Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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| In the Matter of | ) | |
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| Amendment of Part 15 of the Commission's Rules to Establish Regulations for Tank Level Probing Radars in the Frequency Band 77-81 GHz | ) | ET Docket No. 10-23 |
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| and | ) | |
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| Amendment of Part 15 of the Commission's Rules to Establish Regulations for Level Probing Radars and Tank Level Probing Radars in the Frequency Bands 5.925-7.250 GHz, 24.05-29.00 GHz and 75-85 GHz | ) | |

**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; see appendix), hereby submits its comments in response to the Commission's March 26, 2012, Further Notice of Proposed Rulemaking in the above-captioned docket (FNPRM). In these comments, CORF discusses the importance to the Radio Astronomy Service (RAS) of observations in the 75-85 GHz band, the vast majority of which is allocated to the RAS on a primary basis. CORF does not oppose the sharing of spectrum in this band with a service permitting level probing radars (LPRs), subject to the protections proposed in the FNPRM. CORF suggests, however, that in order to facilitate resolution of any possible

interference issues with RAS observatories, that manufacturers of LPR equipment also be required to maintain a database with information on the purchasers of such equipment, and to place that information in a publicly accessible database.

## I. Introduction: The Role of Radio Astronomy, 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 RAS bands. RAS 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. It 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. Measurements of radio spectral line emission have identified and characterized the birth sites of stars in our own galaxy, the processes by which stars slowly die, and the complex distribution and evolution of galaxies in the universe. Radio astronomy measurements have discovered the cosmic microwave background (CMB), the radiation left over from the original big bang after it cooled to only 2.7 degrees above zero. Later observations discovered the weak fluctuations in the CMB of only one thousandth of a percent, generated in the early universe, which later formed the stars and galaxies we know today. Radio observations uncovered the first evidence for the existence of a black hole in our galactic center, a phenomenon that may be crucial to galaxy formation. Observations of supernovae have allowed us to witness the

distribution of heavy elements essential to the formation of planets like Earth, and of life itself.

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.

In sum, the important science performed by radio astronomers cannot be performed without access to interference-free spectrum. Loss of such access constitutes a loss for the scientific and cultural heritage of all people, as well as a loss of the practical applications from the information learned and the technologies developed.

It should be noted that the RAS has primary allocations at 76-77.5 GHz and at 78-85 GHz.[1] Thousands of spectral lines are cataloged within this frequency range. Of particular importance in this proceeding are observations of deuterated molecules, long-chain molecules, and sulfur dioxide. These long-chain molecules could be the progenitors of life and hence are very important to study of the universe. This band can also be used for the sensitive characterization of continuum phenomena from various

[1] RAS also has a secondary allocation at 77.5-78 GHz.

poorly understood physical phenomena, including radio galaxies, quasars, pulsars, and the remnants of supernovae and gamma-ray bursts.[2]

## II. CORF Does Not Oppose Use of the 75-85 GHz Band for Level Probing Radars, Subject to Certain Protections.

CORF recognizes the importance of maximizing spectrum efficiency through thoughtful sharing of spectrum bands, and accordingly, CORF does not oppose use of the 75-85 GHz band for LPRs. However, CORF remains concerned about the possibility of interference to vulnerable RAS observations. Accordingly, CORF urges the Commission to enact the provisions proposed in paragraph 16 of the FNPRM designed to limit interference to authorized users of the band: (1) requiring that the LPR antenna be dedicated or integrated as part of the transmitter and professionally installed in a downward position; (2) limiting installations of LPR devices to fixed locations; and (3) prohibiting hand-held applications of LPR and the marketing of LPR devices to residential consumers.

In addition, CORF suggests that the Commission make permanent a version of the requirement it enacted to protect RAS facilities in the earlier *Order* in this proceeding: that manufacturers of LPR equipment maintain lists of LPR installations that will be available to the Commission in the event that a complaint of interference is

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[2] CORF notes that there are important Earth Exploration-Satellite Service (passive) observations made in the primary allocated bands at 22.21-22.5 GHz and 23.6-24.0 GHz, and although the FCC has proposed "to require that all spurious/unwanted emission limits from LPRs not exceed the general emission limits in Section 15.209 when measured in the main beam of a device's transmit antenna," [para. 16 of the FNPRM], CORF is generally concerned about the *aggregate* impact of interference from multiple LPRs on EESS activities in these bands. Radio frequency interference to EESS is cumulative. *See,* National Research Council, *Spectrum Management for Science in the 21st Century,* The National Academies Press, Washington, D.C., 2010, at p. 81 and Appendix C. Accordingly, CORF urges the Commission to consider aggregate emission limits for LPRs in this band.

raised by an authorized user. *See*, *Amendment of Part 15 of the Commission's Rules to Establish Regulations for Tank Level Probing Radars in the Frequency Band 77-81 GHz, Notice of Proposed Rulemaking and Order*, 25 FCC Rcd 601 (2010), at paragraph 38.[3] Such lists of LPR installations would be necessary to enable investigation of complaints of interference. This record-keeping requirement would constitute a minor burden at most, since manufacturers probably keep such records for their own purposes in any case. However, rather than limiting access to such records to Commission staff, the information should be placed in a publicly accessible database. This approach would facilitate more rapid access by the RAS community to information needed for reports of interference events, and would minimize the burden on Commission staff who might otherwise search for and forward information in such cases.

Last, CORF recommends that the Commission require minimal exclusion zones around radio astronomy facilities that observe in the 75-85 GHz band. Notably, in paragraphs 11 and 16 of the FNPRM, the Commission bases its proposed LPR emission limits in part on a technical standard adopted by the European Telecommunications Standards Institute (ETSI) and incorporated into Report 139 of the Electronic Communications Committee (ECC) within the European Conference of

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[3] *See also, Notice of Proposed Rule Making and Order, In the Matter of Amendment of the Commission's Rules to Permit Radiolocation Operations in the 78-81 GHz Band*, 26 FCC Rcd 17476 (2011) at para. 11 [seeking comments on whether the Commission "should require manufacturers to maintain a record of FOD [foreign object debris] detection radar equipment that they operate or sell (including the identity of the customer and the address or geographic coordinates of the airport), to be made available to the Commission upon request."].

Postal and Telecommunications Administrations. However, the FNPRM does not refer to additional protections for radio astronomy that were included when the ECC adopted its rules for operation of LPRs. Specifically, Annex 2 of the March 2011 ECC Decision in this matter[4] requires an exclusion zone of 4 kilometers around radio astronomy facilities (except when individual exceptions are granted) and limits to 15 meters the height at which LPRs may be installed within 40 kilometers of such facilities. Accordingly, the Commission should require minimal exclusion zones around radio astronomy facilities that observe in the 75-85 GHz band, along with the proposed increased emission limits for LPRs.[5] Given the limited number of radio astronomy facilities that observe in the 75-85 GHz band,[6] such zones are unlikely to impose a significant burden on users of LPRs.

## III. Conclusion

CORF does not oppose sharing of spectrum in the 75-85 GHz band to permit

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[4] Available at http://www.erodocdb.dk/docs/doc98/official/pdf/ECCDec1102.pdf. See also, item 5 of the Executive Summary of ECC Report 139, available at http://www.erodocdb.dk/docs/doc98/official/pdf/ECCRep139.pdf.

[5] While a 4 kilometer exclusion zone generally would be preferable for the full scope of frequencies in the FNPRM, in the 75-85 GHz band a radius of 2 kilometers may be sufficient. As set forth in para. 24 of the FNPRM, the Commission limits the equivalent average reflected emissions of LPRs to an effective isotropic radiated power (EIRP) of -41.3 dBm/MHz in the 75-85 GHz band. The -41 dBm/MHz EIRP results in a spectral power flux density (pfd) of -41 -77.0 -30 -60 = -208 dBW/m$^2$/Hz at a distance of 2 km where -77 dB is the free space inverse square law 1/(4*PI*d*d), -30 dB converts from milliwatts to watts, and -60 dB converts from Hz to MHz. Since the threshold interference level in table 2 of the ITU-R RA.769-2 is -208 dBW/m$^2$/Hz in this band, an LPR within 2 km of a millimeter-wave observatory could result in interference detrimental to radio astronomy spectral line observations. Given the short distance, this distance applies from the location of the individual antenna locations within the observatory, not from cadastral boundaries. In contrast, a similar calculation for the 24.05-29.0 GHz band for which the spectral pfd from table 2 of the ITU-R RA.769-2 is -215 dBW/m$^2$/Hz shows that there could be detrimental interference if the LPR is within 4.5 km of an observatory.

[6] The radio astronomy observatories currently needing protection in this band are those listed in Footnote US 388.

LPRs, as set forth in the FNPRM. However, the authorization of such uses should be subject to the protections proposed in the FNPRM, as well as to a requirement that equipment manufacturers maintain lists of LPR installations that will be publicly available so that possible interference issues can be investigated by RAS facilities and others. Last, the Commission should require minimal exclusion zones around radio astronomy facilities that observe in the 75-85 GHz band.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

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Appendix

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