

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)
)
Amendment of Parts 1, 2, 15, 74, 78, 87,)
90, and 97 of the Commission's Rules)
Regarding Implementation of the Final Acts) ET Docket No. 12-338
of the World Radiocommunication)
Conference (Geneva, 2007) (WRC-07),)
Other Allocation Issues, and Related Rule)
Updates)

**COMMENTS OF THE
NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES**

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies (hereinafter, CORF),¹ hereby submits its Reply Comments in response to the Commission's November 19, 2012, Notice of Proposed Rulemaking in the above-captioned docket (NPRM).² In these Comments, CORF briefly addresses two proposals in the NPRM to relax the recommended levels of unwanted emissions into the 22-23 and 31 GHz passive service bands. CORF does not oppose the Commission's clarification regarding 22-23 GHz inter-satellite links, but does oppose the proposal regarding limits on unwanted emissions for fixed stations transmitting in the 31-31.3 GHz band. CORF also addresses elements of the Commission's proposals

¹ Members of CORF are listed in the appendix.

² CORF hereby seeks leave to file these Comments after the filing deadline. The press of business caused this delay. The public interest would be served by the Commission's acceptance of this filing because although many of the proposals in the NPRM addressed allocations to passive scientific services, no other entity representing passive scientific users of the spectrum has filed reply comments.

regarding power and elevation angles in the 10.6-10.68 GHz band.

I. Introduction: The Role of Radio Astronomy and Earth Remote Sensing, and the Unique Vulnerability of Passive Services to Interference.

CORF has a substantial interest in this proceeding, because it represents the interests of the passive scientific users of the radio spectrum, including users of the Radio Astronomy Service (RAS) and Earth Exploration Satellite Service (EESS). RAS and EESS observers perform extremely important yet vulnerable research.

As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. It was through the use of radio astronomy that scientists discovered the first planets outside the solar system, circling a distant pulsar. The discovery of pulsars by radio astronomers has led to the recognition of a widespread galactic population of rapidly spinning neutron stars with gravitational fields at their surface up to 100 billion times stronger than the gravitational field on Earth's surface. Subsequent radio observations of pulsars have revolutionized our understanding of the physics of neutron stars and have resulted in the only experimental evidence so far for gravitational radiation. Radio astronomy has also enabled the discovery of organic matter and prebiotic molecules outside our solar system, leading to new insights into the potential existence of life elsewhere in our galaxy. Radio spectroscopy and broadband continuum observations have identified and characterized the birth sites of stars in the galaxy, the processes by which stars slowly die, and the complex distribution and evolution of galaxies in the universe. Observation of the enormous energies contained in the enigmatic quasars and radio

galaxies discovered by radio astronomers has led to the recognition that galaxies, including our own Milky Way, may contain supermassive black holes at their center, a phenomenon that appears to be crucial to the creation and evolution of galaxies. Synchronized observations using widely spaced radio telescopes around the world give extraordinary angular resolution, far superior to that which can be obtained using the largest optical telescopes, on the ground or in space.

However, the critical science undertaken by RAS observers cannot be performed without access to interference-free spectrum. Notably, the emissions that radio astronomers receive are extremely weak—a radio telescope receives less than 1 percent of one-billionth of one-billionth of a watt (10^{-20} W) from a typical cosmic object. Because radio astronomy receivers are designed to pick up such remarkably weak signals, radio observatories are particularly vulnerable to interference from in-band emissions, spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands, and emissions that produce harmonic signals in the RAS bands. Even weak, distant in-band man-made emissions can preclude RAS use.

The Commission has also long recognized that satellite-based Earth remote sensing, including sensing by users of the EESS bands, is a critical and uniquely valuable resource for monitoring aspects of the global atmosphere, land, and oceans. For certain applications, satellite-based microwave remote sensing represents the only practical method of obtaining atmospheric and surface data for the entire planet. EESS data have contributed substantially to the study of meteorology, atmospheric chemistry, climatology, and oceanography. Currently, instruments operating in the EESS bands provide regular and reliable quantitative atmospheric, oceanic, and land measurements

to support a broad variety of scientific, commercial, and government (civil and military) data users. Major governmental users of EESS data include the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation, the National Aeronautics and Space Administration (NASA), the Department of Defense (especially the U.S. Navy), the Department of Agriculture, the U.S. Geological Survey, the Agency for International Development, the Federal Emergency Management Agency (FEMA), and the U.S. Forest Service.

II. Unwanted Emissions into the 22-23 and 31 GHz Passive Service Bands.

The NPRM includes proposals to modify the recommended limits on unwanted emissions in certain bands that were enacted at WRC-07 and endorsed by the National Telecommunications and Information Administration (NTIA). CORF's view is that, in general, increasing the levels of unwanted emissions without demonstration of a compelling need to do so would set an undesirable precedent affecting the ability of long-term sharing of the spectrum among differing users.

As a shared resource with a very large and diverse suite of users, the electromagnetic spectrum must be carefully shepherded to avoid the "tragedy of the commons."³ Stringent controls on unwanted emissions are vital in maintaining the viability of the electromagnetic spectrum as a resource for an evolving set of multiple users. CORF lauds the WRC-07, NTIA, and the Commission for working to keep proper

³ See, e.g., Hardin, *Science* 162:1243, December 1968.

controls on unwanted emissions, and CORF strongly supports all recommendations that advance that goal. It must be recognized that with shared use of the spectrum comes a shared responsibility for its stewardship, as well as for cooperation among its users.

22-23 GHz

In paragraphs 111-118 of the NPRM, the Commission discuss NTIA's recommendation that it adopt WRC-07's mandatory limits on unwanted emission—limits that are more stringent than the general emission limits for satellite communications services regulated under Part 25 of the Commission's rules. Of particular interest to CORF are non-geosynchronous-orbit inter-satellite service (NGSO ISS) links in the 22.55-23.55 GHz band. This band is near the 23.6-24.0 GHz band allocated to the RAS and the EESS. NTIA recommended that the Commission adopt WRC-07's mandatory limits on unwanted emissions for NGSO ISS systems transmitting in the 22.55-23.55 GHz band. The NPRM proposes to implement WRC-07's mandatory limits on unwanted emissions in the 22.55-23.55 GHz band for all new NGSO ISS systems, and requests comment on how these limits should apply to Iridium's existing satellites going forward.

Regarding the existing 22.55-23.55 GHz ISS links, CORF's members are not currently aware of any harm from these links to RAS and EESS observations. CORF's understanding of the WRC-07 Recommendation is that it is not intended to apply to existing NGSO constellations. CORF therefore believes that the NPRM and WRC-07 views are aligned in this matter and that the NPRM should state this as a clarification rather than as a recommendation for relaxed limits.

31 GHz

In paragraphs 119-126 of the NPRM, the Commission considers unwanted emissions at 31 GHz. In the U.S. Table of Allocations, the 31-31.3 GHz band is allocated to the Fixed Service and the Mobile Service on a primary basis for non-federal use. The 31.3-31.8 GHz band is allocated to the EESS and the RAS on a primary basis and pursuant to Footnote US246, which states that “no station shall be authorized to transmit” in this band. NTIA recommended that the Commission adopt WRC-07’s mandatory limit on unwanted emissions for fixed stations transmitting in the 31-31.3 GHz band. Specifically, NTIA recommended that fixed stations transmitting in the 31-31.3 GHz band be required to limit the power of their unwanted emissions in any 100 megahertz of the 31.3-31.5 GHz band to –38 dBW (–38 dBW/100 MHz), as measured at the input to a transmitting antenna.⁴

The NPRM asserts that the Commission believes that “the adoption of WRC-07’s mandatory unwanted emission limit for fixed stations transmitting in the 31-31.3 GHz band may be unnecessary to satisfy the operational requirements of EESS (passive) systems in ITU Region 2, because unlike in ITU Regions 1 and 3, no station can be authorized to transmit in the 31.5-31.8 GHz band in Region 2. That is, because co-channel interference is prohibited in Region 2, we believe that the unwanted emission limit in the larger EESS (passive) band (31.3-31.8 GHz) for fixed stations transmitting in the adjacent LMDS band (31-31.3 GHz) could be significantly higher in ITU Region 2.”⁵ Nevertheless, the NPRM acknowledges that the Commission is “cognizant of the fact

⁴ NPRM at para. 123.

⁵ *Id.* at para. 125.

that ITU Resolution 750 states that long-term protection of the EESS (passive) in the 31.3-31.5 GHz and other bands is vital to weather prediction and disaster management.” The NPRM thus solicits comment on whether the Commission should adopt WRC-07’s mandatory limit on unwanted emissions for the 31-31.3 GHz band or, alternatively, the following limit on emissions: For all new stations in the 31-31.3 GHz band, the power of any emission in any 1 megahertz of the 31.3-31.8 GHz band shall be attenuated below the transmitter power (P) within the licensed bands of operation, in watts, by a factor not less than $43 + 10 \log_{10} (P)$ dB (-43 dBW/MHz), which is equivalent to -23 dBW/100 MHz.⁶

In response, CORF opposes the proposal to degrade by 15 dB (from -38 dBW/100 MHz to -23 dBW/100 MHz) the limit on unwanted emissions in this band. Such a large increase in allowable emissions is likely to harm passive service observations in this band in which emissions are prohibited.⁷ CORF advocates stating the limit as ‘-43 dBW/MHz across the 100 MHz’ band to clarify the spectral flux limit. Furthermore, this proposal cannot properly be based on the premise that ITU region 2 also has a passive service allocation on the upper edge of its band. The NPRM contends that this fact was overlooked and not considered by WRC-07. However, Resolution 750 explicitly states that “EESS (passive) sensors provide worldwide measurements that benefit all countries, even if those sensors are not operated by their country,” meaning that it was understood and considered that a particular region’s potential relaxation of the Recommendation could harm worldwide efforts to measure

⁶ *Id.* at para. 126.

⁷ RR 5.340

these important properties. It should also be noted that although ITU Resolution 750 is crafted around the EESS, this band is also an important RAS band that is used in determining the structure and evolution of the early universe.

III. Power and Elevation Angles for 10.6 GHz Fixed Operations.

As noted in the NPRM, WRC-07 revised the sharing criteria for EESS (passive) and Space Research Service (SRS) (passive) operations in the 10.6-10.68 GHz band, which is shared on a co-equal basis with the Fixed Service (FS) and Mobile Service in the ITU Allocation Table. In the U.S. Table, the 10.55-10.68 GHz band is allocated to the Fixed Service on a primary basis for non-federal use. Footnote US265 states that in the 10.6-10.68 GHz band, the FS is restricted to 40 dBW effective isotropic radiation power (EIRP) and that the power delivered to the antenna must not exceed -3 dBW/250 kHz. The 10.6-10.68 GHz band is also allocated to the EESS (passive), SRS (passive), and RAS on a co-primary basis. In connection with the WRC-07 actions regarding the 10.6 GHz band, the NPRM (at para. 148) seeks comments on whether the Commission should (1) prohibit FS stations with main beam elevation angles greater than 20° from transmitting on frequencies in the 10.6-10.68 GHz band; (2) require FS stations (using paired frequencies) to transmit on frequencies in the 10.6-10.68 GHz band using the lower elevation angle; and (3) require the use of automatic transmitter power control (ATPC).

CORF supports the three actions listed above. The first two deal with transmit angles, which correspond to local Earth incidence angles of the main beams on most

conical-scanning spaceborne microwave radiometers, and these actions would therefore protect from interference those EESS missions that use this band. The third proposal, i.e., to urge licensees to employ ATPC, would reduce the required transmit power most of the time, and will therefore have a significant positive effect on reducing radio frequency interference.

Regarding the proposal to urge licensees to limit the off-axis EIRP above 20° to -10 dBW, CORF deems this level to be too high, according to simulation studies that include polarization mismatch and other factors, as stated in ITU-R RS.2096.⁸ CORF recommends following the recommendations of ITU-R RS.2096 to determine the appropriate EIRP to protect EESS passive receiving in the relevant band.

IV. Conclusion.

As a shared resource with a very large and diverse suite of users, the electromagnetic spectrum must be carefully shepherded. Stringent controls on unwanted emissions are vital in maintaining the viability of the electromagnetic spectrum as a resource for an evolving set of multiple users. CORF lauds the WRC-07, NTIA, and the Commission for working to keep proper controls on unwanted emissions, and CORF strongly supports all recommendations that advance that goal. Nevertheless, because there is no current evidence of harm, CORF does not oppose the proposals in the NPRM regarding unwanted emissions from 22-23 GHz ISS links.

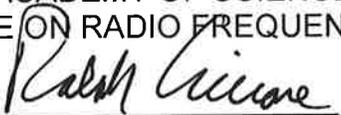
⁸ Rep. ITU-R RS.2096 (2007) at pages 32-35, available at http://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-RS.2096-2007-PDF-E.pdf.

However, CORF does oppose the unwarranted and harmful degradation by 15 dB of the limit on unwanted emissions into the 31.3-31.8 GHz passive services band. In addition, CORF recommends following the recommendations of ITU-R RS.2096 to determine a lower maximum EIRP to protect EESS passive receiving in the 10.6-10.68 GHz band.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

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