FCC and EMC: ORIGIN AND DEVELOPMENT OF THE EQUIPMENT AUTHORIZATION PROGRAM

History

At its beginning in 1934, the FCC expected to continue the policy adopted by its predecessors: that all uses of RF devices for non-communications purposes should be covered by license as if the operation were that of a radio station. This view soon became impracticable. Industrial and individual use of RF devices was continually increasing, and uncontrolled emissions were causing many instances of interference to essential communications. In the 1930s, technical standards even for transmitters were indefinite ("... good engineering practice") and none existed for other RF devices.

In 1938, acting on a Petition for Rulemaking, the FCC adopted Part 15 of its rules. Part 15 permitted operation of low-power communication devices without a license, if the radiation from the device did not exceed 15 microvolts per meter at a distance of lambda/2 pi (approx. 1/6 wavelength). This reasonable distance protected others from radiation from the proposed devices, which were operating in the AM broadcast band.

The FCC Laboratory, a division of the Office of the Chief Engineer, was established in 1946 to conduct research in technical areas of interest to the Commission, and to make tests on medical diathermies and other devices submitted for type approval under Part 18.

In 1947, after a Notice of Proposed Rulemaking (NPRM), the FCC adopted Part 18 of its rules, which permitted the unlicensed operation of industrial, scientific, and medical RF devices if the devices complied with technical standards limiting radiation to certain levels. These rules provided for operation within certain frequency bands. They did not limit in-band radiation, but strictly limited out-of-band radiation. Out-of-band operation was also permitted, providing the radiation on the fundamental frequency as well as harmonic and spurious frequencies complied with specified limits. Devices operating in the bands could be type approved after testing by the FCC; others were required to be certified after measurements were taken at the user's installation.

In the 1950s, the FCC adopted rules requiring type acceptance of most kinds of transmitters. Technical standards specified maximum levels for harmonic and spurious emissions and limitations on occupied bandwidth, frequency instability, etc. Except for certain marine equipment, for which treaty or law specified performance standards, these specifications were aimed at assuring that the transmitter's operation would not adversely affect use of the spectrum on other frequencies.

At about the same time, Part 15 was extended to provide for certification of VHF/UHF receivers, with a technical standard setting limitations on both radiation and line-conducted emissions. This change was mainly due to the large number of instances of interference to safety communications caused by emissions from such receivers. In the period 1955 to 1968, both Part 15 and Part 18 were amended to include additional kinds of equipment.

Until 1968, responsibility for compliance with these rules lay upon the user; the marketer could comply or not as he chose. In 1968, the Communications Act was amended to authorize the FCC to regulate the manufacture, importation, and marketing of equipment subject to its rules. Rule changes were adopted in 1972 which placed the responsibility for compliance on the marketer, and made issuance of an equipment authorization a prerequisite to the lawful marketing of devices.

Present Scope of Program

The FCC now regulates nearly 100 kinds of equipment. Specific requirements and technical standards cover nearly all kinds of transmitters, VHF/UHF and CB receivers, diathermies, induction and dielectric heaters and other industrial RF devices, medical and industrial ultrasonic equipment, domestic and industrial microwave ovens, domestic induction heaters, broadcast monitors, marine emergency communication equipment, cordless telephones, and personal and commercial digital computing devices. More than 80% of the total number is estimated to be in consumer use.

Equipment authorization categories are:

- Type Approval
- Type Acceptance
- Certification
- Registration
- Advance Approval of Pay TV Systems
- Verification
- Notification (proposed)

Type approval requires an application to the FCC. Tests on a sample are performed by the Authorization & Standards Division, formerly the Laurel Laboratory, after which a grant of type approval is issued by the FCC. Type Acceptance, Certification, Registration and Advance Approval of Pay TV Systems each requires an application, plus test data, on the device. A grant is then issued by the FCC. Verification now applies only to commercial and certain other computing devices. In this procedure the marketer is required to make tests and retain test results and device technical data on file, but neither an application to the FCC nor a grant is

required. The proposed Notification procedure would entail an application to the FCC without technical data, and issuance of a grant by the FCC. For any of these categories, the FCC may at its discretion require submission of additional samples for testing, either before or after marketing of the equipment.

For transmitters, the technical standards now are based primarily on requirements set by treaties to which the US is signatory. Most of the regulations on other RF devices were set many yeas ago, and were based, in part, on a practicable level of emissions supression from the type of equipment, rather than on the basis of tolerable levels of interference vs. frequency, as in many VDE regulations. In recent rulemakings, there is a trend toward acceptance of VDE or CISPR limits, in the interest of more widespread market acceptability of equipment. This approach was followed in the recent rulemaking which brought computers and other digital devices under regulation. The limits on both radiated and line-conducted emissions from computers are near the levels established by VDE for consumer and commercial devices.

Pending Rulemakings and Prospective Changes in the Program

A general revision of Part 15 was proposed in a NPRM released under Docket 20780 in 1976. This proposal provided specific regulations and technical standards for several kinds of equipment (computing devices, RF power supplies, carrier current systems, campus radio stations, etc.) previously subject only to the general provision for compliance with the limitation of Section 15.7 (radiation not to exceed $15\mu V/m$ @ $\lambda/2\pi$). A First Report and Order (R&O), covering computing devices only, was released in 1979 because of the number of interference cases due to the use of computers, and the expected increased use of these devices. Action on other parts of the 20780 rulemaking is not expected in the immediate future. Because opinions held that there were no nationally accepted test methods for evaluating a computer's interference potential, the FCC under General Docket 80-284 adopted test methods as Appendix A to Part 15 of the rules. Petitions for partial reconsideration of these test methods have not yet been acted upon by the FCC.

A general revision of Part 18 was proposed in the NPRM released under Docket 20718 in 1978. This proposed a new category termed "ISM Registration," applying to large ISM devices that could only be tested after assembly on premises of use, and requiring a certification before marketing of all other Part 18 devices. This proposal is still pending. It is expected that a Report and Order (R&O) will be on the agenda for FCC action next year.

In 1981, the FCC adopted an R&O in Docket 20990 which amended Part 15 with respect to rules pertaining to low-power transmitters used for radio control and security alarm purposes. These rules were revised in 1982 after petitions for reconsideration of the 1981 action.

On October 4, 1982, acting upon a Petition for Waiver (of Section 15.7), the FCC adopted an Order Granting Conditional Waiver, which permits operation of the base station part of cordless telephones as carrier current devices, providing the RF currents introduced into the associated power and telephone lines do not exceed certain limits. This is an interim measure, since this part of the system operates in the range of 1.6-1.8 MHz, which may be opened to AM broadcasting after ratification of the treaty recommended by the 1979 World Administrative Radio Conference. If this occurs, these telephones will have to be relocated to some other part of the spectrum.

The 1982 Congress enacted Public Law 97-259, which amended the Communications Act of 1934 in several respects. This will have an effect on the equipment program because it authorizes the FCC to require a minimum shielding and filtering capability for "home electronic equipment and systems," in order to provide immunity from the effects of ambient RF energy. The Committee Report on this measure makes it clear that it was the intent of Congress not to limit this only to TV or AM/FM receivers, but to include the gamut of electronic devices used by consumers in the home and elsewhere. It did indicate that the FCC should attempt to obtain compliance on a voluntary basis before setting specific standards as part of the equipment authorization program. As a first step, the FCC will probably issue a Notice of Inquiry (NOI) to elicit opinion as to the kinds of equipment to be covered, the strength of signal(s), etc. to be specified in a technical standard, or other rulemaking.

Reports suggest that Mr. Wirtz (co-author of the bill which was enacted as PL 97-259) expects to introduce legislation in the 1983 Congress which would propose new changes in the Communications Act, reportedly to further de-regulate both broadcasting and common carrier operations. The anti-trust case before Judge Green, which would separate the Bell System into various independent entities, is now expected to go to the Supreme Court for final adjudication. The need of the Reagan Administration for further economy in government operations may very well reduce the FCC appropriation. The extent to which these may affect the equipment authorization program cannot now be estimated. Potentially, some devices now required to be type accepted or certified may be transferred into the proposed Notification category, which could reduce staffing requirements.

Standard Test Methods

When receiver certification was proposed in the 1950s, the FCC arranged for study of test methods by an IEEE committee with broad industry participation. Similar efforts have been made by the IEEE and EIA in the development of standard test methods for various kinds of transmitters and receivers, including those for the land mobile service. The FCC itself has issued bulletins describing acceptable test methods for many other RF devices. American National Standards Institute has also worked in this area, issuing National Standards for qualification of field strength measurement instrumentation and for test methods. Committee work is now in progress on developing a supplement to the national standards qualification of a radiation measurement site. Many of these standards have been listed as acceptable in various parts of the FCC rules.

Some of the more important of these standards are:

Standard	Title
IEEE 184	Test Procedure, FM Mobile Communications Receivers
IEEE 187	Spurious Radiation, FM/TV Receivers, Open Field Method
IEEE 213	Measurement of Conducted Interference, FM/TV Receivers
IEC 106	Measurement of Radiated & Conducted Emissions, AM/FM/TV Receivers
EIA RS-152-B	Minimum Standards Land Mobile, FM or PM Transmitters
EIA RS-204-A	Minimum Standards Land Mobile, FM or PM Receivers
EIA RS-378	Spurious Radiation, FM/TV Receivers, EIA-Laurel Antenna
ANSI C63.2	Specs, EM Noise & Field Strength Instrumentation, 10 kHz/1GHz.
ANSI C63.4	Measurement Methods, EM Emissions from Equipment, 10 kHz/1 GHz.

Similar publications have been issued by CISPR and VDE. These differ in some respects from the US standards because of differing national regulations and areas of concern.

The FCC Office of Science and Technology has issued 55 bulletins to date. About half of these describe acceptable measurement methods tailored to specific devices regulated under either Part 15 or Part 18. Some of these are:

Bulletin	Title
OCE 20	Test procedure, Microwave Ovens
OCE 30	Measurement of UHF Tuning Accuracy, Detent tuning
OCE 33	Test procedure, Class I TV Devices
OCE 35	Receiver radiation measurement methods
OCE 39	Test procedure, Medical Diathermy
OCE 40	Test procedure, Microwave Field Distrubance Sensor
OCE 43	Pk. Env. Pwr. & Output Limiting, CB Transmtrs.
OCE 45	Pk. Eff. Rad. Pwr. (PERP) of EPIRB transmitters
OCE 50	Meas. of UHF Noise Figure, TV Receivers
OST 55	Characteristics of Open Field Sites
FCC MP-1	Methods of Meas. of Radio Control/Security Alarm Devices & Assoc. Receivers (Appendix C to Docket 20990, Report & Order, Oct. 22, 1981)

The rules permit use of measurement methods other than those in one of the accepted standards if the method is adequately documented in the application.

As new technology comes into use, it is frequently found that the test methods previously used do not adequately serve for the new products. For example, the PLL oscillator came into use in CB and scanning receivers a few years ago. These oscillators can produce spurious frequencies not found in conventional oscillator cicuits. In the scanning mode, the oscillator of a receiver may emit a comb of frequencies which sweeps over a band quite diffeent from that which the receiver is trying to tune. In 1979, there were many complaints of interference to amateur repeaters from scanning receivers. These emissions had not been reported in the original certification measurements on these receivers. Relatively simple design changes eliminated the interference.

Another case, of greater public importance, occurred during the landing of the first NASA shuttle at Edwards Air Force Base in California. Some transmitters, including those used in Part 74 Broadcast remote pickup service, are not required to be type accepted, though they are expected to comply with a technical standard. In early stages of the shuttle landing, there was severe interference to the telemetry (essential to safe landing) from the shuttle. After FCC/DOD investigation, the interference was found to be caused by spurious emissions from portable TV cameras operating on frequencies near the shuttle telemetry channels. Though tests had been made, the test methods employed did not discover these spurious emissions near the operating frequencies of the cameras. The immediate solution was to prohibit operation of these cameras at the site by FCC order; design changes have since been made.

Since the beginning of the program, the FCC has been interested in assuring that measurement data taken and reported by engineers are accurately representative of the device tested. FCC equipment is calibrated by an in-house calibration laboratory, with traceability to the national stan-

dard maintained by the National Bureau of Standards. Section 15.38 has, since the 1950s, required that parties making certification measurements file separate information as to their measurement facilities and equipment calibration standards. In 1977, a NPRM (under Docket 21371) proposed that this requirement be updated to provide more information, and that such filings be required for parties conducting type acceptance and type approval testing, in addition to continuing the requirement for certification sites. Recently, ANSI has begun work on an addition to ANSI Standard C63.4 which would cover essentially the same ground. Because of this, on August 6, 1982, the FCC terminated the Docket 21371 proceeding. With this action, it included Bulletin OST 55, entitled "Characteristics of Open Field Test Sites," to serve as an interim standard until final adoption of the ANSI proposal and its acceptance by the FCC.

Qualification of Test Sites

All of the test standards recognized by the FCC envisage the making of radiation measurements out of doors in an area acceptably free from any conducting objects other than the device under test or the measuring equipment. Such a site is, in current parlance, termed an "Open Field Test Site." If an enclosed site is to be used, it must be housed with essentially non-conducting materials, or use anechoic materials as a lining so that measurements on that site can be correlated with those made on a true open field site. Obviously, a shielded anechoic chamber so correlated would be free from interference due to ambient RF signals which cause problems with measurements on many open field sites.

The technique described in OST 55 for determining the quality of a test site normally is intended for sites measuring radiation in the range 25 to 1000 MHz, with the equipment under test separated from the antenna of the measurement equipment by a distance of 3, 10 or 30 meters. The method relies on the fact that in free space at a given distance from an antenna, the field strength of the signal radiated by the antenna can be calculated accurately from the test parameters (antenna characteristics, radiated power, distance, etc.) For an actual test site, the radiating antenna is placed at a fixed distance above the ground plane, and the receiving antenna is moved in height between certain limits to obtain the maximum signal level. This can approach twice the free space value, because the signal reflected from the ground plane combines with the direct signal to the receiving antenna. When the ground plane is metal, or the ground itself is of good conductivity and there are no sources of unwanted reflections on or too near the site, the observed signal strength at a given test frequency can agree closely with that predicted by theory. Discussion of this technique in detail would require far more space than that available here. Those wishing to obtain a copy of FCC OST Bulletin 55 should call or write Mr. Julius P. Knapp, Office of Science & Technology, FCC Washington, DC 20554 (tel.: 202-653-8247). There were articles on this subject in the August and November 1982 issues of the IEEE Transactions on Electromagnetic Compatibility.

Rulemaking and Enforcement

The procedure which an agency such as the FCC must follow is prescribed by the Administrative Procedures Act. If the agency desires to solicit opinion on a proposal, it must issue a Notice of Inquiry (NOI). A statutory minimum period of 30 days is provided for the filing of comments by any interested parties, with a further period of 15 days for filing replies to those comments. Following this, a Notice of Proposed Rulemaking is issued, followed by periods for filing comments and reply comments. The NOI approach may be omitted if the agency has a definite rulemaking proposal in mind. After the NPRM comment periods have elapsed, the agency staff considers the various comments on the NPRM together with any other information that it may have, and develops a draft Report & Order (R&O) for the agency members to consider. If adopted, the R&O is placed on public notice. Any aggrieved party may file a timely petition for reconsideration. If the agency denies this, they may appeal to the Federal Courts. After completion of this process, the rules are, in effect, part of Federal law.

In the case of apparent violations of equipment authorization requirements, the EA Division first attempts to ascertain the pertinent facts. It may, and often does, require samples to be submitted for testing. The FCC Field Operations Bureau may assist in the investigation. If the problem cannot be settled by agreement, the FOB can assess fines for non-compliance. The party fined can appeal to the Commission for relief, and then to the Federal Courts. As a last resort to obtain compliance, the FCC may, after hearings, request the US District Attorney of the party's residence to prosecute. Penalties for conviction at this level are up to two years penal confinement and $10,000 fine for an individual or corporate officer(s).

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