Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of

Amendment of Parts 1, 2, 15, 25, 27, 74, 78, 80, 87, 90, 97, and 101 of the Commission's Rules Regarding Implementation of the Final Acts of the World Radiocommunications Conference (Geneva, 2007) (WRC-07), Other Allocation Issues and Related Rule Updates	)	**ET Docket No. 12-338 (Proceeding Terminated)**
Amendment of Parts 2, 15, 80, 90, 97 and 101 of the Commission's Rules Regarding Implementation of the Final Acts of the World Radiocommunications Conference (Geneva, 2012) (WRC- 12), Other Allocation Issues, and Related Rule Updates	)	**ET Docket No. 15-99**
Petition for Rulemaking of Xanadoo Company and Spectrum Five LLC to Establish Rules Permitting Blanket Licensing of Two-Way Earth Stations With End-User Uplinks in the 24.75-25.05 GHz Band	)	**IB Docket 06-123**
Petition for Rulemaking of James E. Whedbee to Amend Parts 2 and 97 of the Commission's Rules to Create a Low Frequency Allocation for the Amateur Radio Service	)	
Petition for Rulemaking of ARRL to Amend Parts 2 and 97 of the Commission's Rules to Create a New Medium-Frequency Allocation for the Amateur Radio Service	)	

To the Commission:

Comments from James F. Hollander,
W5EST, Amateur Radio Extra Class Operator, B.S.E.E., J.D.

COMMENTER'S REVISIONS TO PROPOSED RULES (*italicized*)

§ 97.15 Station antenna structures.
* * * * *
(c) Antennas used to transmit in the 2200 m and 630 m bands must not exceed 60.96 meters (200

feet) in height above ground level, *except that such antenna height, when located a distance 0.1 to 1.0 kilometer from an electric power transmission line of 97.303(g)(1), shall be limited to one tenth of such distance when such limit is less than the first said height*.

§ 97.303 Frequency sharing requirements.

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(g) In the 2200 m and 630 m bands:

(1) Power line carrier (PLC) systems are authorized in accordance with 47 CFR 15.113 to operate in the 9-490 kHz range on transmission lines that deliver electric power from generation plants to distribution substations. Amateur stations are restricted to use at permanent fixed *and fixed portable* locations. The transmitting antenna of amateur fixed stations must be located at a horizontal distance of least *0.1* km (*0.06214* mile) from *the nearest electric power-energized segment of* any electric power transmission line. Electric power transmission lines do not include those electric lines which connect the distribution substation to the customer or house wiring.

§ 97.313 Transmitter power standards.

* * * * *

(k) No station may transmit in the 2200 m band with an equivalent isotropically radiated power (EIRP) exceeding 1 W (0.61 W ERP). *No station, when located a fractional distance 0.1 to 1.0 kilometer from an electric power transmission line of 97.303(g)(1), may transmit in the 2200 m band with an EIRP exceeding that fraction-squared times the first said 2200 m EIRP*.

(l) No station may transmit in the 630 m band with an equivalent isotropically radiated power (EIRP) exceeding 5 W (3.049 W ERP). *No station, when located a fractional distance 0.1 to 1.0 kilometer from an electric power transmission line of 97.303(g)(1), may transmit in the 630 m band with an EIRP exceeding that fraction-squared times the first said 630 m EIRP*. In Alaska, stations in the 630 m band located within 800 kilometers (497 miles) of the Russian Federation may not transmit with an EIRP exceeding 1 W (0.61 W ERP).

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COMMENTER'S REMARKS

These comments respond to several of the FCC questions posed in NPRM paragraphs 175-179, 168-169 and 180. http://apps.fcc.gov/ecfs/comment/view?id=60001030137

Commenter supports FCC's proposed rules pertaining to radio amateurs and Part 97, subject to and as improved by commenter's revisions. Statements are to best of my knowledge and belief.

Commenter James F. Hollander is an Amateur Extra Class amateur radio licensee since 2011. The amateur radio activities emphasize CW (Morse) contacts on lower HF bands using 3 watts down to milliwatts of RF power to antenna. Hollander is an active volunteer examiner for amateur radio license examinations under the ARRL VEC. He is a patent attorney, retired 2012 from the law department of a large semiconductor manufacturer based in Texas. Now in Little

Rock, Arkansas, his residence apparently lies about 0.2 km from an electric power transmission line. He has monitored the 630 m band most days and nights since mid-2014 and has monitored 2200 m several days and some nights since late April, 2015.

COMMENTER'S ANSWERS TO FCC QUESTIONS

Regarding FCC question **paragraph 175**, commenter's revisions to FCC's proposed rules require that the antenna of any 2200/630 m station be at least 0.1 km--more than the length of a football field--distant from an electric power transmission line. Moreover, the antenna height must scale down with distance proximity less than 1 km, so that antenna height amounts to no more than one-tenth the distance. At 2200/630m the radiation efficiency of a given size antenna dramatically declines with its height. That self-enforces EIRP limitations commenter proposes.

Requiring a distance of more than a football field recognizes the concerns of utilities and transmission line operators, whether those concerns are scientifically well-founded or not. In commenter's proposed rule revision, EIRP scales down as the square of the fraction of a kilometer of distance to the electric power transmission line. Given that a kilometer distance is satisfactory at EIRP 1w/5w on 2200m/630m, the scaled down EIRP equally recognizes such concerns and is equally unobjectionable. Neil Owen Klagge's WG2XSV June 9, 2015, comments to FCC indicate coexistence with 630m 1 watt ERP at 432 feet (0.132 km) distance.

These revisions to FCC's proposed rules provide requirements that effectively but gradually vary with distance. In this way, policy stairsteps and precipitous thresholding with distance are avoided. The chance of these rules fostering discontent and contorted physical antenna decision-making by amateurs is greatly diminished by the revisions, which promote robust FCC administrative policymaking on this topic.

Fixed-portable operation offers just as much time and opportunity as does permanent-fixed operation for the radio amateur to plan under and comply with antenna distance, antenna height and EIRP limits mandated by the proposed FCC rules and commenter's revisions. The John Langridge WG2XIQ comments to FCC June 8, 2015, demonstrate that fixed-portable 630 m operation is feasible, indeed feasible even at 1/4 mile (0.4 km) distance to an electric power transmission line. Fixed-portable flexibility is vital for amateurs' simulated emergency tests and events such as Field Day which exercise and publicly demonstrate amateur communications capabilities. Commenter has inserted the phrase "*and fixed-portable*" in the proposed rules to appropriately relax the "permanent-fixed" restriction consistent with the FCC's policy reasoning.

Commenter's revised proposed rules require a minimum separation distance of an amateur 2200/630m transmit antenna from electric power transmission lines of more than a football field's length while avoiding the original tenfold separation of one kilometer in the FCC NPRM. Commenter's revision reduces a disadvantage otherwise imposed on amateurs in more-populated

areas compared to amateurs in open countryside. The number of affected amateurs in the rule-forbidden area increases with the population density of amateurs and the number of blocks in the rule-specified minimum distance band on either side of an electric power transmission line.

A one-kilometer rule would establish swaths of exclusion *two kilometers* wide. Spur ends of electric power transmission lines would extend each of these 2 km wide swaths into a semicircular zone of exclusion extending out a further kilometer beyond. Unless a town has its own electric power generation plant without connection to the larger transmission grid, amateurs in large parts of such county seats and county towns would probably be excluded from access to 2200/630m. The burden of persuasion ought to rest on the 1.0 km distance proposition to justify itself vis-à-vis the 0.1 km revision. Furthermore, a 1.0 km distance rule also inequitably burdens amateurs in urban and suburban areas compared to the revision that commenter proposes instead.

For example, commenter lives about 200 meters--0.2 km, two football fields distance away--from a utility substation that serves some midtown neighborhoods in Little Rock, which is Arkansas' capital city. A metal-tower electric power transmission line delivers power into this substation. That 0.2 km distance is probably the distance from the nearest point of the electric power transmission line to commenter's residence. In turn, the substation delivers lower-level high voltage power to neighborhoods where pole transformers distribute ordinary house power.

In response to FCC question **paragraph 176**: Simply driving in a car around the area discloses the existence of the electric power transmission line. Publicly available satellite photography at Google maps "satellite" button helps one conveniently estimate distance to the transmission line.

Regarding FCC question **paragraph 177** generally, commenter suggests that the revised proposed rules here help to bypass the need for complicated calculations and considerations on which the questions are premised. By scaling the antenna height down for distances less than 1 km and reducing the EIRP limit in that distance regime, the fine points of calculating complex geometries do not need to be addressed. Likewise at distances 1 km or more, high precision calculations lose their decision relevance as well.

Regarding part of FCC question **paragraph 177**, commenter has revised the proposed rule language to say "from *the nearest electric power-energized segment of* any electric power transmission line" thereby modeling on a phrase used in that paragraph 177. Inactive, unenergized electric power transmission line structures that may exist in some localities should not impose a restriction on amateurs. The distance calculation will often mean the horizontal perpendicular distance from the antenna to the electric power transmission line. However, corners or substation termination ends of the electric power transmission line may, in cases like mine, constitute the nearest segment. Since earth ground itself extends all the way from the radio antenna to an electric power transmission line, the extent and proximity of artificial ground

radials are irrelevant to the distance rule. Real estate property lines do not matter to this distance rule. For instance, an electric power transmission line might run along an easement on the amateur operator's property itself. If the distance rule is complied with, an amateur's antenna elsewhere on the property is permissible for 630m/2200m regardless of real estate boundaries.

EXAMPLE: EASILY CALCULATED MAXIMUM HEIGHT AND EIRP LIMIT
Regarding FCC question **paragraph 178**: Amateur radio operators just need to know what the rules are so we can follow the rules. The main thing is for whatever signal coupling, if any exists at all into a utility transmission line resulting from following the rules, to come out no more than what the hypothetical coupling would have been from 2200/630 m band-specific maximum EIRP from a 200' high antenna at 1 km. Commenter's proposed rules revisions intend just that.

Be that as it may, under the Commission's draft rules, all 2200m and 630m operation by commenter would nevertheless be forbidden. But under commenter's revised rules, 2200m and 630m operation by commenter is permitted with the following restrictions: A) Maximum antenna height: 40 feet (200 feet x 0.2). B) Maximum EIRP on 630m: only *200 milliwatts* (5 watts x 0.2-squared). C) Maximum EIRP on 2200m: only *40 milliwatts* (1 watt x 0.2-squared). The radically-limited radiation efficiency due to the self-enforcing maximum antenna height 40 feet will make even the low EIRP limits difficult to approach. In short, commenter's revised rules not only recognize whatever Power Line Carrier (PLC, e.g., NPRM paragraphs 14-16) concerns might be, but also equitably make transmission experimentation possible here on both 2200 m and 630m under steep limitations that incentivize a high technical level for such experimentation.

The EIRP limits calculated for the example are very low and probably should be relaxed as further evidence comes in. The EIRP limit formula commenter proposes would at least enable amateur signal experimentation here and in like populated areas in the high-noise, lightning-laboratory 2200/630m bands currently foreclosed to amateurs. Such flexibility can promote 2200/630m repeater keying-up by a lower power station to move data at proximate low-power into a higher-EIRP 2200/630m repeater more satisfactorily situated beyond the 1 km distance.

I do reception experiments on 2200/630m in daytime and nighttime. On June 2, 2015, 9:30-10:00 pm evening local time, I successfully received *50 milliwatt* 630m sky wave transmissions at 485 km (300 miles) from the John Langridge Part 5 experimental station WG2XIQ, Duncanville, Texas. The mode was slow Morse code CW with 60 second dits. Unless revised along the lines of these comments, the FCC proposed rules would forbid me as an amateur radio operator from ever doing such weak signal transmission experiments on the 2200/630 m bands.

Regarding FCC question **paragraph 179**, and in view of the example, I believe ARRL's 1998 study provides helpful technical information but should *not* mean that FCC should adopt *transmitter power* limits for 2200/630m. Instead, the ARRL study helps inform and support a

focus on antenna height and EIRP regardless of the transmitter or antenna by which that EIRP is radiated. These comments comprehend antenna height limitation and EIRP limitation.

FACILITATE STEM EDUCATION

Moreover, the low frequencies of 2200/630 m permit larger, more effective STEM educational displays and experimental circuit boards with far less critical circuit placement and interactions than higher frequencies impose. *School-based amateur stations* should not be foreclosed from 2200/630 m transmissions merely because of proximity to an electric power transmission line closer than 1 km. (This is real: A high school with an amateur radio club lies about the same 0.2 km distance as my residence in another direction from the same electric power transmission line. Another high school in my neighborhood lies at about 0.5 km from that transmission line.)

IS PART 15 PLC AT RISK?

Generally regarding FCC question **paragraphs 168-169**, I answer that I have no reason to think that Part 15 PLC is at risk from prospective amateur operations on 2200/630 m. Given the as-yet modest amount of specific technical information on PLC in the record, the FCC's overall proposed framework seems reasonable to begin with, subject to the rule revisions of this comment. Regarding technological matters, I offer some further comments about electrical power transmission lines and PLC, amateur stations, and lightning interference.

Vertical-oriented radiating sections are the effective parts of 2200/630m transmitting antennas. Electromagnetic fields from horizontal sections of such antennas are subject to substantial self-cancellation by ground reflections. Regarding antennas I have been mindful not only of the usual far-field considerations, but also nearer-proximity evanescent fields and induction coupling. Electric power transmission lines are almost always horizontally oriented. The PLC transmitter(s) hardware-connect by capacitors to one or more of the transmission line conductors themselves (Sanders & Ray, Figure 1). By contrast, the vertical sections of 2200/630m radio antennas are cross-oriented to and electrically decoupled from horizontal electric power transmission lines. The "earth wire" protective conductor, which is strung overhead and parallel to the electric power transmission line, provides a degree of shielding from incident RF as well. Consequently, any coupling from a 2200/630m antenna to PLC is remotely tenuous and hypothetical, even without considering the next topic: *lightning*.

LIGHTNING INTERFERENCE TO PLC AND AMATEURS

Lightning interference on 2200/630m is a preponderant interference concern for Part 5 experimental stations, prospective Part 97 amateur use, and Part 15 PLC too (Sanders & Ray, Figure 21). Consider lightning strikes within 100 km (62 miles) of an electric power transmission line. (See Lucas; see Baba & Rakov.) A typical lightning stroke is on the order of ten million volts at ten thousand amperes: *10,000,000 volts* at *10,000 amperes*. The stroke power is the product of voltage times current or *100 billion watts*. Consider the effective RF power

EIRP of lightning over a conventional 2.5 KHz receiver bandwidth (facing PLC or amateur) in the lightning prone frequency range 1KHz to 1MHz. Concurrently consider the RF power of lightning at 100 km distance (62 miles) discounted down to the 1 km distance under consideration in the proposed rules. Commenter emphasizes that the form of the lightning calculation and not necessarily its precision is the primary focus here.

A lightning stroke that RF-radiates even 1% of 1% (0.0001 or 1/10,000 or one ten-thousandth) of its power in radio frequency emissions gives a *2.5 watt estimate of equivalent RF power EIRP at 1km in 2.5 KHz bandwidth for 2200m or 630m from 100km distant lightning (62 miles)*. A lightning stroke delivers extremely high amperage along a high radiation-efficiency lightning path hundreds of meters long or even kilometers long. Compared to amateur antennas under the proposed rules, the lightning path is ten times longer or even far more than that, whereby conferring high RF radiation efficiency for lightning RF that no amateur could ever match.
2.5 watts = 100 billion watts x 1/10,000 x 2.5KHz/1MHz x (1km/100km)^2.

Closer than 62 miles, the lightning radiates increasingly square-law more-powerful radio frequencies (RF) pouring into amateur receiving antennas and PLC systems. That's why the form of the calculation is the focus here since the numerical results vary so widely. A thunderstorm takes hour(s) to geographically move across the locality of an electric power transmission line.

My receiver has frequently received 2200/630m lightning crashes at occurrence rates exceeding one each second in local storms and even in broad daylight when thunderstorms are moving through the outlying region. On 630 m, due to lightning interference from passing thunderstorms, my receiver has shown a 100-fold (20dB) reduction in 4-FSK WSPR SNR lasting many hours receiving nearby Part 5 experimental station WD2XSH/15 from 16 km (10 miles) distance. My 2200m reception many days faces lightning interference even in daytime from storms shown on regional Doppler radars far beyond 100 km.

Consequently, *PLC systems must necessarily be resistant to lightning interference*, not to mention the high voltage electric power transmission line's own corona discharge noise and interference by multiple PLC transmitters with multiple PLC receivers in the PLC system itself (Sanders & Ray, Figures 21 and 29). Lightning is no respecter of distance from electric power transmission lines. Lightning may strike *less than* one-tenth kilometer from an electric power transmission line, or between 0.1 and 1 km away or still farther. Lightning can deliver sustained powerful interference on the 2200/630 m bands from distances up to 100 km and more. It strains credulity to suppose that PLC systems, which necessarily must be lightning interference-resistant, would be vulnerable to the conservative maximum EIRP levels proposed for Part 97 by either the FCC draft or commenter's more-equitable revised rules. Amateurs, however, can find a bonanza in the frequent lightning interference on these bands to help us promote enhanced-reliability long-distance ground wave at hundreds of kilometers range. If FCC acts favorably

now, amateurs can engage even longer distance weak-signal sky wave experimentation and reliability--where the trailblazing Part 5 experimental stations have pointed the way forward.

Regarding FCC's questions at **paragraph 180**, all my answers are "Yes" in support of the ARRL positions for the following reasons. Automatic or dynamic control of 2200/630m fixed stations, and including repeaters, can be an important area of amateur experimentation because of the pervasive noise and lightning interference on receive, and because only some amateur stations on transmit will be able to muster EIRPs equaling the EIRP limits proposed for them. These days, physical station presence of the human operator is irrelevant, such as at a repeater--given the station operator has remote control capability sufficient to supervise and turn the system off if necessary. The formidably-low antenna radiation efficiencies at 2200/630m, the nearness to utility transmission lines for many hams, and the high lightning/atmospherics noise level-- all these considerations commend some remotely accessible transmitters. FCC should avoid any ill-considered action that would impair a full range of amateur-inspired supportive technology.

Likewise, the full 2200/630 m bands should be available to software-driven modes, firstly because PLC interference, if it arises, may only be resolvable by software-driven avoidance notwithstanding PLC responsibilities to avoid interference under Part 15. And second, because amateurs would be secondary users with respect to the maritime mobile and aeronautical mobile services. All forms of CW, RTTY, and data emissions should be permitted to foster propagation experience and communications mode experimentation staying within these 2200/630 m bands.

Based on my experience as a Volunteer Examiner (VE) meeting amateur license applicants, I support the ARRL position that amateurs holding General Class licenses or higher be permitted to operate 2200m and 630m.

CONCLUSION

Commenter urges FCC to speedily finalize all of the FCC's proposed Part 97 rules, much preferably including commenter's revisions as shown. The time and efforts of all concerned are most appreciated.

Respectfully submitted June 10, 2015,
(signed) /James F. Hollander/
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[Figure 1: Basic PLC Terminal.
Figure 21: Typical Average Noise Levels on a 230 kV Line in a 3KHz Bandwidth.
Figure 29: Interference between Transmitters & Receivers (of the PLC system itself).
Figure 41: Blocking Scheme (for protective relaying).]
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