Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Carrier Current Systems, including	)	
Broadband over Power Line	)	**ET Docket No. 03-104**
Systems	)	
	)	
Amendment of Part 15 regarding	)	**ED Docket No. 04-37**
new requirements and measurement	)	
guidelines for Access Broadband	)	
over Power Line Systems	)	

To: The Commission

Reply Comments to Notice of Proposed Rule Making (03-104)

Comments by the Amateur Radio Research and Development Corporation (AMRAD)

The Amateur Radio Research and Development Corporation (AMRAD) is a worldwide group of amateur radio and computer experimenters. The purpose of AMRAD is to develop skills and knowledge in radio and electronics technology. AMRAD has initiated a project to examine Broadband over Power Line (BPL) technologies, understand how they work and project how a full-scale system would work and its impact on amateur radio. These Comments are submitted to address the interference ingress problem we have observed with a trial BPL system. If any BPL system goes into widespread deployment with this sensitivity to RF fields, a significant interference problem exists.

This problem is similar to Television Interference (TVI) experienced in the 1950s involving the FCC and radio amateurs. At that time the addition of low pass filters to amateur transmitters and high pass filters fitted to victim TV receivers resolved many of those TVI problems. But with BPL systems the interfering signal is in the same band as the intended signal. Filtering generally cannot be used to separate the interfering signal from the intended signal. AMRAD constructed a filter consisting of open quarter wave stubs and found only about 20 dB of rejection could be consistently obtained but 60 dB at a minimum is needed.

Another difference is that BPL does not present the voice of the amateur coming from the speaker of the TV set, as was the case in TVI. Instead, BPL system data transfer may fail due to RF fields from any source in the HF band, which presents a much more subtle malfunction for the customer to diagnose.

The NPRM does not address this problem. Before widespread deployment of BPL the trial system designs should be changed to provide more accommodation for interfering signals. The signal processing technologies generally can provide this but the BPL signal processing front end is now much too sensitive to overload from interfering signals. Reduced gain between the power line and the BPL signal processor would correct this oversight. FCC rules should provide for laboratory tests to assure the BPL components indeed have suitable headroom to accommodate expected amateur interference.

I - Description of Tests

AMRAD conducted an RF susceptibility experiment at the Potomac BPL test site on November 9, 2003. This test site is part of a system test being conducted by the Potomac Electric Power Company (PEPCO). The test home was constructed in 1966 and uses unshielded Romex wiring. The BPL technology is from Current Technologies. The data communications is done using the HomePlug Alliance protocols using a chip set from Intellon. The BPL user interface is an Asoka power line to USB modem. The Potomac test neighborhood has overhead power lines in the area these tests were conducted.

A mobile amateur radio station equipped with an HF transmitting capability was used. The station transmit power was adjustable from a minimum of 4 watts to a maximum of 500 watts of continuous carrier (in this report, all power levels are expressed in PEP). A tunable mobile whip antenna was used. This mobile station was used to radiate on the 75, 40, 20, 18, 15, 12 and 10-meter bands. The transmitted polarization was vertical in this test. It is likely increased coupling into the power lines would have occurred using horizontal polarization. Also, mobile antennas are generally less efficient than a full-sized dipole. A full-sized horizontal dipole antenna would change these test results, most likely with increased levels of interference.

UHF and VHF radio was used to coordinate between the test site and the mobile station. This coordination included the correlation of when transmitter power was being radiated and when the test site was or was not able to transfer data over the Internet.

II - Results

When transmitting at the street curb adjacent to the test site property

- Data transfer ceased in all but one case at a transmitter power of 4 watts in the BPL operating band of 4 to 21 MHz. (3980, 7150, 14348, 18153 and 21383 kHz.)
- The exception was at one frequency where it is suspected that the house wiring exhibited a resonant absorption of the energy. In that case data transfer ceased at 14055 kHz at 15 watts.
- Higher power levels of 12 and 35 watts caused data transfer to cease in two of the bands tested even though they were above the BPL operating band. (24900 and 28150 kHz.)

At 0.1 miles, data transfer ceased at:

- 3980 kHz at 10 watts in one case and 15 watts in another.
- 7150 kHz at 45 watts

- 14348 kHz at 60 watts.

At 0.15 miles data transfer ceased at:
- 3980 kHz at 120 watts

At 0.25 miles, data transfer:
- Was in one case, intermittent at 3980 kHz at 120 watts and ceased at 30 watts depending on distance to the local power lines.

At 0.30 miles data transfer occurred with a transmitter power of 500 watts at 3980 kHz.

At 0.36 miles data transfer ceased at:
- 3980 kHz at 10 watts

At 0.43 miles data transfer:
- Was unaffected.

At 0.51 miles, data transfer:
- Ceased at 3980 kHz at 100 watts in one case and was unaffected in another.

The transmitter could be reduced only to 4 watts, so many observations were made at this minimum power.

III - Potential for Interference

The amateur radio license authorizes a power level of 1500 watts output in this frequency range. The commonly available radios have a power level of around 100 watts. Those radio amateurs seeking more performance attach a power amplifier that can increase power into the range of 500 to 1500 watts. Directional antennas can be used that will add to the effective radiated power in the selected direction.

From this test data, it is apparent that radio amateur operations in the test neighborhood could cause many homes to lose their Internet connection during the times when the radio amateur is transmitting. At least an area out to a radius of 0.51 miles from the transmitting station could have their Internet connection interrupted. Closer in homes would almost certainly have their Internet service interrupted.

This particular BPL test site uses an Asoka PL9710-USB device. These HomePlug devices are highly proprietary and information would have been available to us only upon signing a non-disclosure agreement

IV - Resolving Interference

Since these Internet modems use the same frequency range as the interference, simple interference filters would remove the intended signal along with the interference so this approach will not work. The power company or homeowner can reduce sensitivity to this kind of interference in several other ways.

The first is to change the house wiring from the commonly used unshielded Romex to the commercially used "BX" armored cable along with metal outlet boxes to introduce better shielding from the interference. This is more practically done during construction rather than as a retrofit. Undesired interference could still be introduced into the house wiring through the house's power entrance cable and unshielded power cords. The use of long extension cords could introduce especially troublesome levels of interference.

The second is the use of quarter-wave coaxial stubs at the wall plug to absorb energy at the interfering frequency. These would be needed in each house at each wall plug used to connect the Internet modem where interference is experienced. If the radio transmitter operates on multiple frequencies, multiple quarter wave stubs would be required at each point. AMRAD has constructed and tested such a filter and found it reduced interference levels by 20 dB or more. More rejection than this would be desirable.

We were unable to discern whether the Internet data transfers were being interfered with either inside (In-House BPL) or outside (Access BPL) the test house. These suggested approaches do not address interference in the power company's Access BPL equipment external to the test house.

These BPL devices are generally authorized under the FCC rules (47 CFR 15.5). These rules are very specific. These Part 15 devices "shall not be deemed to have any vested or recognizable right to continued use" in the event interference occurs. Thus, in cases of interference, these Internet users would have to discontinue their Internet use and defer to licensed operations. Under Part 15.15 (47 CFR 15.15) it is the responsibility of the manufacturer and PEPCO to "advise the user as how to resolve harmful interference problems." Thus, when signing up new customers PEPCO is obligated to advise and when receiving trouble calls, the PEPCO Internet control center is obligated to advise their Internet service customers about the unavoidably intermittent nature of their Internet service and methods to mitigate the interference. Similar printed statements can be found in the instructions of other electronic devices that conform to Part 15 such as comes with the Asoka device used.

Respectfully Submitted,

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