02/12/2001

To: Federal Communications Commission
From: IEEE/Power System Relaying Committee

In the matter of RM-9404: Request from the ARRL to create a Low Frequency Allocation for the Amateur Radio Service.

The IEEE/Power System Relaying Committee (PSRC) remains concerned that interference resulting from the use of the Power Line Carrier (PLC) band by the Amateur Radio Service will impact the reliability of electrical service in the United States. The ARRL proposal requests an allocation at 135.7 to 137.8 and 160 to 190 kHz which represents spectrum, that although unlicensed, is used by the majority of utilities in North America to protect the integrity of bulk transmission system. The current FCC Part 15 regulations have allowed utilities to use PLC and achieve high reliability. The ARRL proposal will expose PLC systems to interference that may result in reduced levels of power system reliability.

The recent ARRL submittal titled "Operating Procedure That Will Ensure That ARS LF Transmissions Do Not Interfere With PLC Receivers, January 16th, 2001" does not consider the actual operation of the PLC systems by utilities and in fact will do little to change the interference risk.

The Amateur Radio Station will not be able to determine the frequencies to avoid:

Most Utility PLC applications utilize two types of PLC schemes. ON / OFF and Frequency Shift Keying.

ON / OFF equipment is normally in the off state except for short (less than 1 second) encoded test bursts which occur automatically or manually between 1 and 3 times per day. These test bursts ensure that the communication path is valid since it is normally in the off state. This is used to detect equipment failure only. When a power system disturbance occurs, a brief transmission is sent which prevents a utility transmission line's remote breaker from opening. This is called Blocking. This transmission contains no encoding and is generally 10 watts. If this signal is interfered with, unfaulted lines will disconnect from the power system resulting in unnecessary outages. The receiving locations has a 4 ms window in which the decision to open a breaker is made or prevented.

Frequency Shift Keying normally sends a 1-watt "status" or guard signal to a remote location. Upon detection of a power system fault the guard signal is frequency shifted resulting in a command to "trip". The trip signal is boosted to 10 watts for better signal to noise performance under presumed fault conditions. When the remote receiver detects this signal, the power line is disconnected from the power system. This disconnection takes place regardless of where or if there is an actual fault. Generally it takes less than 32 ms to start the process of opening a breaker. The process cannot be stopped once it is started.

The paper sites that 10 and 20-watt transmitters are typically used the Utilities. In practice, the normal operating levels of continuously transmitted tones are 1 watt. In cases where the lines are very long, such as 100 miles, a 10/100-watt transmitter may be used.

The paper suggests that the Amateur will hear the PLC signal and avoid transmitting on that frequency, therefore avoiding interference. The paper uses a quantitative approach to demonstrate that the Amateur will hear the PLC signal at distances further than the distances in which the PLC receiver would be able to detect the Amateur's signal. The entire paper is predicated on the Amateur being able to avoid the frequencies that they hear PLC signals on. The Amateurs avoidance of interference on 40 meters is used

as an example. However in practice, avoiding PLC interference through monitoring is not possible. In the case of ON/OFF carrier, the receive frequency is the same as the transmit frequency. However, the Amateur will not be able to determine what the frequency is, due to the transmitter normally being off. In the case of frequency shift keying, the transmit and receive frequencies are different and various shifts are used. In either case, the Amateur will not be able to determine what frequencies to avoid. Even the most careful Amateur will not be able to prevent interference.

Region of Potential Interference and Noise:

The paper sites a potential zone of interference on a within 1300 to 4400 feet from a 161 kV line. While certain conservative assumptions were made with respect to antenna height and ground loss, the fact that amateurs could use very long horizontal radiators or Kite/Balloon wire radiators having lengths much longer than 200 feet is not discussed.

PLC is used by utilities on voltages as low as 12 kV to 69 kV. In these situations the noise floor is much less yet the PLC receivers are just as sensitive. In addition, these lines are much closer to residential areas. It must be noted the zone of potential interference is not around a single point. It is a "region" around the transmission line, which can be anywhere from 1 to 100's of miles long. These lines transverse the country with a higher geographic density in the areas of higher population.

The paper, as well as the previous league submittals, attempts to show that the PLC environment is already very noisy so the additional noise produced by an Amateur radio station will be irrelevant. PLC receivers are designed to operate in this environment and have fairly complex receivers that ignore normal power line noise as well as the severe noise that occurs during system faults. Due to the "modal coupling" that takes place between phase conductors paralleled for many miles, the signal can be received when the coupled phase is broken and even lying on the ground.

The paper sites the noise floor in the vicinity of 150 kHz being as -30 dBm on lower voltage lines and as high as -5 dBm on 765 kV lines. IEEE 643-1980 is sited as being the source. The data contained within the standard (page 13, figure 4.) does not agree. The noise data in the standard is provided for various voltages vs. frequency for both fair weather and adverse weather conditions. The standard sites that the fair weather data is valid for more then 75% of the time. The League chose to use highest numbers in the adverse weather data range. The figure shows the noise floor at 150 kHz as being -40 to -45 dBm on 34.5 to 161 kV lines and -25 to -30 dBm on 765 kV lines. These numbers are consistent with other PLC application guides such as the one by RFL Electronics, "The PLC Handbook", August 1979.

The paper also refers to AM radio interference in an automobile driving under a transmission line. The fact that an AM radio in a car detects interference from a transmission line is not relevant since it is using an antenna which is at a distance of less than 150 feet (the height of a high voltage transmission line) from a high magnetic field. This is a factor relating to the level of current on the transmission line and the corresponding corona field. The PLC signals, being conducted, are not affected by this phenomenon.

Risk:

The most important part of this issue is the potential benefits and risks to citizens of the United States.

1. If Amateur radio operators are allowed to pursue new modulation techniques, study long wave propagation and develop specialized antennas, will the public realize any benefit from this?

2. If an Amateur radio operator interferes with the protection of the nation's power system the public will certainly be affected. Considerations include quality of life as well public safety. If a line to a generating station is disconnected from the power system, under situations of reduced operating

margins (such as the recent situations in California), a regional loss of power will occur. This outage would not be momentary as it takes many hours to restore lost generation.

Summary:

The ARRL's proposal to allow stations to use more power and more efficient antenna systems than currently allowed will increase the potential for interference to the Power Line Carrier systems that electric utilities use to protect the power system. The ARRL has acknowledged that interference can occur in their original proposal as well as the recent "operating procedure".

It will not be possible to determine the impact, location or the number of instances where this interference would occur. However it is clear that the greater the number of Amateurs using the spectrum the greater the opportunity for power system interruptions. Power system outage's impact public safety, quality of life as could cost the United States millions or billions of dollars. It is not clear who would be accountable for damages should an outage occur.

There is no reason to take this risk. The current rules allow experimentation by individuals with proven limitations that assure power system reliability. The IEEE, as well as Utilities across the United States, recommends maintaining Part 15 in its current state and rejecting the RM-9404 proposal.

Respectfully Submitted,

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