be fail-safe—the failure of any RF relay to switch would take the station off the air. The chief operator was to review the station logs once a day and sign the log on completion of the review.

Stations that continued to use a first phone for DA operation and lower power non-DA stations that continued to use lesser grade operators, did not need to designate a chief operator or complete a DA partial proof. This rulemaking was one of the Commission's typical trades—requirements were reduced in one area (routine duty operator qualifications), and increased in another (additional requirements regarding chief operator designation). Those stations that did not want to take advantage of the reduced operator requirements did not have to make any changes.

In 1972, the National Association of Broadcasters (NAB) filed a petition seeking several minor changes in the operator requirements [38 FCC 2d 1078]. The FCC denied the request that the DA fail-safe requirement be deleted when lesser grade operators were used. It granted the request that partial proofs be required every three years instead of every year. A skeleton proof was then required every year.

1976 - Overall Review of Operator Licensing

In 1976, the FCC released a Notice of Inquiry (NOI) regarding operator requirements [41 FR 22981]. This NOI considered several questions. Should the service operator requirements of the various radio services be maintained? It had been argued that the FCC tests were not a valid measure of the competence of those who serviced transmitting equipment. Therefore, the license should perhaps not be required.

If the service operator licensing requirement were retained, to what degree should the operator be held responsible for the operation of the station? Generally, the FCC has held the station licensee responsible for the operation of the station, including the hiring of competent technicians. If the FCC's licensing program indeed indicates the competence of the technicians, perhaps the station licensee's only responsibility is hiring an FCC approved technician.

Should holders of the Restricted Radiotelephone Permit be authorized to perform the routine operating duties of broadcast stations? Routine duty operators were required to hold a broadcast endorsed third, which required knowledge of meter readings, power limitations, power determination (direct and indirect methods), DA limits, etc. If the station's chief operator or the station licensee could be held responsible for the hiring and training of routine duty operators, was the FCC's licensing of these operators redundant? At that time, under the Communications Act of 1934, the FCC could not permit the operation of broadcast stations by unlicensed persons, but it was free to determine what class of license was required.

Were the FCC operator license exams producing technically qualified operators? There were many "memorization schools" where someone could learn the test answers to get the first phone. Since many high power or directional stations still required the first phone for routine operation (which kept the station from having to comply with various requirements should lesser grade operators be employed), the first phone increased the employment opportunities of a disk jockey. The graduates of these memorization schools held the same FCC license as those who were competent technicians, making it difficult for station licensees to rely on the FCC license as a measure of technical competency. With these arguments in mind, the Commission pondered the usefulness of the operator license examinations.

Should the FCC consider granting a "beginner" license (similar to a driver's learner's permit) to a person who could pass the written test, but had no experience in the maintenance of broadcast equipment? Once a period of service had been completed, a full license could be granted. Such an experience requirement exists for the First Class Radiotelegraph license.

Should the FCC establish a series of endorsements for the operator licenses and appropriate exams? These endorsements might cover directional antenna systems, television, etc.

Finally, the Commission asked if operator licenses should be granted for the lifetime of the holder, or continue to be periodically renewed? If they should be renewed, what purpose does the renewal serve? Should an examination be required on renewal? Should they randomly conduct re-examinations? Should a service record substitute for a re-examination?

With all these questions, the NOI resulted in more than 500 responses. The responses are discussed in a NPRM released August 4, 1977 [66 FCC 2d 100, 42 FR 40939]. The NPRM proposed establishing two series of non-radiotelegraph operator licenses—the Technician and Routine Operator Series. These proposed rules were never adopted. The Commission also proposed authorized operation of all AM and FM transmitters by holders of Restricted Radiotelephone Operator Permits, instead of the then required broadcast endorsed third.

1977 - RP's Operate Most Radio Stations

In November 1977, the FCC contracted with the Georgia Institute of Technology to study broadcast service regulation, including operator licensing. That report, along with the majority of comments on the above NPRM, suggested reducing the operator requirements for routine operation of most AM and FM stations (except those AMs with critical arrays) from the broadcast endorsed third to the restricted permit. The FCC adopted this proposal in December 1978 [70 FCC 2d 2371, 44 FR 1733]. It also stopped issuing the broadcast endorsed third and the provisional certificate. The FCC cited its experience with the provisional as justification for dropping the broadcast endorsed third. It found no more violations with operators utilizing the provisional certificate (which required no examination, but required operator certification by the station chief operator) than with broadcast endorsed thirds, who had passed the FCC exams.

1979 - RPs Can Operate All Stations

In November 1979, the FCC again amended the operator requirements [44 FR 66816], permitting the operation of critical AM directional antenna systems and TV stations by Restricted Permit (RP) holders. TV, directional AM, high power AM or high power FM stations using lesser grade operators were required to have a designated chief operator. Lower power non-directional AM and FM stations still did not need to designate a chief operator if they used RP operators. Further, stations not electing to use lesser grade operators were not required to designate a chief operator.

1980 - Third Phone Discontinued

In 1980, the FCC found that many broadcast transmitter operators were still taking the exam for the third class radiotelephone license—even though it did not grant any more broadcast transmitter operating authority than the RP, for which no exam was required. This resulted in a significant workload for the Commission staff, with no public benefit. 53,000 third class licenses were issued each year, yet only 2% of the operators needed the license to operate the transmitter they intended to operate (typically marine radio). For this reason, the FCC discontinued the third class radiotelephone license. A similar license was still needed by international agreement for marine radio operation, so the Marine Radio Operator Permit was established. To keep broadcast operators from continuing to pursue this permit, the Marine Radio Operator Permit did not allow the operation of broadcast transmitters [45 FR 52154].

Also in 1980, the FCC dropped the requirement that the FCC EIC be notified of the designation of a chief operator [77 FCC 2d 251].

1981 - Chief Operator Does Not Need First Phone

In 1981, the FCC finally finished its review of the broadcast station operator requirements [FCC 81-266, 87 FCC 2d 44, 46 FR 35450]. In the final R&O, the requirement that transmitter maintenance technicians hold any license above a restricted permit was eliminated. Prior to this point, directional AM stations, TV stations, high power AM or FM stations were required to

designate a chief operator in writing, *if* the station elected to use lesser grade (less than first class radiotelephone) operators for routine transmitter operation. The chief operator was required to have a first phone. With this action, *all* AM, FM and TV stations were required to designate a chief operator in writing. The chief operator could hold any class of license (other than a Marine Radio Operator Permit). The chief operator was responsible for operator training, review of logs and various inspections.

In making these changes, the FCC concluded that the written examination for the first class radiotelephone license was not a good method for evaluating the qualifications of a broadcast equipment maintenance technician. Most of the commenters on the proceeding agreed with this idea. The FCC then concluded that a written exam would not be a good evaluation, and they were not in a position to offer a "hands-on" exam. While qualifying experience was probably the best training for a technician, the FCC decided against re-establishing the service record on a license (which had been suspended in 1952). The service record duplicated data readily obtained from an applicant's resume.

Various groups petitioned the FCC to reconsider the decision to allow the chief operator to hold a restricted permit. They also petitioned for clarification of the chief operator responsibilities [90 FCC 2d 735]. The FCC replied that the requests provided no new information, so reconsideration was denied. The FCC did, however, modify the responsibilities of the chief operator [47 CFR 73.1870(c)]. Previously, the rule had listed specific duties of the chief operator (required inspections, log entries, etc.). The FCC agreed that this put an unnecessary restriction on labor division at individual stations. The section was modified to allow the chief operator to delegate specific duties, but retain sufficient oversight to insure each requirement was properly completed.

In 1984, the FCC extended the authority of the restricted permit holder to several other radio services, including the broadcast auxiliary services [96 FCC 2d 1123]. In this proceeding, the National Association of Radio and Telecommunications Engineers (NARTE) suggested the FCC certify industry groups that certify technicians. The FCC decided, however, to limit its

actions in technician certification to a "vigorous overall endorsement of such a certification program or programs."

1992 - Section 318 Revisited

In 1992, as part of the reauthorization of the National Telecommunications and Information Administration, Congress amended Section 318 of the Communications Act of 1934. The amendment removed the prohibition on the FCC waiving the licensed operator requirement for broadcast transmitters. With this amendment, the FCC was free to allow operation of broadcast transmitters by unlicensed operators, or operation of broadcast transmitters without an operator present.

1995 - FCC Drops Licensed Operator Requirements

On November 10, 1994, the FCC proposed eliminating the requirement that broadcast stations have a licensed operator (FCC 94-130, MM Docket 94-130). Since Congress had amended the Communications Act in 1992 to allow the FCC to waive the licensed operator requirement for broadcast stations, the FCC proposed allowing the use of unlicensed operators and proposed allowing stations to run without an operator present. The rules were adopted October 2, 1995, and became effective December 1, 1995 (FCC 95-412, MM Docket 94-130). No changes are required in station operation to use unlicensed transmitter operators. Various considerations must be made before starting unattended operation. These considerations are the subject of this book.

Transmitter Control

1950 - Remote Control of Class D NCE-FM Stations

Prior to 1950, broadcast stations were required to have a licensed operator *at the transmitter site* monitoring the operation of the transmitter. In 1950, the FCC proposed authorizing remote control of class D NCE-FM stations (transmitter output powers of 10 watts

and under) [15 FR 6789]. The origin of recent remote control rules can be seen in this proposal. Control circuit faults were not to activate the transmitter, and any fault causing loss of on/off control would shut down the transmitter. No telemetry was specified, though stations needed to monitor the demodulated radiated RF at the control point.

Since all comments were in favor of adopting rules authorizing remote control of class D NCE-FM stations, the rules were adopted. These stations were required to have a modulation percentage indicator at the control point, or a suitable program level meter from which modulation could can be determined [15 FR 9189].

1952 - Remote Control of 10 KW Nondirectional Radio Stations

In 1952, as part of a NPRM in response to a petition by the National Association of Radio and Television Broadcasters (NARTB) regarding reduced operator licensing requirements, the FCC discussed the possibility of remote control of non-directional AM stations and FM stations (both 10 KW and below). They discussed the complicating factor of emergency frequency changes to comply with Conelrad requirements [17 FR 5435].

In 1953, the FCC reduced operator requirements for routine operation of non-directional AM and FM stations (with powers of 10 KW or less) to restricted radiotelephone permits and permitted the remote control operation of such stations [18 FR 726]. This rulemaking added Section 3.66 permitting remote control operation of non-directional standard (AM) broadcast stations (of 10 KW or less). The new rules required only that control and transmitter sites be secure against operation by anyone other than those authorized by the station licensee. Control circuitry was to provide positive on and off control. Line faults would not activate the transmitter. Line faults causing loss of control would shut down the transmitter. Control and monitoring equipment was installed to allow operators to perform all functions required (*e.g.*, sufficient metering to comply with logging requirements). Similar rule sections were added for FM stations (Section 3.274) and NCE-FM stations (Section 3.572).

In July 1953, the broadcast station rules were published in the *Federal Register* [18 FR 3834]. The rules required operating log entries to include the final plate voltage and current,

frequency monitor reading and crystal oven temperature reading (if thermometer used). Section 3.281(b) required plate voltage and current, transmission line meter reading and frequency monitor reading for FM station logs. No required remote metering accuracy was given.

Note that throughout the history of broadcast station remote control, no specific parameters were ever listed that required remote metering. Instead, it was very clear which parameters required monitoring, since operators made frequent (every 30 minutes then, every 3 hours later) operating log entries, and the rules *did* specify which parameters needed to be logged. When the operating log requirement eventually was dropped, so were the specifications for remote metering parameters.

1957 - Remote Control of High Power and Directional Radio Stations

In 1956, responding to a petition from the NARTB, the FCC proposed authorizing remote control operation of radio (not television) stations above 10 KW and those with directional antennae. The NARTB proposal suggested that all stations (above 10 KW) that operate by remote control, have the capability of changing from their normal operating frequency to the Conelrad frequency from the remote control point. NARTB further proposed that DA stations have remote indications of base currents and common point current, and that these indications be logged hourly [21 FR 2534].

After extending the comment deadline several times, the FCC authorized the remote control of high power and directional radio stations in 1957 [21 FR 3438, 21 FR 4893, 21 FR 6495, 22 FR 7682]. Stations applying for remote control authorization were to submit an analysis of both the operation and maintenance logs indicating the transmitter and DA stability and reliability were sufficient to not require constant on-site supervision. DA stations were also to file a partial proof demonstrating proper operation. Stations over 10 KW or DA had to be able to change to the Conelrad frequency from the remote control point, and transmit on the Conelrad frequency with at least 5 KW or 50% of the normally authorized power (whichever was less). Some DA stations authorized prior to 1940, were previously not required to have an antenna phase monitor. They were required to install one to allow the required DA stability measurements

prior to applying for remote control. DA stations needed to complete a skeleton proof every year. These stations were also required to log base currents every half hour (at the remote control point) and log the common point current, base currents and antenna monitor readings within two hours of beginning operation with that pattern once each day (at the transmitter site). Modulation was to be continuously monitored at the control point or an automatic device installed to limit modulation on negative peaks to 100%.

In 1958, the FCC got rid of the 5 KW or 50% requirement on remotely activated Conelrad operation [23 FR 2925]. Instead, stations were only required to transmit with the power required by the Conelrad Field Supervisor. On a petition by International Brotherhood of Electrical Workers, the rules were stayed in 1959, since the FCC did not follow proper administrative procedure [24 FR 6264]. The FCC resubmitted the proposal later in 1959 [24 FR 6266]. The rules were finally re-adopted in 1960 [24 FR 7386, 25 FR 14].

1961 - Remote Control of UHF-TV Stations Proposed

In 1961, along with other measures aimed at improving the competitiveness of UHF-TV stations, the FCC proposed allowing remote control of UHF-TV transmitters. The remote control operation would require standard fail-safe on/off control of the transmitter, a means of determining the input power to the final amplifier, and a means to compensate for variations in line voltage. The control point would be required to have a video waveform monitor and an aural modulation monitor [26 FR 7282].

1962 - Radio Station Automatic Logging

In 1962, in response to a petition by the NAB, the FCC proposed authorizing the use of automatic logging equipment to make required log entries in the operating log. This NPRM also restructured logs into program, operating, and maintenance logs. Operating logs were to include plate voltage and current, antenna or common point current, and frequency monitor indications for AM stations. Where remote operation of directional AMs was authorized, antenna monitor and base current readings were required to be logged within two hours of commencement of

directional operation. Similar requirements were proposed for FM and NCE-FM (substitute transmission line meter for antenna or common point current). Operating log entries were required every half hour [27 FR 5614].

In 1963, the FCC adopted rules permitting the use of automatic logging equipment [28 FR 1872, 28 FR 2281, 28 FR 3205, 28 FR 4793, 28 FR 6270]. The rules assumed the use of chart recorders with scales of not less than 2 inches. Since logs generated by the automatic logging system were viewed only periodically, systems were required to have alarm circuits that indicated out of tolerance operation. Alarm circuits were to check parameters at least every 10 minutes. These rule changes applied to AM, FM and NCE- FM stations.

The new rules authorizing automatic logging brought several petitions for reconsideration. In July 1963, the FCC resolved the problems by clarifying that alarm circuits were to check each parameter limited by the rules or the station license at least every ten minutes. Further, logging of antenna current could be done *with* modulation *if* the indication was not affected by modulation. Finally, due to a large number of rule violations noted by the FCC, a five day a week transmitter inspection was instituted [28 FR 7378].

1963 - Remote Control of UHF-TV Stations Adopted

In 1963, the FCC adopted rules to increase the use of UHF television [28 FR 3394]. This rulemaking added Section 3.676, allowing remote control of UHF-TV transmitters. It required circuitry to turn the transmitter on and off, determine the aural and visual output power, adjust to compensate for variations in line voltage, and make any other necessary adjustments to comply with the technical requirements of the rules. It also required a visual waveform monitor and aural modulation monitor at the control point. Control circuit faults were not to activate the transmitter. Faults causing loss of control would shut down transmitter. The transmitter and control point were protected against unauthorized personnel. Metering accuracy was checked as often as necessary, and at least once a week, until it could be demonstrated to the FCC that less frequent checks were required.

1965 - Remote Control of VHF-TV Stations Proposed

In 1965, in response to a petition filed by the NAB, the FCC proposed authorizing remote control of VHF television stations [30 FR 12419]. The requirements were basically the same as those on UHF stations, but in addition, they required a device that would automatically shut down the transmitter on detection of out-of-band emissions. Alternately, stations could employ a detector at the control point to detect emissions. It had to be checked at least every three hours. The FCC argued that the spectrum surrounding VHF-TV stations was densely populated, especially by safety radio users. UHF stations were not in such densely populated spectrum. The proposed rules permitted the use of an aural subcarrier for telemetry return. The aural subcarrier was between 20 and 25 KHz.

In 1966, acting on another NAB petition, the FCC proposed deleting the requirement of showing proper operation of a radio transmitter above 10 KW for a one year period before remote control was authorized [31 FR 14883]. NAB suggested that a reliability test be included as part of the transmitter type acceptance procedure; the FCC thought it was not necessary. However, the FCC proposed retaining the stability showing before authorizing remote control operation of directional antennae.

In 1967, in response to a petition from ABC, the FCC proposed authorizing digital indicating instruments (on transmitters and monitors). These instruments were required to have at least 3 digit resolution, except antenna monitors which would require four digits (indicating phase to 0.1 degree). The required accuracy was 2% of the reading. Displays were to include a decimal point indication [32 FR 5564].

1967 - Remote Control of VHF-TV Stations Rejected

In 1967, the FCC denied the NAB petition for remote control of VHF-TV stations. The FCC expressed concern that remote operation would only provide a bare minimum of parameter monitoring and control, quite possibly resulting in problems going undetected, or those detected could not be corrected by remote control. Uncorrected problems could cause interference to the many other users of VHF spectrum. Due to remote location of many TV transmitters, stations

operating by remote control would suffer long periods of down time while waiting for an operator to arrive at the transmitter site to correct the problems. Continued remote control of UHF-TV stations was authorized as an economic benefit to UHF stations, and because of limited interference capability of UHF stations (uncrowded spectrum that is allocated exclusively to broadcast) [31 FR 2555, 32 FR 3566].

1967 - AM Subaudible Metering Proposed

In 1967, in response to a petition from Moseley Associates, the FCC proposed the use of subaudible metering on AM broadcast transmitters. Stations would be allowed to modulate the carrier with tones not exceeding 36 Hz to send transmitter telemetry data. The tone modulation could not exceed 10%. Precautions were to be taken against overmodulation and degradation of the program audio. The FCC pointed out that over the years, proposals to use an AM broadcast carrier to transmit secondary signals unrelated to broadcasting had been rejected [32 FR 16054].

1969 - Remote Control of VHF-TV Stations Proposed (again)

In 1969, in response to a NAB petition, the FCC proposed authorizing remote control of VHF-TV stations [34 FR 1061]. Stations were required to simulate remote control for a period of six months. During this time, a licensed operator at the transmitter site would insure everything operated properly, while a trained (but unlicensed) operator would do the required logging and control at the remote control point. After this period, an application demonstrating proper operation of system was submitted. The application documented whenever remote and local indications differed by more than 2%. Fail-safe requirements were expanded to require that line noise (as opposed to line faults) would not activate the transmitter. Loss of essential telemetry also caused transmitter shutdown. The proposed rules required transmitter site and remote control calibration and inspection five days per week. If the duty operator was employed for other duties that diverted their attention from remote control, the remote control had to include alarm circuits to insure prompt attention to deviations.

1969 - Remote Reading Antenna Monitors Proposed

Also in 1969, in response to a NAB petition, the FCC proposed modifying the rules to permit stations operating by remote control to log antenna monitor indications at the remote control point, provided the monitor was type approved for remote operation. In such a case, the then required antenna monitor and base current logging (within two hours after commencement of operation with each pattern) was reduced to a once a day transmitter site inspection, with no more than 48 hours between successive inspections of the same DA pattern. In a related rulemaking, the FCC proposed the type approval of antenna monitors and set limits on indicated phase. Previous rules required maintenance of base current ratios to within 5% of licensed. These proposed rules required phase monitors to be accurate to 1 degree and required stations to maintain indicated phase to within 2 degrees [34 FR 3854].

1969 - AM Subaudible Metering Adopted

With a rather extensive investigation into possible interference to programming, the FCC adopted rules permitting the use of subaudible tones for telemetry by AM stations. Tones were limited to 6% modulation and no higher than 30 Hz, and were present only while readings were being observed or logged. The addition of the tone could not cause overmodulation, interference to other stations or interference to programming. One comment filed suggested the use of frequency shift keying of the AM carrier, allowing interference-free performance at higher data rates. The FCC did not want to further delay this rulemaking, so it was not considered [32 FR 20882, 33 FR 2452, 33 FR 5422, 33 FR 8395, 33 FR 13034, 34 FR 17874].

1971 - Remote Control of VHF-TV Authorized

In 1971, the FCC authorized remote control for VHF television stations. It also required existing remote controlled UHF stations to meet new rule requirements within one year. The new rules were similar to those in other services, but quite a bit more stringent.

As in other services, remote control had to provide a means to turn the transmitter on and off at will. Faults in the communications circuit must not activate the transmitter. Faults causing loss of control must shut the transmitter down (control fail-safe).

Although not specified for other services, it had been common practice to use indicators that read the actual value of the parameter or a decimal multiple. (This use of digital displays without decimal points is specifically allowed in the new rules.) Tabulations of the multiplying factors on all required parameters (those required to be remoted, since they must be routinely logged) were required to be posted at the control point, and, if automatic logging was used, printed on the log at least once each day.

A "telemetry fail-safe" requirement unique to television was imposed. It required an automatic transmitter shutdown (without operator intervention) on the loss of any required telemetry. The loss was not defined, but some remote control manufacturers provided equipment at the transmitter site that would activate the timer on a signal from the studio, indicating there was a general telemetry failure (return circuit loss). It would also start the timer if any of the required sample voltages were below some minimum value. Telemetry failures could include a sample voltage going too high, or just inaccurately reflecting the measured parameter, but this was generally not considered. In addition, stations had to provide a means to turn the transmitter on, since when it was off, most telemetry values were zero, which would be interpreted as a failure, which would turn off the transmitter.

Television stations were required to provide various off-air monitors at the control point. These included an aural modulation monitor, a waveform monitor, and, if transmitting in color, a vectorscope. The waveform monitor needed a full field display capability, as well as the capability of displaying selected lines, allowing the display of vertical interval test signals (VITS).

Stations were also required to insert VITS in the video leaving the studio, though the specifications for the test signals had not been determined, so this portion of the requirements was delayed.

Stations were required to conduct inspections of the transmitter site five days per week. Stations with standby equipment that allowed continued transmission at 20% or more of the normal power (standby transmitters), could reduce the required inspections to once per week.

Television stations were authorized to add a single aural subcarrier for the transmission of telemetry. This subcarrier could not cause observable degradation of the visual or aural signal, was limited to 10% injection, and was to be between 20 and 50 KHz (instantaneous frequency) [34 FR 5607, 34 FR 7823 ,35 FR 2998, 36 FR 5499].

The FCC continued to seek comment on the required (but suspended) VITS [36 FR 5521, 36 FR 8382]. Finally, in August 1971, the FCC adopted the EIA proposed VITS for remote control of TV stations. These signals were transmitted continuously on fields 1 and 2, lines 18 and 19. A monitor displaying these signals was continuously available to the operator. Results of these observations were logged every half hour (along with other transmitter parameters). Since the equipment was not yet available, the effective date was set at April 1, 1972. Further, since the test signals were specified in IRE units, the FCC included an explanation of IRE units in the rules [36 FR 17426].

1971 - Old Rules for UHF-TV Remote Extended, VITS Questioned

In December 1971, the FCC authorized noncommercial remote controlled UHF stations to continue the once per week transmitter site inspection until April 30, 1974. Other existing remote UHFs were allowed to continue the once per week inspection until April 30, 1971 (later extended to October 1, 1972) [37 FR 6402]. By these dates, all remote controlled television stations (VHFs had to comply prior to going remote) had to either have standby equipment that allowed continued operation at 20% power or greater on failure of the main transmitter, or conduct a five day per week transmitter site inspection.

NBC requested the order establishing VITS test signal be vacated, since the text of the proposed rules had not been published for comment. The FCC pointed out, however, that rules were based on comments supplied by the Electronic Industries Association (EIA), which were available for reply comments. No one filed any reply comments. NBC's request was denied.

CBS suggested that mandatory transmission, monitoring and logging of the composite VITS signal was not reasonable, since there were no parameter tolerances specified by the rules for the video characteristics measured by VITS. The FCC retained the requirements.

Various petitioners questioned various aspects of the VITS signal. The FCC made no changes [36 FR 23908, 36 FR 25413].

1972 - Logging and Inspection Frequencies Reduced

In response to comments on its comprehensive review of broadcast regulations, the FCC reduced the every half hour logging of transmitter meter readings to at least once every three hours, and at the beginning of each mode of operation. In addition, the five day a week radio (not television) transmitter site inspection was reduced to once per week [37 FR 23725].

1973 - Logging of Remote Antenna Monitor Indications Authorized

After years of review, the FCC authorized AM directional stations to log remote antenna monitor indications, as opposed to remote base current indications [34 FR 6397, 34 FR 9395, 38 FR 2430, 38 FR 3983, 39 FR 5251].

1974 - Vertical Interval Reference Signal Proposed

In response to an EIA petition, the FCC proposed allocating line 19 (or perhaps line 20) of the vertical interval for the exclusive use of Vertical Interval Reference Signal (VIRS). VIRS differs from the VITS signal required by the FCC (lines 18 and 19 at this point) for remoted TV stations, in that VITS are inserted at the station studio, while VIRS are inserted when the program source is first encoded to NTSC video (during production). The FCC may move VITS to lines 17 and 18, or put VIRS on line 20 [39 FR 828].

Later that year, the FCC did move VITS to lines 17 and 18, leaving room for VIRS on line 19. Stations were required to make the VITS changes by November 15, 1975 [39 FR 40956].

1974 - Extension Metering Adopted

In 1974, the FCC proposed authorizing use of extension meters. Extension meters were to be within 100 feet of the transmitter. Modulation and antenna monitors were to be located at the operator position (extension meter location). Extension meters were to agree with local meters within 2%. Each extension meter was to continuously indicate the sampled parameter (as opposed to standard practice in remote control) [39 FR 1070, 39 FR 3290].

In late 1974, the FCC adopted rules authorizing extension meters. The extension meter location was to be within 100 feet and 1 floor above or below the transmitter, in the same building. Antenna monitors did not need not to be extended, though the lack of such extension required the operator to go to the transmitter and monitor location at least every three hours to complete required log entries. The requirement that TV stations remote visual plate voltage and current meters was deleted, since the stations were not required to log the parameters. The modulation monitor was required to be at the operator (extension meter) position, except that if meter and peak flasher could be extended, they were [39 FR 38653].

1974 - Remote Metering Accuracy Requirement Proposed

In November 1974, the FCC proposed clarifying the remote meter calibration requirements by specifying that the remote meter must agree with the local meter within 2% of reading. At the time, the rules *did* specify an agreement of 2% of reading between remote base or common point ammeters and remote ammeters, but no tolerance was specified for other remote meters. The basic instrument accuracy specification for transmitter meters was 2% of full scale [39 FR 38668].

1974 - VHF-TV Site Inspections Reduced

In December 1974, the FCC finally reduced the transmitter site inspection requirement for VHF-TV stations from five days per week (unless a standby transmitter was present) to once per week. This then matched the requirements on UHF-TV stations [39 FR 42365].

1975 - Remote Meter Accuracy Specified

Prior to this rulemaking, the rules did not specify the degree that remote meters must agree with the local transmitter meters (other than remote antenna ammeters). With this rulemaking, all *required* remote meters had to agree with the local meter within 2% [39 FR 45048, 40 FR 11353]. Note that the rules *still* did not specify which parameters had to be remoted, however, the existing transmitter logging requirements specified various parameters that had to be logged every three hours. Meeting the logging requirement without remoting at least these parameters was impossible. The new rules also specified that remote meters had to be calibrated at least once each calendar week.

1975 - An ATS Inquiry

In 1975, the FCC released a NOI proposing authorization of Automatic Transmission Systems (ATS). The possibility of automatic systems monitoring broadcast transmitters had first been mentioned in 1957. In this NOI, the FCC proposed an ATS monitor critical parameters including power, frequency, and modulation. The system would shut down the transmitter if any of these parameters were outside specified limits. The FCC noted that stations utilizing ATS would still be required to have an operator (since a licensed operator was then required by Section 318 of the Communications Act of 1934). The FCC proposed that stations adopting ATS have the required grade of operator license reduced [40 FR 17317].

1976 - ATS Proposed

In 1976, the FCC proposed ATS. Petitioners had proposed unattended operation of broadcast transmitters, but the FCC noted that this was not permissible under Section 318 of the Communications Act of 1934.

In the FCC's proposal, stations operating with ATS would be required to have a fail-safe on/off control. The system would monitor power, generating an alarm if the power went below 90% or above 105%. If the condition causing the alarm was not corrected within three hours, the

ATS would shut down the station. The ATS would also shut the station down if the power went above 110% or below 80%.

The proposal also called for the ATS to monitor AM antenna resistance or transmitter efficiency. The ATS was to generate an alarm if the resistance or efficiency varied by more than 5%. Systems in FM and TV stations were to determine net power (forward power minus reflected power).

The proposal also called for the ATS to include circuitry that would monitor modulation at the transmitter output. Sustained overmodulation would cause an alarm. Overmodulation that continued for three hours would shut the transmitter down. Sustained modulation below 25% would cause an alarm. Undermodulation that continued for one hour would cause a shutdown.

Stations changing modes at specified times had a clock that was accurate to within one minute and remained accurate through power failures of 48 hours. The clock would shut down the transmitter or make mode changes at specified times. The transmitter had to be turned on manually. The clock would automatically change its settings to accommodate daylight savings time and varying mode change times (based on sunrise and sunset for each month). The ATS in directional stations would alarm if phase indications varied more than three degrees from licensed or sample ratios, or more than 5% from licensed. If this condition remained for one hour, the ATS would shut the transmitter down. If the ATS detected a six degree or 10% deviation, it would shut down the transmitter immediately. Stations using non-approved DA sampling systems were required to monitor both the antenna monitor indications and base currents. Critical directional arrays (tolerances tighter than 3 degrees and 5%) would be authorized to use ATS if the system automatically adjusted the DA system to maintain the specified DA tolerances.

To allow for emergency operation (daytime AM facilities at night), the FCC proposed ATS systems that included an emergency time clock override switch at the ATS alarm and control point. Activation of this switch allowed operation with daytime facilities for one hour. Continued emergency operation required reactivation of the switch.

FM station ATS systems were required to alarm based on stereo pilot injection, subcarrier injection and subcarrier deviation. Automatic shutdown was not required on these parameters.

Television stations were permitted to use ATS if automatic correction circuitry monitoring the VIRS at the transmitter output adjusted the following: transmitter output power, reference white level, blanking level, color burst amplitude, burst phase (relative to VIR), set up, sync amplitude to picture signal ratio, and chrominance to luminance ratio. Automatic shutdown was required on overpower, but only alarms were required on other video parameters.

Stations using ATS were permitted to reduce required transmitter site inspections from weekly to monthly. ATS systems were required to check tower lighting. ATS systems were to monitor all required parameters continuously, except DA parameters, which were checked every 15 minutes [41 FR 15711].

1977 - FCC Adopts ATS

In 1977, the FCC adopted the ATS rules for FM and non-directional AM stations. The requirements were considerably relaxed from those proposed. Required transmitter site inspections were reduced from weekly to monthly. AM ATS systems were required to determine power by monitoring antenna current without the effects of modulation. The ATS would shut down the transmitter if it was unable to adjust the transmitter power to less than 105% after three minutes or three samplings.

An AM ATS was required to adjust modulation down if more than 10 -100% peaks occur within a one minute period or if any +125% peaks occurred. The new rules defined successive modulation peaks within a five millisecond period to be a single peak.

If an AM station had restricted hours (daytime) or mode changes, the ATS had a clock that was accurate within one minute. This clock prevented station operation outside authorized hours (an emergency clock override was authorized). The clock performed the required mode changes. Failure in the clock circuitry (or inaccuracy caused by a power failure) caused ATS operation to be terminated. This could involve a station shutdown or reversion to manual control of the transmitter.

The ATS was to include a means of testing the alarm and shutdown circuitry. It was required to shut down the transmitter if any of various problems—over power, over modulation,

clock failure, failure of the circuit to the alarm/control point, failure of the alarm circuit or loss of an ATS required sample—existed for three minutes.

Similar requirements were adopted for FM and NCE-FM stations [41 FR 21793, 42 FR 1233, 42 FR 3646].

1977 - Automatic EBS?

Collins Radio proposed automatic EBS operation and automatic distortion detection in ATS at FM stations. The FCC replied that it would be considered in a continuing rulemaking [42 FR 54578].

1982 - Required VITS Go Away

In 1981, ABC petitioned for a rule change to authorize the use of the VITS utilized by AT&T for analysis of its video distribution system, instead of the existing VITS requirement for remote controlled TV stations. The FCC proposed deleting the VITS requirement, since marketplace pressures would insure high video quality. The FCC expected stations to utilize appropriate test procedures and signals to insure that quality. The FCC further indicated a desire to not distinguish between locally operated and remotely operated TV transmitters.

In 1982, the VITS requirement on remote controlled TV stations was deleted [46 FR 28681, 47 FR 3789].

1984 - Fail-safe Deleted, Making Dial-up Control Legal

Acting on a petition by George Edward Molnar, Jr., the FCC proposed modifying the remote control rules for AM, FM and TV stations. The petition suggested rules be modified to permit operation for one hour after loss of control and fail-safe circuits. It also suggested the required automatic shutdown of TV transmitters one hour after loss of telemetry be deleted (making it match radio rules). The FCC proposed requiring all remote control points be able to turn the transmitter on and off at all times; include instruments to determine the operating power of the transmitter; and, have a means to adjust power, modulation and any other adjustments

required on a daily basis. The operator at a remote control point would be able to complete required tower light inspections. Each remote control point would have monitoring equipment to monitor the off-air program signal, including SCA and teletext. The operator at the remote control point needed to be able to receive and transmit emergency action notifications, unless that equipment was at a location where other station staff was on duty and could perform these duties. The remote control equipment would include a telemetry loss alarm. Remote meters had to agree with local meters within 2%. The FCC also proposed allowing the use of various dedicated circuits to provide the final transmitter off control. These included STL carrier, program audio, as well as the remote control circuit. Loss of the ability to turn the transmitter off by any means would require the transmitter to automatically shut down within three minutes. Loss of other required control (such as adjustment of operating power) or loss of accurate telemetry would require the transmitter be shut down within three hours [49 FR 8268].

Later in 1984, the FCC adopted new rules allowing continued operation on loss of transmitter control, pending repair, as long as the station continued to operate properly. Loss of telemetry (indicating transmitter parameters cannot be monitored remotely) required a shutdown within three hours after detection of the telemetry failure. Stations could be operated by remote control using any method that assured an operator was on duty, the transmitter system operated properly, and the Commission could contact station personnel during hours of operation. The new rules dropped the fail-safe requirement that an interruption in the control circuit must immediately shut down the transmitter. Control circuit malfunctions still could not cause the transmitter to be activated or change modes [49 FR 47608].

1986 - ATS "How To" Rules Deleted

In 1985, the FCC proposed amending the rules regarding ATS. The proposed rules would delete the detailed how to provisions of the existing rules, and place full responsibility on each licensee to assure compliance with all station operation requirements. Unattended operation was still not permitted, since Section 318 of the Communications Act of 1934 still required a licensed operator be in control of broadcast transmitters. The proposed rules extended ATS authority to

directional AM stations and TV stations. They specified that each of the ATS duty operator duty points must have a means to turn off the transmitter at all times (similar to the old fail-safe requirement of remote control). ATS was required to shut down the transmitter if the control circuitry could not correct overpower, mode change failure, or out of tolerance antenna monitor indications within three minutes [50 FR 13838].

In 1986, the FCC amended the ATS rules and authorized ATS for all broadcast stations. In its comments, ABC requested that ATS not be required to automatically adjust directional arrays. The FCC agreed and did not include the requirement in the rules. The NAB requested the three minute shutdown on detection of an interference causing condition be extended to 30 minutes to allow an operator to take corrective action. The FCC retained the three minute shutdown requirement, since ATS was intended to make the required adjustment without operator intervention, and because thirty minutes of interference was excessive. The adopted rules required that the ATS control point have a means of shutting down the transmitter at all times. The transmitter had to be manually activated at the beginning of each broadcast period (to insure an operator was on duty) [51 FR 1374].

1988 - Remote Control Rules Clarified

In 1988, the FCC issued a policy statement regarding remote control of broadcast transmitters in an effort to reduce or eliminate misinterpretation of the rules during the design of transmitter remote control systems (particularly those which utilized dial-up telephone circuits). The FCC did not specify what parameters had to be adjusted or monitored by remote control systems, since they vary from station to station. The remote control and monitoring capability had to be "appropriate to the particular circumstances." Dial-up circuits, dedicated circuits, RPU, microwave and other circuits were acceptable for metering, adjustments and control of broadcast station operations.

Station personnel could obtain technical data and adjust the transmitter from any location, but there had to be a designated operator at a fixed control point.

When dial-up telephone circuits were used, the station had to ensure the dial-up circuit was available for the exclusive use of the duty operator at all times. The station also had to provide a means for the duty operator to interrupt or preempt any other telephone access to the remote control, or provide some independent means for the duty operator to turn the transmitter off. Possible methods included interruptions to program audio, a second dial-up circuit, STL and other circuits.

The duty operator had to be in control of the transmitter at all times and the station had to be able to meet its EBS responsibilities without delay.

Use of portable telephones or paging receivers did not excuse the station from having a duty operator continually present at the fixed remote control point to have a positive means to interrogate the transmitter, turn the transmitter off, and carry out EBS functions.

Automatic alarms (though not required for remote control) of conditions that might cause interference were directed to the duty operator first. If a corrective response was not received by the remote control from the duty operator within five minutes, the remote control turned the transmitter off automatically. This was a new requirement that is not in the existing remote control rules. The five minute requirement also differs from the three minute requirement in the ATS rules.

Stations had three hours to restore monitoring of operating parameters if such monitoring failed. If this could not be accomplished, the station had to resort to local control or shut down. The station had to shut down upon operating in an interference causing condition. Loss of various control functions was permissible as long as the station could always be shut down by the duty operator.

The duty operator or other station staff had to monitor the EBS receiver. They also had the capability of activating the EBS encoder and broadcasting EBS tests and emergency action announcements [53 FR 37762].

1990 - More Changes Coming?

The FCC semiannual regulatory agenda included *Item 4013: FCC Proposes Clarifying Remote Control Rules.* Discussions with FCC staff indicated that the change would have authorized control and metering equipment to be within 100 feet of the operator, and not require it to be visible to the operator from his duty position. This would have eliminated the need for extension metering and makes remote control and transmitter location more flexible. An NPRM was scheduled for June 1990, but it was never released [55 FR 17080].

1995 - FCC Drops Licensed Operator Requirements

November 10, 1994, the FCC proposed eliminating the requirement that broadcast stations have a licensed operator (FCC 94-130, MM Docket 94-130). Since Congress had amended the Communications Act in 1992 to allow the FCC to waive the licensed operator requirement for broadcast stations, the FCC proposed allowing the use of unlicensed operators and allowing stations to run without an operator present. These rules were adopted October 2, 1995 and became effective December 1, 1995 (FCC 95-412, MM Docket 94-130). Remote control rules existed only because the Communications Act *required* broadcast stations to have a licensed operator in charge of the transmitter. If no licensed operator (or no operator at all) is required, is remote control required? Does *remote control* make sense if there is not an operator at a remote control point? Should an automatic control system replace the operator, monitoring the transmitter, adjusting it, and shutting it down should an interference causing condition exist? Or, is equipment stability sufficient to not require supervisory equipment? These questions were raised in the rulemaking and are discussed in this book.

Deregulatory Trend

Since World War II, the FCC has tended to shift the responsibility for insuring a broadcast station employ qualified operators from the FCC itself to the station licensees. The FCC decided that its written tests were not a good measure of technician competence. Further, varying levels of competence were required for the operation and maintenance of the various types of broadcast

stations. The exam for the first phone included information that was not required for the operation of a typical station. However, the exam did not include enough information for the repair and maintenance of the more complex directional or television stations. The FCC accepted the argument of Representative Griffin of New York against the licensing of radio operators in the Radio Act of 1927 [67 Cong.Rec. 5573 (1926)].

> *Why should an operator be required to procure a license? We have locomotive engineers running great trains all over the country; trackwalkers, signalmen, and other employees engaged in great undertakings, where human life is at stake and where there is great responsibility, who are not required to submit to this license nuisance. I ask the gentleman proposing this bill: 'What is the earthly reason for requiring the licensing of an operator at a broadcasting station' Do you not suppose that the employer of that operator knows whether he is efficient or not? Is it not his duty and his obligation to look after the character of the men he employs and whether or not they are efficient? Why should the United States Government assume this responsibility and undertake to establish a bureau, with numerous clerks, filing cases, and an elaborate mechanism, in order to provide help for the operating stations all over the United States? The next logical thing in order, with this precedent established, will be to require Federal licenses for telephone and telegraph operators. It would surely be just as reasonable. This whole section and all of these paragraphs ought to be eliminated from the bill. Let the people who control the stations select their own operators and use their own judgment.*

The 1927 Radio Act did require operator licensing, but the requirements necessary to obtain the appropriate operator license were not detailed. This continued into the Communications Act of 1934. Until 1995, the FCC had reduced the requirements for an operator license for a broadcast station to a certification that the operator is eligible for employment in the United States, can speak and hear, can keep a written log, and is familiar with the provisions of the treaties, laws, rules and regulations that govern the station to be operated [47 CFR 13.22(c)]. These regulations were more of an operator "registration" system than a "licensing" system. Since they provided little value in insuring the competency of broadcast station operators, Congress authorized the FCC to waive the licensed operator requirement, and the FCC adopted the appropriate rules. Congressman Griffin's ideas were finally accepted 70 years later!